

CONTRACT DOCUMENTS AND SPECIFICATIONS

for

ROUTE 33 RECREATION FIELD

BID # 48-18

John P. Bohenko, City Manager

City of Portsmouth

State of New Hampshire

Prepared by:

Weston & Sampson
427 Main Street, Suite 400
Worcester MA, 01608

TABLE OF CONTENTS

INVITATION TO BID	3
INSTRUCTION TO BIDDERS	5
AWARD AND EXECUTION OF CONTRACT	8
PROPOSAL FORM	10
BID SECURITY BOND	16
BIDDER'S QUALIFICATIONS	18
CONTRACT AGREEMENT	20
NOTICE OF INTENT TO AWARD	23
NOTICE TO PROCEED	24
CHANGE ORDER	25
PERFORMANCE BOND	26
LABOR AND MATERIALS PAYMENT BOND	28
CONTRACTOR'S AFFIDAVIT	30
CONTRACTOR'S RELEASE	31
GENERAL REQUIREMENTS	32
CONTROL OF WORK	34
TEMPORARY FACILITIES	36
INSURANCE	37
MEASUREMENT AND PAYMENT	38
STANDARD SPECIFICATIONS	42
TECHNICAL SPECIFICATIONS	43

City of Portsmouth
Portsmouth, New Hampshire
Department of Public Works

**ROUTE 33 RECREATION FIELD
Bid #48-18**

INVITATION TO BID

Sealed bid proposals, **plainly marked, Route 33 Recreation Field, Bid Proposal #48-18 on the outside of the mailing envelope as well as the sealed bid envelope.** addressed to the Finance/Purchasing Department, City Hall, 1 Junkins Avenue, Portsmouth, New Hampshire, 03801, will be accepted until **Tuesday, April 3, 2018 at 3:00 PM EST**; at which time all bids will be publicly opened and read aloud.

This project consists of the installation of a new multi-purpose synthetic turf field, including, parking, pavement, fencing, safety netting, sports and parking lighting, shade shelters, stormwater system improvements, site amenities, and other ancillary tasks. Work may begin at any time after the notice to proceed is issued. Substantial Completion of the project must occur by **August 31, 2018**. Liquidated damages shall be assessed at \$300.00 per day until final completion has been achieved. Substantial completion shall consist of the following:

- Complete Synthetic turf field installation, inspection, and signoff for play.
- All paving for the project shall be complete
- All underground utility work including electrical, water and drainage installations completed.

There will be a mandatory pre-bid walkthrough on **Wednesday, March 21, 2018 at 10:00 AM EST** at the Route 33 Field site.

The General Contractor must have a minimum of five (5) years' experience with the installation of athletic facilities of similar size and type that include the installation of athletic field lighting and parking. No award will be made to any bidder who cannot satisfy the OWNER that he has sufficient ability and experience in this class of work and sufficient capital and plant to enable him to prosecute and complete the work successfully within the time named. The OWNER's decision or judgment on these matters will be final, conclusive, and binding to the fullest extent permitted by law. It is required that the Contractor retain the services or employ a **certified sports field builder by the American Sports Builders Association (ASBA)** who will be present at the site regularly throughout the project to supervise and inspect all phases, including subgrade verification of the synthetic turf field. The identity of the certified builders and documentation of their credentials will be provided in the statement of bidder's qualifications as part of this bid submittal.

All electrical work on this project, including conduit, will be installed under the supervision of a New Hampshire Licensed Electrician. An electrical permit is required prior to any project work being completed.

Bidders must determine the quantities of work required and the conditions under which the work will be performed.

The City reserves the right, after bid opening and prior to award of the contract, to modify the amount of the work in the event that bids exceed budgeted amounts. The City of Portsmouth further reserves the right to reject any or all bids, to waive technical or legal deficiencies, to re-bid, and to accept any bid that it may deem to be in the best interest of the City. Also, the City reserves the right to approve or deny subcontractors for this project. An award of this project is contingent upon additional process and funding.

Each Bidder shall furnish a bid security in the amount of ten percent (10%) of the bid. The Bid Security may be in the form of a certified check or a bid bond executed by a surety company authorized to do business in the State of New Hampshire, made payable to the City of Portsmouth, N.H.

The Contractor will be required to keep roadways and sidewalks passable for the public to the maximum degree possible.

All questions regarding bid documents, plans, and specifications for this project should be emailed to Ryan Flynn, Project Coordinator, at raflynn@cityofportsmouth.com. Questions will be accepted until 7:30 AM EST on Monday, **March 26, 2018**.

Specifications can be obtained from the City's website at <http://www.cityofportsmouth.com/finance/purchasing.htm>.

Bidders may contact the Purchasing Coordinator at (603) 610-7227 or by email purchasing@cityofportsmouth.com with any procedural questions.

Addenda to this bid document, if any, including written answers to questions, will be posted by close of business on Wednesday, March 28, 2018 on the City of Portsmouth website at <http://www.cityofportsmouth.com/finance/purchasing.htm>, under the project heading.

INSTRUCTIONS TO BIDDERS

BIDDING REQUIREMENTS AND CONDITIONS

1. Special Notice to Bidders

Appended to these instructions is a complete set of bidding and general contract forms. These forms may be detached and executed for the submittal of bids. The plans, specifications, and other documents designated in the proposal form will be considered as part of the proposal, whether attached or not.

Addenda to this bid document, if any, including written answers to questions, will be posted by Wednesday, March 28, 2018 on the City of Portsmouth website at <http://www.cityofportsmouth.com/finance/purchasing.htm> under the project heading. Addenda and updates will NOT be sent directly to firms. Contractors submitting a bid should check the web site daily for addenda and updates after the release date. Firms should print out, sign and return addenda with the proposal. Failure to do so may result in disqualification.

2. Interpretation of Quantities in Bid Schedules

The quantities appearing in the bid schedule are approximate only and are prepared for the comparison of bids. Payment to the contractor will be made only for actual work performed and accepted in accordance with the contract. Any scheduled item of work to be done and materials to be furnished may be increased, decreased or omitted as hereinafter provided, and no claim for loss, anticipated profits or costs incurred in anticipation of work not ultimately performed will be allowed due to such increase or decrease.

3. Examination of Plans, Specifications and Site Work

The bidder is expected to examine carefully the site of the proposed work, the plans, standard specifications, supplemental specifications, special provisions and contract forms before submitting a proposal. The submission of a bid shall be considered conclusive evidence that the bidder has made such examination and is satisfied as to the conditions to be encountered in performing the work and as to the requirements of the contract. It will be conclusive evidence that the bidder has also investigated and is satisfied with the sources of supply for all materials.

Plans, surveys, measurements, dimensions, calculations, estimates and statements as to the condition under which the work is to be performed are believed to be correct, but the contractors must examine for themselves, as no allowance will be made for any errors or inaccuracies that maybe found therein.

4. Familiarity with Laws

The bidder is assumed to have made himself or herself familiar with all federal and state laws and all local by-laws, ordinances and regulations which in any manner affect those engaged or employed on the work or affect the materials or equipment used in the work or affect the conduct of the work, and the bidder, if awarded the contract, shall be obligated to perform the work in conformity with said laws, by-laws, ordinances and regulations notwithstanding its ignorance thereof. If the bidder shall discover any provision in the plans or specifications which is in conflict with any such law, by-law, ordinance or regulation the bidder shall forthwith report it to the engineer in writing.

5. Preparation of Proposal

a) The bidder shall submit its proposal upon the forms furnished by the Owner. The bidder shall specify a lump sum price in figures, for each pay item for which a quantity is given and shall also show the products of the

respective prices and quantities written in figures in the column provided for that purpose and the total amount of the proposal obtained by adding the amount of the several items. All words and figures shall be in ink or typed. If a unit price or a lump sum bid already entered by the bidder on the proposal form is to be altered it should be crossed out with ink, the new unit price or lump sum bid entered above or below it and initialed by the bidder, also with ink.

b) The bidder's proposal must be signed with ink by the individual, by one or more general partners of a partnership, by one or more members or officers of each firm representing a joint venture; by one or more officers of a corporation, by one or more members (if member-managed) or managers (if manager-managed) of a limited liability company, or by an agent of the contractor legally qualified and acceptable to the owner. If the proposal is made by an individual, his or her name and post office address must be shown, by a partnership the name and post office address of each general and limited partner must be shown; as a joint venture, the name and post office address of each venture must be shown; by a corporation, the name of the corporation and its business address must be shown, together with the name of the state in which it is incorporated, and the names, titles and business addresses of the president, secretary and treasurer.

6. Nonconforming Proposals

Proposals will be considered nonconforming and may be rejected in the Owner's sole discretion for any of the following reasons:

- If the proposal is on a form other than that furnished by the Owner, or if the form is altered or any portion thereof is detached;
- If there are unauthorized additions, conditional or altered bids, or irregularities of any kind which may tend to make the proposal or any portion thereof incomplete, indefinite or ambiguous as to its meaning;
- If the bidder adds any provisions reserving the right to accept or reject an award, or to enter into a contract pursuant to an award; or
- If the proposal does not contain a unit price for each pay item listed except in the case of authorized alter pay items.

7. Proposal Guaranty

No proposal will be considered unless accompanied by a bid bond, surety, or similar guaranty of the types and in an amount not less than the amount indicated in the Invitation to Bid. All sureties shall be made payable to the "City of Portsmouth". If a bid bond is used by the bidder it shall be:

- In a form satisfactory to the Owner;
- With a surety company licensed, authorized to do business in, and subject to the jurisdiction of the courts of the State of New Hampshire; and
- Conditioned upon the faithful performance by the principal of the agreements contained in the sub-bid or the general bid.

In the event any irregularities are contained in the proposal guaranty, the bidder will have four business days (not counting the day of opening) to correct any irregularities. The corrected guaranty must be received by 4:00 p.m. If irregularities are not corrected to the satisfaction of the Owner, the Owner, in its sole discretion, may rejected the bid.

8. Delivery of Proposals

When sent by mail, the sealed proposal shall be addressed to the Owner at the address and in the care of the official in whose office the bids are to be received. All proposals shall be filed prior to the time and at the place specified in

the invitation for bids. Proposals received after the time for opening of the bids will be returned to the bidder, unopened.

9. Withdrawal of Proposals

A bidder will be permitted to withdraw his or her proposal unopened after it has been submitted if the Owner receives a request for withdrawal in writing prior to the time specified for opening the proposals.

10. Public Opening of Proposals

Proposals will be opened and read publicly at the time and place indicated in the invitation for bids. Bidders, their authorized agents, and other interested parties are invited to be present.

11. Disqualification of Bidders

Any or all of the following reasons may be deemed by Owner in its sole discretion as being sufficient for the disqualification of a bidder and the rejection of his proposal:

- More than one proposal for the same work from an individual, firm, or corporation under the same or different name;
- Evidence of collusion among bidders;
- Failure to submit all required information requested in the bid specifications;
- Failure to submit all required qualifications as described in the bid specifications;
- Failure to identify the ASBA certified builder and provide documentation of their credentials;
- Lack of competency or of adequate machinery, plant or other equipment, as revealed by the statement of bidders qualification or otherwise;
- Uncompleted work which, in the judgment of the owner, might hinder or prevent the prompt completion of additional work if awarded;
- Failure to pay, or satisfactorily settle, all bills due for labor and materials on former contracts;
- Default or unsatisfactory performance on previous contracts; or
- Such disqualification would be in the best interests of the Owner.

12. Material Guaranty and Samples

Before any contract is awarded, the bidder may be required to furnish a complete statement of the origin, composition and manufacture of any or all materials to be used in the construction of the work, and the Owner may, in its sole discretion, reject the bid based on the contents of the statement or as a result of the failure of the bidder to submit the statement.

AWARD AND EXECUTION OF CONTRACT

1. Consideration of Proposals

After the proposals are opened and read, they will be compared on the basis of the total price for all sections of work and any such additional considerations as may be identified in the bid documents. The results of such comparisons will be immediately available to the public. In case of a discrepancy between the prices written in words and those written figures, the prices written in words shall govern. In case of a discrepancy between the total shown in the proposal and that obtained by adding the products of the quantities of items and unit bid prices, the latter shall govern.

2. Award of Contract

Within 30 calendar days after the opening of proposals, if a contract is to be awarded, the award will be made to the lowest responsible and qualified bidder whose proposal complies with all the requirements prescribed. The successful bidder will be notified, in writing, mailed to the address on his or her proposal, that his or her bid has been accepted and that the bidder has been awarded the contract.

3. Reservation of Rights

The Owner reserves the right to reject any or all proposals, to waive technicalities or to advertise for new proposals, if, in the sole discretion of the Owner, the best interest of the City of Portsmouth will be promoted thereby. The Owner further reserves the right to conduct such investigations of the contractor's history, financial resources, and other qualifications as it deems necessary to determine whether bidder is qualified to do the work. Bidder may be asked to execute releases. Failure to execute a release upon request may result in disqualification.

The Owner reserves the right to cancel the award of any contract at any time before the execution of such contract by all parties without any liability of the Owner.

The City reserves the right, after bid opening and prior to award of the contract, to modify the amount of the work in the event that bids exceed budgeted amounts. An award of this project is contingent upon additional process and funding.

4. Return of Proposal Guaranty

All proposal guaranties, except those of the three lowest bidders, will be returned upon request following the opening and checking of the proposals. The proposal guaranties of the three lowest bidders will be returned within ten days following the award of the contract if requested.

5. Contract Bonds

At the time of the execution of the contract, the successful bidder shall furnish:

- A performance bond in the amount of 100 percent of the contract amount.
- Labor and materials payment bond in the sum equal to 100 percent of the contract amount.

Each bond shall be: (1) in a form satisfactory to the Owner; (2) with a surety company licensed and authorized to do business and with a resident agent designated for services of process in the State of New Hampshire; and (3) conditioned upon the faithful performance by the principal of the agreements contained in the original bid. All premiums for the contract bonds are to be paid by the contractor.

6. Execution and Approval of Contract

The successful bidder is required to present all contract bonds, to provide proof of insurance, and to execute the contract within 10 days following receipt of the City's notification of acceptance of the bid. No contract shall be considered as in effect until it has been fully executed by all parties.

7. Failure to Execute Contract

Failure to execute the contract and to provide acceptable bonds and proof of insurance within 10 days after notification of acceptance of bid shall be just cause for the cancellation of the award and the forfeiture of the proposal guarantee which shall become the property of the Owner, not as a penalty, but in liquidation of damages sustained. Award may then be made to the next lowest responsible bidder, or the City may exercise its reserved rights including the rejection of all bids or re-advertisement.

8. Conditions of Work

Each bidder must inform itself fully of the conditions relating to the construction of the project and the employment of labor thereon. Failure to do so will not relieve a successful bidder of its obligation to furnish all material and labor necessary to carry out the provisions of its contract. Insofar as possible the CONTRACTOR, in carrying out its work, must employ such methods or means as will not cause any interruption of or interference with the work of any other contractor.

PROPOSAL FORM

ROUTE 33 RECREATION FIELD

CITY OF PORTSMOUTH, N.H.

To the City of Portsmouth, New Hampshire, herein called the Owner.

The undersigned, as Bidder, herein referred to as singular and masculine declares as follows:

1. All interested in the Bid as Principals are named herein.
2. This bid is not made jointly, or in conjunction, cooperation or collusion with any other person, firm, corporation, or other legal entity;
3. No officer, agent or employee of the Owner is directly or indirectly interested in this Bid.
4. The bidder has carefully examined the sites of the proposed work and fully informed and satisfied himself as to the conditions there existing, the character and requirements of the proposed work, the difficulties attendant upon its execution and the accuracy of all estimated quantities stated in this Bid, and the bidder has carefully read and examined the Drawings, Agreement, Specifications and other Contract Documents therein referred to and knows and understands the terms and provisions thereof;
5. The bidder understands that the quantities of work calculated in the Bid or indicated on the Drawings or in the Specifications or other Contract Documents are approximate and are subject to increase or decrease or deletion as deemed necessary by the Director of Public Works. Any such changes will not result in or be justification for any penalty or increase in contract prices; and agrees that, if the Bid is accepted the bidder will contract with the Owner, as provided in the Contract Documents, this Bid Form being part of said Contract Documents, and that the bidder will supply or perform all labor, services, plant, machinery, apparatus, appliances, tools, supplies and all other activities required by the Contract Documents in the manner and within the time therein set forth, and that the bidder will take in full payment therefore the following item prices, to wit:
6. The General Contractor must have a minimum of five (5) years' experience with the installation of athletic facilities of similar size and type that include the installation of athletic field lighting and parking. No award will be made to any bidder who cannot satisfy the OWNER that he has sufficient ability and experience in this class of work and sufficient capital and plant to enable him to prosecute and complete the work successfully within the time named. The OWNER's decision or judgment on these matters will be final, conclusive, and binding to the fullest extent permitted by law. It is required that the Contractor retain the services or employ a **certified sports field builder by the American Sports Builders Association (ASBA)** who will be present at the site regularly throughout the project to supervise and inspect all phases, including subgrade verification of the synthetic turf field. The identity of the certified builders and documentation of their credentials will be provided in the statement of bidder's qualifications as part of this bid submittal.

BASE PROPOSAL: Bidder agrees to perform all of the work as awarded described in the specifications and shown on the plans within the timeframe indicated for the lump sum as indicated below.

Route 33 Field and Associated Amenities:

\$ _____
Amount Written in Numbers

\$ _____
Amount Written in Words

TOTAL FOR PROJECT AND BASIS OF AWARD

In Figures \$ _____

In Words \$ _____

To Bidder:

The City reserves the right, after bid opening and prior to award of the contract, to modify the amount of the work in the event that bids exceed budgeted amounts and/or easements and agreements from one or more impacted property owners are not received.

It is the intention of this contract that the items listed above describe completely and thoroughly the entirety of the work as shown on the plans and as described in the specifications. All other items required to accomplish the above items are considered to be subsidiary work, unless shown as a pay item.

ADD ALTERNATES:

Bidder agrees to perform all of the work described in the specifications and shown on the plans for the below described add alternates.

Alternate Number 1 – Route 33 Field Sports Lighting Poles, Fixtures and Wiring:

\$ _____
Amount Written in Numbers

\$ _____
Amount Written in Words

Alternate Number 2 – Route 33 Field Alternative Turf Infill System – Envirofill with shock pad:

\$ _____
Amount Written in Numbers

\$ _____
Amount Written in Words

Alternate Number 3 – Route 33 Field Alternative Turf Infill System – Safeshell with shock pad:

\$ _____
Amount Written in Numbers

\$ _____
Amount Written in Words

Alternate Number 4 – Route 33 Field Shade Shelter:

\$ _____
Amount Written in Numbers

\$ _____
Amount Written in Words

Alternate Number 5 – Route 33 Field Parking Lot Light Poles and Wiring\Fixtures, Bituminous Concrete Paving, Tree Filter Planting Drains, and Curbing:

\$ _____
Amount Written in Numbers

\$ _____
Amount Written in Words

Alternate Number 6 – Route 33 Field Port-a-Potty Shade Shelters:

\$ _____
Amount Written in Numbers

\$ _____
Amount Written in Words

Alternate Number 7 – Route 33 Field Scoreboard and Associated Wiring and Conduit:

\$ _____
Amount Written in Numbers

\$ _____
Amount Written in Words

Alternate Number 8 – Route 33 Field Tree Planting and Shrubs:

\$ _____
Amount Written in Numbers

\$ _____
Amount Written in Words

ADJUSTMENT CLASSES: Should certain additional work be required or certain work be omitted or should the quantities of certain classes of work be increased or decreased by written order or approval of the Engineer from those on which the Bid is to be based, the undersigned agrees that the following supplemental unit prices shall be the basis of payment to it or credit to the Owner for such additions, omissions, increases, or decreases in work.

CLASS ITEM #	UNITS	ITEM DESCRIPTION & UNIT PRICE IN WORDS	UNIT PRICE IN FIGURES
1	Ea	Tree Protection	\$ _____
2	Lf	Temporary construction fence (6' Ht.)	\$ _____
3	Lf	Temporary erosion control	\$ _____
5	Sy	Fine Grading	\$ _____
6	Ton	Bituminous Concrete Paving	\$ _____
7	Lf	Parking Lot Striping	\$ _____
8	Lf	BVCL Fence (4' Ht.)	\$ _____

9	Lf	BVCL Fence (6' Ht.)	\$ _____
10	Ea	Single BVCL Swing Gate (' Ht.)	\$ _____
11	Ea	Double BVCL Gate (10' Ht.)	\$ _____
12	Sy	Loam and Seed Lawn Areas	\$ _____
13	Lf	12" drain pipe installed	\$ _____
14	Lf	1" water line installed	\$ _____
15	Lf	Granite curbing and concrete bedding installed	\$ _____
16	Sf	4" concrete paving installed	\$ _____
17	Cy	Common Excavation	\$ _____
18	Ea	Street sign	\$ _____
19	Lf	Conduit installation and trenching	\$ _____

The undersigned agrees that for extra work, if any, performed in accordance with the terms and provisions of the Contract Documents, the bidder will accept compensation as stipulated therein.

Date:

Company

By: _____
Signature

Business Address

Title: _____

City, State, Zip Code

Telephone: _____

The Bidder has received and acknowledged Addenda No. _____ through _____.

All Bids are to be submitted on this form and in a sealed envelope, plainly marked on the outside with the Bidder's name and address and the Project name as it appears at the top of the Proposal Form.

In order to follow the City's sustainability practices, future bid invitations/specifications may be sent electronically. Please provide an email address as to where I could email future bid invitations/specifications of this type. Thank you in advance for your cooperation.

Email
Address: _____

BID SECURITY BOND

(This format provided for convenience, actual Bid Bond is acceptable in lieu of, if compatible.)

KNOW ALL MEN BY THESE PRESENTS, that we the undersigned

_____, as Principal, and

_____, as Surety, are hereby

held and firmly bound unto _____

IN THE SUM OF _____

as liquidated damages for payment of which, well and truly to be made we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors and assigns.

The condition of this obligation is such that whereas the Principal has submitted to the

_____ A CERTAIN Bid attached hereto and hereby made a part hereof to enter into a contract in writing, hereinafter referred to as the "AGREEMENT" and or "CONTRACT", for

NOW THEREFORE,

- (a) If said Bid shall be rejected or withdrawn as provided in the INFORMATION FOR BIDDERS attached hereto or, in the alternative,
- (b) If said Bid shall be accepted and the Principal shall duly execute and deliver the form of AGREEMENT attached hereto and shall furnish the specified bonds for the faithful performance of the AGREEMENT and/or CONTRACT and for the payment for labor and materials furnished for the performance of the AGREEMENT and or CONTRACT,

then this obligation shall be void , otherwise it shall remain in full force and effect; it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder in no event shall exceed the amount of this obligation.

BID SECURITY BOND (continued)

The Surety, for value received, hereby agrees that the obligation of said surety and its bond shall be in no way impaired or affected by any extensions of the time within such BID may be accepted and said Surety does hereby waive notice of any such extension.

IN WITNESS WHEREOF, the parties hereto have duly executed

this bond on the _____ day of _____, 2018.

(Name of Principal) L.S.

(SEAL)

BY _____

(Name of Surety)

BY _____

STATEMENT OF BIDDER'S QUALIFICATIONS

Supply with Bid

All questions must be answered, and the data given must be clear and comprehensive. This statement must be notarized. Add separate sheets if necessary

1. Name of Bidder
2. Permanent Main Office Address
3. Form of Entity
4. When Organized
5. Where Organized
6. ASBA Certified Field Builder Qualifications
7. How many years have you been engaged in the contracting business under your present name; also state names and dates of previous firm names, if any.
8. Contracts on hand; (schedule these, showing gross amount of each contract and the approximate anticipated dates of completion).
9. General character of work performed by your company.
10. Have you ever failed to complete any work awarded to you? ____ (no) ____ (yes). If so, where and why?
11. Have you ever defaulted on a contract?
____ (no) ____ (yes). If so, where and why?
12. Have you ever failed to complete a project in the time allotment according to the Contract Documents?
____ (no) ____ (yes). If so, where and why?
13. List the most important contracts recently executed by your company, stating approximate cost for each, and the month and year completed.
14. List your major equipment available for this contract.
15. List your key personnel such as project superintendent and foremen available for this contract.
16. List subcontractors for the following categories whom you will use for the following (unless this work is to be done by your own organization, in which case please state).
 - a. Paving _____
 - b. Synthetic Turf Field _____
 - c. Landscaping _____

STATEMENT OF BIDDERS QUALIFICATIONS (continued)

- d. Fencing _____
- e. Electrical _____
- f. Paint Striping _____
- g. Concrete Flatwork _____
- h. Excavation/Site Work _____

The City reserves the right to disallow any subcontractor work including any subcontract work proposed to be completed by the General Contractor.

16. With what banks do you do business?

a. Do you grant the Owner permission to contact this/these institutions?
____(yes) ____ (no).

b. Latest Financial Statements, certified audited if available, prepared by an independent certified public accountant, may be requested by Owner. If requested, such statements must be provided within five (5) business days or the bid proposal will be rejected. Certified Audited Statements are preferred. Internal statements may be attached only if independent statements were not prepared.

Dated at _____ this _____ day of _____, 2018.

Name of Bidder

BY _____

TITLE _____

State of _____

County of _____

_____ being duly sworn, deposes and

says that the bidder is _____ of _____
(Name of Organization)

and answers to the foregoing questions and all statements contained therein are true and correct.

Sworn to before me this _____ day of _____, 20__.

Notary of Public
My Commission expires _____

CONTRACT AGREEMENT

ROUTE 33 RECREATION FIELD

THIS AGREEMENT made as of the _____ day of _____ in the year **2018**, by and between the City of Portsmouth, New Hampshire (hereinafter call the Owner) and _____ (hereinafter called the Contractor),

WITNESSETH; that the Owner and Contractor, in consideration of the mutual covenants hereinafter set forth, agree as follows:

ARTICLE I- Work - The Contractor shall perform all work as specified or indicated in the Contract Documents for the completion of the Project. The Contractor shall provide, at his expense, all labor, materials, equipment and incidentals as may be necessary for the expeditious and proper execution of the Project.

ARTICLE II - ENGINEER - The Director of Public Works or his authorized representative will act as engineer in connection with completion of the Project in accordance with the Contract Documents.

ARTICLE III - CONTRACT TIME - The work will commence in accordance with the Notice to Proceed. **All work shall be substantially completed no later than August 31st, 2018.**

ARTICLE IV - CONTRACT PRICE - Owner shall pay Contractor for performance of the work in accordance with the Contract Documents. This Contract includes the Lump Sum Base Bid and all selected Add Alternate Bids listed below, as described in the Contract Documents.

Selected Add Alternates:

ARTICLE V - PAYMENT - Partial payments will be made in accordance with the Contract Documents. Upon final acceptance of the work and settlement of all claims, Owner shall pay the Contractor the unpaid balance of the Contract Price, subject to additions and deductions provided for in the Contract Documents.

ARTICLE VI - RETAINAGE – To insure the proper performance of this Contract, the Owner shall retain ten percent of the monthly payments claimed by the Contractor until 50% of the original contract work is invoiced and approved by the City. Once the Contractor has invoiced more than 50% of the contract value, provided that the Contractor has satisfied the City regarding the quality and timeliness of the work and provided further that there is no specific cause for withholding additional retainage, no further amount will be withheld. Upon substantial completion of the work the amount of retainage shall be reduced to 2% of the total contract value plus any additional retainage amounts required by the City based on the City’s estimate of the fair value of any remaining punch list items. Any additional retainage held for punch list items shall be held until such time as all items on the punch list are repaired or completed to the City’s acceptance. The final 2% of retainage shall be held until the warranty period has expired.

ARTICLE VII - LIQUIDATED DAMAGES - In event the Contractor fails to successfully execute the work within the specified contract time for each phase the Owner shall assess the Contractor liquidated damages in the amount of **three hundred dollars (\$300)** for each calendar day beyond the specified completion date for each section of work. Liquidated damages shall be deducted from the Contract Price prior to final payment of the Contractor.

ARTICLE VIII – CONTRACT DOCUMENTS – The Contract Documents which comprise the contract between Owner and Contractor are attached hereto and made a part hereof and consist of the following:

- 8.1 This Agreement
- 8.2 Contractor’s Bid and Bonds
- 8.3 Notice of Award, Notice to Proceed
- 8.4 Instruction to Bidders
- 8.5 General Requirements, Control of Work, Temporary Facilities, Measurement and Payment, Standard Specifications
- 8.6 Insurance Requirements
- 8.7 Standard and Technical Specifications
- 8.8 Special Provisions
- 8.9 Drawings
- 8.10 Any modifications, including change orders, duly delivered after execution of this Agreement.

ARTICLE IX – TERMINATION FOR DEFAULT – Should contractor at any time refuse, neglect, or otherwise fail to supply a sufficient number or amount of properly skilled workers, materials, or equipment, or fail in any respect to prosecute the work with promptness and diligence, or fail to perform any of its obligations set forth in the Contract, Owner may, at its election, terminate the employment of Contractor, giving notice to Contractor in writing of such election, and enter on the premises and take possession, for the purpose of completing the work included under this Agreement, of all the materials, tools and appliances belonging to Contractor, and to employ any other persons to finish the work and to provide the materials therefore at the expense of the Contractor.

ARTICLE X – INDEMNIFICATION OF OWNER – Contractor will indemnify Owner against all suits, claims, judgments, awards, loss, cost or expense (including without limitation attorneys’ fees) arising in any way out of the Contractor’s negligent performance of its obligations under this Contract. Contractor will defend all such actions with counsel satisfactory to Owner at its own expense, including attorney’s fees, and will satisfy any judgment rendered against Owner in such action.

ARTICLE XI – PERMITS –The Contractor will secure at its own expense, all other permits and consents required by law as necessary to perform the work and will give all notices and pay all fees and otherwise comply with all applicable City, State, and Federal laws, ordinances, rules and regulations.

ARTICLE XII – INSURANCE – The Contractor shall secure and maintain, until acceptance of the work, insurance with limits not less than those specified in the Contract.

ARTICLE XIII – MISCELLANEOUS –

- A. Neither Owner nor Contractor shall, without the prior written consent of the other, assign, sublet or delegate, in whole or in part, any of its rights or obligations under any of the Contract Documents; and, specifically not assign any monies due, or to become due, without the prior written consent of Owner.
- B. Owner and Contractor each binds himself, his partners, successors, assigns and legal representatives, to the other party hereto in respect to all covenants, agreements and obligations contained in the Contract Documents.
- C. The Contract Documents constitute the entire Agreement between Owner and Contractor and may only be altered amended or repealed by a duly executed written instrument.

D. The laws of the State of New Hampshire shall govern this Contract without reference to the conflict of law principles thereof.

E. Venue for any dispute shall be the Rockingham County Superior Court unless the parties otherwise agree.

IN WITNESS WHEREOF, the parties hereunto executed this
AGREEMENT the day and year first above written.

BIDDER:

BY: _____

TITLE: _____

CITY OF PORTSMOUTH, N.H.

BY: _____
John P. Bohenko

TITLE: City Manager

NOTICE OF INTENT TO AWARD

Date:

TO:

IN AS MUCH as you were the low responsible bidder for work entitled:

**ROUTE 33 RECREATION FIELD
Bid #48-18**

You are hereby notified that the City intends to award the aforesaid project to you.

Immediately take the necessary steps to execute the Contract and to provide required bonds and proof of insurance within ten (10) calendar days from the date of this Notice.

The City reserves the right to revoke this Notice if you fail to take the necessary steps to execute this Contract.

City of Portsmouth
Portsmouth, New Hampshire

Judie Belanger,
Finance Director

NOTICE TO PROCEED

DATE:

**ROUTE 33 RECREATION FIELD
Bid #48-18**

TO:

YOU ARE HEREBY NOTIFIED TO COMMENCE WORK IN ACCORDANCE
WITH THE AGREEMENT DATED _____ AND ALL
WORK SHALL BE COMPLETED BY _____.

CITY OF PORTSMOUTH, N.H.

BY: Peter H. Rice, PE

TITLE: Public Works Director

ACCEPTANCE OF NOTICE

RECEIPT OF THE ABOVE NOTICE TO
PROCEED IS HEREBY ACKNOWLEDGED BY

This the _____ day of _____ 20__

By: _____

Title: _____

CHANGE ORDER

Change Order Number:

Date of Issuance:

Owner: CITY OF PORTSMOUTH, N.H

Contractor:

You are directed to make the following changes in the Contract Documents:

Description:

Purpose of Change Order:

Attachments:

CHANGE IN CONTRACT PRICE

CHANGE IN CONTRACT TIME

Original Contract Price:

\$

Original Completion Date:

August 31, 2018

Contract Price prior to this
Change Order:

\$

Contract date prior to this
Change Order:

Net Increase or Decrease of
this Change Order:

\$

Net Increase or Decrease of
this Change Order:

Contract Price with all
approved Change Orders:

\$

Contract Due date with all
approved Change Orders:

RECOMMENDED:

APPROVED:

APPROVED:

by _____

by _____

by _____

by _____

PW Director

City Finance

City Manager

Contractor

PERFORMANCE BOND

(This format provided for convenience, actual Performance Bond is acceptable in lieu, if compatible)

Bond Number _____

KNOW ALL MEN BY THESE PRESENTS

that _____ as Principal, hereinafter called Contractor, and _____ (Surety Company) a corporation organized and existing under the laws of the State of _____ and authorized to do business in the State of New Hampshire as surety, hereinafter called Surety, are held and firmly bound unto the City of Portsmouth, N.H. Obligee, hereinafter called Owner, in the amount of _____ Dollars (\$_____), for the payment whereof Contractor and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents. WHEREAS, Contractor has by written agreement dated _____ entered into a contract with Owner for _____ in accordance with drawings and specifications prepared by the Public Works Department, 680 Peeverly Hill Road, Portsmouth, N.H. 03801, which contract is by reference made a part hereof, and is hereinafter referred to as the Contract.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION is such that if the Contractor shall well and faithfully do and perform the things agreed by him to be done and performed, according to the terms of said Contract and such alterations as may be made in said Contract during progress work, and shall further indemnify and save harmless the said Owner in accordance with the Contract and shall remedy without cost to the Owner any defect which may develop within one year from the time of completion and acceptance of the work.

The Surety hereby waives notice of any alteration in work or extension of time made by the Owner or any of its agents or representatives.

Whenever Contractor shall be, and declared by Owner to be, in default under the Contract, the Owner having performed Owner's obligations thereunder, the Surety may promptly remedy the default, or shall promptly:

- (1) Complete the Contract in accordance with its terms and conditions, or

PERFORMANCE BOND (continued)

(2) Obtain a bid or bids for submission to the Owner for completing the Contract in accordance with its terms and conditions, and upon determination by Owner and Surety of the lowest responsible bidder, arrange for a contract between such bidder and Owner and make available as work progresses (even though there should be a default or a succession of defaults under the contract of completion arranged under this paragraph) sufficient funds to pay the cost of completion less the balance of the contract price; but not exceeding, including other costs and damages for which the Surety may be liable hereunder, the amount set forth in the first paragraph hereof. The term "balance of the contract price", as used in this paragraph, shall mean the total amount payable by the Owner to Contractor under the Contract and any amendments thereto, less the amount paid by Owner to Contractor.

Any suit under this bond must be instituted before the expiration of (2) years from the date on which final payment under the contract falls due.

No right of action shall accrue on this bond to or for the use of any person or corporation other than the Owner named herein or the heirs, executors, administrators or successors of Owner.

Signed and sealed this _____ day of _____

A.D., 2018 .

In the presence of:

_____ BY: _____
 (Witness) (Principal) (Seal)

 (Surety Company)

_____ BY: _____
 (Witness) (Title) (Seal)

Note:

If the Principal (Contractor) is a partnership, the Bond should be signed by each of the partners.

If the Principal (Contractor) is a corporation, the Bond should be signed in its correct corporate name by its duly authorized Officer or Officers.

If this bond is signed on behalf of the Surety by an attorney-in-fact, there should be attached to it a duly certified copy of his Power of Attorney showing his authority to sign such Bonds.

There should be executed an appropriate number of counterparts of the bond corresponding to the number of counterparts of the Agreement.

LABOR AND MATERIAL PAYMENT BOND

(This format provided for convenience, actual Labor and Material Bond is acceptable in lieu, if compatible)

Bond Number _____

KNOW ALL MEN BY THESE PRESENTS:

that _____

as Principal, hereinafter called Contractor, and _____ (Surety Company) a corporation organized and existing under the laws of the State of

_____ and authorized to do business in the State of New Hampshire hereinafter called Surety, are held and firmly bound unto the City of Portsmouth, N.H. Obligee, hereinafter called Owner, for the use and benefit of claimants as herein below defined, in the

amount of _____ Dollars (\$_____), for the payment whereof Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, Principal has by written agreement dated _____ entered into a

contract with Owner for _____ in accordance with drawings and specifications prepared by the Public Works Department, 680 Peverly Hill Road, Portsmouth, N.H. 03801, which contract is by reference made a part hereof, and is hereinafter referred to as the Contract.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION is such that the Principal shall promptly make payment to all claimants as hereinafter defined, for all labor and material used or reasonably required for use in the performance of the Contract and for the hire of all equipment, tools, and all other things contracted for or used in connection therewith, then this obligation shall be void, otherwise it shall remain in full force and effect, subject however, to the following conditions:

(1) A claimant is defined as one having a direct contract with the Principal or, with a subcontractor of the Principal for labor, material, equipment, or other things used or reasonably required for use in the performance of the Contract. "Labor and material" shall include but not be limited to that part of water, gas, power, light, heat, oil and gasoline, telephone service or rental of equipment applicable to the Contract.

(2) The above named Principal and Surety hereby jointly and severally agree with the Owner that every claimant as herein defined, who has not been paid in full before the expiration of a period of ninety (90) days after the date on which the last of such claimant's work or labor was done or performed, or materials were furnished by such a claimant, may sue on this bond for the use of such claimant, prosecute the suit by final judgment for such sum or sums as may be justly due claimant, and have execution thereon. The Owner shall not be liable for the payment of any such suit or any costs or expenses of any such suit, and principal and surety shall jointly and severally indemnify, defend and hold the Owner harmless for any such suit, costs or expenses.

(3) No suit or action shall be commenced hereunder by any claimant:

(a) Unless Claimant, other than one having a direct contract with the Principal, shall have given notice to all the following:

LABOR AND MATERIAL PAYMENT BOND (continued)

The Principal, the Owner and the Surety above named, within six (6) calendar months after such claimant did or performed the last of the work or labor, or furnished the last of the materials for which said claim is made, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were furnished, or for whom the work or labor was done or performed. Such notice shall be served by mailing the same by registered mail or certified mail, postage prepaid, in an envelope addressed to the Principal, Owner, and Surety, at any place where an office is regularly maintained for the transaction of business, or served in any manner in which legal process may be served in the State of New Hampshire save that such service need not be made by a public officer.

(b) After the expiration of one (1) year following the date on which Principal ceased all work on said contract, it being understood, however, that if any limitation embodied in this bond is prohibited by any law controlling the construction hereof, such limitation shall be deemed to be amended so as to be equal to the minimum period of limitation permitted by such law.

(c) Other than in a State court of competent jurisdiction in and for the county or other political subdivision of the State in which the project, or any part thereof, is situated, or in the United States District Court for the district in which the project, or any part thereof, is situated, and not elsewhere. (4) The amount of this bond may be reduced by and to the extent of any payment of payments made in good faith hereunder, inclusive of the payment by Surety of mechanics' liens which may be filed on record against said improvement, whether or not claim for the amount of such lien by presented under and against this bond.

Signed and sealed this _____ day of _____, 20____. In the presence of:

(Witness) BY: _____
(Principal) (Seal)

(Surety Company)

(Witness) BY: _____
(Title) (Seal)

Note:

If the Principal (Contractor) is a partnership, the Bond should be signed by each of the partners.

If the Principal (Contractor) is a corporation, the Bond should be signed in its correct corporate name by its duly authorized Officer or Officers.

If this bond is signed on behalf of the Surety by an attorney-in-fact, there should be attached to it a duly certified copy of his Power of Attorney showing his authority to sign such Bonds.

There should be executed an appropriate number of counterparts of the bond corresponding to the number of counterparts of the Agreement.

CONTRACTOR'S AFFIDAVIT

STATE OF _____:

COUNTY OF _____:

Before me, the undersigned, a _____
(Notary Public, Justice of the Peace)

in and for said County and State personally appeared, _____
(Individual, Partner, or duly authorized representative of Corporate)

who, being duly sworn, according to law deposes and says that the cost of labor, material, and equipment and outstanding claims and indebtedness of whatever nature arising out of the performance of the Contract between

CITY OF PORTSMOUTH, NEW HAMPSHIRE

and _____
(Contractor)

of _____

Dated: _____

has been paid in full for Construction of: **Route 33 Recreation Field**

(Individual, Partner, or
duly authorized
representative of
Corporate Contractor)

Sworn to and subscribed
before me this _____ day
of _____ 20__

CONTRACTOR'S RELEASE

KNOW ALL MEN BY THESE PRESENTS that _____

(Contractor) of _____, County of _____ and State of

_____ does hereby acknowledge

that _____ (Contractor)

has on this day had, and received from the CITY OF PORTSMOUTH NEW HAMPSHIRE, final and completed payment for the Construction of:

Route 33 Recreation Field

NOW THEREFORE, the said _____

(Contractor)

for myself, my heirs, executors, and administrators) (for itself, its successors and assigns) do/does by these presents remise, release, quit-claim and forever discharge the City of Portsmouth, New Hampshire, its successors and assigns, of and from all claims and demands arising from or in connection with the said Contract dated _____, and of and from all, and all manners of action and actions, cause and causes of action and actions, suits, debts, dues, duties, sum and sums of money, accounts, reckonings, bonds, bills, specifications, covenants, contracts, agreements, promises, variances, damages, judgments, extents, executions, claims and demand, whatsoever in law of equity, or otherwise, against the City of Portsmouth, New Hampshire, its successors and assigns, which (I, my heirs, executors, or administrators) (it, its successors and assigns) ever had, now have or which (I, my heirs, executors, or administrators) (it, its successors and assigns) hereafter can shall or may have, for, upon or by reason of any matter, cause, or thing whatsoever; from the beginning of record time to the date of these presents.

IN WITNESS WHEREOF,

Contractor:

Print name of witness: _____

By: _____
Its Duly Authorized _____

Dated: _____

GENERAL REQUIREMENTS

SCOPE OF WORK

1. INTENT OF CONTRACT

The intent of the Contract is to provide for the construction and completion in every detail of the work described. The Contractor shall furnish all labor, materials, equipment, tools, transportation and supplies required to complete the work in accordance with the terms of the Contract. The Contractor shall be required to conform to the intent of the plans and specifications. No extra claims shall be allowed for portions of the work not specifically addressed in the plans and specifications but required to produce a whole and complete project, such work will be considered subsidiary to the bid items.

2. INCIDENTAL WORK

Incidental work items for which separate payment is not measured includes, but is not limited to, the following items:

- a. Clearing, grubbing and stripping
- b. Clean up
- c. Plugging existing sewers and manholes
- d. Signs
- e. Mobilization/Demobilization
- f. Restoration of property
- g. Cooperation with other contractors, abutters and utilities
- h. Utility crossings
- i. Minor items - such as replacement of fences, guardrails, rock wall, etc.
- j. Steel and/or wood sheeting as required
- k. Accessories and fasteners or components required to make items paid for under unit prices or lump sum items complete and functional

3. ALTERATION OF PLANS OR OF CHARACTER OF WORK

The Owner reserves the right, without notice to Surety, to make such alterations of the plans or of the character of the work as may be necessary or desirable to complete fully and acceptably the proposed construction; provided that such alterations do not increase or decrease the contract cost. Within these cost limits, the alterations authorized in writing by the Owner shall not impair or affect any provisions of the Contract or bond and such increases or decreases of the quantities as a result from these alterations or deletions of certain items, shall not be the basis of claim for loss or for anticipated profits by the contractor. The contractor shall perform the work as altered at the contract unit price or prices.

4. EXTRA WORK ITEMS

Extra work shall be performed by the Contractor in accordance with the specifications and as directed and will be paid for at a price as provided in the Contract documents or if such pay items are not applicable than at a price negotiated between the contractor and the Owner or at the unit bid price. If the Owner determines that extra work is to be performed, a change order will be issued.

SCOPE OF WORK (continued)

5. CHANGE ORDERS

The Owner reserves the right to issue a formal change order for any increase, decrease, deletion, or addition of work or any increase in contract time or price. The contractor shall be required to sign the change order and it shall be considered as part of the Contract documents.

6. FINAL CLEANING UP

Before acceptance of the work, the contractor shall remove from the site all machinery, equipment, surplus materials, rubbish, temporary buildings, barricades and signs. All parts of the work shall be left in a neat and presentable condition. On all areas used or occupied by the contractor, regardless of the contract limits, the bidder shall clean-up all sites and storage grounds.

The items prescribed herein will not be paid for separately, but shall be paid for as part of the total contract price.

7. ERRORS AND INCONSISTENCY IN CONTRACT DOCUMENTS

Any provisions in any of the Contract Documents that may be in conflict with the paragraphs in these General Requirements shall be subject to the following order of precedence for interpretation.

1. Standard Specifications for NH DOT Road & Bridge Construction will govern General Requirements.
2. Technical Specifications will govern Standard Specifications.
3. Plans will govern Technical Specifications, and General Requirements.

CONTROL OF WORK

1. AUTHORITY OF ENGINEER

(a) All work shall be done under supervision of the Engineer and to his satisfaction. The Engineer will decide all questions which may arise as to the quality and acceptability of materials furnished and work performed and as to the rate of progress of the work; all questions that may arise as to the interpretation of the plans and specifications; and all questions as to the acceptable fulfillment of the Contract by the Contractor.

(b) The Engineer will have the authority to suspend the work wholly or in part for such periods as he may deem necessary due to the failure of the Contractor to correct conditions unsafe for workers or the general public; for failure to carry out provisions of the Contract; for failure to carry out orders; for conditions considered unsuitable for the prosecution of the work, including unfit weather; or for any other condition or reason deemed to be in the public interest. The Contractor shall not be entitled any additional payments arising out of any such suspensions.

(c) The Owner reserves the right to demand a certificate of compliance for a material or product used on the project. When the certificate of compliance is determined to be unacceptable to the Engineer the Contractor may be required to provide engineering and testing services to guarantee that the material or product is suitable for use in the project, at its expense (see Sample of Certificate of Compliance).

2. PROTECTION AND RESTORATION OF PROPERTY AND LANDSCAPES

(a) The Contractor shall use every precaution to prevent injury or damage to wires, poles, or other property of public utilities; trees, shrubbery, crops, and fences along and adjacent to the right-of-way, all underground structures such as pipes and conduits, within or outside of the right-of-way; and the Contractor shall protect and carefully preserve all property marks until an authorized agent has witnessed or otherwise referenced their location.

(b) The Contractor shall be responsible for all damage or injury to property of any character, during the prosecution of the work, resulting from any act, omission, neglect, or misconduct in his manner or method of executing the work, or at any time due to defective work or materials, and said responsibility will not be released until the project shall have been completed and accepted.

(c) When or where any direct or indirect damage or injury is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the work, or as a result of the failure to perform work by the Contractor, the Contractor shall restore, at its own expense, such property to a condition similar or equal to that existing before such damage or injury was done, by repairing rebuilding, or otherwise restoring as may be directed, or the Contractor shall make good such damage or injury in an acceptable manner.

(d) The Contractor shall paint with tree paint all scars made on fruit or ornamental trees by equipment, construction operations, or the removal of limbs larger than one inch in diameter. Damaged trees must be replaced if so determined by the City Arborist, in his or her sole discretion.

(e) If the Contractor fails to repair, rebuild or otherwise restore such property as may be deemed necessary, the Owner, after 48 hours' notice, may proceed to do so, and the cost thereof may be deducted from any money due or which may become due the Contractor under the contract.

(f) It is the intent of the Parties that the Contractor preserve, to as great an extent as possible, the natural features of the site.

CONTROL OF WORK (continued)

3. MAINTENANCE DURING CONSTRUCTION

The Contractor shall maintain the work during construction and until the project is accepted. This maintenance shall constitute continuous and effective work prosecuted day by day, with adequate equipment and workers to ensure that the structure is kept in satisfactory conditions at all times.

4. SAFETY PRECAUTIONS

Upon commencement of work, the Contractor shall be responsible for initiating, maintaining and supervising all safety precautions necessary to ensure the safety of employees on the site, other persons who may be affected thereby, including the public, and other property at the site or adjacent thereto.

5. PERMITS

It will be the responsibility of the Contractor to obtain all permits required for the operation of equipment in, or on, all city streets and public ways.

6. BARRICADES, WARNING SIGNS AND TRAFFIC OFFICERS

(a) The Contractor shall provide, erect and maintain all necessary barricades, suitable and sufficient lights, danger signals, signs and other traffic control devices, and shall take all necessary precautions for the protection of the work and safety of the public. Roadway closed to traffic shall be protected by effective barricades. Obstructions shall be illuminated during hours of darkness. Suitable warning signs shall be provided to control and direct traffic in a proper manner, as approved by the engineer.

(b) The Contractor will be held responsible for all damage to the work from traffic, pedestrians, animals or any other cause due to lack of adequate controlling devices.

(c) The Contractor shall provide such police officers or flaggers as the Engineer deems necessary for the direction and control of traffic within the site of project.

The work prescribed herein will not be paid for separately but will be paid for as part of the Contract Price unless specifically appearing as a bid item.

TEMPORARY FACILITIES

1. STORAGE FACILITIES

(a) The Contractor shall not store materials or equipment in a public right-of-way beyond the needs of one working day. Equipment and materials shall be stored in an approved location.

(b) The Contractor shall protect all stored materials from damage by weather or accident and shall insure adequate drainage at and about the storage location.

(c) Prior to final acceptance of the work all temporary storage facilities and surplus stored materials shall be removed from the site.

2. SANITARY FACILITIES

(a) The Contractor shall provide for toilet facilities for the use of the workers employed on the work.

(b) Temporary toilet facilities may be installed provided that the installation and maintenance conform with all State and local laws, codes, regulations and ordinances governing such work. They shall be properly lit and ventilated, and shall be kept clean at all times.

(c) Prior to final acceptance of the work all temporary toilet facilities shall be removed from the site.

3. TEMPORARY WATER

The Contractor shall make all arrangements with the local water department for obtaining water connections to provide the water necessary for construction operations and shall pay all costs.

4. TEMPORARY ELECTRICITY

The Contractor shall make all arrangements with the Public Service Company for obtaining electrical connections to provide the electrical power necessary for construction operations and security lighting and shall pay all electrical connection and power costs.

The Contractor shall be responsible with obtaining an electrical permit from the City Electrical Inspector.

INSURANCE REQUIREMENTS

Insurance shall be in such form as will protect the Contractor from all claims and liabilities for damages for bodily injury, including accidental death, and for property damage, which may arise from operations under this contract whether such operation by himself or by anyone directly or indirectly employed by him.

AMOUNT OF INSURANCE

- A) Commercial General Liability:
Bodily injury or Property Damage - \$2,000,000
Per occurrence and general aggregate
- B) Automobile and Truck Liability:
Bodily Injury or Property Damage - \$2,000,000
Per occurrence and general aggregate

Coverage amounts may be met with excess policies

Additionally, the Contractor shall purchase and maintain the following types of insurance:

- A) Full Workers Comprehensive Insurance coverage for all people employed by the Contractor to perform work on this project. This insurance shall at a minimum meet the requirements of the most current laws of the State of New Hampshire.
- B) Contractual Liability Insurance coverage in the amounts specified above under Comprehensive General Liability.
- C) Product and Completed Operations coverage to be included in the amounts specified above under Comprehensive General Liability.

ADDITIONAL INSURED

All liability policies (including any excess policies used to meet coverage requirements) shall include the City of Portsmouth, New Hampshire as named Additional Insureds.

- 1) The contractor's insurance shall be primary in the event of a loss.
- 2) City of Portsmouth shall be listed as a Certificate Holder. The City shall be identified as follows:

City of Portsmouth
Attn: Legal Department
1 Junkins Avenue
Portsmouth, NH 03801

MEASUREMENT AND PAYMENT

1. BASE BID

(a) Measurement - Measurement for payment for construction of this project shall be on a lump-sum basis.

(b) Payment- Payment of the lump-sum price under the Base Bid of the Proposal shall fully compensate the Contractor for furnishing all labor, materials, equipment and incidentals required for work described in SECTION 011000, SUMMARY OF WORK of these Specifications.

(c) Contractor shall submit substantiated estimates for payment in an approved form at monthly intervals or when mutually agreed by Contractor and Landscape Architect/Engineer.

2. ADDITIONAL WORK

(a) Increases or decreases in the quantities of certain classes of work, when ordered or approved in writing by the Engineer.

(b) Additional Work, if any shall be performed at a mutually satisfactory price agreed upon between the Landscape Architect/Engineer and Contractor or by the unit price adjustment clauses indicated on the Form of General Bid.

3. SUPPLEMENTAL UNIT MEASUREMENT

(a) All work completed under the contract will be measured according to the United States standard measure.

(b) The method of measurement and computations to be used in determination of quantities of material furnished and of work performed under the contract will be those methods generally recognized as conforming to good engineering practice. Unless otherwise stated all quantities measured for payment shall be computed or adjusted for "in place" conditions.

(c) The term "lump sum" when used as an item of payment will mean complete payment for the work described in the item.

(d) When a complete structure or structural unit (in effect, "lump sum" work) is specified as the unit of measurement, the unit will be construed to include all necessary fittings and accessories, so as to provide the item complete and functional. Except as may be otherwise provided, partial payments for lump sum items will be made approximately in proportion to the amount of the work completed on those items.

(e) Material wasted without authority will not be included in the final estimate.

2. SCOPE OF PAYMENT

(a) The Contractor shall receive and accept compensation provided for in the contract as full payment for furnishing all materials and for performing all work under the contract in a complete and acceptable manner and for all risk, loss, damage or expense of whatever character arising out of the nature of the work or the prosecution thereof.

(b) The Contractor shall be liable to the Owner for failure to repair, correct, renew or replace, at his own expense, all damage due or attributable to defects or imperfections in the construction which defects or imperfections may be discovered before or at the time of the final inspection and acceptance of the work.

MEASUREMENT AND PAYMENT (continued)

(c) No monies, payable under the contract or any part thereof, except the first estimate, shall become due or payable if the Owner so elects, until the Contractor shall satisfy the Owner that the Contractor has fully settled or paid all labor performed or furnished for all equipment hired, including trucks, for all materials used, and for fuels, lubricants, power tools, hardware and supplies purchased by the Contractor and used in carrying out said contract and for labor and parts furnished upon the order of said Contractor for the repair of equipment used in carrying out said contract; and the Owner, if he so elects, may pay any and all such bills, in whole or in part, and deduct the amount of amounts so paid from any partial or final estimate, excepting the first estimate.

3. COMPENSATION FOR ALTERED QUANTITIES

(a) Except as provided for under the particular contract item, when the accepted quantities of work vary from the quantities in the bid schedule the Contractor shall accept as payment in full, so far as contract items are concerned, at the original contract unit prices for the accepted quantities of work done. No allowance will be made for any increased expense, loss of expected reimbursement, or loss of anticipated profits suffered or claimed by the Contractor resulting either directly from such alterations or indirectly from unbalanced allocation among the contract items of overhead expense on the part of the Bidder and subsequent loss of expected reimbursements therefore or from any other cause.

(b) Extra work performed will be paid for at the contract bid prices or at the price negotiated between the Owner and the Contractor if the item was not bid upon. If no agreement can be negotiated, the Contractor will accept as payment for extra work, cost plus 15% (overhead and profit). Costs shall be substantiated by invoices and certified payroll.

4. PARTIAL PAYMENTS

Partial payments of work accepted by the City will be made on a monthly basis during the contract period minus the retainage amount. See Article VI of the Contract Agreement regarding retainage schedule.

5. FINAL ACCEPTANCE

Upon due notice from the Contractor of presumptive completion of the entire project, the Engineer will make an inspection. If all construction provided for and contemplated by the contract is found complete to his satisfaction, this inspection shall constitute the final inspection and the Engineer will make the final acceptance and notify the Contractor in writing of this acceptance as of the date of the final inspection.

If, however, the inspection discloses any work in whole or in part, as being unsatisfactory, the Engineer will give the Contractor the necessary instructions for correction of such work, and the Contractor shall immediately comply with and execute such instructions. Upon correction of the work, another inspection will be made which shall constitute the final inspection provided the work has been satisfactorily completed. In such event, the Engineer will make the final acceptance and notify the Contractor in writing of this acceptance as of the date of final inspection.

6. ACCEPTANCE AND FINAL PAYMENT

(a) When the project has been accepted and upon submission by the Contractor of all required reports, completed forms and certifications, the Owner will review the final estimate of the quantities of the various classes of work performed. The Contractor may be required to certify that all bills for labor and material used under this contract have been paid.

MEASUREMENT AND PAYMENT (continued)

(b) The Contractor shall file with the Owner any claim that the Contractor may have regarding the final estimate at the same time the Contractor submits the final estimate. Failure to do so shall be a waiver of all such claims and shall be considered as acceptance of the final estimate. From the total amount ascertained as payable, an amount equal to two percent (2%) of the whole will be deducted and retained by the Owner for the guaranty period.

(c) All prior partial estimates and payments shall be subject to correction in the final estimate and payment.

7. GENERAL GUARANTY AND WARRANTY OF TITLE

(a) Neither the final certification of payment nor any provision in the contract nor partial or entire use of the improvements embraced in this Contract by the Owner or the public shall constitute an acceptance of work not done in accordance with the Contract or relieve the Contractor of liability in respect to any express or implied warranties or responsibility for faulty materials or workmanship. The Contractor shall promptly remedy any defects in the work and pay for any damage to other work resulting therefrom which shall appear within a period of twelve (12) months from the date of final acceptance of the work. The Owner will give notice of defective materials and work with reasonable promptness.

(b) No material, supplies or equipment to be installed or furnished under this Contract shall be purchased subject to any chattel mortgage or under a conditional sale, lease purchase or other agreement by which an interest therein or in any part thereof is retained by the Seller or supplier. The Contractor shall warrant good title to all materials, supplies and equipment installed or incorporated in the work and upon completion of all work, shall deliver the same together with all improvements and appurtenances constructed or placed thereon by him to the Owner free from any claims, liens or charges. Neither the Contractor nor any person, firm or corporation furnishing any material or labor for any work covered by this Contract shall have the right to a lien upon any improvements or appurtenances thereon.

Nothing contained in this paragraph, however, shall defeat or impair the right of persons furnishing materials or labor to recover under any bond given by the Contractor for their protection or any rights under any law permitting such persons to look to funds due the Contractor in the hands of the Owner. The provisions of this paragraph shall be inserted in all subcontractors and material contracts and notice of its provisions shall be given to all persons furnishing materials for the work when no formal contract is entered into for such materials.

8. NO WAIVER OF LEGAL RIGHTS

(a) Upon completion of the work, the Owner will expeditiously make final inspection and notify the Contractor of acceptance. Such final acceptance, however, shall not preclude or stop the Owner from correcting any measurement, estimate, or certificate made before or after completion of the work, nor shall the Owner be precluded or be stopped from recovering from the Contractor or his Surety, or both, such overpayment as it may sustain by failure on the part of the Contractor to fulfill his obligations under the contract. A waiver on the part of the Owner of any breach of any part of the contract shall not be held to be a waiver of any other or subsequent breach.

(b) The Contractor, without prejudice to the Contract shall be liable to the terms of the Contract, shall be liable to the Owner for latent defects, fraud or such gross mistakes as may amount to fraud, and as regards the Owner's right under any warranty or guaranty.

MEASUREMENT AND PAYMENT (continued)

9. TERMINATION OF CONTRACTOR'S RESPONSIBILITY

Whenever the improvement provided for by the Contract shall have been completely performed on the part of the Contractor and all parts of the work have been released from further obligations except as set forth in his bond and as provided in Section 8 above.

STANDARD SPECIFICATIONS

The Standard Specifications for Road and Bridge Construction of the State of New Hampshire Department of Transportation and any Addenda shall apply but without regard to Section 100 “General Conditions” of those Standard Specifications and without regard to any of those NHDOT provisions that allow for an adjustment for changing fuel and asphalt prices.

TECHNICAL SPECIFICATIONS

Additional Technical Specifications and Special Provisions for this project are attached.

SECTION 00 31 32
SUBSURFACE DATA

PART 1 - GENERAL:

1.01 SCOPE:

- A. A subsurface exploration program consisting of soil borings has been performed, with reasonable care. The following geotechnical report is appended hereto and is part of the Contract Documents.


- “Geotechnical Report, Route 33 Recreation Field, Portsmouth, New Hampshire,” dated January 3, 2017.

Samples of the materials encountered in the explorations may be viewed upon request during the bidding period only at the office of Weston & Sampson Engineers, Inc., 5 Centennial Drive, Peabody, Massachusetts. If Contractors deem the subsurface information insufficient, they may, after obtaining Owner’s permission, carry out additional subsurface explorations, at no expense to the Owner.

- B. Subsurface information provided in the Contract Documents and the above report is limited by the methods used for obtaining and expressing such data, and is subject to various interpretations. The terms used to describe soils, rock, groundwater and such other conditions are subject to local usage and individual interpretation.
- C. Borings have been completed substantially at the locations indicated on the drawings and advanced to the depths shown on the logs. Soil information presented in the logs, as to classification, gradation, properties, density and consistency, is based on visual observation of recovered samples. Reported groundwater levels are those measured in the field at the particular location and at the time measurements were made, and do not necessarily represent permanent groundwater elevations. Groundwater elevations may be affected by temperature, rainfall, and other factors that may not have been present at the time the measurements were made. The Contractors should be aware that groundwater level fluctuations may affect methods of construction.
- D. Subsurface exploration, soil and rock data are for the general information of the Contractor. The Contractors bidding on the project are obligated to examine the site, review boring logs, all available information and records of explorations, investigations and other pertinent data for the site, and then based upon their own interpretations and investigations decide the character of material to be encountered and excavated, the suitability of the materials to be used for backfilling and such other purposes, the groundwater conditions, difficulties or obstacles likely to be encountered, and other conditions affecting the work. The subsurface data is accurate only at the particular locations and times the subsurface explorations were made. No other warranty either expressed or implied by the Owner, Engineer or their agents is made as to the accuracy of the subsurface information and data shown on the drawings or presented in the Contract Documents.

END OF SECTION

Project:
CITY OF PORTSMOUTH, NH



RTE 33 RECREATIONAL FIELD
305 GREENLAND RD.
PORTSMOUTH, NH 03801

Weston & Sampson
427 Main Street
Suite 400, Worcester, MA 01608
978 977 0110 800 SAMPSON
www.westonandsampson.com

TFM
CONSULTANTS

MSC
ARCHITECTS

170 Commerce Way, Suite 102
Portsmouth, NH 03801
Phone (603) 431-2222
Fax (603) 431-0910
www.mscengineers.com

Revisions:	No.	Date	Description

Scale: AS SHOWN

Date: 12-19-2016

Drawn By: EJA

Reviewed By: MSM

Approved By: JP

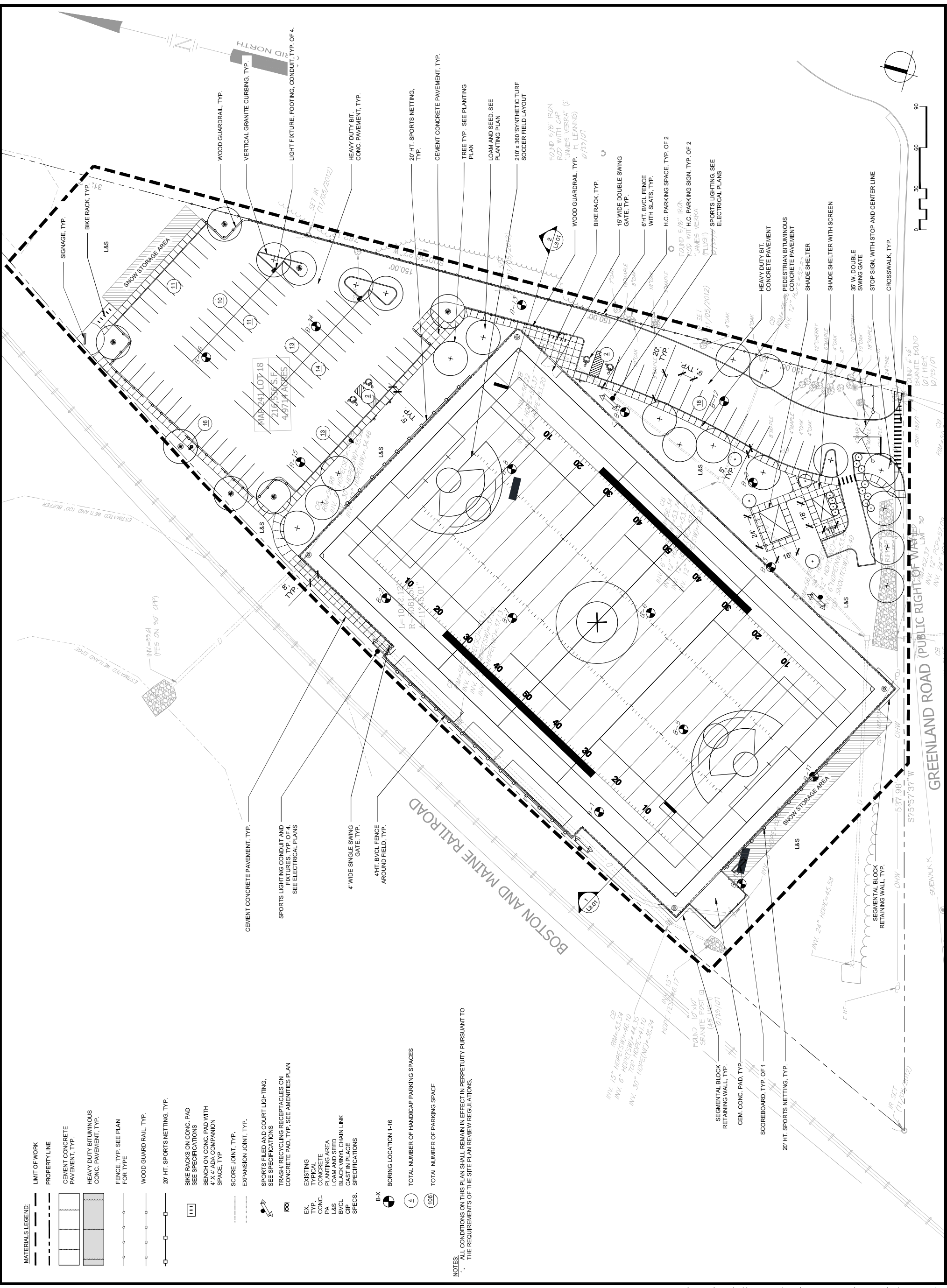
W&S Project No: 2160648

W&S File No:

Issued For:
FOR PERMITTING ONLY
DESIGN DEVELOPMENT
NOT FOR CONSTRUCTION

Drawing Title:
SITE PLAN

Sheet Number:
L3.00



MATERIALS LEGEND:

- LIMIT OF WORK
- - - PROPERTY LINE
- ▭ CEMENT CONCRETE PAVEMENT, TYP.
- ▭ HEAVY DUTY BITUMINOUS CONC. PAVEMENT, TYP.
- FENCE, TYP. SEE PLAN FOR TYPE
- WOOD GUARD RAIL, TYP.
- 20' HT. SPORTS NETTING, TYP.
- ☐ BIKE RACKS ON CONC. PAD SEE SPECIFICATIONS
- ☐ BENCH ON CONC. PAD WITH 4' X 4' ADA COMPANION SPACE, TYP.
- SCORE JOINT, TYP.
- EXPANSION JOINT, TYP.
- ☐ SPORTS FILED AND COURT LIGHTING, SEE SPECIFICATIONS
- ☐ TRASH RECYCLING RECEPTACLES ON CONCRETE PAD, TYP. SEE AMENITIES PLAN
- EX. TYP. EXISTING
- CONC. PAD
- PA
- L&S
- BVCL
- CIP
- SPECS.
- BLACK VINYL CHAIN LINK CAST IN PLACE
- SPECIFICATIONS
- B-X BORING LOCATION 1-16
- ④ TOTAL NUMBER OF HANDICAP PARKING SPACES
- ④ TOTAL NUMBER OF PARKING SPACE

NOTES:
1. ALL CONDITIONS ON THIS PLAN SHALL REMAIN IN EFFECT IN PERPETUITY PURSUANT TO THE REQUIREMENTS OF THE SITE PLAN REVIEW REGULATIONS.



PROJECT
Rt. 33 Recreation Field
Portsmouth, NH

REPORT OF BORING No. B-1
SHEET 1 OF 1
Project No. 2160648.A
CHKD BY Thomas J. Strike, PE

BORING Co. New England Boring Contractors **BORING LOCATION** See attached plan
FOREMAN Sam Shaw **GROUND SURFACE ELEV.** 55 ft. +/- **DATUM** NAVD88
WSE ENGINEER: Julie A. Eaton, EIT **DATE START** 9/27/16 **DATE END** 9/27/16

SAMPLER: 2 IN. OD SPLIT SPOON SAMPLER (SPT) DRIVEN 24 INCHES
USING A 140 lb. CATHEAD OPERATED HAMMER.
CASING: HOLLOW STEM AUGER DRILLING METHODS
TRUCK RIG
CASING SIZE: 2 1/4 IN. INSIDE DIAMETER. OTHER:

GROUNDWATER READINGS				
DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME
Groundwater not observed.				

DEPTH (feet)	CASING (blows/ft)	SAMPLE				PID (ppm)	SAMPLE DESCRIPTION	NOTES	STRATUM DESCRIPTION
		No.	REC/PEN (in)	DEPTH (ft)	BLOWS/6"				
0		S-1	18/24	0-2	5-21-30-35	0.2	Very dense, brown, gravelly, fine to coarse SAND FILL, some silt, trace debris (brick, asphalt); moist. Bottom 12" grades to little silt.	1,2	SAND FILL WITH DEBRIS
5		S-2	8/24	5-7	5-6-9-6	0.1	Medium dense, dark brown, fine to medium SAND FILL, some silt, little gravel; moist.		
10		S-3	14/24	10-12	17-27-21-22	0.1	Dense, brown, fine to medium SAND, little gravel, trace to little silt; moist.		
15		S-4	15/24	15-17	13-27-36-59	0.1	Very dense, brown, fine to medium SAND, little gravel, trace silt; moist.		
20		S-5	10/10	20-20.8	88-100/4"		Very dense, brown, fine to medium SAND, some gravel, trace silt; moist.		
25		S-6	13/24	25-27	38-15-18-19		Dense, brown, fine to medium SAND, trace silt; moist.		
30							Boring terminated at 27 ft.		SAND

GRANULAR SOILS		COHESIVE SOILS		NOTES:
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY	
0-4	V. LOOSE	0-2	V. SOFT	1. Grab sample submitted for environmental analysis. 2. Periodic auger grinding from about 0 to 25 ft. (possible cobbles, boulders, and/or debris).
4-10	LOOSE	2-4	SOFT	
10-30	M. DENSE	4-8	M. STIFF	
30-50	DENSE	8-15	STIFF	
> 50	V. DENSE	15-30	V. STIFF	
		> 30	HARD	

GENERAL NOTES: i) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
ii) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THIS BORING LOG. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS ARE MADE.

BORING No. B-1



PROJECT
Rt. 33 Recreation Field
Portsmouth, NH

REPORT OF BORING No. B-2
SHEET 1 OF 1
Project No. 2160648.A
CHKD BY Thomas J. Strike, PE

BORING Co. New England Boring Contractors **BORING LOCATION** See attached plan
FOREMAN Sam Shaw **GROUND SURFACE ELEV.** 55 ft. +/- **DATUM** NAVD88
WSE ENGINEER: Julie A. Eaton, EIT **DATE START** 9/28/16 **DATE END** 9/28/16

SAMPLER: 2 IN. OD SPLIT SPOON SAMPLER (SPT) DRIVEN 24 INCHES
USING A 140 lb. CATHEAD OPERATED HAMMER.
CASING: HOLLOW STEM AUGER DRILLING METHODS
TRUCK RIG
CASING SIZE: 2 1/4 IN. INSIDE DIAMETER. OTHER:

GROUNDWATER READINGS				
DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME
Groundwater not observed.				

DEPTH (feet)	CASING (blows/ft)	SAMPLE				PID (ppm)	SAMPLE DESCRIPTION	NOTES	STRATUM DESCRIPTION
		No.	REC/PEN (in)	DEPTH (ft)	BLOWS/6"				
0		S-1	15/24	0-2	10-19-10-9	0.2	Medium dense, dark brown, fine to medium SILTY SAND FILL, little gravel, little debris (wood, brick); moist.	1	SAND FILL WITH DEBRIS
5		S-2	9/19	5-6.6	4-3-7-50/1"	2.4	Medium dense, dark brown, fine to medium SILTY SAND FILL, little gravel, trace debris (wood); moist.	2 3 4	
10		S-3	0/24	10-12	7-8-9-8	N/A	No recovery.		
15		S-4	8/24	12-14	56-17-19-14	3.3	Dense, dark brown, fine to medium SAND FILL, some debris (wood, concrete, brick, paper), little silt, little gravel; moist.		
20		S-5	7/24	15-17	9-7-9-5	5.4	Medium dense, dark brown, fine to medium SAND FILL, some wood fragments, little to some silt, trace gravel; moist.		
25		S-6	18/24	20-22	12-17-19-16	2.6	Dense, brown, fine to coarse SAND, trace gravel, trace silt; moist.		
30		S-7	18/24	25-27	17-18-11-14	0.1	Medium dense, brown, fine to coarse SAND, some gravel, trace to little silt; moist.		
		S-8	18/24	30-32	16-19-19-20		Dense, dark gray, fine to coarse SAND, some silt, some gravel; moist. Boring terminated at 32 ft.		

GRANULAR SOILS		COHESIVE SOILS		NOTES:
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY	
0-4	V. LOOSE	0-2	V. SOFT	1. Periodic auger grinding from about 0 to 5 ft. 2. Grab sample submitted for environmental analysis. 3. Auger refusal at 6.5 ft. Moved east 5 ft. Auger refusal at 5 ft. Moved south 8 ft. Auger grinding 0 to 3 ft. and 4.5 to 6.5 ft. with concrete fragments observed in cuttings. 4. Periodic auger grinding from about 7 to 12.5 ft. with wood fragments observed in cuttings. (possible cobbles, boulders, and/or debris)
4-10	LOOSE	2-4	SOFT	
10-30	M. DENSE	4-8	M. STIFF	
30-50	DENSE	8-15	STIFF	
> 50	V. DENSE	15-30	V. STIFF	
		> 30	HARD	

GENERAL NOTES: i) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
ii) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THIS BORING LOG.
FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS ARE MADE.

BORING No. B-2



PROJECT
Rt. 33 Recreation Field
Portsmouth, NH

REPORT OF BORING No. B-3
SHEET 1 OF 1
Project No. 2160648.A
CHKD BY Thomas J. Strike, PE

BORING Co. New England Boring Contractors **BORING LOCATION** See attached plan
FOREMAN Sam Shaw **GROUND SURFACE ELEV.** 55 ft. +/- **DATUM** NAVD88
WSE ENGINEER: Julie A. Eaton, EIT **DATE START** 9/27/16 **DATE END** 9/27/16

SAMPLER: 2 IN. OD SPLIT SPOON SAMPLER (SPT) DRIVEN 24 INCHES
USING A 140 lb. CATHEAD OPERATED HAMMER.
CASING: HOLLOW STEM AUGER DRILLING METHODS
TRUCK RIG
CASING SIZE: 2 1/4 IN. INSIDE DIAMETER. OTHER:

GROUNDWATER READINGS				
DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME
Groundwater not observed.				

DEPTH (feet)	CASING (blows/ft)	SAMPLE				PID (ppm)	SAMPLE DESCRIPTION	NOTES	STRATUM DESCRIPTION	
		No.	REC/PEN (in)	DEPTH (ft)	BLOWS/6"					
0		S-1	15/24	0-2	5-5-4-4	0.0	Stiff, brown, CLAYEY SILT FILL, little fine sand, little gravel, trace debris (asphalt, brick); very moist.		SAND/CLAYEY SILT FILL WITH DEBRIS	
5		S-2	9/24	5-7	5-8-5-5	0.1	Medium dense, brown, fine to medium SILTY SAND FILL, some gravel; very moist. Bottom 3": pulverized asphalt debris.			
10		S-3	5/24	10-12	4-6-8-11	0.2	Stiff, brown, CLAYEY SILT FILL, little fine sand, little gravel; wet.	1		
15		S-4	13/24	15-17	55-25-29-30	0.4	Very dense, gray-brown fine to coarse SAND FILL, some debris (concrete), some gravel, little silt; moist. Bottom 4": brown, fine to medium SAND, trace gravel, trace silt; moist.	2		SAND
20		S-5	13/24	20-22	28-31-28-25	0.2	Very dense, brown, fine to coarse SAND, little gravel, little silt; moist.			
25		S-6	13/24	25-27	27-32-26-31		Very dense, brown, gravelly, fine to coarse SAND, trace silt; moist.			
30		S-7	14/24	30-32	35-29-18-10		Dense, brown, fine to coarse SAND, little gravel, trace silt; moist.			
							Boring terminated at 32 ft.			

GRANULAR SOILS		COHESIVE SOILS		NOTES:
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY	
0-4	V. LOOSE	0-2	V. SOFT	1. Auger grinding from about 13.5 to 15.5 ft. (possible cobbles, boulders, and/or debris) 2. Grab sample submitted for environmental analysis. 3. Periodic auger grinding from about 18 to 30 ft. (possible cobbles)
4-10	LOOSE	2-4	SOFT	
10-30	M. DENSE	4-8	M. STIFF	
30-50	DENSE	8-15	STIFF	
> 50	V. DENSE	15-30	V. STIFF	
		> 30	HARD	

GENERAL NOTES: i) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
ii) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THIS BORING LOG.
FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS ARE MADE.

BORING No. B-3



PROJECT
Rt. 33 Recreation Field
Portsmouth, NH

REPORT OF BORING No. B-4
SHEET 1 OF 1
Project No. 2160648.A
CHKD BY Thomas J. Strike, PE

BORING Co. New England Boring Contractors **BORING LOCATION** See attached plan
FOREMAN Sam Shaw **GROUND SURFACE ELEV.** 56 ft. +/- **DATUM** NAVD88
WSE ENGINEER: Julie A. Eaton, EIT **DATE START** 9/27/16 **DATE END** 9/27/16

SAMPLER: 2 IN. OD SPLIT SPOON SAMPLER (SPT) DRIVEN 24 INCHES
USING A 140 lb. CATHEAD OPERATED HAMMER.
CASING: HOLLOW STEM AUGER DRILLING METHODS
TRUCK RIG
CASING SIZE: 2 1/4 IN. INSIDE DIAMETER. OTHER:

GROUNDWATER READINGS				
DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME
Groundwater not observed.				

DEPTH (feet)	CASING (blows/ft)	SAMPLE				PID (ppm)	SAMPLE DESCRIPTION	NOTES	STRATUM DESCRIPTION
		No.	REC/PEN (in)	DEPTH (ft)	BLOWS/6"				
0		S-1	15/24	0-2	17-24-20-11	0.1	Dense, brown, fine to coarse SAND FILL, some gravel, some silt, trace debris (brick, asphalt); moist.	1	SAND FILL WITH DEBRIS
5		S-2	12/24	5-7	6-8-9-10	0.5	Medium dense, dark brown, SILTY SAND FILL, little gravel; very moist.		
10		S-3	13/24	10-12	5-6-4-7	0.8	Medium dense, dark brown, fine to medium SAND FILL, some silt, little debris (asphalt), trace gravel, trace organics (roots); moist.	2	
15		S-4	17/24	15-17	25-31-78-71	2.4	Very dense, dark brown, fine to medium SAND FILL, some silt, little debris (wood, asphalt), trace gravel; moist. Bottom 6": brown, fine to coarse SAND, some gravel, trace silt; moist.		
20		S-5	3/9	20-20.8	68-100/3"	1.5	Very dense, brown, gravelly, fine to coarse SAND, trace to little silt; moist.		
25		S-6	12/24	25-27	73-43-27-37		Very dense, brown, gravelly, fine to coarse SAND, trace silt; moist.		
30							Boring terminated at 27 ft.		SAND

GRANULAR SOILS		COHESIVE SOILS		NOTES:
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY	
0-4	V. LOOSE	0-2	V. SOFT	1. Periodic auger grinding from about 1 to 25 ft. (possible cobbles, boulders, and/or debris). Wood fragments observed in cuttings to about 18 ft. 2. Grab sample submitted for environmental analysis.
4-10	LOOSE	2-4	SOFT	
10-30	M. DENSE	4-8	M. STIFF	
30-50	DENSE	8-15	STIFF	
> 50	V. DENSE	15-30	V. STIFF	
		> 30	HARD	

GENERAL NOTES: i) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
ii) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THIS BORING LOG. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS ARE MADE.

BORING No. B-4



PROJECT
Rt. 33 Recreation Field
Portsmouth, NH

REPORT OF BORING No. B-5
SHEET 1 OF 1
Project No. 2160648.A
CHKD BY Thomas J. Strike, PE

BORING Co. New England Boring Contractors **BORING LOCATION** See attached plan
FOREMAN Sam Shaw **GROUND SURFACE ELEV.** 57 ft. +/- **DATUM** NAVD88
WSE ENGINEER: Julie A. Eaton, EIT **DATE START** 9/28/16 **DATE END** 9/28/16

SAMPLER: 2 IN. OD SPLIT SPOON SAMPLER (SPT) DRIVEN 24 INCHES
USING A 140 lb. CATHEAD OPERATED HAMMER.
CASING: HOLLOW STEM AUGER DRILLING METHODS
TRUCK RIG
CASING SIZE: 2 1/4 IN. INSIDE DIAMETER. OTHER:

GROUNDWATER READINGS				
DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME
Groundwater not observed.				

DEPTH (feet)	CASING (blows/ft)	SAMPLE				PID (ppm)	SAMPLE DESCRIPTION	NOTES	STRATUM DESCRIPTION
		No.	REC/PEN (in)	DEPTH (ft)	BLOWS/6"				
0		S-1	12/23	0-1.9	7-8-40-100/5"	0.0	Dense, brown, gravelly, fine to coarse SAND FILL, little silt, trace debris (wood); moist.	1	SAND FILL WITH DEBRIS
5		S-2	18/24	5-7	10-79-60-38	0.2	Very dense, dark brown, fine to coarse SAND FILL, some gravel, little silt; moist.		
10		S-3	5/24	10-12	6-7-6-8	0.1	Medium dense, brown, fine to coarse SAND FILL, little gravel, trace silt; moist.		
15		S-4	14/24	15-17	10-28-33-13	0.6	Very dense, brown, gravelly, fine to coarse SAND FILL, some silt, trace debris (asphalt); moist.	2	
20							Boring terminated at 17 ft.		
25									
30									

GRANULAR SOILS		COHESIVE SOILS		NOTES:
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY	
0-4	V. LOOSE	0-2	V. SOFT	1. Periodic auger grinding from about 0 to 13 ft. (possible cobbles, boulders, and/or debris). 2. Grab sample submitted for environmental analysis.
4-10	LOOSE	2-4	SOFT	
10-30	M. DENSE	4-8	M. STIFF	
30-50	DENSE	8-15	STIFF	
> 50	V. DENSE	15-30	V. STIFF	
		> 30	HARD	

GENERAL NOTES: i) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
ii) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THIS BORING LOG.
FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS ARE MADE.

BORING No. B-5



PROJECT
Rt. 33 Recreation Field
Portsmouth, NH

REPORT OF BORING No. B-6
SHEET 1 OF 1
Project No. 2160648.A
CHKD BY Thomas J. Strike, PE

BORING Co. New England Boring Contractors **BORING LOCATION** See attached plan
FOREMAN Sam Shaw **GROUND SURFACE ELEV.** 56 ft. +/- **DATUM** NAVD88
WSE ENGINEER: Julie A. Eaton, EIT **DATE START** 9/28/16 **DATE END** 9/28/16

SAMPLER: 2 IN. OD SPLIT SPOON SAMPLER (SPT) DRIVEN 24 INCHES
USING A 140 lb. CATHEAD OPERATED HAMMER.
CASING: HOLLOW STEM AUGER DRILLING METHODS
TRUCK RIG
CASING SIZE: 2 1/4 IN. INSIDE DIAMETER. OTHER:

GROUNDWATER READINGS				
DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME
Groundwater not observed.				

DEPTH (feet)	CASING (blows/ft)	SAMPLE				PID (ppm)	SAMPLE DESCRIPTION	NOTES	STRATUM DESCRIPTION
		No.	REC/PEN (in)	DEPTH (ft)	BLOWS/6"				
0		S-1	15/24	0-2	10-19-26-20	0.0	Dense, brown, fine to coarse SAND FILL, little to some gravel, little silt, trace debris (brick, asphalt); moist.	1	SAND FILL WITH DEBRIS
5		S-2	4/8	5-5.6	14-100/2"	0.5	Very dense, dark brown, gravelly fine to coarse SAND FILL, little to some silt, little debris (wood fragments); moist.		
10		S-3	13/24	10-12	18-15-12-12	0.0	Medium dense, dark brown, fine to coarse SAND FILL, some silt, little debris (brick, ash, asphalt), trace gravel; moist. Bottom 4": grades to brown, silty.	2	
15		S-4	6/24	15-17	17-15-13-14	0.3	Medium dense, dark brown, fine to medium SAND FILL, some silt, little debris (wood fragments, asphalt), little gravel; moist.		
20							Boring terminated at 17 ft.		
25									
30									

GRANULAR SOILS		COHESIVE SOILS		NOTES:
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY	
0-4	V. LOOSE	0-2	V. SOFT	1. Periodic auger grinding from about 3 to 6 ft. (possible cobbles, boulders, and/or debris). 2. Grab sample submitted for environmental analysis.
4-10	LOOSE	2-4	SOFT	
10-30	M. DENSE	4-8	M. STIFF	
30-50	DENSE	8-15	STIFF	
> 50	V. DENSE	15-30	V. STIFF	
		> 30	HARD	

GENERAL NOTES: i) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
ii) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THIS BORING LOG. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS ARE MADE.

BORING No. B-6



PROJECT
Rt. 33 Recreation Field
Portsmouth, NH

REPORT OF BORING No. B-7
SHEET 1 OF 1
Project No. 2160648.A
CHKD BY Thomas J. Strike, PE

BORING Co. New England Boring Contractors **BORING LOCATION** See attached plan
FOREMAN Sam Shaw **GROUND SURFACE ELEV.** 56 ft. +/- **DATUM** NAVD88
WSE ENGINEER: Julie A. Eaton, EIT **DATE START** 9/28/16 **DATE END** 9/28/16

SAMPLER: 2 IN. OD SPLIT SPOON SAMPLER (SPT) DRIVEN 24 INCHES
USING A 140 lb. CATHEAD OPERATED HAMMER.
CASING: HOLLOW STEM AUGER DRILLING METHODS
TRUCK RIG
CASING SIZE: 2 1/4 IN. INSIDE DIAMETER. OTHER:

GROUNDWATER READINGS				
DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME
Groundwater not observed.				

DEPTH (feet)	CASING (blows/ft)	SAMPLE				PID (ppm)	SAMPLE DESCRIPTION	NOTES	STRATUM DESCRIPTION
		No.	REC/PEN (in)	DEPTH (ft)	BLOWS/6"				
0		S-1	19/24	0-2	9-14-29-23	0.0	Dense, dark brown, fine to coarse SAND FILL, some gravel, little debris (concrete, asphalt), little silt; moist.	1	SAND FILL WITH DEBRIS
5		S-2	8/24	5-7	25-61-16-13	0.3	Very dense, dark brown, fine to coarse SAND FILL, some gravel, some silt, little debris (brick, wood); moist.		
10		S-3	3/24	10-12	10-1/12"-1	1.0	Very loose, dark brown, fine to medium SAND FILL, some silt, some debris (wood, ash), trace gravel; moist.		
15		S-4	12/24	15-17	11-14-13-26	4.1	Medium dense, dark brown, fine to medium SAND FILL with debris (wood, fabric, ash), some silt, little gravel; moist.		
20							Boring terminated at 17 ft.		
25									
30									

GRANULAR SOILS		COHESIVE SOILS		NOTES:
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY	
0-4	V. LOOSE	0-2	V. SOFT	1. Grab sample submitted for environmental analysis.
4-10	LOOSE	2-4	SOFT	
10-30	M. DENSE	4-8	M. STIFF	
30-50	DENSE	8-15	STIFF	
> 50	V. DENSE	15-30	V. STIFF	
		> 30	HARD	

GENERAL NOTES: i) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
ii) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THIS BORING LOG.
FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS ARE MADE.

BORING No. B-7



PROJECT
Rt. 33 Recreation Field
Portsmouth, NH

REPORT OF BORING No. B-8
SHEET 1 OF 1
Project No. 2160648.A
CHKD BY Thomas J. Strike, PE

BORING Co. New England Boring Contractors **BORING LOCATION** See attached plan
FOREMAN Sam Shaw **GROUND SURFACE ELEV.** 56 ft. +/- **DATUM** NAVD88
WSE ENGINEER: Julie A. Eaton, EIT **DATE START** 9/28/16 **DATE END** 9/28/16

SAMPLER: 2 IN. OD SPLIT SPOON SAMPLER (SPT) DRIVEN 24 INCHES
USING A 140 lb. CATHEAD OPERATED HAMMER.
CASING: HOLLOW STEM AUGER DRILLING METHODS
TRUCK RIG
CASING SIZE: 2 1/4 IN. INSIDE DIAMETER. OTHER:

GROUNDWATER READINGS				
DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME
Groundwater not observed.				

DEPTH (feet)	CASING (blows/ft)	SAMPLE				PID (ppm)	SAMPLE DESCRIPTION	NOTES	STRATUM DESCRIPTION
		No.	REC/PEN (in)	DEPTH (ft)	BLOWS/6"				
0		S-1	12/24	0-2	5-8-18-42	0.2	Medium dense, brown, sandy GRAVEL FILL, little silt; moist.	1	SAND FILL WITH DEBRIS
5		S-2	6/24	5-7	13-14-12-10	9.5	Medium dense, dark brown, fine to coarse SAND FILL, trace gravel, trace to little silt, trace debris (wood fragments, brick, asphalt); moist.	2	
10		S-3	6/24	10-12	6-7-4-29	1.6	Medium dense, dark brown, fine to medium SILTY SAND FILL with debris (wood fragments, ash, asphalt), trace gravel; moist.		
15		S-4	5/24	15-17	14-25-15-12	2.6	Dense, dark brown, fine to medium SILTY SAND FILL with wood fragments; very moist.		
20							Boring terminated at 17 ft.		
25									
30									

GRANULAR SOILS		COHESIVE SOILS		NOTES:
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY	
0-4	V. LOOSE	0-2	V. SOFT	1. Periodic auger grinding from about 0 to 14 ft. (possible cobbles, boulders, and/or debris). 2. Grab sample submitted for environmental analysis.
4-10	LOOSE	2-4	SOFT	
10-30	M. DENSE	4-8	M. STIFF	
30-50	DENSE	8-15	STIFF	
> 50	V. DENSE	15-30	V. STIFF	
		> 30	HARD	

GENERAL NOTES: i) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
ii) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THIS BORING LOG.
FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS ARE MADE.

BORING No. B-8



PROJECT
Rt. 33 Recreation Field
Portsmouth, NH

REPORT OF BORING No. B-9
SHEET 1 OF 1
Project No. 2160648.A
CHKD BY Thomas J. Strike, PE

BORING Co. New England Boring Contractors **BORING LOCATION** See attached plan
FOREMAN Sam Shaw **GROUND SURFACE ELEV.** 57 ft. +/- **DATUM** NAVD88
WSE ENGINEER: Julie A. Eaton, EIT **DATE START** 9/27/16 **DATE END** 9/27/16

SAMPLER: 2 IN. OD SPLIT SPOON SAMPLER (SPT) DRIVEN 24 INCHES
USING A 140 lb. CATHEAD OPERATED HAMMER.
CASING: HOLLOW STEM AUGER DRILLING METHODS
TRUCK RIG
CASING SIZE: 2 1/4 IN. INSIDE DIAMETER. OTHER:

GROUNDWATER READINGS				
DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME
Groundwater not observed.				

DEPTH (feet)	CASING (blows/ft)	SAMPLE				PID (ppm)	SAMPLE DESCRIPTION	NOTES	STRATUM DESCRIPTION
		No.	REC/PEN (in)	DEPTH (ft)	BLOWS/6"				
0		S-1	13/24	0-2	12-22-27-14	0.0	Very dense, dark brown, gravelly, fine to coarse SAND FILL, little to some silt; moist.	1	SAND/CLAYEY SILT FILL WITH DEBRIS
5		S-2	15/24	5-7	3-32-27-6	0.0	Hard, gray, CLAYEY SILT FILL, little gravel, little fine sand; moist.	2	
10		S-3	7/24	10-12	3-2-3-6	0.7	Medium stiff, gray-brown, ORGANIC CLAYEY SILT FILL, little to some fine sand, trace gravel, trace debris (asphalt); moist.	2	
15		S-4	4/5	15-15.4	100/5"	3.2	Brown WOOD DEBRIS, little fine to medium sand, trace silt, trace gravel; moist.	3	
20		S-5	12/24	20-22	27-36-30-29	9.6	Very dense, brown, gravelly, fine to coarse SAND, little silt; moist.	3	
25		S-6	11/24	25-27	14-21-28-41	1.2	Very dense, brown, gravelly, fine to coarse SAND, little silt; moist. Bottom 4": grades to fine to medium SAND, trace silt; moist.	3	
30		S-7	9/24	30-32	37-41-45-40	2.7	Very dense, brown, gravelly, fine to coarse SAND, trace silt; moist. Boring terminated at 32 ft.	3	

GRANULAR SOILS		COHESIVE SOILS		NOTES:
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY	
0-4	V. LOOSE	0-2	V. SOFT	1. Periodic auger grinding from about 0 to 30 ft. with heavy auger grinding from about 15 to 16.5 ft. (over 10 minutes to advance). Wood fragments observed in auger cuttings. 2. Grab sample submitted for environmental analysis. 3. Slow auger advancement from about 20 to 30 ft.
4-10	LOOSE	2-4	SOFT	
10-30	M. DENSE	4-8	M. STIFF	
30-50	DENSE	8-15	STIFF	
> 50	V. DENSE	15-30	V. STIFF	
		> 30	HARD	

GENERAL NOTES: i) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
ii) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THIS BORING LOG.
FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS ARE MADE.

BORING No. B-9



PROJECT
Rt. 33 Recreation Field
Portsmouth, NH

REPORT OF BORING No. B-10
SHEET 1 OF 1
Project No. 2160648.A
CHKD BY Thomas J. Strike, PE

BORING Co. New England Boring Contractors **BORING LOCATION** See attached plan
FOREMAN Sam Shaw **GROUND SURFACE ELEV.** 56 ft. +/- **DATUM** NAVD88
WSE ENGINEER: Julie A. Eaton, EIT **DATE START** 9/29/16 **DATE END** 9/29/16

SAMPLER: 2 IN. OD SPLIT SPOON SAMPLER (SPT) DRIVEN 24 INCHES
USING A 140 lb. CATHEAD OPERATED HAMMER.
CASING: HOLLOW STEM AUGER DRILLING METHODS
TRUCK RIG
CASING SIZE: 2 1/4 IN. INSIDE DIAMETER. OTHER:

GROUNDWATER READINGS				
DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME
Groundwater not observed.				

DEPTH (feet)	CASING (blows/ft)	SAMPLE				PID (ppm)	SAMPLE DESCRIPTION	NOTES	STRATUM DESCRIPTION
		No.	REC/PEN (in)	DEPTH (ft)	BLOWS/6"				
0		S-1	16/24	0-2	8-12-12-12	0.1	Medium dense, brown, fine to medium SAND FILL, little gravel, little silt, trace debris (fabric); moist.	1	SAND/CLAYEY SILT FILL WITH DEBRIS
5		S-2	12/24	5-7	4-4-3-4	0.2	Medium stiff, dark brown, CLAYEY SILT FILL, some fine sand, little gravel, trace debris (wood, ash); very moist.		
10		S-3	12/24	10-12	4-3-8-8	0.5	Stiff, brown, CLAYEY SILT FILL, little fine sand, little gravel, trace debris (brick, wood); very moist.	2	
15		S-4	10/24	15-17	15-8-4-3	0.1	Medium dense, brown, fine to medium SAND FILL, little to some silt, little gravel, trace debris (asphalt, ash, wood); moist.		
20							Boring terminated at 17 ft.		
25									
30									

GRANULAR SOILS		COHESIVE SOILS		NOTES:
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY	
0-4	V. LOOSE	0-2	V. SOFT	1. Periodic Auger grinding from about 2 to 13ft. (possible cobbles, boulders, and/or debris). 2. Grab sample submitted for environmental analysis.
4-10	LOOSE	2-4	SOFT	
10-30	M. DENSE	4-8	M. STIFF	
30-50	DENSE	8-15	STIFF	
> 50	V. DENSE	15-30	V. STIFF	
		> 30	HARD	

GENERAL NOTES: i) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
ii) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THIS BORING LOG. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS ARE MADE.

BORING No. B-10



PROJECT
Rt. 33 Recreation Field
Portsmouth, NH

REPORT OF BORING No. B-11
SHEET 1 OF 1
Project No. 2160648.A
CHKD BY Thomas J. Strike, PE

BORING Co. New England Boring Contractors **BORING LOCATION** See attached plan
FOREMAN Sam Shaw **GROUND SURFACE ELEV.** 56 ft. +/- **DATUM** NAVD88
WSE ENGINEER: Julie A. Eaton, EIT **DATE START** 9/29/16 **DATE END** 9/29/16

SAMPLER: 2 IN. OD SPLIT SPOON SAMPLER (SPT) DRIVEN 24 INCHES
USING A 140 lb. CATHEAD OPERATED HAMMER.
CASING: HOLLOW STEM AUGER DRILLING METHODS
TRUCK RIG
CASING SIZE: 2 1/4 IN. INSIDE DIAMETER. OTHER:

GROUNDWATER READINGS				
DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME
Groundwater not observed.				

DEPTH (feet)	CASING (blows/ft)	SAMPLE				PID (ppm)	SAMPLE DESCRIPTION	NOTES	STRATUM DESCRIPTION
		No.	REC/PEN (in)	DEPTH (ft)	BLOWS/6"				
0		S-1	14/24	0-2	17-46-33-24	0.0	Very dense, brown, gravelly, fine to coarse SAND FILL, some silt; moist.	1	SAND/CLAYEY SILT FILL WITH DEBRIS
5		S-2	11/24	5-7	8-8-6-7	0.0	Stiff, brown, CLAYEY SILT FILL, some fine sand, some debris (concrete, brick, asphalt), little gravel; moist.	2	
10		S-3	12/24	10-12	22-8-9-9	0.5	Stiff, brown, sandy SILT FILL, little gravel, little clay, trace debris (asphalt); moist. Bottom 6": grades to little organics (fine roots).	3	
15		S-4	13/24	15-17	8-15-17-19		Dense, light brown, fine to medium SAND, trace gravel, trace silt; moist. Boring terminated at 17 ft.		SAND
20									
25									
30									

GRANULAR SOILS		COHESIVE SOILS		NOTES:
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY	
0-4	V. LOOSE	0-2	V. SOFT	1. Periodic auger grinding from about 0 to 10 ft. (possible cobbles, boulders, and/or debris). 2. Grab sample submitted for environmental analysis. 3. Possible buried topsoil layer.
4-10	LOOSE	2-4	SOFT	
10-30	M. DENSE	4-8	M. STIFF	
30-50	DENSE	8-15	STIFF	
> 50	V. DENSE	15-30	V. STIFF	
		> 30	HARD	

GENERAL NOTES: i) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
ii) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THIS BORING LOG.
FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS ARE MADE.

BORING No. B-11



PROJECT
Rt. 33 Recreation Field
Portsmouth, NH

REPORT OF BORING No. B-12
SHEET 1 OF 1
Project No. 2160648.A
CHKD BY Thomas J. Strike, PE

BORING Co. New England Boring Contractors **BORING LOCATION** See attached plan
FOREMAN Sam Shaw **GROUND SURFACE ELEV.** 57 ft. +/- **DATUM** NAVD88
WSE ENGINEER: Julie A. Eaton, EIT **DATE START** 9/29/16 **DATE END** 9/29/16

SAMPLER: 2 IN. OD SPLIT SPOON SAMPLER (SPT) DRIVEN 24 INCHES
USING A 140 lb. CATHEAD OPERATED HAMMER.
CASING: HOLLOW STEM AUGER DRILLING METHODS
TRUCK RIG
CASING SIZE: 2 1/4 IN. INSIDE DIAMETER. OTHER:

GROUNDWATER READINGS				
DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME
Groundwater not observed.				

DEPTH (feet)	CASING (blows/ft)	SAMPLE				PID (ppm)	SAMPLE DESCRIPTION	NOTES	STRATUM DESCRIPTION
		No.	REC/PEN (in)	DEPTH (ft)	BLOWS/6"				
0		S-1	11/24	0-2	14-35-32-69	0.1	Very dense, brown, gravelly, fine to coarse SAND FILL, trace silt; moist.	1, 2	SAND FILL WITH DEBRIS
5		S-2	11/24	5-7	8-9-8-2	0.0	Medium dense, dark brown, SILTY SAND FILL, little gravel, trace debris (wood, asphalt); moist.		
10		S-3	7/24	10-12	5-14-15-33	0.2	Very dense, brown, gravelly, fine to coarse SAND FILL, trace silt; moist. Bottom 3": Very dense, brown, gravelly, fine to coarse SAND, trace silt; moist.		SAND
15		S-4	13/24	15-17	18-22-35-24		Very dense, brown, gravelly, fine to coarse SAND, little silt; moist. Boring terminated at 17 ft.		
20									
25									
30									

GRANULAR SOILS		COHESIVE SOILS		NOTES:
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY	
0-4	V. LOOSE	0-2	V. SOFT	1. Periodic auger grinding from about 0 to 15 ft. (possible cobbles, boulders, and/or debris). 2. Grab sample submitted for environmental analysis.
4-10	LOOSE	2-4	SOFT	
10-30	M. DENSE	4-8	M. STIFF	
30-50	DENSE	8-15	STIFF	
> 50	V. DENSE	15-30	V. STIFF	
		> 30	HARD	

GENERAL NOTES: i) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
ii) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THIS BORING LOG. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS ARE MADE.

BORING No. B-12



PROJECT
Rt. 33 Recreation Field
Portsmouth, NH

REPORT OF BORING No. B-13
SHEET 1 OF 1
Project No. 2160648.A
CHKD BY Thomas J. Strike, PE

BORING Co. New England Boring Contractors **BORING LOCATION** See attached plan
FOREMAN Sam Shaw **GROUND SURFACE ELEV.** 56 ft. +/- **DATUM** NAVD88
WSE ENGINEER: Julie A. Eaton, EIT **DATE START** 9/28/16 **DATE END** 9/28/16

SAMPLER: 2 IN. OD SPLIT SPOON SAMPLER (SPT) DRIVEN 24 INCHES
USING A 140 lb. CATHEAD OPERATED HAMMER.
CASING: HOLLOW STEM AUGER DRILLING METHODS
TRUCK RIG
CASING SIZE: 2 1/4 IN. INSIDE DIAMETER. OTHER:

GROUNDWATER READINGS				
DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME
Groundwater not observed.				

DEPTH (feet)	CASING (blows/ft)	SAMPLE				PID (ppm)	SAMPLE DESCRIPTION	NOTES	STRATUM DESCRIPTION
		No.	REC/PEN (in)	DEPTH (ft)	BLOWS/6"				
0		S-1	14/24	0-2	12-21-22-17	0.1	Dense, brown, gravelly, fine to coarse SAND FILL, little silt, trace debris (asphalt, brick); moist.	1	SAND FILL WITH DEBRIS
5		S-2	9/24	5-7	8-11-7-6	0.7	Medium dense, dark brown, fine to coarse SAND FILL, some silt, trace debris (asphalt), trace gravel; moist.		
10		S-3	11/24	10-12	7-15-9-12	2.2	Medium dense, dark brown, fine to coarse SAND FILL, some gravel, little silt, trace debris (brick, asphalt); moist.	2	
15		S-4	14/24	15-17	14-23-43-49		Very dense, brown, fine to coarse SAND, some gravel, trace silt; moist. Boring terminated at 17 ft.		
20									
25									
30									

GRANULAR SOILS		COHESIVE SOILS		NOTES:
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY	
0-4	V. LOOSE	0-2	V. SOFT	1. Periodic auger grinding from about 0 to 10 ft. (possible cobbles, boulders, and/or debris). 2. Grab sample submitted for environmental analysis.
4-10	LOOSE	2-4	SOFT	
10-30	M. DENSE	4-8	M. STIFF	
30-50	DENSE	8-15	STIFF	
> 50	V. DENSE	15-30	V. STIFF	
		> 30	HARD	

GENERAL NOTES: i) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
ii) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THIS BORING LOG.
FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS ARE MADE.

BORING No. B-13



PROJECT
Rt. 33 Recreation Field
Portsmouth, NH

REPORT OF BORING No. B-14
SHEET 1 OF 1
Project No. 2160648.A
CHKD BY Thomas J. Strike, PE

BORING Co. New England Boring Contractors
FOREMAN Sam Shaw
WSE ENGINEER: Julie A. Eaton, EIT
BORING LOCATION See attached plan
GROUND SURFACE ELEV. 56 ft. +/- **DATUM** NAVD88
DATE START 9/29/16 **DATE END** 9/29/16

SAMPLER: 2 IN. OD SPLIT SPOON SAMPLER (SPT) DRIVEN 24 INCHES
USING A 140 lb. CATHEAD OPERATED HAMMER.
CASING: HOLLOW STEM AUGER DRILLING METHODS
TRUCK RIG
CASING SIZE: 2 1/4 IN. INSIDE DIAMETER. OTHER:

GROUNDWATER READINGS				
DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME
Groundwater not observed.				

DEPTH (feet)	CASING (blows/ft)	SAMPLE				PID (ppm)	SAMPLE DESCRIPTION	NOTES	STRATUM DESCRIPTION
		No.	REC/PEN (in)	DEPTH (ft)	BLOWS/6"				
0		S-1	11/12	0-1	23-100/6"	0.0	Very dense, brown, fine to coarse SAND FILL, little gravel, little silt; moist. Bottom 3": grades to gravelly.	1	SAND FILL WITH DEBRIS
5		S-2	13/24	5-7	30-31-23-18	0.5	Very dense, dark brown, fine to coarse SAND FILL, some debris (asphalt, brick), little gravel, little silt; moist.		
10		S-3	4/14	10-11.1	3-7-100/2"	1.8	Very dense, dark brown, fine to medium SAND FILL with debris (brick, wood), some silt, trace gravel; very moist.	2	
15		S-4	6/24	15-17	11-10-12-10	32.8	Medium dense, dark brown, fine to medium SANDY DEBRIS FILL (wood, asphalt), some silt, little gravel; very moist.	3	
20							Boring terminated at 17 ft.		
25									
30									

GRANULAR SOILS		COHESIVE SOILS		NOTES:
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY	
0-4	V. LOOSE	0-2	V. SOFT	1. Periodic auger grinding from about 1 to 9 ft. (possible cobbles, boulders, and/or debris). 2. Heavy auger grinding from about 9 to 9.5 ft. and 11.5 to 15 ft. (possible cobbles, boulders, and/or debris) 3. Grab sample submitted for environmental analysis.
4-10	LOOSE	2-4	SOFT	
10-30	M. DENSE	4-8	M. STIFF	
30-50	DENSE	8-15	STIFF	
> 50	V. DENSE	15-30	V. STIFF	
		> 30	HARD	

GENERAL NOTES: i) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
ii) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THIS BORING LOG. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS ARE MADE.

BORING No. B-14



PROJECT
Rt. 33 Recreation Field
Portsmouth, NH

REPORT OF BORING No. B-15
SHEET 1 OF 1
Project No. 2160648.A
CHKD BY Thomas J. Strike, PE

BORING Co. New England Boring Contractors **BORING LOCATION** See attached plan
FOREMAN Sam Shaw **GROUND SURFACE ELEV.** 56 ft. +/- **DATUM** NAVD88
WSE ENGINEER: Julie A. Eaton, EIT **DATE START** 9/29/16 **DATE END** 9/29/16

SAMPLER: 2 IN. OD SPLIT SPOON SAMPLER (SPT) DRIVEN 24 INCHES
USING A 140 lb. CATHEAD OPERATED HAMMER.
CASING: HOLLOW STEM AUGER DRILLING METHODS
TRUCK RIG
CASING SIZE: 2 1/4 IN. INSIDE DIAMETER. OTHER:

GROUNDWATER READINGS				
DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME
Groundwater not observed.				

DEPTH (feet)	CASING (blows/ft)	SAMPLE				PID (ppm)	SAMPLE DESCRIPTION	NOTES	STRATUM DESCRIPTION
		No.	REC/PEN (in)	DEPTH (ft)	BLOWS/6"				
0		S-1	16/24	0-2	6-14-20-21	0.1	Dense, brown, fine to coarse SAND FILL, little gravel, little silt; moist. Bottom 4": grades to some debris (asphalt).	1	SAND/CLAYEY SILT FILL WITH DEBRIS
5		S-2	17/24	5-7	15-15-6-8	0.4	Top 7": Medium dense, brown fine to medium SAND FILL, some silt, little gravel, trace debris (brick, asphalt); moist. Very stiff, dark gray, CLAYEY SILT FILL, some fine sand, trace debris (asphalt, brick); moist.	2	
10		S-3	17/24	10-12	8-7-5-4	14.0	Medium dense, dark brown, SILTY SAND FILL with debris (brick, ash, wood, leaves), trace gravel; very moist.	3	
15		S-4	2/24	15-17	5-5-2/12"	0.5	Dark brown, WOOD DEBRIS, some fine sand, some silt; very moist. Boring terminated at 17 ft.		
20									
25									
30									

GRANULAR SOILS		COHESIVE SOILS		NOTES:
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY	
0-4	V. LOOSE	0-2	V. SOFT	
4-10	LOOSE	2-4	SOFT	
10-30	M. DENSE	4-8	M. STIFF	
30-50	DENSE	8-15	STIFF	
> 50	V. DENSE	15-30	V. STIFF	
		> 30	HARD	

GENERAL NOTES: i) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
ii) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THIS BORING LOG.
FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS ARE MADE.

BORING No. B-15



PROJECT
Rt. 33 Recreation Field
Portsmouth, NH

REPORT OF BORING No. B-16
SHEET 1 OF 1
Project No. 2160648.A
CHKD BY Thomas J. Strike, PE

BORING Co. New England Boring Contractors **BORING LOCATION** See attached plan
FOREMAN Sam Shaw **GROUND SURFACE ELEV.** 56 ft. +/- **DATUM** NAVD88
WSE ENGINEER: Julie A. Eaton, EIT **DATE START** 9/29/16 **DATE END** 9/29/16

SAMPLER: 2 IN. OD SPLIT SPOON SAMPLER (SPT) DRIVEN 24 INCHES
USING A 140 lb. CATHEAD OPERATED HAMMER.
CASING: HOLLOW STEM AUGER DRILLING METHODS
TRUCK RIG
CASING SIZE: 2 1/4 IN. INSIDE DIAMETER. OTHER:

GROUNDWATER READINGS				
DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME
9/29/2016		25 ft. +/-		based on wet sample.

DEPTH (feet)	CASING (blows/ft)	SAMPLE				PID (ppm)	SAMPLE DESCRIPTION	NOTES	STRATUM DESCRIPTION
		No.	REC/PEN (in)	DEPTH (ft)	BLOWS/6"				
0		S-1	7/12	0-1	12-32-50/0"	0.0	Dense, dark brown, fine to medium SAND FILL, little to some silt, trace gravel, trace debris (asphalt); moist.	1	SAND FILL WITH DEBRIS
5		S-2	8/24	5-7	11-29-20-10	0.2	Dense, dark brown, fine to coarse SAND FILL, little to some silt, trace gravel, trace debris (asphalt, ash, concrete); moist.	2	
10		S-3	12/24	10-12	17-49-13-17	2.2	Dark brown, WOOD FRAGMENTS, trace fine sand; moist. Bottom 6": grades to yellow foam debris.	3	
15		S-4	11/24	15-17	11-7-5-6	0.2	Medium dense, dark brown, SILTY SAND FILL, some wood fragments, little gravel; moist.		
20		S-5	9/24	20-22	29-10-9-7	1.2	Same as above.	4	
25		S-6	11/24	25-27	16-51-4-2	0.8	Dark brown, SILTY SAND FILL with WOOD FRAGMENTS; wet.		
30		S-7	18/24	30-32	8-7-7-6	0.6	Medium dense, brown, fine to coarse SAND, trace gravel, trace silt; wet.		
		S-8	5/24	32-34	10-15-47-48		Very dense, brown, fine to coarse SAND, some gravel, trace silt; wet.		SAND
							Boring terminated at 34 ft.		

GRANULAR SOILS		COHESIVE SOILS		NOTES:
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY	
0-4	V. LOOSE	0-2	V. SOFT	1. Spoon was bouncing and tilting. Auger refusal at 1 ft. Moved ~5 ft. south, auger refusal at 1 ft., moved ~8 ft. south, auger grinding from about 0 to 4 ft. and heavy auger grinding from about 4 to 5 ft. (possible boulders and/or debris) 2. Grab sample submitted for environmental analysis. 3. Heavy auger grinding 7 to 7.5 ft. (possible cobbles and/or debris). 4. Periodic auger grinding from about 20 to 27.5 ft. (possible cobbles, boulders, and/or debris).
4-10	LOOSE	2-4	SOFT	
10-30	M. DENSE	4-8	M. STIFF	
30-50	DENSE	8-15	STIFF	
> 50	V. DENSE	15-30	V. STIFF	
		> 30	HARD	

GENERAL NOTES: i) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
ii) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THIS BORING LOG.
FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS ARE MADE.

BORING No. B-16

SECTION 01 10 00

SUMMARY OF WORK

PART 1- GENERAL:

1.01 PROJECT DESCRIPTION

The project is the construction of **Route 33 Field** as described in the Contract Documents.

1.02 CONTRACT TIME

- A. The work of this contract shall be substantially completed by August 31, 2018.
- B. The Contractor shall submit shop drawings, data and samples or place his/her order sufficiently early to permit consideration and approval by the Engineer before materials are necessary for incorporation into the Work. Any delay resulting from the Contractor's failure to do so shall not be used as a basis of a claim against the Owner.

1.03 CONTRACT DOCUMENTS

The Contract Documents are enumerated in the Agreement, and include these Specifications and the Drawings, as prepared for the City of Portsmouth by Weston & Sampson Engineers, Inc.

1.04 INSPECTION OF THE SITE

It is a contract requirement of the Contractor that his/her subcontractor shall have thoroughly inspected the site during the bidding period. By submitting a bid, they confirm that they are thoroughly familiar with the site and all existing conditions which impact and affect their work. Requests for extra compensation will not be considered for any work which could have been foreseen by a visual inspection of the site.

1.05 CONTRACTOR'S USE OF THE SITE

- A. The contractor will have full access to the site shown within the Contract Limit of Work Line.
 - 1. The Contractor, his/her Subcontractors, and their employees may park on the site inside the Contract Limit of Work Line, given that no such on-site parking interferes with the site work.
 - 2. The Contractor shall furnish his/her own toilet facilities on-site.
- B. The Contractor shall take all precautions necessary to protect all abutting properties during construction. Any and all damage caused by construction operations shall be repaired.
 - 1. The project site shall be kept clean and free from accumulation of waste material and debris.

2. The Contractor, his/her Subcontractors, and their employees shall be respectful and courteous of the neighborhood while working on site.
3. The contractor will not conduct any work outside the Property without approval from the Property Owner.

1.06 ENCLOSURES

Provide at the earliest practical time temporary enclosure of materials, work in progress and completed portions of the work to provide protection to the work and the employees.

1.07 SAFETY AND SECURITY

- A. The Contractor shall be responsible for the safety and security of the site within the Contract Limit of Work Line and for the safety of all persons who enter within the Contract Limit of Work Line.
- B. The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions & programs in connection with the work. He/she shall promulgate safety regulations and shall notify the Owner of particular hazards.
- C. The Contractor shall erect and maintain, as required by existing conditions and progress of work, all reasonable safeguards for safety and security. This includes the construction of barriers and the posting of danger signs and other warnings against hazards. By these and other necessary methods the Contractor shall stop unauthorized entry within the Contract Limit of Work Line.
- D. The Contractor shall cooperate with and maintain a close liaison with the Police Department, Fire Department, and City of Portsmouth he/she shall abide by safety or security related requests from any of these authorities.

1.08 WORK TO BE DONE

The work of this Contract includes improvements to the Route 33 Field property and other related site improvements. This includes, but is not necessarily limited to the following:

1. Excavation, backfill and grading
2. Installation of synthetic turf field
3. Installation of new parking, curbing, and walkways
4. Seeding and or sodding of lawn areas as designated
5. Installation of all associated utilities & amenities
6. Installation of other miscellaneous site improvements as designated in the Contract Documents

END OF SECTION

SECTION 01 11 00

CONTROL OF WORK AND MATERIALS

PART 1 – GENERAL

Not Used.

PART 2 – PRODUCTS

Not Used

PART 3 - EXECUTION

3.01 HAULING, HANDLING AND STORAGE OF MATERIALS:

- A. The Contractor shall, at his own expense, handle and haul all materials furnished by him and shall remove any of his surplus materials at the completion of the work.
- B. The Contractor shall provide suitable and adequate storage for equipment and materials furnished by him that are liable to injury and shall be responsible for any loss of or damage to any equipment or materials by theft, breakage, or otherwise.
- C. All excavated materials and equipment to be incorporated in the Work shall be placed so as not to injure any part of the Work or existing facilities and so that free access can be had at all times to all parts of the Work and to all public utility installations in the vicinity of the work. Materials and equipment shall be kept neatly piled and compactly stored in such location as will cause a minimum of inconvenience to public travel and adjoining owners, tenants and occupants.
- D. The Contractor shall be responsible for all damages to the work under construction during its progress and until final completion and acceptance even though partial payments have been made under the Contract.
- E. Construction entrance shall be as marked on Plan L2.00 off of Route 33 and **will require a tracking pad / truck wash station** to ensure no debris leaves the site. Contractor is responsible for cleaning the streets should debris be tracked off site. A detail will be furnished within the conformed plan set.

3.02 OPEN EXCAVATIONS:

- A. All open excavations shall be adequately safeguarded by providing temporary barricades, caution signs, lights and other means to prevent accidents to persons, and damage to property. The Contractor shall, at his own expense, provide suitable and

safe means for completely covering all open excavations and for accommodating travel when work is not in progress.

- B. Bridges provided for access to private property during construction shall be removed when no longer required.
- C. The length of open trench will be controlled by the particular surrounding conditions but shall always be confined to the limits prescribed by the Engineer.
- D. If the excavation becomes a hazard, or if it excessively restricts traffic at any point, then special construction procedures shall be taken, such as limiting the length of trench and prohibiting stocking excavated material in the street.
- E. All street excavations shall be completely closed at the end of each work day. Backfilling or use of steel plates of adequate strength to carry traffic shall be used.

3.03 MAINTENANCE OF TRAFFIC:

- A. Unless permission to close the street is received in writing from the proper authority, all excavated materials and equipment shall be placed so that vehicular and pedestrian traffic may be safely maintained at all times.
- B. The contractor is required by the Director of Traffic and Parking to have workforce carpool to the site in order to reduce traffic at the beginning and end of the work day. Director of Traffic and Parking deem it necessary, uniformed officers will be assigned to direct traffic. The Contractor shall make all arrangements in obtaining uniformed officers required.
- C. The Contractor shall at his own expense, as directed by the Police Traffic Control/Safety Officer, provide and erect acceptable barricades, barrier fences, traffic signs, and all other traffic devices not specifically covered in a bid item, to protect the work from traffic, pedestrians, and animals. He shall provide sufficient temporary lighting such as lanterns/flashers (electric battery operated) or other approved illuminated traffic signs and devices to afford adequate protection to the traveling public, at no additional cost to the Owner.
- D. The Contractor shall furnish all construction signs that are deemed necessary by and in accordance with Part VI of the Manual on Uniform Traffic Control Devices as published by the U.S. Department of Transportation. In addition, the Contractor may be required to furnish up to 128 square feet of additional special construction warning signs. Size and exact wording of signs shall be determined by the Engineer during construction.
- E. The intent of policing is to ensure public safety by direction of traffic. Police officers are not to serve as watchmen to protect the Contractor's equipment and materials.

- F. Nothing contained herein shall be construed as relieving the Contractor of any of his responsibilities for protection of persons and property under the terms of the Contract.

3.04 CARE AND PROTECTION OF PROPERTY:

The Contractor shall be responsible for the preservation of all public and private property, and shall use every precaution necessary to prevent damage thereto. If any direct or indirect damage is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the work on the part of the Contractor, such property shall be promptly restored by the Contractor, at his expense, to a condition similar or equal to that existing before the damage was done, to the satisfaction of the Engineer.

3.05 PROTECTION AND RELOCATION OF EXISTING STRUCTURES AND UTILITIES:

- A. All existing buildings, utilities, pipes, poles, wires fences, curbing, property line markers and other structures which the Engineer decides must be preserved in place without being temporarily or permanently relocated, shall be carefully supported and protected from damage by the contractor. Should such property be damaged, it shall be restored by the Contractor, at no additional cost to the Owner.
- B. The Contractor shall determine the location of all underground structures and utilities (including existing water services, drain lines, electrical lines, and sewers). Services to buildings shall be maintained, and all costs or charges resulting from damage thereto shall be paid by Contractor.
- C. When fences interfere with the Contractor's operations, he shall remove and (unless otherwise specified) promptly restore them in accordance with the contract.
- D. On paved surfaces the Contractor shall not use or operate tractors, bulldozers, or other power-operated equipment with treads or wheels which are shaped so as to cut or otherwise damage such surfaces.
- E. All property damaged by the Contractor's operations shall be restored to a condition at least equal to that in which it was found immediately before work was begun. Suitable materials and methods shall be used for such restoration.
- F. Restoration of existing property and structures shall be carried out as promptly as practicable and shall not be left until the end of the construction period.

3.06 MAINTENANCE OF FLOW:

- A. The Contractor shall at his own cost, provide for the flow of sewers and drains interrupted during the progress of the work, and shall immediately cart away and

dispose of all offensive matter. The entire procedure of maintaining existing flow shall be fully discussed with the Engineer well in advance of the interruption of any flow.

- B. All existing drainage facilities including, but not limited to; brooks, streams, canals, channels, ditches, culverts, catch basins and drainage piping shall be adequately safeguarded so as not to impede drainage or to cause siltation of downstream areas in any manner whatsoever. If the Contractor damages or impairs any of the aforesaid drainage facilities, he shall repair the same within the same day.
- C. At the conclusion of the work, the Contractor shall remove all silt in drainage structures caused by his operations as described in Section 01 74 00, CLEANING UP.

3.07 REJECTED MATERIALS AND DEFECTIVE WORK:

- A. Materials furnished by the Contractor and condemned by the Engineer as unsuitable or not in conformity with the specifications shall forthwith be removed from the work by the Contractor, and shall not be made use of elsewhere in the work.
- B. Any errors, defects or omissions in the execution of the work or in the materials furnished by the Contractor, even though they may have been passed or overlooked or have appeared after the completion of the work, discovered at any time before the final payment is made hereunder, shall be forthwith rectified and made good by and at the expense of the Contractor and in a manner satisfactory to the Engineer.
- C. The Contractor shall reimburse the Owner for any expense, losses or damages incurred in consequence of any defect, error, omission or act of the Contractor or his employees, as determined by the Engineer, occurring previous to the final payment.

3.08 SANITARY REGULATIONS:

Sanitary conveniences for the use of all persons employed on the work, properly screened from public observation, shall be provided in sufficient numbers in such manner and at such locations as may be approved. The contents shall be removed and disposed of in a satisfactory manner as the occasion requires. The Contractor shall rigorously prohibit the committing of nuisances within, on or about the work. Any employees found violating these provisions shall be discharged and not again employed on the work without the written consent of the Engineer. The sanitary conveniences specified above shall be the obligation and responsibility of the Contractor.

3.09 SAFETY AND HEALTH REGULATIONS:

This project is subject to the Safety and Health regulations of the U.S. Department of Labor set forth in 29 CFR, Part 1926, and to the Laws and Rules of the New Hampshire Department of Labor. Contractors shall be familiar with the requirements of these regulations.

3.10 SITE INVESTIGATION:

The Contractor acknowledges that he has satisfied himself as to the conditions existing at the site of the work, the type of equipment required to perform this work, the quality and quantity of the materials furnished insofar as this information is reasonably ascertainable from an inspection of the site, as well as from information presented by the drawings and specifications made a part of this contract. Any failure of the Contractor to acquaint himself with available information will not relieve him from the responsibility for estimating properly the difficulty or cost of successfully performing the work. The Owner assumes no responsibility for any conclusion or interpretation made by the Contractor on the basis of the information made available by the Owner.

3.11 HANGERS, PADS, AND SUPPORTS:

- A. Unless otherwise indicated, hangers and supports shall be by the trade providing the supported item.
- B. Except where detailed or specified, design of hangers and supports shall be the responsibility of the Contractor. All parts of such hangers or supports shall be designed in accordance with accepted engineering practice, using a factor of safety of at least 2½.
- C. When proprietary hangers, etc., are supplied, satisfactory evidence of the strength of such items shall be furnished.
- D. Hangers for items hung from steel and concrete shall be centered on the vertical center of gravity of the beam.
- E. Locations and sizes of openings, sleeves, concrete pads, steel frames, and other equipment supports are indicated on the drawings for bidding purposes only. Final sizes and locations of such items shall be obtained from the shop drawings.

3.12 SLEEVES, HOLES, HANGERS, INSERTS, ETC.:

- A. Except where holes and openings are dimensioned, and hangers, inserts, and supports are fully called for on the architectural and structural drawings (or reference is made thereon to drawings containing such information) to accommodate mechanical or electrical items, they shall be by the mechanical or electrical trade concerned.
- B. Sleeves, inserts, anchors, etc., supplied under the mechanical and electrical contracts in sufficient time to so permit, shall be set in concrete, masonry, etc., or fastened to steel deck, etc., by the respective architectural or structural trade. Where not supplied in sufficient time, installation of such items shall be the responsibility of the mechanical or electrical trade involved.
- C. Nothing shall be suspended from the steel roof deck and no fastenings made to it, except with the prior permission of the Engineer. Request for permission shall be

accompanied by full details of the hanger or fastener, including the weight of the item to be suspended.

- D. Nailers and other wood members attached to steel or masonry, for which fasteners are not indicated on the design drawings or in the specification, shall be fastened with the equivalent of ½-inch diameter bolts at 3 feet o.c.
- E. Openings for mechanical and electrical items in finished areas of the building shall be closed off with near escutcheon plates or similar closures. These closures shall be by the mechanical or electrical trade involved.

3.13 WORK PROTECTION:

Where work must be performed over completed work, the pavement shall be protected by 2 layers of ½-inch thick plywood, laid with joints in the second layer offset 1/2 sheet width and length from joints in the first layer. No material shall be stored or work performed on areas of completed site which are not so protected.

3.14 WEATHER PROTECTION:

In conformance with OSHA and the New Hampshire Department of Labor the General Contractor shall install weather protection and shall furnish adequate heat in the area so protected during the months of November through March.

3.15 ELECTRIC SERVICE:

- A. The Contractor shall make all necessary applications and arrangements and pay for all fees and charges for electrical energy for power and light necessary for the proper completion of this contract during its entire progress. The Contractor shall provide and pay for all temporary wiring, switches, connections, and meters.
- B. There shall be sufficient electric lighting so that all work may be done in a workmanlike manner where there is not sufficient daylight.

END OF SECTION

SECTION 01 14 00

SPECIAL PROVISIONS

1. Water for Construction Purposes
2. Pipe Location
3. Dimensions of Existing Structures
4. Occupying Private Property
5. Existing Utility Locations – Contractor’s Responsibility
6. Coordination of Work
7. Time for Completion of Contract
8. Maintenance of Trench Surface
9. Project Sign
10. Compliance with Permits
11. Cutting, Fitting and Patching
12. Connections to Existing System
13. Contractor’s Representative
14. Visual Recording
15. Hours of Construction Activity
16. Construction Crews
17. Surveys
18. Certified Field Builders

1. Water for Construction Purposes

- A. The Contractor is required to contact the City Department of Public Works (DPW) for any water use during construction. In locations where water is in sufficient supply, the Contractor shall contact the DPW and acquire a temporary meter and pay the associated costs for construction purposes. The express approval of the Owner shall be obtained before water is used. Waste of water by the Contractor shall be sufficient cause for withdrawing the privilege of unrestricted use.
- B. If no water is available, the Contractor shall supply water at no additional cost to the Owner.

2. Pipe Location

Pipe shall be located substantially as indicated on drawings. The Owner reserves the right, acting through the Engineer, to make such modifications as may be deemed desirable to avoid interference with existing structures or for other reasons.

3. Dimensions of Existing Structures

Where the dimensions and locations of existing structures are of critical importance in the installation or connections of new work, the Contractor shall verify such dimensions and

locations in the field before the fabrication of any material or equipment which is dependent on the correctness of such information.

4. Occupying Private Property

The Contractor shall not enter upon nor occupy with men, equipment or materials any property outside of the project sites public highways or Owner's easements, except with the written consent of the property owner or property owner's agent.

5. Existing Utility Locations - Contractor's Responsibility

- A. The location of existing underground services and utilities shown on the drawings is based on available records. It is not warranted that all existing utilities and services are shown, nor that shown locations are correct. The Contractor shall be responsible for having the utility companies locate their respective utilities on the ground prior to excavating.
- B. To satisfy the requirements of the New Hampshire Public Utilities Commission, at least 72 hours, exclusive of Saturdays Sundays and holidays, prior to excavation in the proximity of telephone, gas, cable television and electric utilities, notify the utilities concerned by calling **"DIG SAFE" at telephone number: 1-888-344-7233.**
- C. The Contractor shall coordinate all work involving utilities and shall satisfy himself as to the existing conditions of the areas in which he is to perform his work. He shall conduct and arrange his work so as not to impede or interfere with the work of other contractors working in the same or adjacent areas.

6. Coordination of Work

The General Contractor shall be responsible for coordinating his own work as well as that of any subcontractors. He shall be responsible for notification of the Owner's Representative when each phase of work is expected to begin and the approximate completion date.

For the purposes of this project, General Contractor cooperation and coordination shall mean, but in no way shall be limited to, making provisions for the separate contractor to gain access to needed work areas, providing adequate space for storage of equipment and materials

7. Time for Completion of Contract

The time for completion of this contract is stipulated in the Bid Proposal form. The Bidder shall base his bid on completing the proposed work by the completion date stipulated in Contract Front End.

8. Maintenance of Trench Surface

After backfilling and compacting a trench, the Contractor shall be responsible for keeping the ground surface dry and passable at all times until the surface has been restored to original conditions.

9. Project Sign

- A. The project sign shall be as shown per SECTION 01 58 00 of the specifications. The signs shall be erected within ten (10) days after the construction contract is awarded. The Owner Representative shall indicate the location of the project sign. The signs shall be fabricated, erected, and maintained by the Contractor.
- B. The Contractor shall provide adequate support for the sign as determined by the Engineer. All supports, trim, and back of sign shall be painted with at least two coats of exterior paint.
- C. The project sign shall be maintained by the Contractor in good condition at all times for the duration of construction. The Contractor shall remove the sign upon completion of construction.

10. Compliance with Permits

The Contractor shall perform all work in conformance with requirements of the Permits, which appear in Section 01 35 00, PERMITS.

11. Cutting, Fitting and Patching

- A. The Contractor shall do all cutting, fitting, or patching of his work that may be required to make its several parts come together properly and fit it to receive or be received by work of other Contractors, as shown upon or reasonably implied by the drawings and the specifications for the completed structure, including all existing work.
- B. The Contractor shall not endanger any work by cutting, digging, or otherwise and shall not cut or alter the work of any other Contractor, save with the consent of the Engineer.
- C. All holes or openings required to be made in new or existing work, particularly at pipe, conduit, or other penetrations not covered by escutcheons or plates shall be neatly patched. All such holes shall be made completely watertight as approved by the Engineer.
- D. Size and locations of holes required in steel, concrete, or other structural or finish materials for piping, wiring, ducts, etc., which have not been located and detailed on the drawings shall be approved by the Engineer prior to layout and cutting thereof. All holes shall be suitably reinforced as required by the Engineer.
- E. Workmanship and materials of patching and repair work shall match the adjacent similar work and shall conform to the applicable sections of the specification. Patches and joints

with existing work shall provide, as applicable in each case, visual, structural, and waterproofing continuity.

12. Connections to Existing Water Systems

- A. The Owner will, upon 48-hour notice from the Contractor, assist the Contractor by locating and opening or closing any and all valves required for draining or admitting water to the various sections of the water main as required to perform the proposed work. No damages shall be claimed by the Contractor for delays in dewatering pipelines nor shall any damages be claimed because of water leaking through closed valves after dewatering is completed.
- B. Contractor shall perform all the excavation, backfilling, and surface drainage. The city will install backflow preventor, meter, and make the tap and all connections.
- C. The Contractor will be required to make test excavations to ascertain that the proposed position of the connections will be clear of joints, fittings, or other obstructions.
- D. If any failure occurs in connection to existing mains, service shall be restored in the shortest possible time. The Contractor shall cooperate with the Owner in notifying the consumers or supplying emergency water.

13. Contractor's Representative

The Contractor shall designate a representative who will be available to respond to emergency calls by the Owner at any time day and night and on weekends and holidays should such a situation arise.

14. Visual Recording

Before beginning construction, the Contractor shall make a color video tape DVD recording along the entire work area. One complete recording, for the entire area length, shall be furnished to the Engineer prior to the start of the work. The visual recording shall be identified as "Route 33 Field Existing Conditions".

15. Hours of Construction Activity

- A. The Contractor shall conduct all construction activity between 7:00 a.m. and 5:00 p.m., Monday through Friday. No construction work shall be allowed on Saturdays, Sundays or Holidays without written authorization from the Owner.
- B. The Owner will provide personnel for assistance in locating and operating valves at no cost to the Contractor during the Owner's normal working hours (Monday through Friday 7:00 a.m. to 5:00 p.m.). When this assistance is required by the Contractor outside of the Owner's normal working hours the cost will be incurred by the Contractor at the prevailing overtime rate of pay for the personnel providing the assistance. The Owner will bill the Contractor

directly. In addition, if uniformed officers are required for traffic control, the Contractor shall pay at the prevailing overtime rate of pay for the officers overtime hours.

16. Construction Crews

The Contractor shall not increase the number of construction crews assigned to the work without providing one week advance notice to the Engineer.

17. Surveys

The Contractor shall retain the services of a surveyor licensed in the State of New Hampshire to complete all layouts, surveys, benchmark transfers, etc. required for construction of the project.

18. Certified Field Builders.

The Contractor shall retain the services or employ a Certified Field Builder as certified by the American Sports Builders Association (ASBA) who will be present at the site regularly throughout the project to supervise and inspect all phases of the field construction. The identity of the certified builders and documentation of their credentials will be provided prior to the start of construction.

END OF SECTION

SECTION 01 20 00

PROJECT MEETINGS

PART 1 - GENERAL:

1.01 GENERAL PROVISIONS

Attention is directed to the General Conditions of the Contract, all Divisions of the specifications, and the Contract Drawings, all of which apply to work of this section.

1.02 SCOPE OF WORK

Work included: To enable orderly review during progress of the Work, and to provide for systematic discussion of problems, as long as deemed necessary by the Engineer and Owner throughout the construction period.

Related work: The Contractor's relations with his subcontractors and materials suppliers and discussions relative thereto, are the Contractor's responsibility and normally are not part of Project Meetings content.

1.03 QUALITY ASSURANCE

For those persons designated by the Contractor to attend and participate in Project Meetings, provide required authority to commit the Contractor to solutions agreed upon in the Project Meetings.

1.04 MEETING NOTES

The Engineer will compile minutes of each Project Meeting and will furnish copies to all the attendees, Contractor, and the Owner before next scheduled meeting.

PART 2 - EXECUTION:

2.01 MEETING SCHEDULE

- A. Except as noted below for Preconstruction Meeting, frequency of Project Meetings will be weekly, or as determined by the Owner, depending on work progress.
- B. Coordinate as necessary, to establish mutually acceptable schedule for meetings.

2.02 MEETING LOCATIONS

- A. Project Meetings will be held at the job sites or at the DPW offices, 680 Peverly road as determined by the Owners representative..

2.03 PRECONSTRUCTION MEETING

- A. The Contractor shall arrange for a Preconstruction Meeting within 5 days after the award of contract. The limitations on the use of the premises, as outlined in SECTION 01 10 00, SUMMARY OF WORK, will be discussed, and the Owner will describe the parking assignment, delivery procedures, toilet facilities, and other provisions he/she may wish to establish.
- B. Contractor is to coordinate attendance by authorized representatives of the Owner, the Contractor, site work subcontractors, and the Engineer.
- C. Minimum agenda: Data will be distributed and discussed on at least the following items:
 - 1. Organizational arrangement of Contractor's forces and personnel, and those of subcontractors, materials suppliers, and Owner.
 - 2. Channels and procedures for communication.
 - 3. Construction schedule, including sequence of critical work.
 - 4. Contract Documents and revisions.
 - 5. Processing of Shop Drawings and other data submitted to the Owner for review.
 - 6. Processing of Bulletins, field decisions, and Change Orders.
 - 7. Procedures for safety, first aid, security, quality control, housekeeping, and related matters.
 - 8. Submittal of Construction Fence layout.
 - 9. Submittal of Progress Schedule, Tabulation of Submittals and
 - 10. Schedule of Values.

2.04 PROJECT MEETINGS

- A. Frequency: Project Meetings shall, in general, be held once a week. Meetings shall be chaired by the Engineer, who will also prepare the meeting agenda issued prior to the meeting.

B. Attendance:

1. To the maximum extent practicable, assign the same person or persons to represent the Contractor at Project Meetings throughout progress of the Work.
2. Site work subcontractors, material suppliers, and others may be required to attend those Project Meetings in which their aspect of the Work is involved.

C. Minimum agenda:

1. Review progress of the Work since last meeting, including status of submittals for approval.
2. Identify problems which impede planned progress.
3. Develop corrective measures and procedures to regain planned schedule.
4. Complete other current business.

D. Revisions to Minutes:

1. Unless published minutes are challenged in writing prior to the next regularly scheduled Project Meeting, they will be accepted as properly stating the activities and decisions of the meeting.
2. Persons challenging published minutes shall reproduce and distribute copies of the challenge to all indicated recipients of the particular set of minutes.
3. Challenge to minutes shall be settled at start of the next regularly scheduled meeting.

END OF SECTION

SECTION 01 33 00

SUBMITTALS

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. The Contractor shall provide the Engineer with submittals as required by the contract documents.

1.02 RELATED WORK:

- A. Divisions 01 – 33 of these specifications that require submittals.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.01 GENERAL:

- A. As required by the General Conditions, Contractor shall submit a schedule of shop and working drawing submittals.
- B. The Contractor shall submit the shop and working drawing submittals either electronically or hard copy.

3.02 ELECTRONIC SUBMITTALS:

- A. In accordance with the accepted schedule, the Contractor shall submit promptly to the Engineer by email (morsed@wseinc.com) or on Compact Disc (mail to Weston & Sampson, 427 Main Street, Worcester, MA 01608, attention: Douglas Morse), one electronic copy in Portable Document Format (PDF) of shop or working drawings required as noted in the specifications, of equipment, structural details and materials fabricated especially for this Contract.
- B. Each electronic copy of the shop or working drawing shall be accompanied by the Engineer's standard shop drawing transmittal form, included as Exhibit 1 of this section (use only for electronic submittals), on which is a list of the drawings, descriptions and numbers and the names of the Owner, Project, Contractor and building, equipment or structure.
- C. The Contractor shall receive a shop drawing memorandum with the Engineer's approval or comments via email.

3.03 HARD COPY SUBMITTALS:

- A. In accordance with the accepted schedule, the Contractor shall submit promptly to the Engineer, by hand at a meeting or via mail to the Worcester office one (1) copy each of shop or working drawings required as noted in the specifications, of equipment, structural details and materials fabricated especially for this Contract.
- B. Each shipment of drawings shall be accompanied by the Engineer's (if applicable) standard shop drawing transmittal form on which is a list of the drawings, descriptions and numbers and the names of the Owner, Project, Contractor and building, equipment or structure.

3.04 SHOP AND WORKING DRAWINGS:

- A. Shop and working drawings shall show the principal dimensions, weight, structural and operating features, space required, clearances, type and/or brand of finish of shop coat, grease fittings, etc., depending on the subject of the drawings. When it is customary to do so, when the dimensions are of particular importance, or when so specified, the drawings shall be certified by the manufacturer or fabricator as correct for this Contract.
- B. All shop and working drawings shall be submitted to the Engineer by and/or through the Contractor, who shall be responsible for obtaining shop and working drawings from his subcontractors and returning reviewed drawings to them. All shop and working drawings shall be prepared on standard size, 24-inch by 36-inch sheets, except those, which are made by changing existing standard shop or working drawings. All drawings shall be clearly marked with the names of the Owner, Project, Contractor and building, equipment or structure to which the drawing applies, and shall be suitably numbered. Each shipment of drawings shall be accompanied by the Engineer's (if applicable) standard shop drawing transmittal form on which is a list of the drawings, descriptions and numbers and the names mentioned above.
- C. Only drawings that have been prepared, checked and corrected by the fabricator should be submitted to the Contractor by his subcontractors and vendors. Prior to submitting drawings to the Engineer, the Contractor shall check thoroughly all such drawings to satisfy himself that the subject matter thereof conforms to the Contract Documents in all respects. Shop drawings shall be reviewed and marked with the date, checker's name and indication of the Contractor's approval, and only then shall be submitted to the Engineer. Shop drawings unsatisfactory to the Contractor shall be returned directly to their source for correction, without submittal to the Engineer. Shop drawings submitted to the Engineer without the Contractor's approval stamp and signature will be rejected. Any deviation from the Contract Documents indicated on the shop drawings must be identified on the drawings and in a separate submittal to

the Engineer, as required under subsection 6.17 Shop Drawings and Samples; D. Submittal Procedures, Paragraph 3 of the 1996 General Conditions.

- D. The Contractor shall be responsible for the prompt submittal and resubmittal, as necessary, of all shop and working drawings so that there will be no delay in the work due to the absence of such drawings.
- E. The Engineer will review the shop and working drawings as to their general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Corrections of comments made on the drawings during the review do not relieve the Contractor from compliance with requirements of the Contract Documents. The Contractor is responsible for: confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating his work with that of all other trades; and performing his work in a safe and satisfactory manner. The review of the shop drawings is general and shall not relieve the Contractor of the responsibility for details of design, dimensions, code compliance, etc., necessary for interfacing with other components, proper fitting and construction of the work required by the Contract and for achieving the specified performance. The Engineer will review submittals two times: once upon original submission and a second time if the Engineer requires a revision or corrections. The Contractor shall reimburse the Owner amounts charged to the Owner by the Engineer for performing any review of a submittal for the third time or greater.
- F. With few exceptions, shop drawings will be reviewed and returned to the Contractor within 30 days of submittal.
- G. No material or equipment shall be purchased or fabricated especially for this Contract nor shall the Contractor proceed with any portion of the work, the design and details of which are dependent upon the design and details of equipment or other features for which review is required, until the required shop and working drawings have been submitted and reviewed by the Engineer as to their general conformance and compliance with the project and its Contract Documents. All materials and work involved in the construction shall then be as represented by said drawings.
- H. Two copies of the shop and working drawings and/or catalog cuts will be returned to the Contractor. The Contractor shall furnish additional copies of such drawings or catalog cuts when he needs more than two copies or when so requested.

3.05 SAMPLES:

- A. Samples specified in individual Sections include, but are not necessarily limited to, physical examples of the work such as sections of manufactured or fabricated work, small cuts or containers of materials, complete units of repetitively-used products, color/texture/pattern swatches and range sets, specimens for coordination of visual

effect, graphic symbols, and units of work to be used by the Engineer or Owner for independent inspection and testing, as applicable to the work.

- B. The number of samples submitted shall be as specified. Submittal and processing of samples shall follow the procedures outlined for shop and working drawings unless the specifications call for a field submittal or mock-up.
- C. Acceptance of samples will be acknowledged via a copy of the transmittal noting status. When samples are not acceptable, prompt resubmittal will be required.

3.06 OPERATING AND MAINTENANCE MANUALS AND SPARE PARTS LISTS:

- A. Where reference is made in technical specification sections to operating and maintenance manuals and/or spare parts lists, the Contractor shall submit four copies to the Engineer for review in accordance with the instructions furnished under "Shop and Working Drawings." If the submittal is complete and does not require any changes, an acknowledgement (copy of transmittal) will be returned noting status. If the submittal is incomplete or does require changes, corrections, additions, etc., two copies of the submittal will be returned with a copy of transmittal noting status. Four copies of the final operating and maintenance manuals and/or spare parts list shall be delivered to the Engineer prior to or with the equipment when it is delivered to the job site. For systems requiring field adjustment and balancing, such as heating and ventilating, the Contractor shall submit separate test results and adjustment data on completion of the work, to be incorporated into the system manual.
- B. The information included in the manual shall be as described in the specification sections, but as a minimum shall contain clear and concise instructions for operating, adjusting, lubricating and maintaining the equipment, an exploded assembly drawing identifying each part by number and a listing of all parts of the equipment, with part numbers and descriptions required for ordering spare parts. Spare parts lists shall include recommended quantity and price.
- C. Operating and maintenance manuals shall be in durable loose-leaf binders, on 8½-inch by 11-inch paper, with diagrams and illustrations either on 8½-inch by 11 inch or multiple foldouts. The instructions shall be annotated to indicate only the specific equipment furnished. Reference to other sizes or models of similar requirement shall be deleted or neatly lined out.

END OF SECTION

EXHIBIT 1 TO SECTION 01330 SUBMITTALS
SHOP DRAWING TRANSMITTAL FORM

Shop Drawing Transmittal	
---------------------------------	-------------------------------------------------------------------------------------

Instruction for Preparing Transmittal No action will be taken on any item unless accompanied by this form. TRANSMITTAL NOS. to be consecutive (1, 2, 3, etc.). Each resubmittal of same item shall use same number with suffix letter (A, B, etc.). SPEC. SECT. NO: Only one spec. section no. to each transmittal. DESCRIPTION: Complete identification of document or group of documents. SOURCE: Originator of document(s) being submitted.	DRAWING NO: Identification of document(s). CONTRACT DRAWING REFERENCE: Contract drawing number(s) showing details of document(s). SPECIAL INSTRUCTIONS: Special cases and emergencies, changes in distribution and special handling requests, etc. should be entered here. SIGNATURE OF CONTRACTOR: Signature of individual who reviews and approves material prior to submittal to engineer.
-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

THIS SECTION TO BE COMPLETED BY CONTRACTOR

TRANSM. NO.	SPEC. SECT. NO.	DATE	CONTRACTORS JOB NO.	W&S JOB NO.	
PROJECT NAME & CONTRACT NO.			LOCATION		
T O	Weston & Sampson 427 Main Street, Suite 400 Worcester, MA 01608		F R O M		

BY W&S

ITEM NO.	DESCRIPTION	SOURCE	DRAWING NO. CATALOG NO. BROCHURE, ETC	NO. OF COPIES	CONTRACT DRAWING REF.	ACTION CODE	REVIEWED BY
1							
2							
3							
4							

THIS CERTIFIES THAT ALL ITEMS SUBMITTED HEREWITH HAVE BEEN CHECKED BY THE CONTRACTOR, ARE IN CONFORMANCE WITH THE REQUIREMENTS OF THE CONTRACT DOCUMENTS, EXCEPT AS NOTED, AND ARE APPROVED BY THE CONTRACTOR FOR THIS PROJECT.	SIGNATURE & TITLE	
---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-------------------	--

THIS SECTION TO BE COMPLETED BY W&S

ACTION CODE: 1. FURNISH AS SUBMITTED 2. FURNISH AS NOTED 3. REVISE AND RESUBMIT 4. REJECTED- SEE REMARKS 5. ACKNOWLEDGEMENT 6. SUBMITTAL NOT REQUIRED, RETURNED WITHOUT REVIEW	a. INSTALLATION SHALL PROCEED ONLY WHEN ACTION CODE IS 1 OR 2 b. ACTION CODED 3 SHALL BE RESUBMITTED WITHIN TIME LIMIT SET IN CONTRACT c. REVIEW DOES NOT RELIEVE CONTRACTOR FROM RESPONSIBILITY OF COMPLIANCE WITH ALL REQUIREMENTS OF THE CONTRACT DOCUMENTS		Weston & Sampson
--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--	------------------

SECTION 01 35 00

PERMITS

PART I - GENERAL

1.01 SCOPE OF WORK

- a. The Contractor shall be responsible for obtaining all permits required to complete the work of this contract, to provide all coordination and furnish all bonds, assurances and required warranties. As applicable, the Contractor shall be responsible for any/all fees associated with the securing of permits necessary for the execution of the work of this contract. Should any street work be required, an approved City contractor shall perform it.

1.02 GENERAL REQUIREMENTS

A.

Permits by Contractor

Backflow Preventers

Trench Permit

Electrical Permit

Plumbing Permit

(Contractor shall prepare permit application and obtain the permit after contract is awarded, bearing all expenses.)

-
- B. The Contractor shall perform the work in accordance with the Contract Documents, including and any applicable municipal requirements.

1.03 DIGSAFE

- A. Contact Digsafe seventy-two (72) hours prior to initiating work at telephone # 1-888-344-7233.

PART II - MATERIALS

- A. All materials and equipment shall conform to permit requirements and the City's standards for utilities, excavation, backfill, patching, and surveying or other work unless otherwise stated in these specifications. Coordinate as necessary with the appropriate City official and/or private utility.

3.01 EXECUTION

- A. Execute all work per permit requirements. All plumbing and electric work to be approved by City Inspectors, sidewalk ramps to be approved by City Engineer.

4.01 GUARANTEE

- A. Guarantee all work per permit requirements.

- - - END OF SECTION - - -

SECTION 01 45 00

SAMPLING & TESTING

PART I - GENERAL

1.01 SCOPE OF WORK

- a. The work under this Section shall consist of performing or ordering the work of collecting samples for testing, having tests performed by a Certified Testing Laboratory satisfactory to the Engineer, having all test results forwarded to the Engineer for approval, and paying all costs associated with the collection and sampling, transportation, shipping, postage, and testing, and the coordination of test results and approvals.

1.02 SUBMITTALS

- a. In accordance with Section 01 33 00 of these Specifications, submit the names, addresses and certification of laboratories to be utilized for approval by the Engineer.

PART II - MATERIALS

2.01 CONTAINERS AND TOOLS

- a. Utilize tools recommended by the laboratory to obtain samples, packaging or containers suitable to, or furnished by, the laboratory, and collect all samples in the proper number and quantity to permit tests to be conducted.

2.02 TESTS

- a. Refer to Section specifications for test requirements and criteria for results; coordinate with the Owner's Representative.
- b. All locking gates, lighting systems, and any other components from the scope of work as requested by the Owner's Representative shall be tested to ensure complete compliance with manufacturer's installation instructions and warranty requirements.

PART III - EXECUTION

3.01 METHODOLOGY

- a. Unless otherwise directed by the Section specifications, perform sampling and testing will be ordered by the Contractor and approved by the Owner's

Representative. Locations, number and quantity of samples shall be submitted for approval as directed in accordance with the Specifications.

- b. Sampling and Testing results must be provided to the Owner's Representative and Approved prior to the installation of any work potentially impacted by unacceptable test results.

- - - END OF SECTION - - -

SECTION 01 45 10

STRUCTURAL TESTS AND INSPECTIONS

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. Provide labor, materials, and equipment necessary to complete the work of this Section, including but not limited to the following:
 - 1. Obtaining, coordinating, and providing notifications to the Owner and Engineer.
 - 2. Provide safe access to the work of this Contract to accommodate the indicated tests and inspections.
 - 3. Implementing corrective action and providing additional tests and/or inspections for work identified as non-conforming by the Independent Testing Agency.

1.02 GENERAL REQUIREMENTS:

- A. The New Hampshire State Building Code, Latest Edition, BCR 300, requires the Structural Engineer of Record (SER) to provide a program of structural tests and inspections for this project.
- B. Attachment A, Program of Structural Tests and Inspections, shall not relieve the Contractor or its subcontractors of their responsibilities and obligations for quality control of the Work; their other obligations for supervising the Work; for any design work which is included in their scope of services; for full compliance with the requirements of the Contract Documents; the detection of, or failure to detect, deficiencies or defects, whether detected or undetected, in all parts of the Work, and to otherwise comply with all requirements of the Contract Documents.
- C. The Program of Structural Tests and Inspection does not apply to the Contractor's equipment, temporary structures used by the Contractor to construct the project, the Contractor's means, methods, procedures, and job site safety.

1.03 CONTRACTOR RESPONSIBILITIES:

- A. The Contractor shall provide free and safe access to the Work for the SER and all other individuals who are observing the Work or performing structural tests or inspections. The Contractor shall provide all ladders, scaffolding, staging, and up-to-date safety equipment, all in good and safe working order, and qualified personnel to handle and erect them, as may be required for safe access.

- B. The Contractor shall give reasonable notice to the Owner and the Engineer of when the various parts of the Work will be ready for testing and/or inspection. The Contractor shall notify the Owner and the Engineer a minimum of 48 hours before such tests and/or inspections are to take place.

PART 2 - PRODUCTS

NOT USED.

PART 3 - EXECUTION

NOT USED.

ATTACHMENT A

PROGRAM OF STRUCTURAL TESTS AND INSPECTIONS

The following is a summary of Work subject to Tests and Inspections under the Program.

1. In-situ Bearing Strata for Footings
2. Controlled Structural Fill
3. Cast-In-Place Concrete
4. Masonry
5. Structural Steel

Abbreviation Agent

SER Structural Engineer of Record
ITA Contractor – Independent Testing Agency

In-Situ Bearing Strata for Footings

Item	Agent	Scope
1. Bearing Strata QC Review	ITA	Review Contractor's field quality control procedures.
2. General Excavation	ITA	Inspect strata for conformance to the structural drawings, specifications, and/or geotechnical report.
3. General Excavation	ITA	Ensure that excavation is to proper depth or material.
4. General Excavation	ITA	Ensure that excavation is controlled and contains no unsuitable materials.
5. Bearing surfaces for footings	ITA	Inspect bearing surfaces for conformance to the requirements of the structural drawings, specifications, and/or geotechnical report.

Controlled Structural Fill

Item	Agent	Scope
1. Controlled Structural Fill QC Review	SER	Review Contractor's field quality control procedures
2. Fill Material	ITA	Test material for conformance to specifications or geotechnical report. Perform laboratory compaction tests in accordance with the specifications to determine optimum water content and maximum dry density.
3. Installation of controlled structural fill	ITA	Provide full-time inspection of the installation, in accordance with the specifications.
4. Density of Fill	ITA	Perform field density tests of the in-place fill in accordance with the specifications.

Cast-In-Place Concrete Construction

Item	Agent	Scope
1. Cast-In-Place Concrete Construction QC Review	SER	Review Contractor's field quality control procedures. Review frequency and scope of field testing and inspections.
2. Mix Design	SER	Review Mix Designs
3. Materials	SER	Review material certifications for conformance to Specifications
4. Batching Plant	ITA	Review Plant quality control procedures and batching and mixing methods
5. Reinforcement Installation	ITA	Inspect reinforcing for size, quantity, condition and placement
6. Anchor Rods	ITA	Inspect anchor rods prior to and during placement of concrete.
6. Formwork	ITA	Inspect form sizes for proper sizes of concrete members.
7. Concrete Placement and Sampling fresh Concrete	ITA	Observe concrete placement operations. Verify conformance to specifications including cold-weather and hot-weather placement procedures. Perform slump, density and air content tests at point of discharge.
8. Evaluation of Concrete	ITA	Test and evaluate in accordance with the specifications.
9. Curing and Protection	ITA	Observe procedures for conformance to the specifications.

END OF SECTION

SECTION 01 52 00
TEMPORARY FACILITIES

PART 1 -GENERAL

1.01 SCOPE OF WORK:

- A. The Contractor shall provide all temporary facilities as described in this Section for the proper completion of the work, as required and as specified.

1.02 TEMPORARY FACILITIES:

- A. Promptly at the start of work on the project, the Contractor shall furnish all labor, materials and equipment, perform all work to furnish, deliver, set up, and maintain for the duration of the project a field office trailer for the exclusive use of the Engineer, including the connection of electric and telephone services. The trailer and furniture shall be relatively new and in good condition and acceptable to the Engineer. The Contractor may provide a joint use trailer provided that the Engineer has their own section separated by a partition wall, and with a separate entrance.
- B. The office shall be adequately lighted for detailed working conditions, heated and air conditioned during the appropriate seasons. The office shall have at least one closet for storage of equipment. The contractor shall enclose and weatherproof the areas beneath the trailer with insulation and exterior grade plywood.
- C. The trailer shall be located at the work site where it will not interfere with the construction as approved by the Engineer, and shall be not less than 400 square feet. The trailer shall have provisions for locking and the Contractor shall provide two sets of keys to the Engineer.
- D. Space shall be provided adjacent to the trailer for parking for the exclusive use of the Engineer and visitors to the Engineer's trailer. The Contractor shall be responsible for snow removal, dust control etc. for the parking area.

1.03 UTILITIES:

- A. All electric services shall be continuously connected. Electric lights and adequate electric power, proper heat, hot water and satisfactorily cooled drinking water. A sufficient number of electrical outlets shall be provided and suitably located in the trailer for the equipment and desks specified in this section of the specifications. The trailer shall have thermostatically controlled heating and air conditioning units to maintain a minimum temperature of 68°F and a maximum temperature of 72°F.

- B. Toilet facilities shall be provided and maintained in continual service; trash, garbage and other wastes shall be properly and satisfactorily disposed of. The toilet facility shall be built into the trailer or at minimum, a portable type as manufactured by Comfort Castle, Inc., Handy House Toilet Co., Port-o-Let, or an approved equal. This unit shall be installed as a complete facility with regular maintenance and pump-outs as required.
- C. Janitor service, to keep the quarters and equipment neat and clean as acceptable working space, shall be furnished weekly by the Contractor. Repairs shall be made from time to time, as required and as directed by the Engineer.
- D. The Contractor shall submit catalogs and vendors data for the trailer and for the additional equipment and furnishings for review and approval by the Engineer.

1.04 EQUIPMENT AND FURNISHINGS:

- A. The Contractor shall also furnish the following computer equipment:
Printer: HP 5650 laserjet printer or better.
- B. **Internet Access**: High speed internet access must be provided by a mobile “hotspot” or other wireless means.
- C. The Contractor shall also furnish the following, as a minimum:
 - 1 Class ABC type Fire Extinguisher of at least 4-lb capacity
 - 1 First aid kit as specified herein – **Refer to Paragraph 1.05 A below**
 - 1 Private line telephone with remote accessing answering machine
 - 1 Double desk - Formica top with three 2 drawer, steel file cabinets under
 - 2 Straight back chairs – metal
 - 8 Folding metal chairs
 - 1 3’ X 6’ Conference Table
 - 1 Drafting table - 3’ X 5’
 - 1 Swivel type drafting stool with back - metal
 - 1 Air conditioner - Automatic heating - gas or electric
 - 1 Toilet facility
 - 1 Electric water cooler with refrigerator compartment and continual supply of spring water and paper cups
 - 1 Four-drawer filing cabinet with lock, fire proof or fire resistant
 - 2 Wastebaskets with provisions for trash collection
 - 1 Plan Rack
 - 1 Printer/Copier/Fax/Scanner (plain paper) including paper and toner and dedicated phone line

1.05 SAFETY EQUIPMENT:

A. FIRST AID KIT shall be wall mount cabinet and must include the following:

Band-Aids – Finger tip	1 Box
Band-Aids – Knuckle	1 Box
Band-Aids – Strip	1 Box
Band-Aids – Large Patch	1 Box
Band-Aids – Butterfly – Large	1 Box
Band-Aids – Butterfly – Small	1 Box
Triangular Bandage	1 Each
Compression Bandage	2 Each
Roller Bandage	2 Each
Gauze Pads (3”X3”)	1 Box
Gauze Pads (4”X4”)	1 Box
Waterproof Tape	1 Roll
Latex Gloves	1 Box
Anti-Microbial Towelettes	1 Box
Hydrocortisone Ointment Packets	1 Box
Antibiotic Ointment Packets	1 Box
Burn Gel Packets	1 Box
Scissors	1 Pair
Tweezers	1 Pair
Ice Packs- (Chemical Activated)	4 Each
Saline Eyedroppers	1 Box
CPR Pocket Mask	1 Each
Cotton Balls	1 Box
Flashlight with Working Batteries	1 Each

B. Contractor to provide stairs and platforms to doorway(s) of field offices and window shades, blinds, or curtains. Screens and storm windows shall also be provided.

PART 2 - PRODUCTS

NOT PART OF THIS SECTION

PART 3 - EXECUTION

3.01 UTILITIES:

A. All monthly service charges for telephone, electricity, hot spot connection service, water supply, and heating of the Temporary Facility shall be paid for by the Contractor.

END OF SECTION

SECTION 01 56 16

DUST CONTROL

PART 1 - GENERAL

1.01 DESCRIPTION:

This section of the specification covers the control of dust via calcium chloride and water, complete. Please note that site security fence with scrims is also considered a dust control measure and shall be employed as required where site limits abut residential property.

PART 2 - PRODUCTS

2.01 CALCIUM CHLORIDE:

- A. Calcium chloride shall conform to the requirements of AASHTO-M 144, Type I or Type II and Specification for Calcium Chloride, ASTM D98. The calcium chloride shall be packaged in moisture proof bags or in airtight drums with the manufacturer, name of product, net weight, and percentage of calcium chloride guaranteed by the manufacturer legibly marked on each container.
- B. Calcium chloride failing to meet the requirements of the aforementioned specifications or that which has become caked or sticky in shipment may be rejected by the Engineer.

2.02 WATER:

- A. Water shall not be brackish and shall be free from oil, acid, and injurious alkali or vegetable matter.

PART 3 - EXECUTION

3.01 APPLICATION:

- A. Calcium chloride shall be applied when ordered by the Engineer and only in areas which will not be adversely affected by the application. See Section 01 57 19, ENVIRONMENTAL PROTECTION.
- B. Calcium chloride shall be uniformly applied at the rate of 1-1/2 pounds per square yard or at any other rate as required by the Engineer. Application shall be by means of a mechanical spreader, or other approved methods. The number and frequency of applications shall be determined by the Engineer.
- C. Water may be sprinkler applied with equipment including a tank with gauge-equipped pressure pump and a nozzle-equipped spray bar.

- D. Water shall be dispersed through the nozzle under a minimum pressure of 20 pounds per square inch, gauge pressure.

END OF SECTION

SECTION 01 57 19

ENVIRONMENTAL PROTECTION

PART 1 – GENERAL

1.01 DESCRIPTION:

- A. The work covered by this section of the specifications consists of furnishing all labor, materials, tools and equipment and performing all work required for the prevention of environmental pollution during and as a result of construction operations under this contract.
- B. The requirements set forth in this section of the specifications apply to cross-country areas, river and stream crossings, and construction in and adjacent to wetlands, unless otherwise specifically stated.
- C. Prior to commencement of work, the Contractor shall meet with representatives of the Engineer to develop mutual understandings relative to compliance of the environmental protection program.

1.02 RELATED WORK:

- A. Section 00 31 43, PERMITS
- B. Section 01 56 16, DUST CONTROL
- C. Section 01 33 00, SUBMITTALS
- D. Section 31 00 00, EARTHWORK
- E. Section 31 10 00, CLEARING AND GRUBBING
- F. Section 31 23 19, DEWATERING
- G. Section 31 50 00, SUPPORT OF EXCAVATION

1.03 SUBMITTALS:

- A. The Contractor shall submit for approval six sets of details and literature fully describing environmental protection methods to be employed in carrying out construction activities.

PART 2 - PRODUCTS

2.01 SILT FENCE:

- A. The silt fence shall consist of a 3-foot wide continuous length sediment control fabric, stitched to a mesh backing, and stapled to preweathered oak posts installed as shown on the drawings. The oak posts shall be 1-1/4-inches by 1-1/4-inches (Minimum Dimension) by 48-inches and shall be tapered. The bottom edge of the silt fence shall be buried as shown on the drawings.
- B. The silt fence shall be DOT Silt Fence PPDM3611, as manufactured by U.S. Silt & Site Supply/Getsco, Concord, NH, or approved equal.
- C. Silt fence properties:

<u>Physical Properties</u>	<u>Test Method</u>	<u>Minimum Value</u>
Grab Strength, lbs.	ASTM-D-4632	124
Grab Elongation, %	ASTM-D-4632	15
Mullen burst, psi	ASTM-D-3786	300
Puncture, lbs.	ASTM-D-4833	65
Trapezoidal Tear, lbs.	ASTM-D-4833	65
UV Resistance ² , % ³	ASTM-D-4355	80@500 hrs.
AOS, US Sieve No.	ASTM-D-4751	30
Flow Rate, gal/min/sq ft	ASTM-D-4491	10
Permittivity,(1/sec)gal/min/sq ft	ASTM-D-4491	0.05 sec ⁻¹

2.02 STRAW BALES:

- A. Straw bales shall consist of certified seed free stems of agricultural grain and cereal crops and shall be free of grasses and legumes. Standard bales shall be 14-inches high, 18- inches wide and 36- to 40-inches long tied with polypropylene twine and weigh within 5 percent of 7 lbs. per cubic ft.

2.03 STRAW WATTLES:

- A. Straw Wattles shall consist of a 100% biodegradable exterior jute or coir netting with 100% wheat straw interior filling as manufactured by Granite Environmental, Inc., Sebastian, Florida (Phone: 888-703-9889; website: www.GraniteEnvironmental.com), or approved equal.

2.04 SILT CURTAIN:

- A. The silt curtain shall be a Type-1-Silt-Barrier consisting of 18-ounce vinyl fabric skirt with a 6-inch marine quality floatation device. The skirt shall be ballasted to hang vertical in the water column by a minimum 3/16-inch galvanized chain. The silt curtain shall extend into the water as shown on the drawings. If necessary, join adjacent ends of the silt curtain by connecting the reinforcing grommets and shackling ballast lines.

2.05 CATCH BASIN PROTECTION:

- A. To trap sediment and to prevent sediment from clogging drainage systems, catch basin protection in the form of a siltation sack (Siltsack as manufactured by ACF Environmental, Inc. or approved equal) shall be provided as approved by the Engineer.

PART 3- EXECUTION

3.01 NOTIFICATION AND STOPPAGE OF WORK:

- A. The Engineer will notify the Contractor in writing of any non-compliance with the provisions of the Order of Conditions. The Contractor shall, after receipt of such notice, immediately take corrective action. Such notice, when delivered to the Contractor or his authorized representative at the site of the work, shall be deemed sufficient for the purpose. If the Contractor fails to act promptly, the Owner may order stoppage of all or part of the work through the Engineer until satisfactory corrective action has been taken. No claim for an extension of time or for excess costs or damage incurred by the Contractor as a result of time lost due to any stop work orders shall be made unless it was later determined that the Contractor was in compliance.

3.02 AREA OF CONSTRUCTION ACTIVITY:

- A. Insofar as possible, the Contractor shall confine his construction activities to those areas defined by the plans and specifications. All land resources within the project boundaries and outside the limits of permanent work performed under this contract shall be preserved in their present condition or be restored to a condition after completion of construction at least equal to that which existed prior to work under this contract.

3.03 PROTECTION OF WATER RESOURCES:

- A. The Contractor shall not pollute streams, lakes or reservoirs with fuels, oils, bitumens, calcium chloride, acids or other harmful materials. It is the Contractor's responsibility to comply with all applicable Federal, State, County and Municipal laws regarding pollution of rivers and streams.
- B. Special measures should be taken to insure against spillage of any pollutants into public waters.

3.04 CONSTRUCTION IN AREAS DESIGNATED AS WETLANDS ON THE DRAWINGS:

- A. Insofar as possible, the Contractor shall make every effort to minimize disturbance within areas designated as wetlands or within 100-feet of wetland resource areas. Total easement widths shall be limited to the widths shown.
- B. The Contractor shall perform his work in such a way that these areas are left in the

condition existing prior to construction.

- C. The elevations of areas designated as wetlands shall not be unduly disturbed by the Contractor's operations outside of the trench limits. If such disturbance does occur, the Contractor shall take all measures necessary to return these areas to the elevations which existed prior to construction.
- D. In areas designated as wetlands, the Contractor shall carefully remove and stockpile the top 24 inches of soil. This topsoil material shall be used as backfill for the trench excavation top layer. The elevation of the trench shall be restored to the preconstruction elevations wherever disturbed by the Contractor's operation.
- E. The Contractor shall use a trench box, sheeting or bracing to support the excavation in areas designated as wetlands.
- F. Excavated materials shall not be permanently placed or temporarily stored in areas designated as wetlands. Temporary storage areas for excavated material shall be as required by the Engineer.
- G. The use of a temporary gravel roadway to construct the pipeline in the wetlands area is not acceptable. The Contractor will be required to utilize timber or rubber matting to support his equipment in these areas. The timber or rubber matting shall be constructed in such a way that it is capable of supporting all equipment necessary to install the pipeline. The timber or rubber matting shall be constructed of materials and placed in such a way that when removed the material below the matting will not be unduly disturbed, mixed or compacted so as to adversely affect recovery of the existing plant life.
- H. Bentonite dams shall be placed in wetlands to prevent drainage. Locations for dams are as indicated on the drawings or as required by the Engineer.
- I. During construction, easements within wetlands shall be lined with a continuous straw bale/siltation fence barrier or line of straw wattles.

3.05 PROTECTING AND MINIMIZING EXPOSED AREAS:

- A. The Contractor shall limit the area of land which is exposed and free from vegetation during construction. In areas where the period of exposure will be greater than two (2) months, temporary vegetation, mulching or other protective measures shall be provided as specified.
- B. The Contractor shall take account of the conditions of the soil where temporary cover crop will be used to insure that materials used for temporary vegetation are adaptive to the sediment control. Materials to be used for temporary vegetation shall be approved by the Engineer.

3.06 LOCATION OF STORAGE AREAS:

- A. The location of the Contractor's storage areas for equipment and/or materials shall be upon cleared portions of the job site or areas to be cleared as a part of this project, and shall require written approval of the Engineer. Plans showing storage facilities for equipment and materials shall be submitted for approval of the Engineer.
- B. No excavated materials or materials used in backfill operations shall be deposited within a minimum distance of one hundred (100) feet of any watercourse or any drainage facility. Adequate measures for erosion and sediment control such as the placement of baled straw around the downstream perimeter of stockpiles shall be employed to protect any downstream areas from siltation.
- C. There shall be no storage of equipment or materials in areas designated as wetlands.
- D. The Engineer may designate a particular area or areas where the Contractor may store materials used in his operations.
- E. Storage areas in cross-country locations shall be restored to pre-construction conditions with the planting of native species of trees and shrubs.

3.07 PROTECTION OF LANDSCAPE:

- A. The Contractor shall not deface, injure, or destroy trees or shrubs nor remove or cut them without written authority from the Owner. No ropes, cables, or guys shall be fastened to or attached to any existing nearby trees for anchorages unless specifically authorized by the Engineer. Excavating machinery and cranes shall be of suitable type and be operated with care to prevent injury to trees which are not to be removed, particularly overhanging branches and limbs. The Contractor shall, in any event, be responsible for any damage resulting from such use.
- B. Branches, limbs, and roots shall not be cut except by permission of the Engineer. All cutting shall be smoothly and neatly done without splitting or crushing. When there is unavoidable injury to branches, limbs and trunks of trees, the injured portions shall be neatly trimmed and covered with an application of grafting wax or tree healing paint as directed.
- C. Where, in the opinion of the Engineer, trees may possibly be defaced, bruised, injured, or otherwise damaged by the Contractor's equipment or by his blasting or other operations, the Engineer may require the Contractor to adequately protect such trees by placing boards, planks, poles or fencing around them. Any trees or landscape feature scarred or damaged by the Contractor's equipment or operations shall be restored as nearly as possible to its original condition at the expense of the Contractor. The Engineer will decide what method of restoration shall be used, and whether damaged trees shall be treated and healed or removed and disposed of under the provisions of Section 31 10 00, CLEARING AND GRUBBING.

- D. Cultivated hedges, shrubs, and plants which could be injured by the Contractor's operations shall be protected by suitable means or shall be dug up, balled and temporarily replanted and maintained. After construction operations have been substantially completed, they shall be replanted in their original positions and cared for until growth is re-established. If cultivated hedges, shrubs, and plants are injured to such a degree as to affect their growth or diminish their beauty or usefulness, they shall be replaced by items of a kind and quality at least equal to that existing at the start of the work.

3.08 CLEARING AND GRUBBING:

- A. The Contractor shall clear and grub only on the Owner's land or the Owner's easements, and only the area required for construction operations, as approved by the Engineer. Removal of mature trees (4-inches or greater DBH) will not be allowed on temporary easements.
- B. The Contractor shall not remove trees in the Owner's temporary easements without permission of the Engineer.

3.09 DISCHARGE OF DEWATERING OPERATIONS:

- A. Any water that is pumped and discharged from the trench and/or excavation as part of the Contractor's water handling shall be filtered by an approved method prior to its discharge into a receiving water or drainage system.
- B. Under no circumstances shall the Contractor discharge water to the areas designated as wetlands. When constructing in a wetlands area, the Contractor shall discharge water from dewatering operations directly to the nearest drainage system, stream, or waterway after filtering by an approved method.
- C. The pumped water shall be filtered through filter fabric and baled hay, a vegetative filter strip or a vegetated channel to trap sediment occurring as a result of the construction operations. The vegetated channel shall be constructed such that the discharge flow rate shall not exceed a velocity of more than 1 foot per second. Accumulated sediment shall be cleared from the channel periodically.

3.10 DUST CONTROL:

- A. During the progress of the work, the Contractor shall conduct his operations and maintain the area of his activities, including sweeping and sprinkling of streets as necessary, to minimize creation and dispersion of dust. If the Engineer decides it is necessary to use calcium chloride for more effective dust control, the Contractor shall furnish and spread the material, as directed. Calcium chloride shall be as specified under Section 01 56 16, DUST CONTROL.
- B. Calcium Chloride shall not be used for dust control within a drainage basin or in the vicinity of any source of potable water.

3.11 SEPARATION AND REPLACEMENT OF TOPSOIL:

- A. Topsoil shall be carefully removed from cross-country areas where excavations are to be made, and separately stored to be used again as directed. The topsoil shall be stored in an area acceptable to the Engineer and adequate measures shall be employed to prevent erosion of said material.

3.12 BALED HAY OR STRAW:

- A. To trap sediment and to prevent sediment from clogging drainage systems, baled straw shall be used where shown on the drawings. Care shall be taken to keep the bales from breaking apart. The bales should be securely staked to prevent overturning, flotation, or displacement. All deposited sediment shall be removed periodically. Straw bales shall not be placed within a waterway during construction of the pipeline crossing.

3.13 ERECTION AND MAINTENANCE OF SILT FENCE:

- A. Where indicated on the drawings or where required by the Engineer, the Contractor shall erect and maintain a temporary silt fence. In areas designated as wetlands, the Contractor shall line the limits of the construction easement with a silt fence. The silt fence shall be used specifically to contain sediment from runoff water and to minimize environmental damage caused by construction.

3.14 SURFACE RESTORATION OF CROSS COUNTRY AREAS:

- A. Plantings detailed in Section 32 92 00 shall be conducted when construction of the pipeline has been completed within the areas designated. A one-year guarantee of maintenance will be required on these plantings to ensure that they establish in the area.

3.15 CATCH BASIN PROTECTION:

- A. Catch basin protection shall be used for every catch basin, shown on the plans or as required by the Engineer, to trap sediment and prevent it from clogging drainage systems and entering wetlands. Siltation sack shall be securely installed under the catch basin grate. Care shall be taken to keep the siltation sack from breaking apart or clogging. All deposited sediment shall be removed periodically and at times prior to predicted precipitation to allow free drainage flow. Prior to working in areas where catch basins are to be protected, each catch basin sump shall be cleaned of all debris and protected. The contractor shall properly dispose of all debris at no additional cost to the Owner.

3.16 STRAW WATTLES:

- A. The wattles will be placed in a shallow trench (2-3 inches deep) and staked in the ground using wooden stakes driven at 4-foot intervals. The wooden stakes will be placed at a minimum depth of 24-inches into the ground.

END OF SECTION

SECTION 01 58 00

PROJECT SIGN

PART I – GENERAL

1.01 SCOPE OF WORK

- A. Provide all materials, labor, mountings and incidentals for three (3) temporary construction sign, four feet by eight feet (4' x 8'), installed in a location directed by the Owners Representative.

PART II – MATERIALS

2.01 SIGN

- A. Sign shall be made of durable, exterior plywood or metal, securely mounted to wood posts or attached to existing fencing, as directed by the Owner's Representative. Sign shall be professionally lettered. Wording and layout to be supplied by the Owner. Submit samples of color and a Shop Drawing indicating lettering layouts to Engineer for approval. Electronic file with sign layout to be provided to Contractor and Owner's representative by the Landscape Architect.
 - 1. Three (3) signs shall be a project sign (or banner) and will include color renderings of the final layout as well as the City Seal and other pertinent information to be provided by the Owner's Representative. See example included herein.
- B. Sign shall be securely mounted with galvanized metal attachments and shall be framed so as to be durable. All attachments and mountings shall be child safe and vandal resistant. Should a project banner be provided, it may be securely attached to construction fencing.

PART III – EXECUTION

3.01 PLACEMENT

- A. Sign shall be installed facing the street or access point to the construction area so as to be visible and inform the general public. Where possible, the sign should be located so as not to conflict with the construction activity nor to require moving during the construction process.

- B. The construction sign shall be maintained in satisfactory condition during construction and then removed and disposed of legally by the Contractor just prior to the final acceptance of the work.
- C. The Contractor shall coordinate the project sign graphics with the Owner. Sample signs shall be provided to the Owner for approval.

--- END OF SECTION ---

SECTION 01 72 00

CONSTRUCTION LAYOUT

PART I - GENERAL

1.01 SCOPE OF WORK

- a. The work under this section shall consist of field staking the horizontal and vertical alignment of all essential features and proposed work, including fields, courts, sidewalks, fencing, drainage, electrical and utility structures, plantings, and other related features as shown on the plans, by a registered Engineer or Land Surveyor. The Contractor shall familiarize himself with the existing conditions and shall be responsible for locating or re-establishing survey field ties, property lines, and benchmarks indicated on the plans.
- b. Existing survey tie information if available shall be provided by the City, or the Owner's Representative upon request.

1.02 QUALIFICATIONS & SUBMITTALS

- a. The Contractor shall engage the services of a Professional Engineer or Land Surveyor Registered in the State of New Hampshire and shall submit the name, address, and registration number of such person or persons to the Engineer in writing.
- b. Whenever reference is made on the plans or in these specifications to a Land Surveyor registered in the State of New Hampshire, the Contractor may substitute a Registered Professional Engineer, except that only a Registered Land Surveyor will be permitted to conduct property line or boundary surveys.

PART II - MATERIALS

2.01 LAYOUT AND STAKING

- a. The Contractor shall be responsible for furnishing all stakes, pins, and grade markings as required to implement the work of layout and staking and shall make all field adjustments ordered by the Engineer at no extra cost to the Owner.
- b. Upon request by the Engineer, the Contractor shall make available to the Owner survey instruments necessary to check the proposed vertical and horizontal alignments at no extra cost.

PART III - EXECUTION

3.01 SURVEY LAYOUT

- a. The Contractor shall use the alignments shown on the plans to establish the layout of all proposed features and shall perform field adjustments as ordered by the Engineer.
- b. The Surveyor shall lay out the essential or necessary grades and locations of site furnishings, footings, pavements, utilities, structures and other proposed elements. The surveyor shall verify the location of any existing spikes, stakes, pipes, drill holes, etc. and shall be responsible for their accuracy. Proposed features shall be located in relation to dimensions shown on the drawings and as adjusted by the Engineer.
- c. The Contractor shall inform the Engineer when the general layout is completed and shall not begin excavation until the Engineer approves the various alignments. Any discrepancies encountered in field conditions shall be reported to the Engineer immediately and shall be adjusted as directed.
- d. The Contractor shall be responsible for maintaining the correct vertical and horizontal alignment of all elements, which responsibility shall not be waived by the Engineer's approval of basic layout and stakeout.

- - - END OF SECTION - - -

SECTION 01 74 00

CLEANING UP

PART 1 - GENERAL

1.01 DESCRIPTION:

The Contractor must employ at all times during the progress of his work adequate cleanup measures and safety precautions to prevent injuries to persons or damage to property. The Contractor shall immediately, upon request by the Engineer provide adequate material, equipment and labor to cleanup and make safe any and all areas deemed necessary by the Engineer.

1.02 RELATED WORK:

- A. Section 00 70 00 GENERAL CONDITIONS
- B. Section 01 11 00 CONTROL OF WORK AND MATERIALS
- C. Section 01 14 00 SPECIAL PROVISIONS
- D. Section 01 57 19 ENVIRONMENTAL PROTECTION

PART 2 - PRODUCTS

Not applicable

PART 3 - EXECUTION

2.01 DAILY CLEANUP:

- A. The Contractor shall clean up, at least daily, all refuse, rubbish, scrap and surplus material, debris and unneeded construction equipment resulting from the construction operations and sweep the area. The site of the work and the adjacent areas affected thereby shall at all times present a neat, orderly and workmanlike appearance.
- B. Upon written notification by the Engineer, the Contractor shall within 24 hours clean up those areas, which in the Engineer's opinion are in violation of this section and the above referenced sections of the specifications.
- C. If in the opinion of the Engineer, the referenced areas are not satisfactorily cleaned up, all other work on the project shall stop until the cleanup is satisfactory.

2.02 MATERIAL OR DEBRIS IN DRAINAGE FACILITIES:

- A. Where material or debris has washed or flowed into or has been placed in existing watercourses, ditches, gutters, drains, pipes, structures, such material or debris shall be entirely removed and satisfactorily disposed of during progress of the work, and the ditches, channels, drains, pipes, structures, and work shall, upon completion of the work, be left in a clean and neat condition.

2.03 REMOVAL OF TEMPORARY BUILDINGS, STRUCTURES AND EQUIPMENT:

- A. On or before completion of the work, the Contractor shall, unless otherwise specifically directed or permitted in writing, tear down and remove all temporary buildings and structures built by him; shall remove all temporary works, tools and machinery or other construction equipment furnished by him; shall remove all rubbish from any grounds which he has occupied; shall remove silt fences and hay bales used for trapping sediment; and shall leave the roads and all parts of the property and adjacent property affected by his operations in a neat and satisfactory condition.

2.04 RESTORATION OF DAMAGED PROPERTY:

- A. The Contractor shall restore or replace, when and as directed, any property damaged by his work, equipment or employees, to a condition at least equal to that existing immediately prior to the beginning of operations. To this end the Contractor shall do as required all necessary highway or driveway, walk and landscaping work. Materials, equipment, and methods for such restoration shall be as approved by the Engineer.

2.05 FINAL CLEANUP:

- A. Before acceptance by the Owner, the Contractor shall perform a final cleanup to bring the construction site to its original or specified condition. This cleanup shall include removing all trash and debris off of the premises. Before acceptance, the Engineer shall approve the condition of the site.

END OF SECTION

SECTION 01 77 00

PROJECT CLOSEOUT

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. This Section covers administrative and procedural requirements for closing out the project, including, but not limited to:
 - 1. Project as-built documents
 - 2. Checkout and Certification
 - 3. Startup and Testing
 - 4. Final Cleaning
 - 5. Substantial Completion
 - 6. Closeout Procedures
 - 7. Final Completion
 - 8. Operations and Maintenance Manuals
 - 9. Correction/Warranty Period
- B. Closeout checklist to be completed by the Engineer.

1.02 RELATED WORK:

- A. General Requirements in their entirety.
- B. Section 01 74 00, CLEANING UP
- C. Division 2 through Division 16.

1.03 AS-BUILT DOCUMENTS:

- A. Contractor shall maintain on site, separate from the documents used for construction, one set of the documents listed below, and as construction progresses, shall legibly record on these documents all changes made during construction.
 - 1. Contract Drawings.

2. Specifications.
3. Addenda.
4. Change Orders and other Modifications to the Contract.
5. Reviewed shop drawings, product data, and samples.
6. Written interpretations and clarifications.
7. Field Orders.
8. Field test reports properly verified.

B. The completed set of as-built documents shall be submitted to the Engineer with the final Application for Payment.

1.04 CHECKOUT AND CERTIFICATIONS:

A. Prior to checkout and certifications the following tasks shall be completed:

1. Construction shall be complete. For this purpose, completion of construction is defined as follows:
 - a. The Contractor has completed construction and erection of the work in conformance with the Contract Drawings and Specifications.
 - b. The Contractor has installed and adjusted operating equipment, systems, or facilities, as applicable, as defined by the manufacturers' erection, installation, operation and maintenance instructions.
2. All shop drawings shall have final approval.
3. All shop tests shall be complete and approved test results submitted to the Engineer.

1.05 START-UP AND TESTING:

A. Prior to start-up the following tasks shall be complete:

1. All checkout and certifications shall be satisfactorily completed,
2. All operations and maintenance manuals shall be approved,
3. All preliminary training by the manufacturer's representative shall be completed,

4. An approved start-up procedure shall be in place.

1.06 FINAL CLEANING:

- A. Complete the following cleaning operations before requesting inspection for Certification of Substantial Completion.
 1. Clean the site, including landscape development areas of rubbish, litter and other foreign substances. Sweep paved areas broom clean; remove stains, spills and other foreign deposits. Rake grounds that are neither paved nor planted, to smooth, even textured surfaces.
 2. Remove waste and surplus materials, rubbish, fencing equipment, temporary utilities and construction facilities from the site, unless otherwise required by the Engineer.
 3. Comply with requirements of Section 01 74 00 CLEANING UP.

1.07 SUBSTANTIAL COMPLETION:

- A. Substantial Completion is officially defined in the General and Supplementary Conditions. The date of substantial completion will be certified by the Engineer. This date will not be certified until the following requirements have been satisfied by the Contractor:
 1. All Contract requirements are coordinated into a fully operational system. All individual units of equipment and treatment are fully operative and performing at specified efficiencies. Where efficiencies are not specified, performance shall meet acceptable standards for the particular unit.
 2. All field tests have been satisfactorily completed and reports forwarded to the Engineer.
 3. All final training has been completed by the manufacturers' representatives.
 4. All spare parts and lubricants have been satisfactorily delivered to the Owner. Spare parts are for the exclusive use of the Owner when the facility has been turned over. Contractor is responsible for all maintenance and repair materials required until the facility is accepted by the Owner.

1.08 CLOSEOUT PROCEDURES:

- A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and is complete in accordance with Contract Documents and ready for Engineer's and Owner's inspection.

- B. Accompany Engineer and Owner on inspection to verify conformance with the Contract Documents. Prepare a punch list of work items that have been determined by inspection to not conform to Contract Documents. Punch list items shall include work items that are missing, incomplete, damaged, incorrect items, or improperly installed or constructed. The Contractor shall correct the punch list deficiencies by re-work, modifications, or replacement, as appropriate, until the items conform to the Contract Documents. The initial punch list shall be produced by the Contractor, with copies to the Engineer and Owner. When the Contractor has reduced the number of deficient items to a reasonable level, the Engineer will develop a definitive punch list for the use of the Contractor.
- C. Provide submittals to Engineer that are required by governing or other authorities.
- D. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due. The Contractor shall submit the following documents with or prior to Final Application for Payment: Set of as-built documents, Contract Completion and Acceptance Certificate, Consent of Surety to Final Payment, Release and Waiver of Liens and Claims, Affidavit of Payment of Debts and Claims, and remaining releases, waivers, warranties/guarantees, and all other data required by the Contract Documents.

1.09 FINAL COMPLETION:

- A. Prior to final completion, the following tasks shall be completed:
 - 1. All items in the punch list shall be completed.
 - 2. All Contract closeout documentation shall be submitted to and accepted by the Engineer.

1.10 CORRECTION/WARRANTY PERIOD:

- A. During the correction period, the Contractor shall correct all deficiencies in equipment and materials.
- B. During the ONE-YEAR warranty period, the Contractor shall perform all corrective work on warranty deficiencies for all work except for plantings. All plantings have a TWO-YEAR warranty period from final acceptance.
- C. Corrective work will be identified by the Engineer or Owner, as appropriate. The Contractor will be notified of the item(s) requiring corrective work.
- D. The Contractor shall begin work on all corrective work within ten days of being notified of the deficiency by the Engineer and shall then work continuously until the deficiency is corrected. Upon completion of the corrective work, the Contractor shall submit a

letter report to the Engineer describing the deficiency and the corrective action that was taken.

- E. The Contractor shall coordinate all corrective work with the Engineer and/or the Owner.

1.11 COMPLETION CHECKLIST:

- A. When the project has been fully completed, Final Payment can be approved.

PROJECT COMPLETION CHECKLIST

Owner _____ Job No.

Project

As part of the project closeout, all items listed below must be checked off as being complete or otherwise accounted for. The person verifying completion of the item shall list the completion date and his/her initials.

Project Closeout Checklist		
	Date Completion Verified	Verified by
AS-BUILT DOCUMENTS HANDED OVER		
1. Contract Drawings		
2. Specifications		
3. Addenda		
4. Change Orders/Contract Modifications		
5. Reviewed Shop Drawings, Product Data and Samples		
6. Written Interpretations/Clarifications		
7. Field Orders		
8. Field Test Reports		
EQUIPMENT CHECKOUT AND CERTIFICATIONS		
1. Construction Complete per Drawings/Specifications		
2. Equipment Installed and Adjusted		
3. All Shop Drawings have Final Approval		
4. All Shop Tests Complete and Results Submitted		

Project Closeout Checklist		
	Date Completion Verified	Verified By
START-UP AND TESTING		
1. All Checkout and Certifications Complete		
2. All O&M Manuals Approved		
3. All Preliminary Training by Manufacturers Rep. Completed		
FINAL CLEANING		
1. All Construction Facilities Removed		
2. All Construction Debris Removed		
3. All Areas Swept/Cleared		
SUBSTANTIAL COMPLETION		
1. All Items Coordinated Into a Fully Operational System		
2. All Equipment Units Operational at Specified Efficiencies		
3. All Field Tests Completed and Reports Submitted		
4. All Final Training by Manufacturer's Rep. Completed		
5. All Spare Parts and Lubricants Provided		
CLOSEOUT PROCEDURES		
1. Written Certification Submitted that Work is Ready for Owner & Engineer Inspector		
2. Inspection by Owner, Engineer, Contractor completed		
3. Punch List of Nonconforming Items Prepared		
4. Documents Required by Governing or Other Authorities Submitted (List Them)		
5. Final Application for Payment Received		
6. Contact Completion and Acceptance Certificate Submittal		
7. Consent of Surety to Final Payment Submittal		
8. Release and Waiver of Liens and Claims Submitted		
9. Affidavit of Payment of Debts and Claims Submitted		

Project Closeout Checklist

	Date Completion Verified	Verified By
10. Warranties/Guarantees Submitted		
11. Other Required Releases and Waivers Submitted (List Them)		
12. Permits Submitted (List Them)		
13. Weekly Payrolls Submitted as Required by Law		
FINAL COMPLETION		
1. All Items in Punch List Completed		
2. All Other Required Documentation Submitted (List It)		
CORRECTION/WARRANTY PERIOD		
1. Correction Period Start Date: _____ End Date: _____		
2. Specific Warranties Provided <u>Item</u> <u>Warranty Duration</u>		

Full name of persons signing their initials on this checklist:

END OF SECTION

SECTION 02 41 13

SITE DEMOLITION

PART 1 - GENERAL

1.01 SCOPE OF WORK:

- A. Work under this Section shall consist of the careful removal, storage for reuse, transportation off-site, or demolition, of all structures and site features encountered or noted to be removed or abandoned to a minimum of three feet below finished grade, unless otherwise noted on the documents. Remove and dispose all materials not called for to be reused or salvaged, in accordance with the contract drawings, these specifications, and Engineer's requirements. Provide all labor, equipment, materials and transportation necessary to complete the work.
- B. Items plan referenced to be removed and stored shall be carefully removed and stored on site in a manner and location designated by the Engineer for reinstallation later as shown on the plans or as indicated by the Engineer.
- C. Items plan referenced, or as indicated by the Engineer to be removed and disposed of shall be removed from the site and properly and legally disposed of by the Contractor.
- D. Items indicated on the contract drawings or in the specifications to be removed and salvaged, or other items required to be removed by the Engineer, shall be transported to a municipal storage facility, located within the City confines, and unloaded and stacked as required by the Engineer.
- E. Items indicated on the contract drawings or in the specification to be removed and reset shall be carefully removed and reset in the same location as existing according to the specification and details.
- F. The following scope describes the general work/demolition requirements of this Section.
 - 1. Stripping and Removal of Topsoil/Subsoil
 - 2. Appurtenances and all related concrete footings complete.
 - 3. Other features as indicated on the drawings.

1.02 PROTECTION:

- A. The Contractor shall assume complete responsibility and liability for the safety and structural integrity of all work and utilities to remain during demolition.

- B. Provide safeguards including, but not limited to, warning signs, barricades, temporary fences, warning lights and other items required for protection of personnel and the general public during performance of all work.
- C. All features related to protection shall be maintained until that work has been completed to the point when such safeguards are no longer required.

1.03 SPECIAL REQUIREMENTS:

- A. The Contractor shall salvage items labelled to be salvaged onsite in a designated location, unless these are called for to be reused or required by the Engineer to be disposed of.
- B. Install erosion controls to protect adjacent areas from eroded materials likely to enter wetlands, resource areas, or drainage ways/systems, downstream of areas disturbed by work activities.
- C. Where items to be demolished are located within or adjacent to pavements to remain, the Contractor shall make provisions to protect that pavement to remain. Cut concrete pavement back to score line and cut bituminous concrete pavement back far enough so as not to allow disturbance to base course materials. Pavements damaged as a result of Contractor activities shall be replaced to the extent determined by the Engineer at no additional cost to the Owner.

PART 2 - PRODUCTS

2.01 BACKFILL:

- A. The Contractor shall provide suitable backfill as specified under Section 31 00 00 of these Specifications, to fill voids left by removal or abandonment of site features, and shall provide all pipe cap ends, mortar, brick and other material needed to cap off or plug pipes of various sizes and kinds.
- B. Suitable materials shall be used as base course fill and topsoil to the depth as specified herein. Restore disturbed areas with similar materials blended to match the line and grades of adjacent surfaces.

2.02 TEMPORARY FENCE:

- A. The work shall include temporary installation of chain link fence around the perimeter of the work limits where shown on the plans, and as required by the Engineer, and as Contractor sees fit to protect work.
- B. Temporary fence shall consist of 6 foot high chain link fence anchored into a base that is both stable and movable to allow access and adjustment as needed.

Reclaimed existing fence fabric and materials may be used with the approval of the Engineer. The Contractor shall submit a shop drawing to the Engineer for approval prior to installation.

PART 3 - EXECUTION

3.01 SALVAGEABLE MATERIAL:

- A. Frames, grates and other salvageable material shall be carefully removed to minimize damage and stored for later reuse, transport, or removal from site.

3.02 ABANDONED STRUCTURES:

- A. All inlets and outlets shall be plugged with at least eight (8) inches of brick and mortar masonry. Upper portions of masonry structures shall be removed to a depth of three feet. The bottoms of all structures shall be broken to allow drainage, and the structure shall be filled with suitable backfill material placed in six (6) inch layers and thoroughly compacted at each level.
- B. The Engineer shall review work related to abandoned structures before backfilling. Those items not reviewed before backfilling shall be uncovered and backfill procedures observed, at no expense to the Owner.

3.03 ABANDONED PIPES OR CONDUITS:

- A. Plug previously abandoned drainpipes encountered with masonry brick at least eight (8) inches in thickness.
- B. Abandon discontinued water supplies that are encountered during the execution of this contract in accordance with Owner requirements.
- C. Electrical conduits encountered and previously abandoned shall be capped or plugged.

END OF SECTION

SECTION 02 41 19

ABANDONMENT OF SEWERS AND DRAINS

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. This Section covers the abandonment of sewers and drains through various means including furnishing, handling and installation of all concrete and masonry plugs; removal and disposal of manholes, and filling existing pipes with controlled density fill, as shown on the Drawings and specified herein.
- B. The Contractor shall furnish all materials, tools, labor, and equipment to abandon existing sewers, combined sewers, and drains.

1.02 RELATED WORK:

- A. Section 31 05 13, FLOWABLE FILL
- B. Section 03 00 00, CAST IN PLACE CONCRETE

1.03 REFERENCES:

The following standards form a part of this specification, as referenced:

American Society for Testing and Materials (ASTM)

ASTM C32 Specifications for Sewer and Manhole Brick (Made from Clay or shale).

1.04 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

The Contractor shall submit six sets of its plan for abandoning existing pipe, showing equipment, methods and materials. The plan shall be submitted to and reviewed by the Engineer before construction.

PART 2 - PRODUCTS

2.01 PLUGS:

- A. Plugs installed at the open ends of the pipe to be abandoned shall be 12-inch thick 3,000-psi cement concrete, or 8-inch thick brick masonry as directed. The pipes to be

abandoned include all sewer, combined sewer, and drains as specified herein and as shown on the Drawings.

- B. Precast cement concrete plugs that are used shall meet the requirements for 3,000 psi concrete and shall be free of cracks and spalls. Brick masonry plugs shall be made of brick meeting the requirements of ASTM C32, for grade SS, hard brick.
- C. Mortar shall be composed of portland cement, hydrated lime, and sand, and the volume of sand shall not exceed three times the sum of the volumes of cement and lime. The proportions of cement and lime shall be as directed and may vary from 1:1/4 for dense hard-burned brick to 1:3/4 for softer brick. In general, mortar for grade SS brick shall be mixed in the volume proportions of 1:1/2:4-1/2; portland cement to hydrated lime to sand. The cement concrete plug shall be covered with non-shrink grout to prevent leakage at the plug.

2.02 PIPE FILL:

- A. Fill used for the abandonment of sewers, combined sewers, and drains as shown on the drawings shall consist of clean fill, or controlled density fill meeting the requirements included in Section 31 05 13 Flowable Fill.
- B. Any variance from the specified material shown on the plans or as specified herein for the abandonment of the pipeline shall be subject to the written approval of the Engineer.

PART 3 - EXECUTION

3.01 INSTALLATION

A. PLUGS:

1. Existing sewers or drains shall be plugged with 3,000 psi concrete or with brick masonry, as required by the Engineer. For non-circular pipes, the largest interior cross sectional dimension shall govern in determining size of abandonment.
2. Plugs shall be of adequate strength to withstand the full soil and groundwater pressure but not less than 5 psi.
3. Open ends of sewer and drain services less than 12 inches in diameter shall be plugged with the appropriate VC plugs or concrete plug as required by the Engineer. Such plug shall be made watertight with an application around the plug of an approved watertight compound.
4. Masonry plugs shall be at least 8-inches thick and concrete plugs shall be at least 12-inches thick. Pipes entering a manhole or catch basin that are to be abandoned shall have a plug installed that is flush with the interior wall of the structure.

B. PIPE FILL:

1. Existing sewers or drains 12-inches and larger shall be abandoned and filled with clean fill, or controlled density fill, and plugged, as shown on the Drawings.
2. Existing sewers or drains smaller than 12-inches shall be plugged and abandoned but need not be filled with clean fill or any other material unless otherwise specified by the Engineer.
3. The method of filling the abandoned pipeline shall fill a minimum of 95 percent of the total annular volume of the pipe.

3.02 REMOVAL AND DISPOSAL OF MANHOLES

A. REMOVAL OF MANHOLES

1. Frames and covers will be removed and delivered to the place designated by the Owner.
2. After filling the pipes to be abandoned that are entering the manhole as specified above, the Contractor shall remove the cone section of a precast manhole or the top four feet of brick in a brick manhole.
3. The Contractor shall place and compact clean fill in the void left by the removal of the manhole.
4. The ground or paved surface shall be restored in accordance with the drawings.

B. DISPOSAL OF MANHOLES

1. The Contractor shall dispose of all manhole materials that are to be removed. Unless the Owner designates a site for receiving the removed materials, the Contractor shall dispose of the materials at a site of his own choosing.

END OF SECTION

SECTION 02 82 10
TEMPORARY CHAIN LINK FENCE

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. The Contractor shall provide all labor, materials and appurtenances necessary for the installation, maintenance and dismantling of 6-foot temporary fencing.
- B. The Contractor shall be responsible for securing the site from trespassers. Temporary fencing shall be installed as shown on the Contract Drawings to restrict access to the construction area.

1.02 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

- A. Six sets of manufacturers literature of the materials specified herein shall be submitted to the Engineer for review.
- B. Six sets of shop drawings of the temporary chain link fence shall be submitted to the Engineers for review.
 - 1. Shop drawings shall indicate layout of temporary fencing, existing pavement and roads, and other site specific conditions. Prepare drawing after site observation and verification of existing conditions.

PART 2 - PRODUCTS-GALVANIZED

2.01 TEMPORARY CHAIN LINK FENCING

- A. Unless otherwise indicated, type of 6-foot temporary chain link fencing shall be Contractor's option. Following types are acceptable:
 - 1. New materials or previously used salvaged chain link fencing in good condition.
 - 2. Posts: Galvanized steel pipe of diameter to provide rigidity. Post shall be suitable for setting in concrete footings, driving into ground, anchoring with base plates, or inserting in precast concrete blocks.
 - 3. Fabric: Woven galvanized steel wire mesh. Provide in continuous lengths to be wire tied to fence posts or prefabricated into modular pipe-framed fence panels.
 - 4. Dust barrier/Wind Screen. Contractor shall apply a dust barrier/wind screen to the chain link mesh.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. The fence shall be erected by skilled mechanics in accordance with the recommendations of the manufacturer and these specifications. These specifications shall take precedence over the recommendations of the manufacturer if any discrepancy exists between them.
- B. Posts
 - 1. Maximum post spacing shall be 10-feet. Post spacing shall be uniform and posts shall be plumb.
 - 2. Drive posts, set in holes and backfill, or anchor in precast concrete blocks.
 - 3. For soft and unstable ground conditions, cast concrete plug around post.
 - 4. Posts over pavement: Use steel post plates or precast concrete blocks.
 - 5. Temporary terminal posts shall be securely connected to existing fence posts to prevent site access/trespassing.
- C. Securely attach wire fabric to posts. Maximum area of unbraced fence fabric shall not exceed 1,500 square feet.
- D. Install with required hardware.
- E. Fabric shall be stretched taut, with the bottom edge following the existing grade, and shall be a continuous mesh between terminal posts. Each span of fabric shall be attached independently at terminal posts. Where terminal posts do not have provisions for weaving fabric to posts, stretcher bars shall be placed through the end weave of the fabric and secured to the post with bar bands spaced not more than 15-inches apart on the post. Temporary terminal posts shall be secured to existing fence posts to prevent Site access/trespassing.
- F. Fabric shall be attached with ties to line posts at intervals of not more than 14-inches (and to the top railing and braces at intervals not exceeding 24-inches).
- G. The bottom tension wire shall be interlaced in the weave of the fabric, pulled taut and fastened to terminal posts. Wind screen/dust barrier shall be applied to the chain link mesh.

3.02 MAINTENANCE AND REMOVAL

- A. Maintain fencing in good condition. If damaged, immediately repair.
- B. Remove temporary fencing upon completion of Work or when no longer required for security or control. Backfill holes and compact. Holes in pavement shall be surfaced to match existing paving. Repair damage caused by installation of temporary fencing.

END OF SECTION

SECTION 03 00 01
REINFORCED CEMENT CONCRETE FENCE STRIP
(MOW CURB)

1.01 SCOPE OF WORK

The work to be done in this section shall be to construct a cast in place reinforced concrete fence strip (mower strip) as located and detailed in the plans and as specified herein. The Contractor shall furnish all labor, material, equipment and transportation necessary to accomplish this task.

A. Reference Standards

1. References herein to any technical society, organization, group of body are made in accordance with the following abbreviations.

AASHTO	American Association of State Highway and Transportation Officials
--------	-----------------------------------------------------------------------

ANSI	American National Standards Institute
------	---------------------------------------

ASTM	American Society for Testing Materials
------	----------------------------------------

1.02 MATERIALS

- A. Gravel base shall conform to Section 31 00 00 EARTHWORK of these Specifications.
- B. Forms, reinforcing steel and cement concrete cast-in-place shall conform to Section 03 30 00 CAST IN PLACE CONCRETE of these Specifications.
- C. All fence posts shall be set into place in accordance with shop drawings and fencing layout; mower strip to be poured between post footings with tooled construction joints.
- D. Cement Concrete shall conform to Section 03 30 00 CAST IN PLACE CONCRETE of these Specifications.
- E. Preformed expansion joint filler shall be of a non-extruding and resilient non-bituminous type conforming to AASHTO-M135.

1.03 EXECUTION

- A. Excavation shall conform to Section 31 00 00 EARTHWORK of these Specifications.
- B. Placement and compaction of processed gravel shall conform to Section 31 00 00 EARTHWORK of these Specifications.
- C. Placement of reinforcing steel shall conform to Section 03 30 00 CAST IN PLACE CONCRETE of these Specifications; Coordinate with fencing sections; cast cement concrete against post footings and tool joints.

Placement and Finish of Cement Concrete: The concrete shall be placed in such quantity that after being thoroughly consolidated in place it shall be to the minimum depth and width as designated on the plans and details. No finishing operation shall be performed until all bleed water and water sheen has left the surface and the concrete has started to stiffen. After water sheen has disappeared, edging operations where required shall be completed. All tool marks shall be eliminated. After edging and jointing operations, the surface shall be floated with aluminum or magnesium floats. If necessary, tooled construction joints and edges shall be rerun to maintain uniformity.

- D. Curing of cement concrete shall conform to Section 03 30 00 CAST IN PLACE CONCRETE of these Specifications.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 -GENERAL

1.01 GENERAL PROVISIONS:

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made part of this Section of the Specifications.

1.02 DESCRIPTION OF WORK:

- A. Work Included: This Section specifies cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes for the following:
 - 1. Footings
 - 2. Exterior slabs-on-grade, sidewalks
- B. Related Work: The following items are not included in this Section and will be performed under the designated Sections:
 - 1. Section 01 45 10, STRUCTURAL TESTS AND INSPECTIONS
 - 2. Section 31 00 00, EARTHWORK; Excavation and establishment of subgrade elevations.

1.03 SUBMITTALS:

- A. Refer to Section 01 33 00, SUBMITTALS for submittal provisions and procedures.
- B. Product data for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, curing compounds, and others if requested by the Engineer.
- C. Shop drawings for reinforcement detailing, fabricating, bending, and placing concrete reinforcement. Comply with ACI 315 “Manual of Standard Practice for Detailing Reinforced Concrete Structures”. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing and supports for concrete.

- D. Concrete mix design for each mix specified. Supporting test data shall be submitted if requested.
 - 1. Submit alternate mix designs when the characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.
 - 2. Indicate the amounts of mixing water to be withheld for later addition at the Project site.
- E. Proposed method of curing and associated products.
- F. Proposed precautions for hot weather and cold weather concreting.
- G. Laboratory test reports for concrete materials and mix design test.
- H. Material test reports for the following, from a qualified testing agency, indicating compliance with specification requirements:
 - 1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
- I. Material certificates for each of the following, signed by the manufacturers:
 - 1. Cementitious material.
 - 2. Admixtures
 - 3. Form materials and form-release agents.
 - 4. Steel reinforcement and accessories.
 - 5. Non-metallic shrinkage resistant grout.
 - 6. Curing compounds.
 - 7. Floor and slab treatments.
 - 8. Bonding agents.
 - 9. Adhesives.
 - 10. Semi-rigid joint filler.
 - 11. Joint-filler strips.
 - 12. Repair materials.
- J. Qualification Data: For Installer and Manufacturer.

1.04 QUALITY ASSURANCE:

- A. Installer Qualifications: A qualified installer who employs on the Project personnel qualified as ACI certified Flatwork Technician and Finisher and a supervisor who is an ACI certified Concrete Flatwork Technician.

- B. **Manufacturer Qualifications:** A firm experienced in manufacturing ready-mix concrete products that complies with ASTM C 94 requirements for production facilities and equipment.
1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. **Testing Agency for Mix Design Qualifications:** An independent agency, registered in the State of New Hampshire as an approved testing agency, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
 2. Personnel performing laboratory tests shall be ACI certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician – Grade 1. The Testing Agency Laboratory supervisor shall be an ACI certified Concrete Laboratory Testing Technician – Grade II.
- D. **Source Limitations:** Obtain each type of class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.
- E. **ACI Publications:**
1. Comply with the following unless modified by requirements in the Contract Documents:
 - a. ACI 117, "Standard Specifications for Tolerances for Concrete Construction and Materials."
 - b. ACI 211.1, "Recommended Practice for Selecting Proportions for Normal and Heavyweight Concrete."
 - c. ACI 214, "Evaluation of Strength Test Results of Concrete."
 - d. ACI 301, "Specification for Structural Concrete."
 - e. ACI 304, "Guide for Measuring, Mixing, Transporting and Placing Concrete."
 - f. ACI 305, "Hot Weather Concreting."
 - g. ACI 306, "Cold Weather Concreting."
 - h. ACI 308, "Guide to Curing Concrete."
 - i. ACI 309, "Guide for Consolidation of Concrete."
 - j. ACI 311.1, "ACI Manual of Concrete Inspection."
 - k. ACI 315, "Details and Detailing of Concrete Reinforcement."

1. ACI 318, "Building Code Requirements for Structural Concrete and Commentary."
 - m. ACI 347, "Guide for Formwork for Concrete."
 2. Where the language in any of the documents referred to herein is in the form of a recommendation or suggestion, such recommendations or suggestions shall be deemed to be mandatory under this Contract.
- F. American Society for Testing and Materials (ASTM):
1. ASTM C309 "Liquid Membrane-Forming Compounds for Curing Concrete."
 2. ASTM C494 "Standard Specification for Chemical Admixtures for Concrete."
 3. ASTM C979 "Standard Specification for Pigments for Integrally Colored Concrete."
- G. American Association of State Highway and Transportation Officials (AASHTO):
1. AASHTO M194 "Chemical Admixtures."

1.05 DELIVERY, STORAGE, AND HANDLING:

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

PART 2 -PRODUCTS

2.01 FORM-FACING MATERIALS:

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
1. Plywood, metal, or other approved panel materials.
- B. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4-inch by 3/4-inch, minimum.

- D. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- E. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral earth pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
- F. Furnish units that will leave no corrodible metal closer than 1-inch to the plane of exposed concrete surface.

2.02 STEEL REINFORCEMENT:

- A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
- B. Plain Steel Wire: ASTM A 82, as drawn.
- C. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.

2.03 NON-METALLIC SHRINKAGE RESISTANT GROUT:

- A. Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, non-staining, mixed with water to consistency suitable for application and a 30-minute working time. The minimum ultimate compressive strength of the grout shall be 5000 psi at 7 days and 7500 psi at 28 days.

2.04 REINFORCEMENT ACCESSORIES:

- A. Joint Dowel Bars: ASTM A 615, Grade 60, plain-steel bars, cut bars true to length with ends square and free of burrs.
- B. Bar Supports: Bolster, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice", of greater of compressive strength than concrete and as follows:
 - 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless steel bar supports.

2. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs. Concrete bricks may be used to support reinforcing steel where application allows.

2.05 CONCRETE MATERIALS:

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout the Project:
 1. Portland Cement: ASTM C 150, Type I/II. Supplement with the following:
- B. Fly Ash: ASTM C 618, Class C or F.
- C. Ground Granulated Blast Furnace Slag: ASTM C 989, Grade 100 or 120.
- D. Cementitious Materials: Percentage, by weight, of cementitious materials other than Portland cement in concrete as follows:
 1. Fly Ash or Ground Granulated Blast Furnace Slag: 25 percent, minimum.
 2. Combined Fly Ash and Pozzolan: 35 percent, maximum.
 3. Ground Granulated Blast Furnace Slag: 50 percent, maximum.
 4. Combined Fly Ash or Pozzolan and Ground Granulated Blast Furnace Slag: 50 percent Portland cement minimum, with fly ash or pozzolan not exceeding 35 percent.
- E. Normal-Weight Aggregates: ASTM C 33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.
 1. Maximum Coarse Aggregate Size: $\frac{3}{4}$ -inch nominal.
 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- F. Water: ASTM C 94 and potable.

2.06 ADMIXTURES:

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 1. Water-Reducing Admixture: ASTM C 494, Type A.

2. Retarding Admixture: ASTM C 494, Type B.
 3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
 6. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.
- C. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor,; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C 494, Type C.
1. Products:
 2. Euclid Chemical Company; Eucon CIA.
 3. Grace Construction Products, W.R. Grace & Co.; DCI.
 4. BASF Admixtures, Inc.; Rheocrete CNI.
 5. Sika Corporation; Sika CNI.
- D. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.
1. Products:
 - a. Grace Construction Products, W.R. Grace & Co.; DCI-S.

2.07 CURING MATERIALS:

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz. /sq. yd. when dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, 18 to 25 percent solids, non-dissipating, certified by curing compound manufacturer to not interfere with bonding of floor coverings.
 1. Products:
 - a. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; High Seal.

- b. Dayton Superior Corporation; Safe Cure and Seal (J-19).
 - c. Euclid Chemical Company; Diamond Clear VOX.
 - d. Lambert Corporation; Glazecote Sealer-20.
 - e. L&M Construction Chemicals, Inc.; Dress & Seal WB.
 - f. Meadows, W.R., Inc.; Vocomp-20.
 - g. Nox-Crete Products Group, Kinsman Corporation; Cure & Seal 200E.
 - h. Sonneborn, Div. Of ChemRex; Kure-N-Seal.
 - i. Symons Corporation, a Dayton Superior Company; Cure & Seal 18 Percent E.
- E. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
- 1. Products:
 - a. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Sealcure 1315 WB.
 - b. Euclid Chemical Company; Super Diamond Clear VOX.
 - c. Lambert Corporation; UV Safe Seal.
 - d. L&M Construction Chemicals, Inc.; Lumiseal WB Plus.
 - e. Meadows, W.R., Inc.; Vocomp-30.
 - f. Symons Corporation, a Dayton Superior Company; Cure & Seal 31 Percent E.

2.08 RELATED MATERIALS:

- A. Expansion and Isolation Joint Filler Strips: ASTM D 1752, cork or self-expanding cork.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.
- C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
 - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.09 CONCRETE MIXTURES, GENERAL:

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than Portland cement in concrete as follows:
 - 1. Fly Ash: 25 percent.
 - 2. Combined Fly Ash and Pozzolan: 25 percent.
 - 3. Ground Granulated Blast-Furnace Slag: 50 percent.
 - 4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing, high-range water reducing or plasticizing admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water cementitious materials ratio below 0.50.
 - 4. Use retarding admixture in combination with Set accelerating Corrosion Inhibitor. Retarder is not required for non-set accelerating corrosion inhibitor.
 - 5. Use corrosion inhibiting admixture in concrete mixtures where indicated.

2.10 CONCRETE MIXTURES FOR BUILDING ELEMENTS:

- A. Foundations, Soldier Pile Wall Cap, Precast Wall Panels, Deadman Anchors: Proportion normal-weight concrete mixture as follows:
 - 1. Minimum Compressive Strength: 4000 psi at 28 days.
 - 2. Maximum Water-Cementitious Materials Ratio: 0.45.

3. Slump Limit: 4-inches for concrete with verified slump of 2-inch to 4-inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1-inch.
 4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.
- B. Exterior slabs-on-grade and sidewalks: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 4000 psi at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: 0.40.
 3. Slump Limit: 4-inches for concrete with verified slump of 2-inch to 4-inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1-inch.
 4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size
 5. Corrosion Inhibiting Admixture: Apply to all slabs at a rate of 4 gallons per cubic yard of concrete.

2.11 FABRICATING REINFORCEMENT:

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice".

2.12 CONCRETE MIXING:

- A. Ready-Mix Concrete: Measure, batch, mix, and deliver concrete according to ASTM C94, and furnish batch ticket information.
- B. When air temperature is between 85 and 90 degrees F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 degrees F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.01 GENERAL:

- A. Coordinate the installation of joint materials and other related materials with placement of forms and reinforcing.

3.02 FORMWORK:

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
 - 1. Class A, 1/8-inch for smooth-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage concrete surfaces.
 - 1. Do not use rust-stained steel form-facing material.
- F. Set edge forms for slabs to achieve required elevations and slopes in finished concrete surfaces. Use strike-off templates or compacting-type screeds.
- G. Chamfer exterior corners and edges of permanently exposed concrete.
- H. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- I. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- J. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.03 EMBEDDED ITEMS:

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges".

3.04 REMOVING AND REUSING FORMS:

- A. General: Formwork that does not support weight of concrete may be removed after cumulatively curing at not less than 50 degrees F for 24 hours after placing concrete, if concrete is hard enough to not be damaged by form removal operations and curing and protection operations are maintained.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by the Engineer.

3.05 STEEL REINFORCEMENT:

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire ties.

3.06 JOINTS:

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or approved by the Engineer.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of slabs.

2. Form keyed joints as indicated. Embed keys at least 1-1/2-inches into concrete.
3. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

3.07 CONCRETE PLACEMENT:

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Engineer.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 1. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 3. Do not use vibrators to transport concrete. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6-inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for slabs in continuous operation, within limits of construction joints, until placement of panel or section is complete.
 1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 2. Maintain reinforcement in position on chairs during concrete placement.

3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 4. Slope surfaces uniformly to drains where required.
 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When average high and low temperature is expected to fall below 40 degrees F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- G. Hot-Weather Placement: Comply with ACI 301 and as follows:
1. Maintain concrete temperature below 90 degrees F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, providing water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Fog-spray forms, steel reinforcement, and subgrade just before placing of concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.08 FINISHING FORMED SURFACES:

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with minimum number of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view.

3.09 FINISHING SLABS:

- A. General: Comply with ACI 302.1R recommendations for screeding, re-straightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Re-straighten, cut down high spots, and fill low spots. Repeat float passes and re-straightening until surface is left with a uniform, smooth, granular texture.
 1. Apply float finish to surfaces to receive trowel finish.
- C. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and re-straightening until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film finish coating system.
 2. Finish surfaces to the following tolerances, according to ASTM E 1155 for a randomly trafficked floor surface:
 3. Specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15.
- D. Broom Finish: Apply a broom finish to exterior platforms, steps, and ramps, and elsewhere as indicated.
 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Engineer before application.

3.10 MISCELLANEOUS CONCRETE ITEMS:

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide equipment bases and foundations as shown on Drawings. Set anchor bolts at correct elevations, complying with diagrams or templates from manufacturer furnishing equipment.

3.11 CONCRETE PROTECTING AND CURING:

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- C. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Curing all slabs in the project with moisture curing. Keep surfaces continually moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 - 2. Moisture-Retaining Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in the widest practicable width, with sides and ends lapped at least 12-inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subject to heavy rainfall within three hours after initial applications. Maintain continuity of coating and repair damage during curing period.
 - a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing

compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

- D. Curing Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces, by moist curing with forms in place for the full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.

3.12 JOINT FILLING:

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 - 1. Defer joint filling until concrete has aged at least one month. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

3.13 CONCRETE SURFACE REPAIRS:

- A. Defective Concrete: repair and patch defective areas when approved by the Engineer. Remove and replace concrete that cannot be repaired and patched to the Engineer's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part Portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than ½-inch in any dimension in solid concrete, but not less than 1-inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush coat holes and voids with bonding agent. Fill and compact patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations

to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by the Engineer.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, pop outs, honeycombs, rock pockets, crazing and cracks in excess of 0.01-inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14-days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Repair defective areas, except random cracks and single holes 1-inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
6. Repair random cracks and single holes 1-inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72-hours.

E. Perform structural repairs of concrete, subject to Engineer's approval, using epoxy adhesive and patching mortar.

- F. Repair materials and installation not specified above may be used, subject to the Engineer's approval.

3.14 FIELD QUALITY CONTROL:

- A. Testing and Inspecting: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Inspections:
 - 1. Steel reinforcement placement.
 - 2. Steel reinforcement welding.
 - 3. Verification of use of required design mixture.
 - 4. Concrete placement, including conveying and depositing.
 - 5. Curing procedures and maintenance of curing temperature.
- C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 - 1. Testing Frequency: Obtain one composite sample of each day's pour of each concrete mixture exceeding 5 cubic yards, but less than 25 cubic yards, plus one set for each additional 50 cubic yards or fraction thereof.
 - 2. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 - 3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - 4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 degrees F and below and when 80 degrees F and above, and one test for each composite sample.
 - 5. Compression Test Specimens: ASTM C 31.
 - 6. Cast and laboratory cure five standard cylinder specimens for each composite sample.
 - 7. Compressive Strength Tests: ASTM C 39; test one set of two-laboratory-cured specimens at 7 days and one set of two specimens at 28 days. Test remaining specimen at 28 days if previous results are satisfactory or retain this specimen for 56 day testing if results are not satisfactory.
 - 8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive strength tests equals or exceeds

specified compressive strength and no compressive strength test value falls below specified compressive strength by more than 500 psi.

- D. Test results shall be reported in writing to the Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7 and 28 day tests.
1. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as the sole basis for approval or rejection of concrete.
 2. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as required by the Engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as required by the Engineer.
 3. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 4. Correct deficiencies in the Work that test reports and inspections indicate does not comply with the Contract Documents.
- E. Measure floor and slab flatness and levelness according to ASTM E 1155 within 24 hours of finishing.

3.15 GROUTING:

- A. Mix grout in accordance with the approved manufacturer's instructions to a consistency which will permit placement. Place grout so as to ensure complete bearing and elimination of air pockets.

END OF SECTION

SECTION 03_41_50

PRECAST CONCRETE WALL PANELS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. This section of the specification covers precast concrete wall panels. This includes installation of the panels at the soldier pile and lagging wall as required or shown on the drawings.
- B. Other items to be furnished and erected under this section include all shims, inserts, and cast-in items as shown on the drawings or as required for panel installation.
- C. The installation and supplying of a true level bearing surface at the required elevations that are to receive precast concrete wall panel.

1.03 ELIGIBILITY OF MANUFACTURER

- A. The precast concrete manufacturer shall be a firm experienced in this type of work. The precast concrete wall panels shall be manufactured in plants having been certified under the PCI Plant Certification Program. The manufacturer shall submit evidence showing that he has successfully completed work of this nature prior to being approved to supply concrete to the project.

1.04 SUBMITTALS

- A. Shop and working drawings, conforming to ACI 318, ACI 512, and in accordance with paragraph 3 of the General Conditions, shall be submitted to the Engineer for review.
- B. The shop and erection drawings shall show the type of precast concrete wall panel; the size, location, all element dimensions; the locations, type, size and strength of inserts, steel reinforcement; and all other information necessary to insure proper handling, fabrication, erection, and installation of the precast concrete wall panels.
- C. The Contractor shall furnish two copies of design calculations to the Engineer for review. Calculations shall show all assumptions and cover all phases of design. All wall panel members shall be designed for handling, transportation, and erection. Fabrication shall not proceed until written approval of the design calculations has been received.

1.05 STANDARDS

The following standards form a part of these specifications:

American Concrete Institute (ACI)

ACI 318 Building Code Requirements for Reinforced Concrete

ACI 533 Precast Wall Panels

American Society for Testing and Materials (ASTM)

ASTM A615 Deformed and Plain Billet Steel Bars for Concrete Reinforcement.

ASTM C33 Concrete Aggregates.

ASTM C94 Ready Mix Concrete

ASTM C150 Portland Cement.

ASTM C260 Air-Entrainment Admixtures for Concrete

ASTM C618 Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Concrete shall have a minimum strength of 3000 psi at the time of handling and transportation and 4000 psi at 28 days.
- B. Cement shall conform to ASTM C150 Type I/II.
- C. Aggregate shall conform to ASTM C33, Class 4S coarse aggregate, uniformly graded, provided from a single source with documented record service.
- D. Grout shall be a neat mortar composed of sand, water, and portland cement mixed of not less than one part cement to three parts sand.
- E. Reinforcing bars shall conform to ASTM A615, Grade 60 Deformed.
- F. Cast-in-place inserts shall be galvanized and of a type approved by the Engineer. Galvanizing shall conform to ASTM A123.

G. Water: ASTM C94

H. Air –Entrainment Admixture: ASTM C-260

2.02 FABRICATION

- A. The Precast concrete wall panels shall be constructed to the dimensions shown on the construction drawings. Concrete and steel reinforcement shall meet the requirement in sections 2.01 above.
- B. The Contractor shall be responsible for any failure to cast precast concrete wall panels to the correct dimensions and for any omissions or inaccuracies in the manufacture of precast concrete wall panels. If in the opinion of the Engineer, proper corrections cannot be made the members shall be rejected and shall be replaced with new members at the Contractor's expense.
- C. The manufacturer shall furnish all inserts and shall coordinate the locations with the Contractor. Each wall panel shall be properly marked to correspond with the designation on the approved shop and erection drawings.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Installation of the precast concrete wall panels shall be done by experienced workers in accordance with the previously mentioned ACI standards.
- B. Contractor to provide precast concrete wall panels, secured in place to the soldier pile (H-Piles), contained in the recesses between the H-flange. Install wall panels horizontally with no gaps between the panels.
- C. No inserts or other items, unless shown on the drawings, shall be installed in the wall panels without written approval of the Engineer.
- D. No field holes or cuts shall be made in any member without the prior approval of the Engineer. All holes shall be cut in accordance with manufactures recommendations.

END OF SECTION

SECTION 10 14 00
SIGNAGE (TRAFFIC CONTROL)

PART 1 - GENERAL

1.01 WORK INCLUDED:

This Section covers furnishing and installing traffic control signs and other devices.

1.02 SYSTEM DESCRIPTION:

The Contractor shall furnish and install all construction signs deemed necessary by and in accordance with the latest edition of Part VI of the Manual on Uniform Traffic Control Devices (MUTCD) as published by the U.S. Department of Transportation.

PART 2 - PRODUCTS

2.01 TRAFFIC WARNING AND REGULATING DEVICES:

Contractor shall provide warning signs, barricades and other devices in accordance with the specifications provided in the MUTCD. Size of signs, lettering, colors, method of support and other factors prescribed in the MUTCD shall be adhered to.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Contractor shall erect barricades, barrier fences, traffic signs, and other traffic control devices as required by the MUTCD, or as required by the Engineer, to protect the work area from traffic, pedestrians, and animals.
- B. Contractor shall relocate barricades, signs and other devices as necessary as the work progresses.
- C. Unless extended protection is required for specific areas, when the work has been completed, all temporary warning and regulatory devices used by the Contractor shall be removed so that traffic can move unimpeded through the area.

END OF SECTION 10 14 00

SECTION 26 00 50

ELECTRICAL WORK - GENERAL PROVISIONS

PART 1 - GENERAL

1.1 WORK INCLUDED:

- A. The Contractor shall furnish all labor, materials, equipment and incidentals required to make ready for use the complete electrical systems as shown on the Drawings and as specified hereinafter.
- B. In conjunction with other sections of Division 26, the work shall include but not be limited to furnishing and installing the following:
 - 1. Electrical services
 - 2. Electrical raceway systems
 - 3. Wires and cables
 - 4. Panelboards
 - 5. Miscellaneous equipment
 - 6. Grounding systems
 - 7. Circuit breakers
- C. Make all necessary connections at "packaged" equipment furnished under other sections and Divisions of these specifications.
- D. Make all connections to equipment and devices furnished under Division 26 and other sections of these specifications except as otherwise specified.
- E. Connect process and instrumentation cables furnished with field-mounted equipment under other sections and Divisions of these specifications.
- F. Mount all motor control equipment enclosures not factory mounted, unless otherwise indicated.
- G. It is the intent of these specifications that the electrical system shall be suitable in every way for the service required. All material and all work which may be reasonably implied as being incidental to the work of this section shall be furnished at no extra cost to the Owner.

1.2 RELATED WORK:

- A. The Contractor's attention is directed to the General Conditions, Supplementary Conditions.

- B. Excavation and backfilling required for underground electrical work is included under Division 2.
- C. Concrete work and reinforcing for electrical equipment pads is included under Division 3.

1.3 CODES, INSPECTIONS, PERMITS AND FEES:

- A. All material and installations shall be in accordance with the latest edition of the Massachusetts Electrical Code (527 CMR 12.00) and all applicable local codes and ordinances.
- B. Obtain all necessary permits and pay all fees for permits and inspections.

1.4 INTERPRETATION OF DRAWINGS:

- A. The Drawings are not intended to show exact locations of conduit runs.
- B. Each three-phase circuit shall be run in a separate conduit unless otherwise shown on the Drawings.
- C. Unless otherwise noted and/or approved by the Engineer all conduits shall be installed concealed.
- D. Where circuits are shown as "home-runs" all necessary fittings and boxes shall be provided for a complete raceway installation.
- E. Any work installed contrary to or without review by the Engineer shall be subject to change as required by the Engineer, and no extra compensation will be allowed for making these changes.
- F. The locations of equipment, shown on the drawings are approximate only. Exact locations shall be as determined by the Engineer during construction. Obtain in the field all information relevant to the placing of electrical work and in case of any interference with other work, proceed as required by the Engineer and furnish all labor and materials necessary to complete the work in an acceptable manner.
- G. Circuit layouts are not intended to show the number of fittings, or other installation details. Furnish all labor and materials necessary to install and place in satisfactory operation all power, lighting and other electrical systems shown. Additional circuits shall be installed wherever needed to conform to the specific requirements of the equipment.

- H. All connections to equipment shall be made as required and in accordance with the approved shop and setting drawings.

1.5 SUBMITTALS:

In accordance with requirements of general specifications, submit the following:

- A. Complete shop drawings shall be submitted for but not limited to the following equipment: panelboards, fire alarm, service cabinets, load centers, conduit and wire.
- B. The manufacturer's name, product designation or catalog number, descriptive literature and data shall be submitted for the following material and equipment:
 - 1. Conduit
 - 2. Boxes and fittings
 - 3. Wires, cables and appurtenances
 - 4. Service cabinets
 - 5. Wiring devices and appurtenances
 - 6. Circuit breakers
 - 7. Panelboards
 - 8. Grounding Equipment
- C. Prior to submittal, all shop drawings shall be checked for accuracy and conformance to contract requirements. Shop drawings shall bear the date checked and shall be accompanied by a statement that the shop drawings have been examined for conformity to the specifications and drawings. This statement shall also list all discrepancies with the specifications and drawings. Shop drawings not so checked and noted shall be returned.
- D. The Engineer's review shall be only for conformance with the design concept of the project and compliance with the specifications and drawings. The responsibility of, and the necessity of, furnishing materials and workmanship required by the specifications and drawings which may not be indicated on the shop drawings is included under the work of this section.
- E. The responsibility for all dimensions to be confirmed and correlated at the job site and for coordination of this work with the work of all other trades is also included under the work of this section.

1.6 MANUFACTURER'S SERVICES:

Furnish manufacturer's services for testing and start-up when required.

1.7 ELECTRIC SERVICES:

- A. The electric utility serving this project is Eversource.
- B. Service to Cabinet will be as shown on the drawings.
- C. The electric utility will furnish and install the primary cables, transformer, and meter.
- D. Make all arrangements with the electric utility for obtaining services and pay all fees and charges by the electric utility for the service installation.
- E. All work and material for the service shall be in accordance with the requirements of the electric utility.

PART 2 - PRODUCTS

2.1 MATERIALS:

- A. The materials used in all systems shall be new, unused and as hereinafter specified. All materials, where not specified, shall be of the very best of their respective kinds. Samples of materials or manufacturer's specifications shall be submitted for review as required by the Engineer.
- B. Materials and equipment used shall be Underwriters' Laboratories, Inc. listed.
- C. Electrical equipment shall at all times during construction be adequately protected against mechanical injury or damage by water. Electrical equipment shall not be stored out-of- doors. Electrical equipment shall be stored in dry permanent shelters. If any apparatus has been damaged, such damage shall be repaired at no additional cost. If any apparatus has been subject to possible injury by water, it shall be thoroughly dried out and put through such special tests as required by the Engineer, or shall be replaced at no additional cost to the Owner.
- D. The Contractor's attention is directed to the requirements of the various sections of division 26 for additional product specifications.

2.2 MANUFACTURER'S NAMEPLATES:

- A. All equipment shall have the manufacturer's name, address, model or type designation, serial number and all applicable ratings clearly marked thereon in a location which can be readily observed after installation. The required information may be die-stamped into the surface of the equipment or may be marked on durable nameplates permanently fastened to the equipment.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Provide and place all sleeves for conduit penetrations through floors, walls, partitions, etc. Locate all necessary slots and inserts for electrical work and place in form before concrete is poured.
- B. Equipment shall be kept upright at all times. When equipment has to be tilted for ease of passage through restricted areas during transportation, the manufacturer shall be required to brace the equipment suitably, to insure that the tilting does not impair the functional integrity of the equipment.

3.2 RECORD DRAWINGS:

As the work progresses, legibly record (red line) all field changes on a set of project contract drawings. Prior to Substantial Completion of the project, submit the red lined prints to the Engineer for use in preparation of the record drawings.

3.3 TESTS AND ADJUSTMENTS:

- A. Test all systems furnished under Division 26, 27 and 28 and repair or replace all defective work. Make all necessary adjustments to the systems and equipment and instruct the Owner's personnel in the proper operation of the systems and equipment.

END OF SECTION

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Copper building wire rated 600 V or less.
 - 2. Metal-clad cable, Type MC, rated 600 V or less.
 - 3. Connectors, splices, and terminations rated 600 V and less.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 COPPER WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Alpha Wire Company.
 - 2. American Bare Conductor.
 - 3. Belden Inc.
 - 4. Okonite Company (The).

5. Southwire Company.
- C. Standards:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 2. RoHS compliant.
 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
- E. Conductor Insulation:
1. Type RHH and Type RHW-2: Comply with UL 44.
 2. Type THHN and Type THWN-2: Comply with UL 83.
 3. Type XHHW-2: Comply with UL 44.

2.2 METAL-CLAD CABLE, TYPE MC

- A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Alpha Wire Company.
 2. Belden Inc.
 3. Okonite Company (The).
 4. Southwire Company.
- C. Standards:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 2. Comply with UL 1569.
 3. RoHS compliant.
 4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Circuits:
1. Single circuit.

- E. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
- F. Ground Conductor: Bare.
- G. Conductor Insulation:
 - 1. Type THHN/THWN-2: Comply with UL 83.
 - 2. Type XHHW-2: Comply with UL 44.
- H. Armor: Steel, interlocked.
- I. Jacket: PVC applied over armor.

2.3 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. 3M Electrical Products.
 - 2. AFC Cable Systems; a part of Atkore International.
 - 3. Hubbell Power Systems, Inc.
 - 4. O-Z/Gedney; a brand of Emerson Industrial Automation.
 - 5. Thomas & Betts Corporation; A Member of the ABB Group.
- C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.
- D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
 - 1. Material: Copper.
 - 2. Type: One hole with standard barrels.
 - 3. Termination: Compression.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type XHHW-2, single conductors in raceway.
- B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.
- C. Feeders Concealed in Concrete and Underground: Type THHN/THWN-2, single conductors in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Complete raceway installation between conductor and cable termination points according to Section 26 05 33 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than un-spliced conductors.

- C. Wiring at Outlets: Install conductor at each outlet, with at least 12-inches of slack.

3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 26 05 53 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes grounding and bonding systems and equipment.
- B. Section includes grounding and bonding systems and equipment, plus the following special applications:
 - 1. Underground distribution grounding.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article.
- B. Qualification Data: For testing agency and testing agency's field supervisor.
- C. Field quality-control reports

1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.
 - 1. Plans showing as-built, dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:
 - a. Ground rods.
 - b. Grounding arrangements and connections for separately derived systems.

2. Instructions for periodic testing and inspection of grounding features at grounding connections for separately derived systems based on NETA MTS.
 - a. Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
 - b. Include recommended testing intervals.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Certified by NETA.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Burndy; Part of Hubbell Electrical Systems.
 2. ERICO International Corporation.
 3. Harger Lightning & Grounding.
 4. O-Z/Gedney; a brand of Emerson Industrial Automation.
 5. SIEMENS Industry, Inc.; Energy Management Division.
 6. Thomas & Betts Corporation; A Member of the ABB Group.

2.3 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 1. Solid Conductors: ASTM B 3.

2. Stranded Conductors: ASTM B 8.
 3. Tinned Conductors: ASTM B 33.
 4. Bonding Cable: 28 kc mil, 14 strands of No. 17 AWG conductor, 1/4-inch in diameter.
 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/-inches wide and 1/16-inch thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4-inches in cross section, with 9/32-inchholes spaced 1-1/8-inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.4 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- C. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
- D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.
- E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- F. Conduit Hubs: Mechanical type, terminal with threaded hub.
- G. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- H. Service Post Connectors: Mechanical type, bronze alloy terminal, in short- and long-stud lengths, capable of single and double conductor connections.
- I. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.
- J. Straps: Solid copper, copper lugs. Rated for 600 A.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor.
 - 1. Bury at least 24-inches below grade.
- C. Grounding Bus: Install in electrical cabinet.
 - 1. Install bus horizontally, on insulated spacers 2-inches minimum from wall, 6-inches above finished floor unless otherwise indicated.
 - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.
- D. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except as otherwise indicated.

3.2 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1. Feeders and branch circuits.
 - 2. Lighting circuits.
 - 3. Receptacle circuits.
 - 4. Flexible raceway runs.

3.4 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
 - 1. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections with the assistance of a factory-authorized service representative.
- B. Tests and Inspections:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 - 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 - 3. Test completed grounding system at service disconnect enclosure grounding terminal. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
 - 4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- C. Grounding system will be considered defective if it does not pass tests and inspections.

- D. Prepare test and inspection reports.
- E. Report measured ground resistances that exceed the following values:
 - 1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10ohms.
- F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

END OF SECTION

SECTION 26 05 33

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetal wireways and auxiliary gutters.
5. Surface raceways.
6. Boxes, enclosures, and cabinets.
7. Handholes and boxes for exterior underground cabling.

B. Related Requirements:

1. Section 27 15 13 "Communications copper horizontal cabling" for conduits, surface pathways, inner duct, boxes, and faceplate adapters serving electronic safety and security.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

A. Metal Conduit:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. AFC Cable Systems; a part of Atkore International.
 - b. Allied Tube & Conduit; a part of Atkore International.
 - c. Anamet Electrical, Inc.
 - d. Opti-Com Manufacturing Network, Inc (OMNI).
 - e. O-Z/Gedney; a brand of Emerson Industrial Automation.
 2. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 3. GRC: Comply with ANSI C80.1 and UL 6.
 4. ARC: Comply with ANSI C80.5 and UL 6A.
 5. IMC: Comply with ANSI C80.6 and UL 1242.
 6. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
 - a. Comply with NEMA RN 1.
 - b. Coating Thickness: 0.040-inch, minimum.
 7. EMT: Comply with ANSI C80.3 and UL 797.
 8. FMC: Comply with UL 1; zinc-coated steel or aluminum.
 9. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- B. Metal Fittings: Comply with NEMA FB 1 and UL 514B.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. AFC Cable Systems; a part of Atkore International.
 - b. Allied Tube & Conduit; a part of Atkore International.
 - c. Anamet Electrical, Inc.
 - d. FSR Inc.
 - e. O-Z/Gedney; a brand of Emerson Industrial Automation.
 2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 3. Fittings, General: Listed and labeled for type of conduit, location, and use.
 4. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
 5. Fittings for EMT:
 - a. Material: Steel.

- b. Type: Setscrew.
 - 6. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
 - 7. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040-inch, with overlapping sleeves protecting threaded joints.
- C. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS AND FITTINGS

A. Nonmetallic Conduit:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. AFC Cable Systems; a part of Atkore International.
 - b. Anamet Electrical, Inc.
 - c. FRE Composites.
 - d. RACO; Hubbell.
 - e. Thomas & Betts Corporation; A Member of the ABB Group.

B. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- 1. ENT: Comply with NEMA TC 13 and UL 1653.
- 2. RNC: Type EPC-40-PVC, or type EPC-80-PVC as noted complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- 3. LFNC: Comply with UL 1660.

C. Nonmetallic Fittings:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. AFC Cable Systems; a part of Atkore International.
 - b. Anamet Electrical, Inc.
 - c. Arnco Corporation.
 - d. FRE Composites.
 - e. RACO; Hubbell.

2. Fittings, General: Listed and labeled for type of conduit, location, and use.
3. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
4. Fittings for LFNC: Comply with UL 514B.
5. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 1. B-line, an Eaton business.
 2. Hoffman; a brand of Pentair Equipment Protection.
 3. MonoSystems, Inc.
 4. Square D.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.
 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

2.4 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 1. Crouse-Hinds, an Eaton business.
 2. Erickson Electrical Equipment Company.
 3. Hoffman; a brand of Pentair Equipment Protection.
 4. Hubbell Incorporated.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

D. Cabinets:

1. NEMA 250, Type 1 or Type 3R galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.5 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Armorcast Products Company.
 - b. NewBasis.
 - c. Oldcastle Enclosure Solutions.
 - d. Oldcastle Precast, Inc.
 - e. Quazite: Hubbell Power Systems, Inc.
2. Standard: Comply with SCTE 77.
3. Configuration: Designed for flush burial with closed bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "ELECTRIC." or per appropriate system.
7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

- C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of hot-dip galvanized-steel diamond plate.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Armorcast Products Company.
 - b. NewBasis.
 - c. Nordic Fiberglass, Inc.
 - d. Oldcastle Precast, Inc.
 - e. Quazite: Hubbell Power Systems, Inc.
 2. Standard: Comply with SCTE 77.
 3. Configuration: Designed for flush burial with closed bottom unless otherwise indicated.
 4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
 5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 6. Cover Legend: Molded lettering, "ELECTRIC." or per appropriate system.
 7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed Conduit: GRC.
 2. Concealed Conduit, Aboveground: GRC.
 3. Underground Concrete Encased Conduit: RNC, Type EPC-40-PVC.
 4. Underground Direct Buried Conduit: RNC, Type EPC-80-PVC.
 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Minimum Raceway Size: 1/2-inch trade size.
- C. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting

manufacturer and apply in thickness and number of coats recommended by manufacturer.

3. EMT: Use setscrew, steel fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

- D. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- E. Install surface raceways only where indicated on Drawings.
- F. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- C. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12-inches of changes in direction.
- D. Support conduit within 12-inches of enclosures to which attached.
- E. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- F. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- G. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- H. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- I. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12-inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

J. Surface Raceways:

1. Install surface raceway with a minimum 2-inch radius control at bend points.

K. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces.

L. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Where otherwise required by NFPA 70.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 31 20 00 "Earth Moving" for pipe less than 6-inches in nominal diameter.
2. Install backfill as specified in Section 31 20 00 "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12-inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 31 20 00 "Earth Moving."
4. Install manufactured duct elbows for stub-up at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3-inches of concrete for a minimum of 12-inches on each side of the coupling.
 - b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60-inches from edge of equipment base. Install insulated grounding bushings on terminations at equipment.

6. Underground Warning Tape: Comply with requirements in Section 26 05 53 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1-inch above finished grade.
- D. Install handholes with bottom below frost line.
- E. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1. RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

2. SUMMARY

A. Section Includes:

- 1. Color and legend requirements for raceways, conductors, and warning labels and signs.
- 2. Labels.
- 3. Bands and tubes.
- 4. Tapes and stencils.
- 5. Tags.
- 6. Signs.
- 7. Cable ties.
- 8. Paint for identification.
- 9. Fasteners for labels and signs.

3. ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

1. PERFORMANCE REQUIREMENTS

- A. Comply with ASME A13.1.
- B. Comply with NFPA 70.
- C. Comply with ANSI Z535.4 for safety signs and labels.

- D. Comply with NFPA 70E requirements for arc-flash warning labels.
 - E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
2. COLOR AND LEGEND REQUIREMENTS
- A. Raceways and Cables Carrying Circuits at 600 V or Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage.
 - B. Color-Coding for Phase-Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit] conductors.
 - 1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
 - 2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - 3. Colors for 480/277-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 - 4. Color for Neutral: White or gray.
 - 5. Color for Equipment Grounds: Green.
 - C. Warning Label Colors:
 - 1. Identify system voltage with black letters on an orange background.
 - D. Warning labels and signs shall include, but are not limited to, the following legends:
 - 1. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36-INCHES."
 - E. Equipment Identification Labels:
 - 1. Black letters on a white field.

3. LABELS

- A. Self-Adhesive Labels: Polyester or Vinyl, thermal, transfer-printed, 3-mil-thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Brady Corporation.
 - b. Brother International Corporation.
 - c. Ideal Industries, Inc.
 - d. Panduit Corp.
 - 2. Minimum Nominal Size:
 - a. 1-1/2 by 6-inches for raceway and conductors.
 - b. 3-1/2 by 5-inches for equipment.
 - c. As required by authorities having jurisdiction.

4. TAPES AND STENCILS

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Champion America.
 - b. Ideal Industries, Inc.
 - c. Panduit Corp.
- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2-inches wide; compounded for outdoor use.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Brady Corporation.
 - b. emedco.
 - c. Marking Services, Inc.
- C. Underground-Line Warning Tape:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Brady Corporation.
 - b. Ideal Industries, Inc.
 - c. Marking Services, Inc.
2. Tape:
 - a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
 - b. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
3. Color and Printing:
 - a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
 - b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
 - c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".

5. SIGNS

A. Laminated Acrylic or Melamine Plastic Signs:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Brady Corporation.
 - b. Carlton Industries, LP.
 - c. emedco.
2. Engraved legend.
3. Thickness:
 - a. For signs up to 20 sq. in., minimum 1/16-inch thick.

- b. For signs larger than 20 sq. in., 1/8-inch thick.
- c. Engraved legend with black letters on white face.
- d. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

6. CABLE TIES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. HellermannTyton.
 - 2. Ideal Industries, Inc.
 - 3. Marking Services, Inc.
 - 4. Panduit Corp.
- B. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
 - 1. Minimum Width: 3/16-inch.
 - 2. Tensile Strength at 73 Deg F according to ASTM D 638: 12,000 psi.
 - 3. Temperature Range: Minus 40 to plus 185 deg F.
 - 4. Color: Black, except where used for color-coding.

7. MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

PART 3 - EXECUTION

1. INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Verify identity of each item before installing identification products.

- C. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
 - D. Apply identification devices to surfaces that require finish after completing finish work.
 - E. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
 - F. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.
 - G. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.
 - H. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.
 - I. Underground Line Warning Tape:
 - 1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8-inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches overall.
 - 2. Install underground-line warning tape for direct-buried cables and cables in raceways.
 - J. Laminated Acrylic or Melamine Plastic Signs:
 - 1. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
 - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on minimum 1-1/2-inch-high sign; where two lines of text are required, use signs minimum 2-inches high.
 - K. Cable Ties: General purpose, for attaching tags, except as listed below:
 - 1. Outdoors: UV-stabilized nylon.
 - 2. In Spaces Handling Environmental Air: Plenum rated.
2. IDENTIFICATION SCHEDULE
- A. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.

- B. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.
- C. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive equipment labels.
 - 1. Apply to exterior of door, cover, or other access.
 - 2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
 - a. Controls with external control power connections.
- D. Arc Flash Warning Labeling: Self-adhesive labels.
- E. Operating Instruction Signs: Laminated acrylic or melamine plastic signs.
- F. Equipment Identification Labels:
 - 1. Indoor Equipment: Laminated acrylic or melamine plastic sign.
 - 2. Outdoor Equipment: Laminated acrylic or melamine sign.

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS

- A. MCCB: Molded-case circuit breaker.
- B. SPD: Surge protective device.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details.
 - 2. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Include evidence of NRTL listing for SPD as installed in panelboard.
 - 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 7. Include wiring diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Panelboard schedules for installation in panelboards.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.7 FIELD CONDITIONS

- A. Service Conditions: NEMA PB 1, usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.
 - 2. Altitude not exceeding 6600 feet.

1.8 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.
 - 1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS COMMON REQUIREMENTS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA PB 1.
- D. Comply with NFPA 70.
- E. Enclosures: Flush and Surface -mounted, dead-front cabinets.
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.

- b. Outdoor Locations: NEMA 250, Type 3R.
 - c. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 - 2. Height: 84-inches maximum.
 - 3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
 - 4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
- F. Incoming Mains Location: Top or Bottom.
 - G. Phase, Neutral, and Ground Buses: Hard-drawn copper, 98 percent conductivity.
 - H. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
 - 3. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
 - I. Future Devices: Panelboards shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
 - J. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
- B. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 2.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Eaton.
 - 2. General Electric Company; GE Energy Management - Electrical Distribution.
 - 3. SIEMENS Industry, Inc.; Energy Management Division.
 - 4. Square D; by Schneider Electric.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker.
- D. Branch Overcurrent Protective Devices: Plug-in or Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Eaton.
 - 2. General Electric Company; GE Energy Management - Electrical Distribution.
 - 3. SIEMENS Industry, Inc.; Energy Management Division.
 - 4. Square D; by Schneider Electric.
- B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers:
 - a. Inverse time-current element for low-level overloads.
 - b. Instantaneous magnetic trip element for short circuits.
 - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2.5 IDENTIFICATION

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.
- B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.
- C. Circuit Directory: Directory card inside panelboard door, mounted in metal frame with transparent protective cover.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Install panelboards and accessories according to NECA 407.
- C. Mount top of trim 90-inches above finished floor unless otherwise indicated.
- D. Mount panelboard cabinet plumb and rigid without distortion of box.
- E. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
- F. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
- G. Install filler plates in unused spaces.
- H. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 26 05 53 "Identification for Electrical Systems."

- B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
- E. Install warning signs complying with requirements in Section 26 05 53 "Identification for Electrical Systems" identifying source of remote circuit.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Panelboards will be considered defective if they do not pass tests and inspections.

END OF SECTION

SECTION 26 27 13

ELECTRICITY METERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes electricity metering.

1.3 DEFINITIONS

- A. KY or KYZ Pulse: Term used by the metering industry to describe a method of measuring consumption of electricity (kWh) that is based on a relay opening and closing in response to the rotation of the disk in the meter. Electronic meters generate pulses electronically.

1.4 ACTION SUBMITTALS

- A. Product Data:
 - 1. For each type of meter.
 - 2. For metering infrastructure components.
 - 3. For metering software.
- B. Shop Drawings: For electricity-metering equipment.
 - 1. Include elevation views of front panels of control and indicating devices and control stations.
 - 2. Include diagrams for power, signal, and control wiring.
 - 3. Wire Termination Diagrams and Schedules: Include diagrams for power, signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features. Differentiate between manufacturer-installed and field-installed wiring.
 - 4. Include series-combination rating data for modular meter centers with main disconnect device.
 - 5. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data

communication paths and identify networks, data buses, data gateways, concentrators, and other devices used. Describe characteristics of network and other data communication lines.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Submit evidence that meters are compatible and conform to Eversource requirements
- B. Qualification Data: For testing agency.
- C. Field quality-control reports.
- D. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1. Application and operating software documentation.
 - 2. Software licenses.
 - 3. Software service agreement.
 - 4. Device address list.
 - 5. Hard copies of manufacturer's operating specifications, user's guides for software and hardware, and PDF files on a USB storage device of hard-copy Submittal.
 - 6. Meter data sheet for each meter, listing nameplate data and serial number, accuracy certification, and test results.
 - 7. Meter installation and billing software startup report.

1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An NRTL.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of metering equipment that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Damage from transient voltage surges.
 - 2. Warranty Period: Cost to repair or replace any parts for 1 year from date of Substantial Completion.

3. Extended Warranty Period: Cost of replacement parts (materials only, f.o.b. the nearest shipping point to Project site), for eight years, that failed in service due to transient voltage surges.

1.9 COORDINATION

A. Electrical Service Connections:

1. Coordinate with utility companies and utility-furnished components.
 - a. Comply with requirements of utility providing electrical power services.
 - b. Coordinate installation and connection of utilities and services, including provision for electricity-metering components.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 916.

2.2 UTILITY METERING INFRASTRUCTURE

- A. Install metering accessories furnished by the utility company, complying with its requirements.
- B. Utility-Furnished Meters: Connect data transmission facility of metering equipment installed by the Utility.
 1. Data Transmission: Transmit pulse data over control-circuit conductors, classified as Class 1 per NFPA 70, Article 725. Comply with Section 260523 "Control-Voltage Electrical Power Cables."
- C. Current-Transformer Cabinets: Comply with requirements of electrical-power utility company.
- D. Meter Sockets:
 1. Comply with requirements of electrical-power utility company.
 2. Meter Sockets: Steady-state and short-circuit current ratings shall meet indicated circuit ratings.
- E. Arc-Flash Warning Labels;
 1. Labels: Comply with requirements for "Self-Adhesive Equipment Labels" and "Signs" in Section 260553 "Identification for Electrical Systems." Apply a 3-1/2-by-5-inch thermal

transfer label of high-adhesion polyester for each work location included in the analysis. Labels shall be machine printed, with no field-applied markings.

- a. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
 - 1) Location designation.
 - 2) Nominal voltage.
 - 3) Flash protection boundary.
 - 4) Hazard risk category.
 - 5) Incident energy.
 - 6) Working distance.
 - 7) Engineering report number, revision number, and issue date.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with equipment installation requirements in NECA 1.
- B. Install meters furnished by utility company. Install raceways and equipment according to utility company's written instructions. Provide empty conduits for metering leads and extend grounding connections as required by utility company.
- C. Install arc-flash labels as required by NFPA 70.
- D. Wiring Method:
 1. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.2 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
 1. Series Combination Warning Label: Self-adhesive labels, with text as required by NFPA 70.
 2. Equipment Identification Labels: Self-adhesive labels with clear protective overlay. For residential meters, provide an additional card holder suitable for printed, weather-resistant card with occupant's name.

3.3 FIELD QUALITY CONTROL

- A. Testing: By Contractor.
- B. Perform tests and inspections with the assistance of a factory-authorized service representative.
- C. Prepare test and inspection reports.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Straight-blade convenience receptacles.
 - 2. GFCI receptacles.
 - 3. Toggle switches.
 - 4. Wall plates.

1.3 DEFINITIONS

- A. Abbreviations of Manufacturers' Names:
 - 1. Cooper: Copper Wiring Devices; Division of Cooper Industries, Inc.
 - 2. Hubbell: Hubbell Incorporated: Wiring Devices-Kellems.
 - 3. Leviton: Leviton Mfg. Company, Inc.
 - 4. Pass & Seymour: Pass& Seymour/Legrand.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: List of legends and description of materials and process used for pre-marking wall plates.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 GFCI RECEPTACLES

- A. General Description:
 - 1. 125 V, 20 A, straight blade, feed-through type.
 - 2. Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, UL 943 Class A, and FS W-C-596.
 - 3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.
- B. Duplex GFCI Convenience Receptacles:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Eaton (Arrow Hart).
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).

2.3 TOGGLE SWITCHES

- A. Comply with NEMA WD 1, UL 20, and FS W-S-896.
- B. Switches, 120/277 V, 20 A:

1. Single Pole:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1) Eaton (Arrow Hart).
 - 2) Hubbell Incorporated; Wiring Device-Kellems.
 - 3) Leviton Manufacturing Co., Inc.
 - 4) Pass & Seymour/Legrand (Pass & Seymour).

2.4 WALL PLATES

- A. Single and combination types shall match corresponding wiring devices.
 1. Plate-Securing Screws: Metal with head color to match plate finish.
 2. Material for Finished Spaces: High-impact thermoplastic in finished spaces.
 3. Material for Unfinished Spaces: Galvanized steel.
 4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

2.5 FINISHES

- A. Device Color:
 1. Wiring Devices Connected to Normal Power System: As required by NFPA 70 or device listing.
- B. Wall Plate Color: For plastic covers, match device color.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
- C. Device Installation:
1. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
 2. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
 3. Connect devices to branch circuits using pigtails that are not less than 6-inches in length.
 4. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
 5. Use a torque screwdriver when a torque is recommended or required by manufacturer.
 6. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
 7. Tighten unused terminal screws on the device.
 8. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.
- D. Receptacle Orientation:
1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.
- E. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- F. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.
- G. GFCI Receptacles: Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.2 FIELD QUALITY CONTROL

- A. Test Instruments: Use instruments that comply with UL 1436.

- B. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- C. Perform the following tests and inspections:
 - 1. Tests for Convenience Receptacles:
 - a. Line Voltage: Acceptable range is 105 to 132 V.
 - b. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 - c. Using the test plug, verify that the device and its outlet box are securely mounted.
 - d. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- D. Wiring device will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION

SECTION 26 56 68
SPORTS LIGHTING

PART 1 – GENERAL

1.1 SUMMARY

- A. Work covered by this section of the specifications shall conform to the contract documents, engineering plans as well as state and local codes.
- B. The purpose of these specifications is to define the lighting system performance and design standards for Portsmouth. The manufacturer/contractor shall supply a lighting system using an HID (metal halide) light source to meet or exceed the standards set forth in these specifications.
- C. The sports lighting will be for the following fields:
 - 1. Rectangular Field
- D. The primary goals of this sports lighting project are:
 - 1. Guaranteed Light Levels: Selection of appropriate light levels impact the safety of the players and the enjoyment of spectators. Therefore light levels are guaranteed to not drop below specified target values for a period of 25 years.
 - 2. Life-cycle Cost: In order to reduce the operating budget, the preferred lighting system shall be energy efficient and cost effective to operate. All maintenance costs shall be eliminated for the duration of the warranty.
 - 3. Control and Monitoring: To allow for optimized use of labor resources and avoid unneeded operation of the facility, customer requires a remote on/off control system for the lighting system. Fields should be proactively monitored to detect luminaire outages over a 25-year life cycle. All communication and monitoring costs for 25-year period shall be included in the bid.
 - 4. Environmental Light Control: It is the primary goal of this project to minimize spill light to adjoining properties and glare to the players, spectators and neighbors.

1.2 LIGHTING PERFORMANCE

- A. Performance Requirements: Playing surfaces shall be lit to an average target illumination level and uniformity as specified in the chart below. Lighting calculations shall be developed and field measurements taken on the grid spacing with the minimum number of grid points specified below. Average illumination level shall be measured in accordance with the IESNA LM-5-04 (IESNA Guide for Photometric Measurements of Area and Sports Lighting Installations). Illumination levels shall not to drop below desired target values in accordance to IES RP-6-15, Page 2, Maintained Average Illuminance and shall be guaranteed for the full warranty period. Hours of usage shall comply with the following:

Area of Lighting	Annual Usage Hours	25 Year Usage Hours
Rectangular Field	300	7,500

- B. Mounting Heights: To ensure proper aiming angles for reduced glare and to provide better playability, minimum mounting heights shall be as described below. Higher mounting

heights may be required based on photometric report and ability to ensure the top of the field angle is a minimum of 10 degrees below horizontal.

# of Poles	Pole Designation	Pole Height
4	F1 – F4	70'

C. Lighting Methodology: There are two methods that will be considered for calculation of the lighting designs for this project. The approved Lighting Method #1 (Musco), automated timed power adjustments, as described in C.1 utilizes methodology that adjusts light levels through a series of programmed adjustments. The alternate Lighting Method #2 (Non-Musco), continuous depreciating light, as described in C.2 uses continuous lamp lumen depreciation which is recovered by relamping and cleaning lenses of the luminaires. Computer models shall reflect initial design lumens, end of life design lumens, recoverable light loss factor (RLLF of .69), and the Coefficient Utilization (CU) for the design. Both methods must be at or above target illumination levels throughout the 25 years of the contract/warranty provided by the manufacturer. A +/- 10% design/testing allowance is not permitted in the design logic.

1. (Base-Bid) Lighting Method #1: Automated Timed Power Adjustments (Musco):

- a. Approved Musco’s Green Generation Lighting® sports lighting system shall use automated timed power adjustments to achieve a lumen maintenance control strategy as described in the IESNA Lighting Handbook 10th Edition, Lighting Controls Section page 16-8: "Lumen maintenance involves adjusting lamp output over time to maintain constant light output as lamps age and dirt accumulation reduces luminaire output. With lumen maintenance control, either lamps are dimmed when new, or the lamp's current is increased as the system ages."
- b. Manufacturers, not pre-approved, bidding an automated timed power adjustment system must provide an independent test report certifying the system meets the lumen maintenance control strategy above and verifying the field performance of the system for the duration of the useful life of the lamp based on lamp replacement hours. Report shall be signed by a licensed professional engineer with outdoor lighting experience. If report is not provided at least 10 days prior to bid opening, the manufacturer shall provide the initial and maintained designs called for in this specification under Lighting Method #2: Alternate Manufacturers, section 1.2.C.2.
- c. Project References: Non-approved manufacturers bidding any form of Automated Timed Power Adjustment light system must provide a minimum of five (5) project references within the state of New Hampshire that have been completed within the last 12 months utilizing this exact technology. Manufacturer will include project name, project city, and if requested, contact name and contact phone number for each reference.

Area of Lighting	Average Target Illumination Levels	Maximum to Minimum Uniformity Ratio	Grid Points	Grid Spacing
Rectangular Field	50 FC	1.5:1.0	84	30 X 30

2. (Base-Bid) Lighting Method #2 – Continuous Depreciating Light (Non-Musco):

- a. The manufacturer bidding Lighting Method #2 must provide a complete submittal package for approval as outlined in Submittal Information at the end of this section at least 10 days prior to bid.
- b. The lighting system shall use continuous lamp lumen depreciation which is recovered by relamping and cleaning lenses of the luminaires. Manufacturer shall provide computer models for initial illumination level and target illumination levels on the field over 25 years. The specified maximum Recoverable Light Loss Factor (RLLF) .65 and maintenance/group relamping schedule shall be provided in accordance with recommendations in the Leukos Abstract Volume 6, Number 3, January 2010, page 183-201: “Light Loss Factors for Sports Lighting”, and presented at the 2009 IESNA Annual Conference

1500 Watt Metal Halide Luminaire
RLLF Requirements

Lamp Replacement Interval (hours)	Recoverable Light Loss Factor (RLLF)
3,000	.65

- c. Independent Test Report: If lamp replacement interval is greater than 3,000 hours for 1500 watt lamps, manufacturer shall supply an independent test report with lumen depreciation over proposed lamp life, initial lumens, and end of life lumens.
- d. Based on anticipated hours of usage listed below, Method #2 systems would require the following minimum group lamp replacements over the 25 years.

Area of Lighting	25 Year Usage Hours	25 Year Group Relamps Required
Rectangular Field	7,500	2

Area of Lighting	Average Initial Illumination Levels	Average Target Illumination Levels	Maximum to Minimum Uniformity Ratio	Grid Points	Grid Spacing
Rect. Field	76.92 FC	50 FC	1.5:1.0	84	30 X 30

- e. Revised Electrical Distribution: Manufacturer shall provide revised electrical distribution plans to include changes to service entrance, panel, and wire sizing if increased power is required which exceeds specified design loads.
- f.

1.3 ENVIRONMENTAL LIGHT CONTROL

- A. Light Control Luminaires: All luminaires shall utilize spill light and glare control devices including, but not limited to, internal shields, louvers and external shields. No symmetrical beam patterns are accepted.
- B. Spill Light and Glare Control: To minimize impact on adjacent properties, spill light and candela values must not exceed the following.

150' from playing surface	Average	Maximum
Property Line Maximum Vertical Footcandles	5 fc	10 fc
Property Line Horizontal Footcandles	5 fc	10 fc
Property Line Max Candela	28,000 Cd	40,000 Cd

- C. Spill Scans: Spill scans must be submitted indicating the amount of horizontal and vertical footcandles along the specified lines. Light levels shall be taken at 30-foot intervals along the boundary line. Readings shall be taken with the meter orientation at both horizontal and aimed towards the most intense bank of lights. Illumination level shall be measured in accordance with the IESNA LM-5-04 at the first 100 hours of operation.
- D. The first page of a photometric report for all luminaire types proposed showing horizontal and vertical axial candle power shall be provided to demonstrate the capability of achieving the specified performance. Reports shall be certified by a qualified independent testing laboratory with a minimum of five years experience or by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products. A summary of the horizontal and vertical aiming angles for each luminaire shall be included with the photometric report.

1.4 LIFE CYCLE COSTS

- A. Manufacturer shall submit 25-year life cycle cost calculation as outlined in the required submittal information.

Lamp replacement schedule per charts below:

Lighting Method 1 Lamp Replacement	Lighting Method 2 Lamp Replacement
5,000 hour intervals	3,000 hour intervals

- B. Preventative and Spot Maintenance: Manufacturer shall provide all preventative and spot maintenance, including parts and labor for 25 years from the date of equipment shipment. Individual outages shall be repaired when the usage of any field is materially impacted. Owner agrees to check fuses in the event of a luminaire outage.

PART 2 – PRODUCT

2.1 SPORTS LIGHTING SYSTEM CONSTRUCTION

- A. Manufacturing Requirements: All components shall be designed and manufactured as a system. All luminaires, wire harnesses, ballast and other enclosures shall be factory assembled, aimed, wired and tested.
- B. Durability: All exposed components shall be constructed of corrosion resistant material and/or coated to help prevent corrosion. All exposed carbon steel shall be hot dip galvanized per ASTM A123. All exposed aluminum shall be powder coated with high performance polyester or anodized. All exterior reflective inserts shall be anodized, coated, and protected from direct environmental exposure to prevent reflective degradation or corrosion. All

exposed hardware and fasteners shall be stainless steel of 18-8 grade or better, passivated and coated with aluminum-based thermosetting epoxy resin for protection against corrosion and stress corrosion cracking. Structural fasteners may be carbon steel and galvanized meeting ASTM A153 and ISO/EN 1461 (for hot dipped galvanizing), or ASTM B695 (for mechanical galvanizing). All wiring shall be enclosed within the cross-arms, pole, or electrical components enclosure.

C. System Description: Lighting system shall consist of the following:

1. Galvanized steel poles and cross-arm assemblies.
2. Non-approved pole technology:
 - a. Square static cast concrete poles will not be accepted.
 - b. Direct bury steel poles which utilize the extended portion of the steel shaft for their foundation will not be accepted due to potential for internal and external corrosive reaction to the soils and long term performance concerns.
3. Pre-stressed concrete base embedded in concrete backfill allowed to cure for 12-24 hours before pole stress is applied. Alternate may be an anchor bolt foundation designed such that the steel pole and any exposed steel portion of the foundation is located a minimum of 18 inches above final grade. The concrete for anchor bolt foundations shall be allowed to cure for a minimum of 28 days before the pole stress is applied unless shorter cure time approved by structural engineer of record.
4. All luminaires shall be constructed with a die-cast aluminum housing or external hail shroud to protect the luminaire reflector system.
5. Manufacturer will remote all ballasts and supporting electrical equipment in aluminum enclosures mounted approximately 10 feet above grade. The enclosures shall be touch-safe and include ballast, capacitor and fusing with indicator lights on fuses to notify when a fuse is to be replaced for each luminaire. Disconnect per circuit for each pole structure will be located in the enclosure. Integral ballast fixtures will not be accepted.
6. Wire harness complete with an abrasion protection sleeve, strain relief and plug-in connections for fast, trouble-free installation.
7. All luminaires, visors, and cross-arm assemblies shall withstand 150 mph winds and maintain luminaire aiming alignment
8. Control cabinet to provide remote on-off control and monitoring of the lighting system. Cabinet shall be constructed of aluminum and be rated NEMA Type 4. Communication method shall be provided by manufacturer. Cabinet shall contain custom configured contactor modules for 30, 60, and 100 amps, labeled to match field diagrams and electrical design. Manual off-on-auto selector switches shall be provided.
9. Lightning Protection: Manufacturer shall provide integrated lightning grounding via concrete encased electrode grounding system as defined by NFPA 780 and be UL Listed per UL 96 and UL 96A. If grounding is not integrated into the structure, the manufacturer shall supply grounding electrodes, copper down conductors, and exothermic weld kits. Electrodes and conductors shall be sized as required by NFPA 780. The grounding electrode shall be minimum size of 5/8 inch diameter and 8 feet long, with a minimum of 10 feet embedment. Grounding electrode shall be connected to the structure by a grounding electrode conductor with a minimum size of 2 AWG for poles with 75 feet mounting height or less, and 2/0 AWG for poles with more than 75 feet mounting height.

10. Enhanced corrosion protection package: Due to the potentially corrosive environment for this project, manufacturers must provide documentation that their products meet the following enhanced requirements in addition to the standard durability protection specified above:

- a) Exposed carbon steel horizontal surfaces on the crossarm assembly shall be galvanized to no less than a five (5) mil average thickness.
- b) Exposed die cast aluminum components shall be Type II anodized per MIL-STD-8625 and coated with high performance polyester.
- c) Exposed extruded aluminum components shall be Type II anodized per MIL-STD-8625 and coated with high performance polyester.

D. Safety: All system components shall be UL listed for the appropriate application.

2.2 ELECTRICAL

A. Electric Power Requirements for the Sports Lighting Equipment:

- 1. Electric power: 480 Volt, 3 Phase
- 2. Maximum total voltage drop: Voltage drop to the disconnect switch located on the poles shall not exceed three (3) percent of the rated voltage.

B. Energy Consumption: The average kW consumption for the field lighting system shall be 68.82 kW. The max kW consumption for the field lighting system shall be 74.8 kW.

C. Revised Electrical Distribution: Manufacturer shall provide, at their cost, revised electrical distribution plans to include changes to service entrance, panel, and wire sizing if using Lighting Method 2.

2.3 STRUCTURAL PARAMETERS

A. Wind Loads: Wind loads shall be based on the 2009 International Building Code. Wind loads to be calculated using ASCE 7-05, a design wind speed of 100, exposure category C and wind importance factor of II.

B. Pole Structural Design: The stress analysis and safety factor of the poles shall conform to 2009 AASHTO Standard Specification for Structural Supports for Highway Signs, Luminaires, and Traffic Signals (LTS-5).

C. Foundation Design: The foundation design shall be based on soil parameters as outlined in the geotechnical report. Weston & Sampson, Project No. 2160648, January 3rd, 2017.

D. Foundation Drawings: Project specific foundation drawings stamped by a registered engineer in the state where the project is located are required. The foundation drawings must list the moment, shear (horizontal) force, and axial (vertical) force at ground level for each pole. These drawings must be submitted at time of bid to allow for accurate pricing.

2.4 CONTROL SYSTEM

A. Remote Lighting Control System: System shall allow owner and users with a security code to schedule on/off system operation via a web site, phone, fax or email up to ten years in advance. Manufacturer shall provide and maintain a two-way TCP/IP communication link. Trained staff shall be available 24/7 to provide scheduling support and assist with reporting needs.

The owner may assign various security levels to schedulers by function and/or fields. This function must be flexible to allow a range of privileges such as full scheduling capabilities for all fields to only having permission to execute “early off” commands by phone. Scheduling tool shall be capable of setting curfew limits.

Controller shall accept and store 7-day schedules, be protected against memory loss during power outages, and shall reboot once power is regained and execute any commands that would have occurred during outage.

- B. Remote Monitoring System: System shall monitor lighting performance and notify manufacturer if individual luminaire outage is detected so that appropriate maintenance can be scheduled. The controller shall determine switch position (manual or auto) and contactor status (open or closed).
- C. Management Tools: Manufacturer shall provide a web-based database and dashboard tool of actual field usage and provide reports by facility and user group. Dashboard shall also show current status of lamp outages, control operation and service scheduling including relamping operations completed and scheduled. Mobile application will be provided suitable for IOS, Android and Blackberry devices.

Hours of Usage: Manufacturer shall provide a means of tracking actual hours of usage for the field lighting system that is readily accessible to the owner.

- 1. Cumulative hours: shall be tracked to show the total hours used by the facility
- 2. Current lamp hours: shall be tracked separately to reflect the amount of hours on the current set of lamps being used, so relamping can be scheduled accurately.
- 3. Report hours saved by using early off and push buttons by users.

- D. Communication Costs: Manufacturer shall include communication costs for operating the controls and monitoring system for a period of 25 years.

PART 3 – EXECUTION

3.1 SOIL QUALITY CONTROL

- A. It shall be the Contractor’s responsibility to notify the Owner if soil conditions exist other than those on which the foundation design is based, or if the soil cannot be readily excavated. Contractor may issue a change order request / estimate for the Owner’s approval / payment for additional costs associated with:
 - 1. Providing engineered foundation embedment design by a registered engineer in the State of New Hampshire for soils other than specified soil conditions.
 - 2. Additional materials required to achieve alternate foundation;
 - 3. Excavation and removal of materials other than normal soils, such as rock, caliche, etc.

3.2 DELIVERY TIMING

- A. Delivery Timing Equipment On-Site: The equipment must be on-site 4 to 6 weeks from receipt of approved submittals and receipt of complete order information.

3.3 FIELD QUALITY CONTROL

- A. Illumination Measurements: Upon substantial completion of the project and in the presence of the Contractor, Project Engineer, Owner's Representative, and Manufacturer's Representative, illumination measurements shall be taken and verified. The illumination measurements shall be conducted in accordance with IESNA LM-5-04. For Lighting Method 1, Timed Power Adjustment systems, light levels must be measured and exceed the

specified target levels. For Lighting Method 2, light levels must be measured and meet the specified initial light levels.

B. Field Light Level Accountability

1. Light levels are guaranteed not to fall below the target maintained light levels for the entire warranty period of 25 Years.
2. The contractor/manufacturer shall be responsible for an additional inspection one year from the date of commissioning of the lighting system and will utilize the owner's light meter in the presence of the owner.
3. The contractor/manufacturer will be held responsible for any and all changes needed to bring these fields back to compliance for light levels and uniformities.
Contractor/Manufacturer will be held responsible for any damage to the fields during these repairs.

C. Correcting Non-Conformance: If, in the opinion of the Owner or his appointed Representative, the actual performance levels including footcandles and uniformity ratios are not in conformance with the requirements of the performance specifications and submitted information, the Manufacturer shall be required to make adjustments to meet specifications and satisfy Owner.

3.4 25-YEAR WARRANTY

- A. Each manufacturer shall supply a signed warranty covering the entire system for 25 years OR for the maximum hours of coverage based on the estimated annual usage, whichever occurs first. Warranty shall guarantee light levels will not fall below target maintained levels. A +/- 10% design/testing allowance will not be allowed. Warranty shall also cover: lamp replacements, system energy consumption, monitoring, maintenance and control services, spill light control, and structural integrity. Manufacturer shall maintain specifically-funded financial reserves to assure fulfillment of the warranty for the full term. Warranty may exclude fuses, storm damage, vandalism, abuse and unauthorized repairs or alterations.
- B. Group lamp replacements for Method 1 systems (Time Powered Adjustment) must occur at end of useful life of lamp as stated by manufacturer. Group lamp replacements for Method 2 systems (Continuous Depreciating Light) must relamp every 3,000.
- C. Maintenance: Manufacturer shall monitor the performance of the lighting system, including on/off status, hours of usage and lamp outage for 25 years from the date of equipment shipment. Individual lamp outages shall be repaired when the usage of any field is materially impacted. Owner agrees to check fuses in the event of a luminaire outage.

PART 4 – DESIGN APPROVAL

4.0 PRE-BID SUBMITTAL REQUIREMENTS (Non-Musco)

- A. Design Approval: The owner / engineer will review pre-bid submittals per section 4.0.B from all the manufacturers to ensure compliance to the specification 10 days prior to bid. If the design meets the design requirements of the specifications, a letter and/or addendum will be issued to the manufacturer indicating approval for the specific design submitted.
- B. Listed Manufacturers:
 1. Method 1: Time Powered Adjustment Technology - Musco's Green Generation Lighting® sports lighting system with a metal halide light source is the listed "Lighting Method 1" product.

2. Method 2: Continuous Depreciating Light – <Enter Manufacturer Name, F11> is the listed “Lighting Method 2” product.
- C. All listed manufacturers not pre-approved shall submit the information at the end of this section at least 10 days prior to bid. An addendum will be issued prior to bid; listing approved lighting manufacturers and the design method to be used.
 - D. Bidders are required to bid only products that have been approved by this specification or addendum by the owner or owner’s representative. Bids received that do not utilize an approved system/design, will be rejected.

REQUIRED SUBMITTAL INFORMATION FOR ALL MANUFACTURERS (NOT PRE-APPROVED) 10 DAYS PRIOR TO BID

All items listed below are mandatory, shall comply with the specification and be submitted according to pre-bid submittal requirements. Complete the Yes/No column to indicate compliance (Y) or noncompliance (N) for each item. Submit checklist below with submittal.

Submitting as: *HID Lighting Method 1* *HID Lighting Method 2*

Yes / No	Tab	Item	Description
	A	Letter/ Checklist	Listing of all information being submitted must be included on the table of contents. List the name of the manufacturer's local representative and his/her phone number. Signed submittal checklist to be included.
	B	Equipment Layout	Drawing(s) showing field layouts with pole locations
	C	On Field Lighting Design	Lighting design drawing(s) showing: <ul style="list-style-type: none"> a. Field Name, date, file number, prepared by b. Outline of field(s) being lighted, as well as pole locations referenced to the center of the field (x & y), Illuminance levels at grid spacing specified c. Pole height, number of fixtures per pole, horizontal and vertical aiming angles, as well as luminaire information including wattage, lumens and optics d. Height of light test meter above field surface. e. Summary table showing the number and spacing of grid points; average, minimum and maximum illuminance levels in foot candles (fc); uniformity including maximum to minimum ratio, coefficient of variance (CV), coefficient of utilization (CU) uniformity gradient; number of luminaires, total kilowatts, average tilt factor; light loss factor. f. Manufacturer's using Lighting Method 2 shall provide both initial and maintained light scans using a maximum recoverable light loss factor (RLLF) as specified in section 1.2.C.2 and shall be shown on lighting design.
	D	Off Field Lighting Design	Lighting design drawing showing initial spill light levels along the boundary line (defined on bid drawings) in footcandles. Light levels shall be taken at 30-foot intervals along the boundary line. Readings shall be taken with the meter orientation at both horizontal and aimed towards the most intense bank of lights.
	E	Environmental Light Control Design	Environmental glare impact scans must be submitted showing the maximum candela from the field edge on a map of the surrounding area until 500 candela or less is achieved.
	F	Photometric Report	Provide first page of photometric report for all luminaire types being proposed showing candela tabulations as defined by IESNA Publication LM-35-02. Photometric data shall be certified by laboratory with current National Voluntary Laboratory Accreditation Program or an independent testing facility with over 5 years experience.
	G	Performance Guarantee	Provide performance guarantee including a written commitment to undertake all corrections required to meet the performance requirements noted in these specifications at no expense to the owner. Light levels must be guaranteed to not fall below target levels for warranty period.
	H	Structural Calculations	Pole structural calculations and foundation design showing foundation shape, depth backfill requirements, rebar and anchor bolts (if required). Pole base reaction

			forces shall be shown on the foundation drawing along with soil bearing pressures. Design must be stamped by a structural engineer in the state of New Hampshire, if required by owner. (May be supplied upon award).
	I	Control & Monitoring System	Manufacturer of the control and monitoring system shall provide written definition and schematics for automated control system to include monitoring. They will also provide ten (10) references currently using proposed system in the state of New Hampshire.
	J	Electrical Distribution Plans	Manufacturer using Lighting Method 2 must include a revised electrical distribution plan including changes to service entrance, panels and wire sizing, signed by a licensed Electrical Engineer in the state of New Hampshire.
	K	Warranty	Provide written warranty information including all terms and conditions. Provide ten (10) references of customers currently under specified warranty in the state of New Hampshire.
	L	Independent Testing Report	<p>a. Lighting Method 1 is to provide an independent test report certifying the system meets the lumen maintenance control strategy defined in Section 1.2.C.1.a, verifying the field performance of the system for the duration of the useful life of the lamp based on lamp replacement hours. Report shall be signed by a licensed professional engineer with outdoor lighting experience.</p> <p>b. If Manufacturer using Lighting Method 2 desires to provide a recoverable light loss factor other than specified in section 1.2.C.2, Independent field test report from licensed professional engineer will be required to substantiate the ability to maintain light levels in accordance with section 1.7-A of the specification. Both initial and maintained light scans must still be provided. Independent Engineer conducting the report must have no affiliation with the manufacturer and report must be based on actual testing data. Testing must be done on the system as a whole, not on individual components.</p>
	M	Project References	Manufacturer to provide a list of five (5) projects where the technology and specific fixture proposed for this project has been installed in the state of New Hampshire. Reference list will include project name, project city, installation date, and if requested, contact name and contact phone number. Manufacturer bidding Lighting Method 2 must supply independent test report if lamp life relamping projection is greater than 3000 hours.
	N	Product Information	Complete bill of material and current brochures/cut sheets for all product being provided.
	O	Delivery	Manufacturer shall supply an expected delivery timeframe from receipt of approved submittals and complete order information.
	P	Non-Compliance	Manufacturer shall list all items that do not comply with the specifications. If in full compliance, tab may be omitted.
	Q	Life-cycle Cost Calculation	Document life-cycle cost calculations as defined in the specification. Identify energy costs for operating the luminaires. Maintenance cost for the system including spot lamp replacement and group relamping costs must be included in the warranty. All costs should be based on 25 Years. (complete table below)

25-year Life Cycle Operating Cost			
a.	Luminaire (1500 Watt Metal Halide) energy consumption _____ luminaires x _____ kW demand per luminaire x \$.16 kWh rate x 300 annual usage hours x 25 years		<Enter, F11>

b.	Demand charges, if applicable	+	<Enter, F11>
c.	Cost for spot relamping and maintenance over 25 years Assume 7.5 repairs at \$500 each if not included with the bid	+	<Enter, F11>
d.	Cost to relamp all luminaires during 25 years 300 annual usage hours x 25 years / 3,000 hours x \$125 lamp & labor x _____ of luminaires if not included with the bid	+	<Enter, F11>
e.	Extra energy used without base bid automated control system \$ Energy consumption in item a. x _____ if control system not included with the bid	+	<Enter, F11>
	TOTAL 25-Year Life-cycle Operating Cost	=	<Enter, F11>

The information supplied herein shall be used for the purpose of complying with the specifications for Portsmouth Route 33 Soccer Field. By signing below I agree that all requirements of the specifications have been met and that the manufacturer will be responsible for any future costs incurred to bring their equipment into compliance for all items not meeting specifications and not listed in the Non-Compliance section.

Manufacturer: _____ Signature: _____

Contact Name: _____ Date: ____/____/____

Contractor: _____ Signature: _____

SECTION 31 00 00

EARTHWORK

PART 1 - GENERAL

1.01 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all SECTIONS within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this section of Specifications.

1.02 DESCRIPTION OF WORK:

- A. Work included: Furnish all labor, supervision, equipment, supplies, and materials and perform all operations necessary to complete the work of this Section, including but not limited to the following:
 - 1. Earth and rock excavation of all types.
 - 2. Sheet piling, shoring and dewatering of excavations and trenches.
 - 3. Excavation and backfill for removal, relocation, and abandonment of existing underground utilities, foundations, and below-grade structures.
 - 4. Providing, processing, placing, and compacting earth and rock fill materials.
 - 5. Removal, hauling, stockpiling, re-handling, and placement of materials.
 - 6. Off-site disposal of excess or unsuitable materials.
 - 7. Rough grading.
- B. The Contractor or Sub-contractor must have a minimum of five (5) years of experience installing athletic fields of similar size and quality of this project.
- C. Site Specific Issues:
 - 1. The site is underlain by at least 28.5 ft. of undocumented fill and debris. These materials were likely generated from various sources. Site preparation and earthwork will therefore encounter varying subsurface conditions. Debris anticipated in site excavations include brick, asphalt, wood, stumps, concrete, ash, and other deleterious materials. Completed explorations indicate subsurface conditions at specific locations only and only to the depths penetrated. They do not reflect subsurface conditions present between exploration locations. Variation of subsurface conditions should be anticipated.
 - 2. The fill soils are highly susceptible to softening and disturbance by construction activity during wet and freezing weather. Subgrade protection is the responsibility of the Contractor. Special precautions and protective measures appropriate for weather conditions during construction shall be used during earthwork and foundation construction to preserve subgrade integrity. Disturbed subgrades shall be

repaired at the sole expense of the Contractor.

D. Geotechnical Field and Laboratory Testing:

1. The Owner will retain the services of a geotechnical testing laboratory to conduct laboratory analyses and field testing of soil materials required for this specification. Coordinate locations and types of field tests to be performed with the Engineer and cooperate in every way with the Engineer and testing laboratory during field testing and with the collection of soil samples for laboratory testing.

1.03 RELATED WORK:

- A. Section 00 31 32, SUBSURFACE DATA
- B. Section 01 35 00, PERMITS
- C. Section 01 11 00, CONTROL OF WORK
- D. Section 01 57 19, ENVIRONMENTAL PROTECTION
- E. Section 31 23 19, DEWATERING
- F. Section 32 91 13, LOAM TOPSOIL

1.04 REFERENCES:

AASHTO - American Association of State Highway and Transportation Officials (tests or specifications). AASHTO or AASHO

American Society for Testing and Materials (ASTM)

- | | |
|----------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| ASTM C 131 | Test Method for Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine. |
| ASTM C136 | Method for Sieve Analysis of Fine and Coarse Aggregates. |
| ASTM C330 | Specification for Lightweight Aggregate for Structural Concrete. |
| ASTM D1556 | Test Method for Density of Soil in Place by the Sand Cone Method. |
| ASTM D1557 | Test Methods for Moisture-density Relations of Soils and Soil Aggregate Mixtures Using Ten-pound (10 Lb.) Hammer and Eighteen-inch (18") Drop. |
| ASTM D2922 | Test Methods for Density of Soil and Soil-aggregate in Place by Nuclear Methods (Shallow Depth). |
| ASTM F-2396-04 | Standard Guide for Construction of High Performance Sand-Based Rootzones for Sports Fields |

State of New Hampshire Department of Transportation Standard Specifications for Road and Bridge Construction.

New Hampshire Code of Administrative Rules ENV-OR 611 Contaminated Soil

New Hampshire Code of Administrative Rules LAB 1400 Safety and Health of Employees

1.05 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

- A. Refer to Section 01 33 23. Submittals, for submittal provisions and procedures.
 - 1. Backfill Materials: Submit 50 pound samples for each backfill material from each proposed source including on-site materials. Samples of off-site soil borrow for submission shall be collected in the presence of the Engineer so that the Engineer has the opportunity to see each borrow material at the source. Submit a grain size distribution curve performed in accordance with ASTM D422 and results of a moisture-density relationship determination in accordance with ASTM D1557 for each proposed backfill material for review by the Engineer. Additional samples and analysis shall be submitted if a change in material occurs at the borrow source.

1.06 EXAMINATION OF SITE DOCUMENTS

- A. It is hereby understood that the Contractor has carefully examined the site and all conditions affecting work under this Section. No claim for additional costs will be allowed because of a lack of knowledge of existing conditions as indicated in the Contract Documents, or obvious from observation of the site.
- B. Plans, surveys, measurements and dimensions under which the work is to be performed are believed to be correct, but the Contractor shall have examined them for himself during the bidding period and formed his own conclusions as to the full requirements of the work involved.

1.07 EXISTING SITE AND SUBSURFACE CONDITIONS

Refer to Section 00 31 32, Subsurface Data for information on site and subsurface conditions.

1.08 EXCAVATION CLASSIFICATIONS:

- A. Earth Excavation or "Excavation" consists of removing materials encountered to the subgrade elevations indicated and subsequent reuse or disposal of the materials removed. All excavation is classified as earth excavation unless it otherwise meets the classifications provided below for unauthorized excavation, additional excavation, or rock excavation.
- B. Unauthorized Excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of the Engineer. Unauthorized excavation, as well as remedial work required by the Engineer, shall be at the Contractor's expense.
 - 1. Under footings, foundations, fields concrete slabs, retaining walls or other structures, fill unauthorized excavations to the proper elevations with Structural Fill as defined herein. Elsewhere, backfill and compact unauthorized excavations as specified for excavations of the same class, unless otherwise required.

C. Additional Excavation:

1. When excavation has reached required subgrade elevations, notify the Engineer, who will observe subgrade conditions.
2. If unsuitable bearing materials are encountered at the required subgrade elevations, carry excavations deeper and to the lateral extent as required by the Engineer. Replace excavated material as required by the Engineer.
3. Removal of unsuitable material and its replacement as required will be paid on the basis of contract conditions relative to changes in work or as provided for under the unit rates for this classification.

D. Rock Excavation:

1. Rock excavation in trenches, footing, and other required excavations includes removal and disposal of materials and obstructions encountered which cannot be excavated with a 1.0 cubic yard (heaped) capacity, 42-inch wide bucket on medium-size track-mounted hydraulic excavator equivalent to Caterpillar Model 215, rated at not less than 90HP flywheel power and 30,000 lb. drawbar pull. Trenches and footing excavations in excess of 10-feet in width are classified as open excavation.
2. Rock excavation in open excavations includes removal and disposal of materials and obstructions encountered which cannot be dislodged and excavated with modern track-mounted heavy-duty hydraulic excavating equipment without drilling or ripping. Rock excavation equipment is defined as Caterpillar Model No. 973 or No. 977K, or equivalent track-mounted loader, rated at not less than 170 HP flywheel power and developing 40,000-lb. breakout force (measured in accordance with SAE J732C).
3. Determination of rock excavation classification will be made by the Engineer. Typical of materials classified as rock are boulders 3.0 cubic yards or more in volume, solid rock, rock in ledges, and rock-hard cementitious aggregate deposits. Intermittent drilling or ripping performed to increase production and not necessary to permit excavation of material encountered will be classified as earth excavation. Do not perform rock excavation work until material to be excavated has been cross-sectioned and classified by the Engineer. Visual observation of the completed excavation may be made by the Engineer to modify the excavation classifications. Removal of rock excavation prior to classification by the Engineer shall be considered as earth excavation unless accepted by the Engineer in writing. Such excavation will be paid on the basis of contract unit rates for this classification.
4. Rock payment lines (if applicable) are limited to the following:
 - a. Two feet outside of concrete work for which forms are required.
 - b. In footing excavations, one foot below bottom-of-footing elevation.

- c. One foot below bottom-of-slab elevation.
- d. One foot below field subbase elevation.
- e. One foot outside of the vertical walls of utility structures.
- d. In pipe trenches, depth limits shall be 6 inches below the bottom of the pipe:

Depth from Ground Surface to Invert of Pipe	Pay Width (Pipe ID)	
	0 - 24"	Over 24"
0 to 12'	5'-0"	Pipe I.D. +3'-0"
12' to 20'	7'-0"	Pipe I.D. +7'-0"
Over 20'	9'-0"	Pipe I.D. +7'-0"

- e. Rock sloping across the width of trench shall have the top of rock established at the rock elevation over the centerline of the pipe.
- f. For all other site improvements not listed above, including but not limited to landscape plantings, and roadways, the payment line for rock removal shall be the subgrade for installation of the earthen components of the particular site improvement.

1.08 EXCAVATION

- A. Perform all excavations and of whatever materials encountered, in a manner as required to allow for placing of temporary earth support, forms, installation of pipe and other work, and to permit access for the purpose of observing the work. Excavations shall be to such widths as will give suitable space for the required work. Bottoms of trenches and excavations shall be protected from frost and shall be firm, dry and in an acceptable condition to receive the work. Work shall not be placed on frozen surfaces nor shall work be placed on wet or unstable surfaces.
- B. All excavations made in open cut will be controlled by the conditions existing at that location. In no case shall earth be excavated or disturbed by machinery so near to the finished subgrade for structures and pipelines as to result in the disturbance of the earth below the subgrade. The final excavation to subgrade should be accomplished with a smooth bladed bucket or by hand. Subgrades shall be observed by the Engineer prior to placement of overlying materials including fill, concrete forms, and rebar.
- C. The Contractor shall segregate and stockpile separately materials that are considered suitable for on-site re-use by the Engineer from unsuitable materials and materials requiring off-site disposal. Costs associated with off-site disposal of materials that are considered suitable for re-use by the Engineer, whether mixed with unsuitable materials or not, shall be borne by the Contractor.
- D. Temporary excavation support shall be provided in accordance with Section 31 50 00, Support of Excavation.
- E. Dewatering shall be provided in accordance with Section 31 23 19, Dewatering.

1.09 PERMITS, CODES, AND SAFETY REQUIREMENTS

- A. Comply with all rules, regulations, laws and ordinances of the municipality, the State of New Hampshire, and other authorities having jurisdiction over the project site or work. All labor, materials, equipment and services necessary to make the work comply with these requirements shall be provided by the Contractor without additional cost to the Owner.
- B. Comply with the provisions of the Manual for Accident Prevention in Construction of the Associated General Contractors of America, Inc., and the requirements of the Occupational Safety and Health Administration, United States Department of Labor.
- C. The Contractor shall obtain and pay for all permits and licenses required to the complete work specified herein and shown on the Contract Drawings.
- D. The Contractor shall not close or obstruct any street, sidewalk, or passageway without written permission from authorities having jurisdiction unless otherwise indicated on the Contract Drawings. The Contractor shall conduct his operations as to minimize interference with the use of roads, driveways, or other facilities near enough to the work to be affected by the work.
- E. The Contractor shall notify "Dig Safe" at 1-888-DIG-SAFE prior to commencing any excavation work.
- F. The Contractor shall provide police details when working in roadways as required by local jurisdictional authorities. The Contractor shall pay for any and all details.

1.10 PROTECTION OF EXISTING CONDITIONS:

- A. All work shall be executed in such a manner as to prevent any damage to existing buildings, streets, curbs, paving, service utility lines, structures and adjoining property.
- B. Locate and mark underground utilities to remain in service before beginning the work. Protect all existing utilities to remain in service during operations. Do not interrupt existing utilities except when authorized in writing by authorities have jurisdiction unless otherwise indicated on the Contract Drawings.
- C. When an active utility line is exposed during construction its location and elevation shall be recorded on the Record Drawings by the Contractor and both the Engineer and the Utility Owner shall be notified in writing. Active utilities existing on the site shall be carefully protected from damage or relocated as required by the work.
- D. Inactive or abandoned utilities encountered during construction operations shall be removed or abandoned in place by completely filling with grout or Controlled Density Fill in a manner to prevent voids. The location of such utilities shall be recorded on the Record Drawings.
- E. Provide barricades, fences, lights, signs, and all other safety devices required to protect the public against injury.
- F. In case of any damage or injury caused in the performance of the work the Contractor shall, at his own expense make good such damage or injury to the satisfaction of, and without cost to, the Owner. Existing streets, sidewalks and curbs damaged during the project work

shall be repaired or replaced to their condition prior to commencement of earthwork operations.

- G. Acceptance of any of the Contractor's plans, design calculations and methods of construction by the Designer shall not relieve the Contractor of the responsibility for the adequacy of the excavation lateral support system; preventing damage to existing or new structures, utilities and streets adjacent to excavations; the safety of persons working within excavated areas and the public at large; and excavation dewatering.

1.11 FROST PROTECTION AND SNOW REMOVAL:

- A. The Contractor shall, at its own expense, keep earthwork operations clear and free of accumulations of snow as required to carry out the work.
- B. The Contractor shall protect the subgrade beneath new structures, fields, and pipes from frost penetration when freezing temperatures are expected.

1.12 DISPOSAL:

- A. All excess and unsuitable excavated soil shall be removed from the site and legally disposed off-site by the Contractor at no additional cost to the Owner.

PART 2 – PRODUCTS

2.01 BACKFILL MATERIALS:

- A. **Class B Backfill:** Class B Backfill shall be well-graded, natural inorganic soil containing no stone greater than 6 inches maximum dimension. The material shall be free of trash, ice, snow, tree stumps, roots and other organic and deleterious materials. It shall be free of plastic clays, of all materials subject to decay or other materials that will corrode piping or metals. Class B Backfill shall have a maximum dry density of not less than 110 pounds per cubic foot. It shall be of such a nature and character that it can be compacted to the specified densities. Topsoil shall not be considered Class B Backfill.
- B. **Gravel:** Gravel shall satisfy the requirements of NHDOT Item No. 304.2.
- C. **Crushed Stone Fine:** Crushed Stone Fine shall satisfy the requirements of NHDOT Item No. 304.4.
- D. **Structural Fill:** Structural Fill shall satisfy the requirements of Gravel or Crushed Stone Fine above.
- E. **Crushed Stone:** Crushed Stone shall be durable, clean, angular crushed rock or stone with maximum particle sizes of either ¾-inch or 1-1/2-inch. Crushed Stone separated from surrounding soils with Filter Fabric as specified herein may be used as Structural Fill where approved by the Engineer.
- F. **Sand:** Sand shall satisfy the requirements of NHDOT Item 304.1.

- G. **On-Site Soils:** Existing available soils from on-site excavations may be reused as Class B Fill or Structural Fill provided the on-site soils meet the material requirements described above.
- H. **Geotextile Fabric:** Geotextile fabric used for drainage or separation shall consist of a non-woven fabric made from polypropylene or polyethylene filaments or yarns. The fabric shall be inert to organic chemicals commonly encountered in the soil. The fabric shall conform to the following recommended property tests:

Property	Unit	Test Method	Minimum Value
Weight	oz/sy	ASTM D-5261	8.0
Grab Strength	lbs	ASTM D-4632	205
Grab Elongation	percent	ASTM D-4632	50
Trapezoid Tear Strength	lbs	ASTM D-4533	80
Mullen Burst Strength	psi	ASTM D-3786	350
CBR Puncture Strength	lbs	ASTM D-6241	500
Apparent Opening Size (AOS)	U.S. std. Size Sieve	ASTM D-4751	80

Edges of filter fabric shall overlap a minimum of one foot.

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS:

- A. The Contract Drawings indicate the proposed finish alignments, elevations, and grades of the work. Establish the line and grade in close conformity with the Contract Drawings. The Engineer, however, may make minor adjustments in the field as necessary due to conditions encountered.
- B. The Contractor is responsible for establishing construction phasing, means, and methods and interim grading and temporary conditions required to attain the finish product required by the Contract Documents. The Contractor is responsible for all construction, protection, movement, and maintenance of stockpiles. Establish and maintain suitable benchmarks and grade control to accurately perform the work.
- C. All excavations shall be performed in the dry. Excavation and dewatering shall be accomplished by methods, which preserve the undisturbed state of the subgrade soils.
- D. No excavation will be permitted below a line drawn downwards at 2 horizontal to 1 vertical from the underside of the closest edge of any in-place footing or utility at a higher elevation without providing adequate sheeting and bracing (designed by a Professional Engineer licensed in the State of New Hampshire and retained by the Contractor) to prevent

movement of the in-place footing or utility.

- E. When excavations have reached the prescribed depths, the condition of the bottom of the trench, subgrade, or foundation bearing surface shall be observed by the Engineer prior to placement of overlying materials including concrete forms and rebar. When excavating to subgrade level for pavement and hardscaping areas has been completed, the subgrade surface shall be observed by the Engineer prior to placement of overlying materials. After observation the Contractor will receive approval to proceed if conditions meet project requirements.
- F. No excavated material shall be deposited or stockpiled at any time to endanger portions of new or existing structures, either by direct pressure or indirectly by overloading areas contiguous to the operation. Material, if stockpiled, shall be stored so as not to interfere with the established sequence of the construction. If there is not sufficient area available for stockpiling within the limits of the project, the Contractor will be required to furnish his own area for stockpiling.
- G. Where the plans require excavation in areas in close proximity to existing buildings, roads, structures and utilities it shall be the responsibility of the Contractor at his expense to use satisfactory means and methods to protect and maintain the stability of such roads, and structures.
- H. Temporary ditches shall be made as needed to drain off surface water to avoid damaged to areas of cut or fill. Such ditches shall be maintained as required for efficient operations, at no additional cost to the Owner.
- I. Provide shoring, sheeting, and/or bracing at excavations, as required, to assure complete safety against collapse of earth at the side of excavations. Provide shoring of public utility lines where exposed in the excavations in accordance with rules and regulations of the local authorities, as no additional cost to the Owner.

3.02 FILLING AND BACKFILLING:

- A. Subgrade Preparation: The subgrades for buildings, retaining walls, athletic field, pavement areas, and other site improvements shall be shaped to lines, grades, and cross-sections shown on the Contract Drawings and observed by the Engineer as described in Paragraph 3.01 E. These operations shall include any required reshaping and moisture conditioning to obtain proper re-compaction of loose granular materials. Material at subgrade elevations are anticipated to consist of existing undocumented fill of varying composition and consistency. Removal of existing fill below proposed site features shall be completed as indicated on the Contract Drawings. Additional removal of fill could be necessary depending on the condition of the subgrade as required by the Engineer. All soft or otherwise unsuitable material at the subgrade shall be removed and replaced with suitable material from excavation or borrow. The resulting area, and all other low sections, holes, or depressions shall be brought to the required grade with accepted material and the entire subgrade shaped to line, grade and cross-section and thoroughly compacted.
 - 1. After initial excavation to subgrade in excavation areas for the athletic fields, the Contractor shall proof-compact the exposed subgrades in the presence of the Engineer.

Proof-compaction shall be defined as at least four complete coverages of the excavation area with the rear wheels of a fully loaded 10-wheel dump truck. Areas of subgrade that deflect, weave or pump under the stress of proof-compaction shall be over-excavated by a minimum 18-inches and backfilled with Structural Fill as defined above.

2. All fills shall be placed in horizontal layers. Fill shall not be placed following the natural contours of the ground. Fill shall be placed starting at the lowest areas working up to finished grades in horizontal layers in the manner specified herein. Each layer of fill shall be benched into the existing slope in order to avoid the formation of a shear plane.
 3. After approval of subgrade by the Engineer, the Contractor shall backfill areas to required contours and elevations with specified materials.
- C. The vertical and lateral limits of Structural Fill below proposed footings and other features requiring Structural Fill (the “zone of influence”) shall be defined by a horizontal plane extending away from the outside bottom edge of the footings/feature for two feet, then by a plane that slopes down and away from the foundation/feature at a maximum 1H:1V slope to a suitable subgrade indicated by the Engineer. Structural Fill shall be placed within the zone described above in maximum 10-inch thick lifts measured prior to compaction. Each lift shall be thoroughly compacted to at least 95 percent of the maximum dry density as determined by Modified Proctor Compaction Testing (ASTM D1557).
- D. Backfill Material: Unless otherwise specified or required, material used for filling and backfilling shall meet the material requirements specified herein. In general, the material used for backfilling utility trench excavations shall be material removed from the excavation provided that the reuse of these materials result in the required trench compaction and meets the requirements for materials specified in the Contract Drawings. Material used to backfill other areas of the site are as follows:
1. Class B Backfill for all unpaved areas of the site.
 2. Structural Fill within three feet below proposed pavement or sidewalk subbases. Class B Backfill below three feet of finished grade below proposed pavements or sidewalks.
 3. All backfill placed within structure limits and below the athletic field subbase shall be Structural Fill unless otherwise specified.

Place backfill in a maximum loose lift thickness of 10-inches. Maintain backfill material with uniform moisture content, with no visible wet or dry streaking, and at a moisture content that allows compaction to the degree specified herein.

E. Trench Backfill:

1. After the utility pipe installation has been observed and approved, trenches shall be backfilled as soon as practicable with specified material. All trench backfilling shall be done with care.
2. Backfill material for pipe bedding shall be deposited in the trench, uniformly on both sides of the pipe, for the entire width of the trench to the springline of the pipe. The backfill material shall be placed by hand shovels, in layers not more than 6-inches thick in loose depth, and each layer shall be thoroughly and evenly compacted by tamping on

each side of the pipe to provide uniform support around the pipe, free from voids.

3. The balance of backfill shall be spread in layers not exceeding 10-inches in loose depth. Each layer shall be thoroughly compacted by mechanical methods and shall contain no rock, stones or boulders larger than 4 inches in their greatest dimension.
4. All trench backfilling shall be done with special care and must be carefully placed so as not to disturb the work at any time; if necessary, a timber grillage or other suitable method shall be used to break the fall of the material. The moisture content of the backfill material shall be such that proper compaction will be obtained. Puddling of backfill with water will not be permitted. Backfill within areas to receive topsoil or pavement construction shall be made to grades required to establish the proper subgrade for the placement of topsoil or pavement base courses.
5. In backfilling trenches, each layer of backfill material shall be moistened and compacted to a density at least equal to that of the surrounding undisturbed earth, and in such a manner as to permit the rolling and compaction of the filled trench or excavation with the adjoining earth to provide the required bearing value, so that paving of the excavated and disturbed areas, where required, can proceed immediately after backfilling is completed.
6. Any trenches or excavations improperly backfilled or where settlement occurs shall be reopened, to the depth required for proper compaction, then refilled and compacted with the surface restored to the required grade and condition, at no additional expense to the Owner.
7. During filling and backfilling operations, pipelines will be checked by the Engineer to determine whether any displacement of the pipe has occurred. If the observation of the pipelines shows poor alignment, displaced pipe or any other defects they shall be remedied in a manner satisfactory to the Engineer at no additional cost to the Owner.

F. Backfilling Against Structures:

1. Backfilling against masonry or concrete shall not be done until permitted by the Engineer. The Contractor shall not place backfill against or on structures until they have attained sufficient strength to support the loads (including construction loads) to which they will be subjected, without distortion, cracking or other damage. As soon as practicable after the structures are structurally adequate and other necessary work has been satisfactorily completed and approved, special leakage tests of the structures shall be made by the Contractor, as required by the Engineer. After satisfactory completion of leakage tests and satisfactory completion of any other required work in connection with the structures, backfilling around the structures shall commence using suitable and approved excavation material. The best of the backfill material shall be used for backfilling within 2-feet of the structure. Just prior to placing backfill, the areas shall be cleaned of all excess construction material and debris and the bottom of excavations shall be in a thoroughly compacted condition. In general, use Structural Fill for backfilling against structures where the finished ground surface will be pavement or sidewalks; use Class B Backfill where the finished ground surface will be lawn or landscaped areas.
2. Symmetrical backfill loading shall be maintained. Special care shall be taken to prevent any wedging action or eccentric loading upon or against the structures. During

backfilling operations, care shall be exercised that the equipment used will not overload the structures in passing over and compacting these fills. Except as otherwise specified or directed, backfill shall be placed in layers not more than 10-inches in loose depth and each layer of backfill shall be compacted thoroughly and evenly using approved types of mechanical equipment. Each pass of the equipment shall cover the entire area of each layer of backfill.

3. In compacting and other operations, the Contractor shall conduct his operations in a manner to prevent damage to structures due to passage of heavy equipment over, or adjacent to, structures, and any damage thereto shall be made good by the Contractor at no additional expense to the Owner.
- G. After backfilling trenches and excavations, the Contractor shall maintain the surfaces of backfill areas in good condition so as to present a smooth surface at all times level with adjacent surfaces. Any subsequent settling over backfilled areas shall be repaired by the Contractor immediately, and such maintenance shall be provided by the Contractor for the life of this Contract, at no additional expense to the Owner.
 - H. The completed and approved subgrades upon which topsoil is to be placed, or pavements are to be installed, shall not be disturbed by traffic of other operations and shall be maintained in a satisfactory condition until the base and finished courses are placed. The storage or stockpiling of materials on finished subgrade will not be permitted.
 - I. Uniformly shape the surfaces of all areas to be graded, to the lines and grades indicated on the Contract Drawings, and as directed, including excavated and filled sections, embankments and adjacent transition areas, and all areas disturbed as a result of the Contractor's operations. The finished surfaces shall be reasonably smooth, compacted and free from surface irregularities.
 - J. The Contractor is responsible to provide the finish grades as shown on the Contract Drawings. The Contractor shall provide temporary erosion control throughout the construction period to maintain all constructed lawns, and to protect all existing drains, catch basins, swales, from any debris or soil entering from excavation, backfill, or erosion. Contractor shall take whatever precautions are necessary to accomplish this temporary erosion control such as straw bales, silt fence, erosion control fabric, or pumping, at no additional cost to the Owner.

3.03 COMPACTION:

- A. **Compaction Requirements:** The degree of compaction is expressed as a percentage of the maximum dry density of the material at optimum moisture content as determined by ASTM Test D 1557, Method C. The compaction requirements are as follows:

Area	ASTM Density Degree of Compaction
In the zone of influence below foundations, slabs, athletic field, and other structural features	95%
Pavement base course	95%
Pavement subgrade	95%
General fill below pavement subbase	95%
Trench backfill - below pavements	95%
- below landscaped areas	92%
- below structures	95%
All other areas	92%

B. **Moisture Control:**

1. Fill that is too wet for proper compaction shall be disced, harrowed, or otherwise mixed and dried to a proper moisture content to allow compaction to the required density. If fill cannot be dried within 24 hours of placement, it shall be removed and replaced with drier fill.
2. Fill that is too dry for proper compaction shall receive water uniformly applied over the surface of the loose layer. Sufficient water shall be added to allow compaction to the required density.

C. **Unfavorable Conditions:**

1. In no case shall fill be placed over material that is frozen. In no case shall frozen soil or soil material containing frost, snow or ice be placed as backfill. No fill material shall be placed, spread or rolled during unfavorable weather conditions. When work is interrupted by heavy rains, fill operations shall not be resumed until the moisture content and the density of the previously placed fill are as specified.
2. In freezing weather, a layer of fill shall not be left in an uncompacted state at the close of the day's operations. Prior to terminating work for the day, the final layer of compacted fill shall be rolled with a smooth wheeled roller to eliminate ridges of soil left by compaction equipment.

D. Compaction Control:

1. In-place density tests shall be made in accordance with ASTM D1 556, D2922, or D2167 as the work progresses, to determine the degree of compaction being attained by the Contractor. Any corrective work required as a result of such tests, such as additional compaction, or a decrease in the thickness of layers, shall be performed by the Contractor at no additional expense to the Owner. Additional in-place density testing shall be made at the Contractor's expense by the geotechnical testing laboratory. Testing locations shall be selected by the Engineer unless otherwise noted.
2. In-place density tests shall be performed at a minimum according to the following:
 - a. One test per lift for each 5,000 square feet of building or athletic field area fill.
 - b. A minimum of one test per lift for each 100 linear feet of trench.
 - c. One test per lift for each 10,000 square feet of parking lot and sidewalk subgrade fill area.
 - d. One test per lift for each 100 linear feet of roadway fills.

3.04 DISPOSAL OF SURPLUS MATERIAL:

- A. Surplus excavated materials, which are acceptable to the Engineer, shall be used to backfill normal excavations or to replace other materials unacceptable for use as backfill. Upon written approval of the Engineer, surplus excavated materials shall be neatly deposited and graded so as to make or widen fills, flatten side slopes, or fill depressions; or shall be neatly deposited for other purposes as indicated by the Owner, within its jurisdictional limits; all at no additional cost to the Owner.
- B. Surplus excavated material not needed as specified above shall be hauled away and disposed of by the Contractor at no additional cost to the Owner, at appropriate locations, and in accordance with arrangements made by him. Disposal of all rubble shall be in accordance with all applicable local, state and federal regulations.
- C. No excavated material shall be removed from the site of the work or disposed of by the Contractor unless approved by the Engineer.
- D. The Contractor shall comply with New Hampshire regulations that govern the removal and disposal of surplus excavated materials. Materials, including contaminated soils, having concentrations of oil or hazardous materials less than an otherwise Reportable Concentration and that are not a hazardous waste, may not be disposed of at locations where concentrations of oil and/or hazardous material at the receiving site are significantly lower than the levels of those oil and /or hazardous materials present in the soil being disposed or reused.
- E. Soil testing, if required, for all materials to be reused on-site or removed and disposed of offsite, shall be the responsibility of the contractor. The town reserves the right to obtain its own test results from the same sample as the contractor without penalties to the owner. The contractor is required to obtain a large enough sample to divide with the owner for this proposes.

END OF SECTION

SECTION 31 05 13

FLOWABLE FILL

PART 1 - GENERAL

1.01 DESCRIPTION:

A. FLOWABLE FILL is to be used where indicated on the contract drawings.

1.02 RELATED WORK:

A. Section 01 11 00, CONTROL OF WORK AND MATERIALS

B. Section 01 33 00, SUBMITTALS

C. Section 31 00 00, EARTHWORK

D. Section 31 50 00, SUPPORT OF EXCAVATION

1.03 REFERENCES:

New Hampshire Department of Transportation's 2016 Standard Specification for Road and Bridge Construction.

1.04 SUBMITTALS:

Proposed Mix Designs for the type(s) of FLOWABLE FILL shall be submitted for review and approval from the Contractor's Ready Mix provider in accordance with Section 01330.

PART 2 - PRODUCTS

2.01 MATERIALS:

Materials employed in the FLOWABLE FILL shall meet the requirements as described below.

2.02 TYPE OF FLOWABLE FILL:

FLOWABLE FILL for this project shall be (Type 1 - Very Flowable (Non-excavatable), Type 1E - Very Flowable (Excavatable), Type 2 - Flowable (Non-excavatable) or Type 2E - Flowable (Excavatable).

Strength and Slump Requirements

FLOWABLE FILL	Type 1 & 2	Type 1E & 2E
Compressive Strength @ 28 Days	30-150 psi	30-80 psi
Compressive Strength @ 28 Days	200 psi maximum	100 psi maximum
Slump	10-12 inches	10-12 inches

PART 3 - EXECUTION

3.01 GENERAL:

- A. FLOWABLE FILL shall be batched at a ready mix plant and is to be used at a high or very high slump of approximately 10- to 12-inches. It shall be flowable, require no vibration and after it has been placed for Type 1E and 2E, be excavatable by hand tools and/or small machines.
- B. FLOWABLE FILL shall be placed so as to not disturb adjacent structures, utilities or the sidewalls of trenches.
- C. FLOWABLE FILL shall be installed to the limits shown on the drawings, or required by permit and shall be kept below the top of the trench to allow for the placement of the required depth of pavement as specified in these documents or as indicated in the contract drawings.
- D. Steel road plates shall protect the FLOWABLE FILL until the fill reaches a point that it will not be deformed by traffic passing over it. Plates are not to be removed until the day that paving operations are performed.

END OF SECTION

Z:\MA-Worcester-Projects\Portsmouth NH\South Mill Courts\Specifications\02058-Control Density Fill.doc

SECTION 31 10 00
CLEARING AND GRUBBING

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. The Contractor shall do all required clearing and grubbing as indicated on the drawings or herein specified in the area required for construction operations.
- B. Unless otherwise noted, all areas to be cleared shall also be grubbed.
- C. The Contractor shall not clear and grub outside of the area required for construction operations.

1.02 RELATED WORK:

Any trees and shrubs specifically designated by the Owner not to be cut, removed, destroyed, or trimmed shall be saved from harm and injury in accordance with Section 01 57 19, ENVIRONMENTAL PROTECTION.

PART 2 - PRODUCTS: NOT APPLICABLE

PART 3 - EXECUTION

3.01 CLEARING:

- A. Unless otherwise indicated, the Contractor shall cut or otherwise remove all trees, saplings, brush and vines, windfalls, logs and trees lying on the ground, dead trees and stubs more than 1-foot high above the ground surface (but not their stumps), trees which have been partially uprooted by natural or other causes (including their stumps), and other vegetated matter such as shags, sawdust, bark, refuse, and similar materials.
- B. Except where clearing is done by uprooting with machinery or where stumps are left longer to facilitate subsequent grubbing operations, trees, stumps, and stubs to be cleared shall be cut as close to the ground as practicable but not more than 6-inches above the ground surface in the case of small trees, and 12-inches in the case of large trees. Saplings, brush and vines shall be manually pulled from the ground along with as much of the root mass as possible to prevent resprouting.

3.02 GRUBBING:

- A. Unless otherwise indicated, the Contractor shall completely remove or grind all stumps and roots to a depth of 18-inches.

- B. Any depression remaining from the removal of a stump and not filled in by backfilling shall be filled with gravel borrow and/or loam, whichever is appropriate to the proposed ground surface.

3.03 DISPOSAL:

All material collected in the course of the clearing and grubbing, shall be disposed of in a satisfactory manner away from the site or as otherwise approved. Such disposal shall be carried on as promptly as possible and shall not be left until the final clean-up period.

END OF SECTION

SECTION 31 13 16
TREE PRUNING, TREE AND STUMP REMOVALS

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. The work of this Section includes the following:
 - 1. Pruning – all trees to remain shall have crown cleaning performed including the removal of dead and crossing limbs as well as all limbs necessary to execute the scope of work required under this contract.
 - 2. Removal of trees and stumps.
- B. Refer to the Contract Drawings for general location of trees to be removed. Trees are to remain and be pruned in conformance with this Specification. Tree removals shall be limited to the locations denoted on the plans and shall include the removal of individual trees that would impede the construction of proposed facilities AS APPROVED BY OWNER’S REPRESENTATIVE.

1.02 QUALIFICATIONS OF CONTRACTOR:

- A. This work shall be limited to individuals, partnerships and corporations who are actively engaged in the field of Arboriculture, and who demonstrate competence, experience and financial capability to carry out the terms of this project. The Owner may require proof of these qualifications.
- B. All work shall be conducted by qualified and trained personnel under the direct supervision of a New Hampshire Arborist Association in the Contractor’s employ.

1.03 PERSONNEL:

- A. The Contractor shall submit each employee’s name and title prior to the commencement of work. The Contractor shall advise the Owner of any changes in personnel assigned to this Contract.
- B. The crew foreman shall have a minimum of five (5) years climbing/pruning experience. At least one (1) crew person shall be an MCA and shall be certified in CPR.
- C. Each trimmer shall be experienced and highly qualified with the necessary tree worker skills to successfully complete the work of this Section, including the ability and training to perform aerial rescue. Said skill shall also include worker safety and ability in compliance with current OSHA and ANSI Z-133.1

Standards.

1.04 SPECIAL REQUIREMENTS:

- A. All wood shall be removed from the site and be properly disposed of in accordance with state and local regulations.
- B. No burning shall be permitted on the project site.
- C. Prior to commencing work, the Contractor shall submit a plan to the Owner for legal disposal of removed materials, in conformance with State and Federal regulations.

1.05 STANDARDS AND DEFINITIONS:

- A. All pruning work shall be performed in accordance with the following:
 - 1. The ANSI A300 'Standard Practices for Trees, Shrubs, and Other Wood Plant Materials' of the Secretariat: National Arborist Association, Post Office Box 1094, Amherst, New Hampshire 03031.
 - 2. American National Standards Institute (ANSI) Standard Z-133.1.
 - 3. The standards and practices of the International Society of Arborists.
 - 4. The standards and practices of the New Hampshire Arborist Association.
 - 5. The standards and practices of the American Association of Nurserymen.
- B. The term 'Owner' shall mean the Owner's designated representative charged with carrying out the requirements of this Project, Architect, Engineer, Planner, or Tree Warden as referenced herein, rendering approvals for the Owner.

1.06 EXAMINATION OF SITE AND DOCUMENTS:

- A. The Contractor shall be responsible for having a clear understanding of the existing site conditions and shall be responsible for fully carrying out the work of this Section, regardless of actual site conditions encountered.

1.07 ORDER OF WORK:

- A. Based on the site conference, the Contractor shall submit a schedule of work for the Owner's review and approval prior to beginning work. Unless otherwise authorized by the Owner, failure of the Contractor to comply with the approved removal schedule shall be sufficient cause to give notice that the Contractor is in default of the contract.

1.08 PROTECTION OF TREES TO BE PRESERVED:

- A. The Contractor shall protect all existing trees and other site features designated to remain. The placement of protection devices, such as snow fence enclosures, shall, however, be at the Contractor's discretion.
- B. Damage no trees to remain by burning, pumping water, cutting of live roots or branches, or any other means. Neither vehicles nor equipment shall be parked within the dripline of trees to remain, or where ever damage may result to trees to be saved. Construction material shall not be stored beneath trees to be saved.
- C. The Contractor shall be liable for any damage to any trees or other site features to remain, and shall immediately report to the Owner. Damaged trees and other site features shall be restored or replaced to match existing to remain to the satisfaction of the Owner.
- D. The Contractor shall compensate the Owner for damages by installing replacement tree(s) of the size and species approved by the Owner and of sufficient quantity such that the sum of the Diameter at Breast Height (DBH) inches for replacement trees equals the total DBH inches of the damaged tree(s). Damaged shrubs shall be replaced with shrubs(s) of the same size, species, and quantity, unless determined otherwise by the Owner.

1.09 USE AND CARE OF THE SITE:

- A. The Contractor shall leave the work site at the end of each working period in a condition satisfactory to the Owner.
- B. Pavements shall be swept and lawns or other surfaces raked and/or otherwise cleaned of all material related to the work operation. Degree of clean-up required will be described by the Owner and will be based upon the character of the work area.
- C. All trimmings or any other form of debris shall be collected and chipped. The Contractor shall remove all materials and shall dispose of such materials off site in a legal manner.
- D. The Contractor shall be fully and solely responsible for any damage to equipment or vehicles left at the site of the work. All necessary permits shall be obtained by the Contractor.

PART 2 - PRODUCTS

2.01 EQUIPMENT:

- A. Equipment necessary for this Contract shall be properly maintained and in good operating condition to the City's satisfaction. The Contractor shall promptly remove and replace any equipment which the Owner deems to be in unsatisfactory condition or otherwise unsuitable.
- B. Cutting tools shall be kept well sharpened to provide clean smooth cuts. Any tools utilized on any tree suspected to have cankers or other fungal, bacterial or viral diseases shall be sterilized or not used on any other specimen.
- C. A disc chipper shall be used which will process material up to twelve (12) inches in diameter.

PART 3 - EXECUTION

3.01 PRUNING:

- A. Under this Section, the Contractor shall furnish all labor, materials, equipment and transportation required to complete all aspects of the work in accordance with all local, state and federal regulations in force at the same time of this Contract and in accordance with tree pruning as specified herein.
- B. The work of this Section consists of all pruning work and related items as specified herein and includes, but is not limited to:
 - 1. Pruning – Crown cleaning on all trees to remain as well as limb removal required to allow for the proper installation of scope of work, as approved by Owner's Representative prior to any pruning operations.

Crown cleaning is defined as medium pruning and shall consist of the removal of dead, dying, diseased, crossing, interfering, objectionable and weak branches on the main trunks as well as those within the leaf area. An occasional branch one (1) inch or less in diameter may remain within the main leaf area where it is not practical to remove it.

3.02 DESCRIPTION OF PRUNING WORK:

- A. Pruning and trimming are generally described as the removal and disposal of limbs, branches and stubs which are either dead, potentially detrimental to the health of the tree or dangerous to pedestrians, visually deficient, interfering or otherwise objectionable as determined by the Owner.
- B. The limits of all trees to be pruned have been identified on the plans or referenced elsewhere in this specification section.

- C. Vehicle access shall be controlled and approved by the Owner.
- D. If the Contractor discovers tree(s) which have not been marked for pruning, but whose condition is such that removal is warranted, whether due to death, disease, decay, or structural weakness, such tree(s) shall not be pruned and the Contractor shall immediately report these findings in writing to the Owner and await the Owner's direction before proceeding with work on the particular tree(s) in question.
- E. All pruning shall be performed in a manner that maintains the natural aesthetic characteristics of the species and variety of trees. No topping or dehorning of trees or stubbing back of branches shall be permitted. All cuts shall be made to a lateral branch that is a minimum of one third (1/3) the size of the branch being removed, unless otherwise instructed by the Owner.
- F. The use of climbing spurs or spiked shoes shall not be permitted and their use will result in the immediate cancellation of the contract.
- G. All cuts shall be made sufficiently close to the parent stem so that wound closure can be readily started under normal conditions. Cuts shall, however, never be made through the branch collar. Slab cuts and rip cuts will result in cancellation of the contract.
- H. All limbs over two (2) inches in diameter to be removed shall be precut to prevent splitting. Any branches that by falling would injure existing trees to remain or other objects shall be lowered to the ground by proper ropes.
- I. On trees known to be diseased and where there is known to be danger of transmitting the disease on tools, tools shall be disinfected with alcohol or bleach after each cut between trees.
- J. Lateral branches as well as occasional branch suckers ("water sprouts") may be retained. Complete removal of secondary laterals and branch suckers resulting in the stripping of major limbs, ("lion tailing") will not be permitted.
- K. Tree paint to seal pruning cuts shall not be used.
- L. All branches and limbs shall be manually lowered to the ground via rope and pulley. This practice must be consistent with the National Arborist Association Standards for Pruning. All grade-level artifacts and landscaping must be protected from damage.

3.03 REMOVALS:

- A. The Contractor shall furnish all labor, materials, equipment and transportation required to complete all aspects of the removals work in accordance with all local,

state, and federal regulations in force at the time of this contract and in accordance with tree and stump removals as specified herein and with approval by owner's representative.

3.04 DESCRIPTION OF REMOVAL WORK:

- A. Removal is generally described as the removal of groups and individual trees which interfere with the growth of more desirable types of trees; the clearing away of lesser growth that may obscure outstanding trees; and thinning out to provide space for healthy growth by the elimination of thinner, weaker trees.
- B. The Contractor shall adhere to the specifications and provide suitable facilities for inspecting the work. Failure of the Owner to immediately reject unsatisfactory work or to notify the Contractor of deviations from the specification shall not relieve the Contractor of responsibility to correct or remedy unsatisfactory work.
- C. The Contractor shall only work on trees designated by the Owner. No compensation will be made for work performed on any other tree or trees.
- D. Trees designated to be removed shall be taken down and all leaves, branches and trunks of trees properly disposed of by chipping and removal from the premises.
- E. Fell trees in a manner that allows all site features and those trees to be saved undamaged.
- F. Removal of all the parts of each tree shall be completed on the same day that the tree is cut.
- G. Stumps shall be ground to eighteen (18) inches below grade by grinding or other means acceptable to the Owner. The void from the stump removal operations shall be filled with ordinary borrow soil to within six (6) inches of finished grade. The top six (6) inches shall be filled with screened loam, moderately tamped to prevent future settling. In grass areas the disturbed area shall be sown with grass seed of a mix appropriate to the location, as directed by the Owner.
- H. Excavation or grading within the branch spread of trees to be saved shall be performed only under the direction of the Owner unless otherwise directed. Removal of pavement such as bituminous concrete in these zones shall be by hand tools and/or air spade to ensure root health for trees to remain.
- I. All equipment to be used and all work to be performed must be in full compliance with all standards as promulgated by OSHA at the time of bidding, including but not limited to those regulations concerning noise levels, protective devices and operator safety.
- J. The Contractor shall be solely responsible for pedestrian and vehicular safety and

control within the work site and shall protect the public and its property from injury or damage that could be caused by the progress of the work. To this end the Contractor shall provide, erect, and maintain protective devices acceptable to the Owner, including but not limited to barricades, lights and warning signs.

- K. Any practice employed by the Contractor that is obviously hazardous as determined by the Owner shall be immediately discontinued by the Contractor upon receipt of either written or oral notice from the Owner to discontinue such practice.

END OF SECTION 31 13 16

SECTION 31 23 01
ROCK EXCAVATION AND DISPOSAL

PART 1 - GENERAL

1.01 WORK INCLUDED:

The Contractor shall excavate rock, if encountered, to the lines and grades indicated on the drawings or as required, shall dispose of the excavated material, and shall furnish the required material as specified in Section 31 00 00, EARTHWORK for backfill in place of the excavated rock. Based on boring and test pit information no rock is expected on this project. Should rock be encountered, the unit price will be utilized to compensate the contractor for unanticipated subsurface conditions as they relate to rock.

1.02 RELATED WORK:

- A. Section 31 50 00, SUPPORT OF EXCAVATION
- B. Section 31 00 00, EARTHWORK

1.03 DEFINITIONS:

- A. The word "rock," wherever used as the name of the excavated material or material to be excavated, shall mean only boulders and pieces of concrete or masonry exceeding one cubic yard in volume, or solid ledge rock which, in the opinion of the Engineer, requires for its removal, drilling and blasting, wedging, sledging, barring, or breaking up with a power-operated tool. No soft or disintegrated rock which can be removed by normal earth excavation methods, no loose, shaken, or previously blasted rock or broken stone in rock fillings or elsewhere, and no rock exterior to the maximum limits of measurement allowed, which may fall into the excavation, will be measured or allowed as "rock."
- B. The word "earth," wherever used as the name of an excavated material, or material to be excavated shall mean all kinds of material other than rock as above defined.

1.04 QUALITY ASSURANCE:

- A. The Contractor shall conform to all municipal ordinances and state and federal laws relating to the transportation, storage, handling, and use of explosives. In the event that any of the above-mentioned laws, ordinances, or regulations require a licensed blaster to perform or supervise the work of blasting, said licensed blaster shall, at all times, have his license on the work site and shall permit examination thereof by the Engineer or other officials having jurisdiction.
- B. The Contractor shall procure all permits required for blasting.

1.05 SUBMITTALS:

- A. At least two weeks before beginning blasting operations, the Contractor shall submit to the Engineer for record the following data:

1. Name of Contractor or Subcontractor responsible for blasting and monitoring operations and license number.
 2. Name, affiliation, and license number of the person or persons who will be directly responsible for designing each blast, supervising the loading of the shot, and firing it.
- B. Copies of all permits required for blasting.
- C. Results of pre-blast survey.
- D. When blasting is in progress, daily reports on blasting operations and blast monitoring results.

1.06 DELIVERY/STORAGE AND HANDLING:

Delivery, storage and handling of explosives shall conform to all federal, state and local regulations and permits.

PART 2 - PRODUCTS - NOT APPLICABLE

PART 3 - EXECUTION

3.01 PREPARATION/PRE-BLAST SURVEY

If required, the pre-blast survey shall be conducted in accordance with state regulations and/or local permit requirements.

3.02 EXCAVATION:

- A. The Contractor shall excavate rock to the lines and grades indicated on the drawings or as required by the Engineer. The excavated rock shall be removed and disposed of by the Contractor as specified for surplus excavated materials under Section 31 00 00, EARTHWORK.
- B. Work damaged by blasting shall be repaired or replaced at the Contractor's expense.
- C. If rock is excavated beyond the limits of payment indicated on the drawings, specified, or authorized in writing by the Engineer, the excess excavation, whether resulting from over breakage or other causes, shall be backfilled, by and at the expense of the Contractor, as specified below:
 1. In pipe trenches, excess excavation shall be filled with the required material and compacted in the same manner as specified for the material in the zone around the pipe under Section 31 00 00, EARTHWORK.
 2. In excavations for structures, excess excavation in the rock beneath foundations shall be filled with concrete which shall have a minimum 28-day compressive strength of 3000 psi. Other excess excavation shall be filled with Class B backfill compacted to a minimum of 92 percent density (ASTM D1557 Method C) as specified under Section 31 00 00, EARTHWORK.
 3. If the rock below normal depth is shattered due to drilling or blasting operations of the Contractor, and the Engineer considers such shattered rock to be unfit for foundations, the

shattered rock shall be removed and the excavation shall be backfilled with concrete as required, except that in pipe trenches crushed stone may be used for backfill, if approved. All such removal and backfilling shall be done by and at the expense of the Contractor.

- D. When required by the Engineer, the Contractor shall remove all dirt and loose rock from designated areas and shall clean the surface of the rock thoroughly to determine whether seams or other defects exist.
- E. When concrete is to be placed on rock, the rock shall be free of all vegetation, dirt, sand, clay, boulders, scale, excessively cracked rock, loose fragments, water, ice, snow, and other objectionable substances.

3.03 VIBRATION AND AIR BLAST MONITORING:

- A. The Contractor shall measure air blast and vibration levels of blasting operations to assure compliance with all applicable regulations and local permits.
- B. Records of each day's air blast and vibration measurements shall be submitted to the Engineer in writing no later than the start of the next day's work. Records shall include, as a minimum:
 - Identification of instrument
 - Name of observer
 - Name of interpreter
 - Distance and direction of recording station from the area of detonation
 - Date and exact time of reading
 - Type of ground at recording station
 - Peak particle velocity for all components as well as resultant for all frequencies of vibrations
 - Duration of motion with a velocity in excess of one thousandth of an inch per second
 - A copy of the photographic record of seismograph readings
 - Peak air blast level.

3.04 BLASTING RECORDS:

The Contractor shall prepare and submit to the Engineer daily blast reports, including logs of each blast. Reports shall be submitted to the Engineer no later than the start of the next day's work. However, during each day of blasting, the Contractor shall review and shall provide access for the Engineer to review the data from that day's blasting. Reports after each blast shall include at least the following information for each blast:

- Date, time, and location of blast

- Permit number and expiration date
- Amount and type of explosives used by weight and number of cartridges
- Total number of delays used and number of holes used for each delay
- On a diagram of the blast pattern, indicate total number and depth of holes, maximum charge per delay, maximum charge per hole, and corresponding delay number
- An evaluation of the blast indicating areas of significant over break, unusual results, and any recommended adjustments for the next blast.

3.05 POST BLASTING INSPECTIONS:

The Contractor shall examine any properties, structures, and conditions where complaints of damage have been received or damage claims have been filed. Advance notice shall be given to all interested parties so that the parties may be present during the final examination. Records of the final examination shall be signed and distributed to the owner of the property, the head of the local fire department, and the Engineer.

END OF SECTION

SECTION 31 23 19
DEWATERING

PART 1 - GENERAL

1.01 WORK INCLUDED:

This section specifies designing, furnishing, installing, maintaining, operating and removing temporary dewatering systems as required to lower and control water levels and hydrostatic pressures during construction; disposing of pumped water; constructing, maintaining, observing and, except where indicated or required to remain in place, removing of equipment and instrumentation for control of the system.

1.02 RELATED WORK:

- A. Section 31 25 15, ENVIRONMENTAL PROTECTION
- B. Section 31 00 00, EARTHWORK
- C. Section 31 50 00, SUPPORT OF EXCAVATION

1.03 SYSTEM DESCRIPTION:

- A. Dewatering includes lowering the water table and intercepting seepage which would otherwise emerge from the slopes or bottom of the excavation; increasing the stability of excavated slopes; preventing loss of material from beneath the slopes or bottom of the excavation; reducing lateral loads on sheeting and bracing; improving the excavation and hauling characteristics of sandy soil; preventing rupture or heaving of the bottom of any excavation; and disposing of pumped water.
- B. Normal dewatering is defined as using conventional pumps installed in open excavations, ditches, or sumps. Special dewatering is defined as using single or two stage well points, deep wells, or educator and ejector systems installed in drilled holes or jetted in place.

1.04 QUALITY ASSURANCE:

- A. The Contractor is responsible for the adequacy of the dewatering systems. He shall retain the services of a Professional Engineer registered in the state where the project is located, experienced in dewatering systems, to independently evaluate the boring and test pit logs and any other soils information available to determine those areas that will require special dewatering techniques and to design the required system. The Contractor's Professional Engineer shall provide sufficient on-site inspection and supervision to assure that the dewatering is carried out in accordance with his design.
- B. The dewatering systems shall be capable of effectively reducing the hydrostatic pressure and lowering the groundwater levels to a minimum of 2 feet below excavation bottom,

unless otherwise required by the Engineer, so that all excavation bottoms are firm and dry.

- C. The dewatering system shall be capable of maintaining a dry and stable subgrade until the structures, pipes and appurtenances to be built therein have been completed to the extent that they will not be floated or otherwise damaged.
- D. The dewatering system and excavation support (see Section 31 50 00) shall be designed so that lowering of the groundwater level within the work area does not adversely affect structures, utilities or wells outside of the work area.
- E. Where special dewatering is used, the Contractor shall obtain at his expense the services of a registered professional engineer to investigate, design and monitor the dewatering system. The Contractor shall also furnish materials and install at least two observation wells at each excavation area. The location of the wells shall be determined in the field by the Contractor's engineer.

1.05 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

- A. At least two weeks prior to installing his dewatering system, Contractor shall submit the attached Certificate of Design completed and signed by Contractor, identifying the engineer responsible for design of the dewatering system. He shall also submit a schedule showing the timing of installation and operation of the dewatering system.
- B. The Contractor shall submit to the Engineer for record purposes only, the following items bearing the Contractor's Engineer's stamp and signature, and identifying the codes and specifications followed in the design.
 - 1. Plans and description of the dewatering system, including the number, location and depth of wells, well points or sumps; designs of filters to prevent pumping of fine soil; method and location for filtering and disposal of pumped water; and flow capacity of proposed system.
 - 2. Locations of observation wells.
- C. The Contractor shall submit records of pump operation and groundwater elevations as required by the Owner's Engineer.

PART 2 - PRODUCTS: NOT APPLICABLE

PART 3 - EXECUTION

3.01 DEWATERING OPERATIONS:

- A. All water pumped or drained from the work shall be disposed of in a manner which will not result in undue interference with other work or damage to adjacent properties, pavements and other surfaces, buildings, structures and utilities. Suitable temporary pipes, flumes or channels shall be provided for water that may flow along or across the site of the work.
- B. Dewatering facilities shall be located where they will not interfere with utilities and construction work to be done by others.
- C. Dewatering procedures to be used shall be as described below:
 - 1. Crushed stone shall encapsulate the suction end of the pump to aid in minimizing the amount of silt discharged.
 - 2. For dewatering operations with relatively minor flows, pump discharges shall be directed into haybale sedimentation traps lined with filter fabric. Water is to be filtered through the haybales and filter fabric prior to being allowed to seep out into its natural water course.
 - 3. For dewatering operations with larger flows, pump discharges shall be into a steel dewatering basin. Steel baffle plates shall be used to slow water velocities to increase the contact time and allow adequate settlement of sediment prior to discharge into waterways.
 - 4. Where indicated on the contract drawings or in conditions of excess silt suspended in the discharge water, silt control bags are to be utilized in catch basins.
- D. The Contractor shall be responsible for repair of any damage caused by his dewatering operations, at no cost to the Owner.

3.02 SPECIAL DEWATERING:

- A. If conventional dewatering methods are inadequate to ensure dry and stable conditions for structural foundations, the Contractor shall be required to use special dewatering as necessary.
- B. Special dewatering techniques may consist of one or two stage wellpoint systems, deep wells, or eductor and ejector type systems. The Contractor shall utilize a system which

provides proper construction conditions and prevents settlement at time of installation and upon backfilling.

- C. In areas requiring special dewatering, the Contractor shall lower the groundwater level to a minimum of 2 feet below the bottom of the final excavation grade prior to any installation and maintain that groundwater level until the excavation has been backfilled. The groundwater levels shall be monitored by the Contractor's engineer to ensure conformance with the requirements of these specifications. Construction will not be allowed until the Owner's Engineer is satisfied that the above provisions are met.

3.03 NOISE LEVEL REQUIREMENTS:

- A. All primary dewatering equipment shall be electrically operated and shall run on commercial power. Standby equipment shall be independent of commercial power and shall provide dewatering upon primary pump or power failure.
- B. All equipment utilized by the Contractor shall conform to the Department of Environmental Protection Division of Air Quality Control regulations governed by the following policy:

"A source of sound will be considered to be violating the Department's noise regulation (310 CMR 7.10) if the source:

1. Increases the broadband sound level by more than 10 dB(A) above ambient, or
2. Produces a "pure tone" condition - when any octave band center frequency sound pressure level exceeds the two adjacent center frequency sound pressure levels by 3 decibels or more.

These criteria are measured both at the property line and at the nearest inhabited residence. Ambient is defined as the background A-weighted sound level that is exceeded 90% of the time measured during equipment operating hours. The ambient may also be established by other means with the consent of the Department."

The Contractor shall construct sound enclosures or utilize other noise reduction techniques if the equipment does not meet the noise level requirements.

END OF SECTION - 31 23 19

(Certificate of Design follows this page)

CERTIFICATE OF DESIGN

Re: Contract Between:

OWNER: _____
(Name)

and

CONTRACTOR: _____
(Name)

on

CONTRACT: _____
(Number)

Date: _____

Title: _____

Contractor hereby certifies that _____:
(Engineer)

1. Is licensed or registered to perform professional engineering work in the state of _____;
(Location of Project)
2. Is qualified to design the _____
(Item)
specified in Section _____ of subject contract;
3. Has designed _____ before;
(Item)
4. Has prepared the design in full compliance with the applications and requirements of Section _____ of subject contract including all applicable laws, regulations, rules, and codes; and
5. The work has been signed and sealed pursuant to applicable state law.

FOR: _____
(Contractor)

BY: _____
(Signature)

(Name and Title)

Dated: _____

Document1

SECTION 31 45 00
GEOTEXTILE FABRICS

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. This Section covers furnishing of all labor, materials, and equipment necessary to install specified geotextile fabrics in locations shown on the drawings and as required by the Engineer.
- B. Related Work: The following items are not included in this Section and will be performed under the designated Sections:
 - 1. Section 01 33 39 – SUBMITTAL PROCEDURE
 - 2. Section 31 00 00 – EARTHWORK
 - 3. Section 31 25 00 – EROSION AND SEDIMENTATION CONTROLS

1.02 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

- A. The Contractor shall submit each item in this Article according to the Conditions of the Contract and Section 01 33 39 – SUBMITTAL PROCEDURE, for information only, unless otherwise indicated.
- B. Shop drawings or working drawings and material specifications shall be submitted to the Engineer for review for each type of geotextile fabric furnished. General installation practices and installation schedule shall be included.

PART 2 - PRODUCTS

2.01 DEMARCATION LAYER GEOTEXTILE:

- A. The demarcation layer shall be an orange, non-woven geotextile composed of continuous polypropylene filament fibers bonded together to form a sheet. The fabric shall meet the following minimum mechanical and physical properties:

Property	Test Method	Unit	Minimum Requirement*
Weight	ASTM D5161	oz/yd ²	8.0
Thickness	ASTM D5199	mils	70
Grab Tensile Strength	ASTM D4632	lbs	240
Grab Tensile Elongation	ASTM D4632	%	70
Trapezoidal Tear Strength	ASTM D4533	lbs	90
CBR Puncture Strength	ASTM D6241	lbs	630
Apparent Opening Size (AOS)	ASTM D4751	US Sieve	80
Permittivity	ASTM D4491	sec ⁻¹	1.5
Flow Rate	ASTM D4491	gal/min/ft ²	95
UV Resistance (at 500 hours)	ASTM D4355	% strength ret.	80

* - in the machine and transverse directions

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Installation of geotextile fabrics shall be strictly in accordance with manufacturer's instructions and specific layout plans and details reviewed by the Engineer.
- B. Geotextile fabrics shall be installed as shown on the Drawings or as required by the Engineer. The Contractor shall follow the manufacturer's installation recommendations to ensure proper completion of the fabric installation.
- C. Demarcation layer geotextile fabric shall be overlapped by a minimum of two feet.

3.02 FINAL INSPECTION AND ACCEPTANCE:

- A. The Contractor shall, at his expense, have a manufacturer's representative inspect the work at completion of the installation. Any work found to be unsatisfactory shall be corrected at the Contractor's expense.
- B. The Engineer, at the Contractor's expense, reserves the right to have a manufacturer's representative inspect the installation process at any time during construction.

END OF SECTION

SECTION 31 50 00
SUPPORT OF EXCAVATION

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. This section of the specification covers wood sheeting and bracing for support of excavations. The requirements of this section shall also apply, as appropriate, to other methods of excavation support and underpinning which the Contractor elects to use to complete the work.
- B. The Contractor shall furnish and place timber sheeting of the kinds and dimensions required, complying with these specifications, where indicated on the drawings or required by the Engineer.

1.02 RELATED WORK:

- B. Section 31 23 00 – EARTHWORK.

1.03 QUALITY ASSURANCE:

- A. This project is subject to the Safety and Health regulations of the U.S. Department of Labor set forth in 29 CFR, Part 1926, and to the New Hampshire Department of Labor regulations. Contractors shall be familiar with the requirements of these regulations.
- B. The excavation support system shall be of sufficient strength and be provided with adequate bracing to support all loads to which it will be subjected. The excavation support system shall be designed to prevent any movement of earth that would diminish the width of the excavation or damage or endanger adjacent structures.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Timber sheeting shall be sound spruce, pine, or hemlock, planed on one side and either tongue and grooved or splined. Timber sheeting shall not be less than nominal 2-inches thick.
- B. Timber and steel used for bracing shall be of such size and strength as required in the excavation support design. Timber or steel used for bracing shall be new or undamaged used material which does not contain splices, cutouts, patches, or other alterations which would impair its integrity or strength.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Work shall not be started until all materials and equipment necessary for their construction are either on the site of the work or satisfactorily available for immediate use as required.
- B. The sheeting shall be securely and satisfactorily braced to withstand all pressures to which it may be subjected.
- C. The sheeting shall be driven by approved means to the design elevation. No sheeting may be left so as to create a possible hazard to safety of the public or a hindrance to traffic of any kind.
- D. If boulders or very dense soils are encountered, making it impractical to drive a section to the desired depth, the section shall, as required, be cut off.
- E. The sheeting shall be left in place where indicated on the drawings or required by the Engineer in writing. At all other locations, the sheeting may be left in place or salvaged at the option of the Contractor. Steel or wood sheeting permanently left in place shall be cut off at a depth of not less than two feet below finish grade unless otherwise required.
- F. All cut-off will become the property of the Contractor and shall be removed by him from the site.
- G. Responsibility for the satisfactory construction and maintenance of the excavation support system, complete in place, shall rest with the Contractor. Any work done, including incidental construction, which is not acceptable for the intended purpose shall be either repaired or removed and reconstructed by the Contractor at his expense.
- H. The Contractor shall be solely responsible for repairing all damage associated with installation, performance, and removal of the excavation support system.

END OF SECTION - 31 50 00

SECTION 32 12 16

BITUMINOUS CONCRETE PAVING

PART 1 - GENERAL

1.01 WORK INCLUDED:

The Contractor shall furnish all labor, materials and equipment and shall replace the pavements as indicated on the drawings and as herein specified.

1.02 RELATED WORK:

- A. Section 01 35 00, PERMITS
- B. Section 01 56 16, DUST CONTROL
- C. Section 31 00 00, EARTHWORK
- D. Section 33 44 13, PRECAST MANHOLES AND CATCH BASINS

1.03 SYSTEM DESCRIPTION:

A. GENERAL

The types of pavement systems to be utilized on this project are as follows:

TYPE 1. PARKING LOT PAVEMENT (Heavy Duty Bit. Conc. Pavement)

Areas shall be paved with binder course pavement, 2 1/2 inches thick, followed by top course pavement, 1 1/2 inches thick.

TYPE 2. SIDEWALK PAVEMENT

Areas shall be paved with binder course pavement, 1 1/2 inches thick, followed by top course pavement, 1 1/2 inches thick.

1.04 REFERENCES

The following standards form a part of these specifications and indicate the minimum standards required:

American Society for Testing and Materials (ASTM)

ASTM D1557 Test for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 Pound Rammer and 18-Inch Drop

State of New Hampshire Department of Transportation
Standard Specifications for Road and Bridge Construction (NHDOT)

NHDOT 304	Aggregate Base Course
NHDOT 306	Reclaimed Stabilized Base
NHDOT 401	Plant Mix Pavements - General
NHDOT 403	Hot Bituminous Pavement
NHDOT 411	Plant Mix Surface Treatment
NHDOT 417	Cold Planing of Bituminous Surfaces

NHDOT 632 Retroreflective Pavement Markings

Federal Specifications

SS-S-1401C	Sealants, Joint, Non-Jet-Fuel-Resistant, Hot Applied, for Portland Cement and Asphalt Concrete Pavement
------------	---------------------------------------------------------------------------------------------------------

American Association of State Highway and Transportation Officials

AASHTO M 220	Standard Specifications for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements
--------------	------------------------------------------------------------------------------------------------------

1.05 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

Six sets of complete job mix formula shall be submitted to the Engineer at least two weeks before any of the work of this section is to begin.

PART 2 - PRODUCTS

2.01 GRAVEL SUBBASE:

- A. Gravel subbase shall consist of inert material that is hard durable stone and coarse sand, free from loam and clay, surface coatings and deleterious materials.
- B. Gradation requirements for gravel subbase shall be as specified in Section 31 00 00, EARTHWORK for Gravel Borrow.

2.03 BITUMINOUS CONCRETE PAVEMENT:

- A. Bituminous concrete mixtures shall be within the composition limits of base courses, binder courses, top courses and surface treatment, in accordance with Section 401 Plant Mix Pavements - General, with constituents that conform to Table A, below.

TABLE A
PERCENT BY WEIGHT PASSING SIEVE DESIGNATION

Standard Sieves (in.)	Base Course	Binder Course	Top Course	Surface Treat.
1-1/4 in	95-100			
1 in	75-95			
3/4 in	62-84	95-100		
1/2 in	50-70	70-92	95-100	
3/8 in	42-60	60-80	85-95	95-100
No.4	28-45	42-57	60-75	64-80
No.10	18-27	28-38	38-50	44-55
No. 20	10-18	16-24	24-32	25-35
No.40	5-13	9-17	14-23	15-25
No.80	1-9	3-11	6-14	6-16
No.200	0-4	0-4	2-6	2-6
Asphalt cement, % of mix	3.8-4.8	4.8-6.0	6.0-7.0	6.25-7.0

- C. The elastomeric joint seal shall conform to AASHTO M 220.
- D. The tack coat shall be an asphalt emulsion, RS-1 , conforming to Section 702 Bituminous Materials.

2.04 PAINT FOR PARKING LOTS

- A. Paint for parking lot lines shall conform to Federal Specification TT-P-115-E Type 1. Paint shall be 11-3 PPG Industries, Pittsburgh, PA or approved equal.

PART 3 - EXECUTION

3.01 GENERAL:

Paving courses required for the project shall be as shown on the drawings and as specified herein. Pavement thicknesses specified are measured in compacted inches. If a pavement course thickness exceeds 2-1/2 compacted inches, the course shall be installed in multiple lifts with each lift not exceeding 2-1/2 compacted inches in thickness.

3.02 GRAVEL SUBBASE:

- A. The gravel subbase to be placed under pavement shall consist of **12-inches** of gravel evenly spread and thoroughly compacted.
- B. The gravel shall be spread in layers not more than 4-inches thick, compacted measure. All layers shall be compacted to not less than 95 percent of the maximum dry density of the material as determined by ASTM D1557 Method C at optimum moisture content.

3.03 BITUMINOUS PAVEMENT:

- A. The bituminous paving mixture, equipment, methods of mixing and placing, and the precautions to be observed as to weather, condition of base, etc., shall be in accordance with Section 401.
- B. **BASE COURSE AND BINDER COURSE PAVEMENT:**
 - 1. Immediately prior to installing the base and/or binder course, the trimmed edges shall be made stable and unyielding, free of loose or broken pieces and all edges shall be thoroughly broomed clean. Contact surfaces of trench sides, curbing, manholes, catch basins, or other appurtenant structures in the pavement shall be painted thoroughly with a uniform coating of asphalt emulsion (tack coat), just before any mixture is placed against them.
 - 2. The binder course shall be repaired as necessary to maintain the surface of the pavement until placement of the permanent overlay. If required, the Contractor shall place a leveling course before placing the permanent overlay.
- C. **TOP (WEARING) COURSE OR SURFACE TREATMENT PAVEMENT (PERMANENT OVERLAY):**
 - 1. Top course or surface treatment shall be placed over the trench or full width as shown on the drawings or as specified.
 - 2. Prior to placement of the top course or surface treatment, the entire surface over which the top course or surface treatment is to be placed shall be broom cleaned and tack coated.

3. Top course or surface treatment pavement placed over trenches may be feathered to meet existing paved surfaces, if approved by the Engineer.
4. Prior to placing full width top course or surface treatment pavements, keyways shall be cut in all intersecting streets.

3.08 PAVEMENT PLACEMENT:

- A. Unless otherwise permitted by the Engineer for particular conditions, only machine methods of placing the pavement shall be used. The equipment for spreading and finishing shall be mechanical, self-powered pavers, capable of spreading and finishing the mixture true to line, grade, width and crown. The mixtures shall be placed and compacted only at such times as to permit proper inspection and checking by the Engineer.
- B. After the paving mixtures have been properly spread, initial and final compaction shall be obtained by the use of steel wheel rollers having a weight of not less than 8 tons. Intermediate compaction shall be done by a pneumatic-tired roller. The rollers shall provide an operating weight of not less than 2,000 pounds per wheel.
- C. Final rolling of the top course or surface treatment pavement shall be performed at a mix temperature and time sufficient to allow for final smoothing of the surface and thorough compaction.
- D. Immediately after placement of top course or surface treatment pavement, all joints between the existing and new top course or surface treatment pavements shall be sealed with hot poured rubberized asphalt sealant meeting the requirements of Federal Specification SS-S-1401.

3.09 PARKING LOTS AND DRIVEWAYS:

- A. Pavement thickness shall be as specified. All thicknesses are compacted thicknesses.
- B. Adjacent concrete work, slate work, sidewalks, structures, etc., shall be protected from stain and damage during the entire operation. Damaged or stained areas shall be replaced or repaired to equal their original condition.
- C. All joints between binder and top course shall be staggered a minimum of 6-inches.
- D. After final rolling, no vehicular traffic of any kind shall be permitted on the pavement until it has cooled and hardened sufficiently to prevent distortion and loss of fines, and in no case in less than 6 hours.
- E. Smoothness of all areas of the finished surface shall not vary more than 1/4-inch when tested with a 10 foot straight-edge, applied both parallel to and at right angles to the centerline of the paved area. At building entrances, curbs, and other locations where an

essentially flush transition is required, pavement elevation tolerance shall not exceed plus or minus 1/8-inch. Irregularities exceeding these amounts, or which retain water on the surface, shall be corrected by removing the defective work and replacing or repairing it to the satisfaction of the Engineer.

- F. The surface area to be seal coated, as shown on the drawings, shall be swept and air cleaned. The first coat shall be applied with eight (8) pounds of #30 silica sand blended with each gallon of emulsion applied at a rate of 0.15 gallons per square yard. The second coat shall be a straight sealer applied at the rate of 0.1 gallons per square yard.
- G. The Contractor shall prepare the pavement surface for painting lines according to the recommendations of the paint manufacturer. Applied markings shall have clean-cut edges, true and smooth alignment and uniform film thickness of 15 mils, +/- 1.0. The Contractor shall be responsible for removing, to the satisfaction of the Engineer, tracing marks, and spilled paint applied in an unauthorized area.

3.11 RAISING AND ADJUSTING CASTINGS:

- A. In areas of permanent top course paving, existing municipally-owned catch basin and manhole castings and valve boxes shall be raised to the proper grade where directed by the Engineer.
- B. Castings owned by private utilities shall be raised by their own forces. The Contractor shall be responsible for coordinating this work.
- C. The method of adjusting these castings shall be as follows: Cut around catch basin or manhole castings a minimum of 8-inches from casting. Excavate and if required rebuild up to 12-inches of masonry below the bottom of the casting. Backfill with suitable material and compact to bottom of casting. Place high, early strength cement or bituminous concrete collar, as directed, to approximately 1½-inches below the raised casting grade. Masonry work shall conform to Section 33 44 13, PRECAST MANHOLES AND CATCH BASINS.
- D. In some areas, raising of castings may not be required. Where directed by the Engineer, castings not to be raised shall have at least 12-inches of bituminous concrete pavement chipped and removed around the casting. New bituminous concrete pavement shall be placed and compacted around such castings to approximately 1-1/2-inches below the top of the casting. The overlay course shall then be sloped down to the level of the casting.
- E. The method of raising valve boxes shall be as follows: Cut around valve box a minimum of 8-inches from valve box. Excavate as required and raise the valve box. Pour high early strength cement or bituminous concrete collar, as directed, to approximately 1-1/2-inches below the top of the valve box.
- F. Castings, which need to be raised or adjusted to complete permanent curb to curb paving, shall be done immediately prior to paving.

3.12 PAVEMENT MARKINGS:

- A. The Contractor shall replace all pavement markings removed or covered-over in carrying out the work, and as directed by the Engineer, no sooner than 48 hours after completion of permanent pavement. The markings shall be 4-inches wide, white or yellow, single or double lines as required.
- B. When directed by the Engineer, the Contractor shall provide temporary markings at no additional cost to the Owner.

3.13 PAVEMENT REPAIR:

- A. If required in the contract or if permanent pavement becomes rough or uneven, permanent pavement patches and trenches shall be repaired and brought to grade utilizing "infrared" paving methods following completion of the construction.
- B. The Contractor performing the work shall use care to avoid overheating the pavement being repaired.
- C. Pavement repair shall extend a minimum of 6-inches beyond all edges of the pavement patch to assure adequate bonding at the pavement joints.

END OF SECTION

SECTION 32 16 40

CURBING

PART 1- GENERAL

1.01 WORK INCLUDED:

- A. Fabricate, furnish and install granite curbing, as indicated on the Drawings and as specified.

1.02 RELATED SECTIONS:

- A. Section 31 00 00 - EARTHWORK
- B. Section 32 12 16 – BIT. CONC. PAVING
- C. Section 03 30 00 – CAST IN PLACE CONCRETE

1.03 REFERENCES:

- A. Comply with applicable requirements of the following standards and those others referenced in this Section, under the provisions of Division 1.
 - 1. ASTM C 131 - Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
 - 2. New Hampshire Department of Transportation

1.04 SUBMITTALS:

- A. Submit the following under provisions of these specifications:
 - 1. Submit complete shop drawings of each curb type and size for Engineer's approval.

1.05 QUALITY ASSURANCE:

- A. Unless otherwise indicated, concrete curb materials and construction shall conform to the applicable portions of New Hampshire Department of Transportation.

1.06 DELIVERY, STORAGE, AND HANDLING:

- A. Curb units shall be delivered to the job adequately protected from damage during transit.
- B. Curb shall be protected against staining, chipping, and other damage. Cracked, badly chipped, or stained units will be rejected and shall not be employed in the work.

PART II - PRODUCTS

2.01 GRANITE CURB:

- A. Granite for curb shall be engineering grade structural granite conforming to ASTM C615 requirements. Sizing of curb and comers shall be as shown on the Drawings. Granite curb shall be as per the "Standard Specification."
- B. Granite shall be of smooth splitting character and free from seams which impair its structural integrity. Natural variations characteristic of the deposit will be permitted. Granite shall come from an approved quarry.
- C. Cement mortar shall be "natural" to match color of curb.
- D. Concrete shall be 4,000 psi concrete as specified under Section 03 30 00 CAST-IN-PLACE CONCRETE, herein.
- E. Processed gravel fill as specified under Section 31 00 00 EARTHWORK, herein.

PART 3 – EXECUTION

3.01 INSTALLATION - GRANITE CURBS:

- A. Furnish and install new granite curb and reset existing granite curb removed and stockpiled for reuse, herein. Curb shall be set straight, plumb and as shown on the Drawings.
- B. Curb shall be set in a concrete cradle in a trench excavated to a width of twenty-four inches (18"). The subgrade of the trench shall be at a depth below proposed finish grade of the curb equal to six inches (6") plus the depth of the curb stone. Base course shall then be filled with processed gravel fill to proper level to support curb at final grade and thoroughly tamped.
- C. Place curb units in accurate line, each piece butting the next with joint spacing no larger than one-quarter inch (1/4). Final points shall be joined by closure pieces made to order. No curb shall be cut in the field. After alignment, the curb shall be carefully backfilled as shown on the Drawings. Extreme care shall be taken not to disturb alignment.
- D. Patch street pavement as required.

SECTION 32 18 13
SYNTHETIC GRASS INFILL SYSTEM

PART 1 - GENERAL

1.01 WORK INCLUDED

- (1.) Provide all labor, materials, equipment and tools necessary for the complete installation of Synthetic Grass Infill System over a graded stone base as outlined in these specifications and in strict accordance with the manufacturer's written specifications with a specially formulated resilient infill of rounded sand and ambiently recycled rubber.
- a. Excavation and placement of graded stone sub-base.
 - b. A drainage system consisting of a pre-fabricated Geocellular interlocking system and collector piping.
 - c. A synthetic grass system with 2.5" long 100% polyethylene fibers, tufted on a 3/8" -1/2" tufting machine. A minimum of 10,800 denier monofilament yarn, and 10,000 denier low friction parallel slit film yarn specifically designed to reduce abrasion, with a fiber weight of not less than 46 ounces per square yard. The turf shall be of dual fiber construction with multi-structured monofilament and slit-film fibers tufted together in same needle stitching of 1/2" gauge, or AB tufting configuration if 3/8" gauge. The system shall include a single, dimensionally stable, three-component backing, and have a minimum of 20 ounces of urethane secondary backing per square yard and a total weight of 74 ounces per square yard. The finished product shall also include perforations (1/4" holes on 4" centers) to ensure maximum drainage. Systems that are tufted on larger than 1/2" gauge tufting machines, are not perforated or include any type of nylon fiber "thatch zone" shall not be acceptable.
 - d. A resilient infill system, consisting of a course, rounded, uniformly sized silica sand and graded ambient SBR crumb rubber. (Minimum total weight of 7 lbs. per square foot with a 50/50 sand and rubber ratio – No Exceptions). Infill shall be installed to a minimum height of 2.0 inches providing no more than 1/2 inch exposed fiber.
 - e. Or an Engineer approved equivalent.
- (2.) Provide all labor, materials, equipment and tools necessary for the complete installation of Synthetic Grass Infill System over a graded stone base as outlined in these specifications and in strict accordance with the manufacturer's written specifications with a specially formulated resilient infill of rounded sand and

ambiently recycled rubber.

- a. Excavation and placement of graded stone sub-base.
- b. A drainage system consisting of a pre-fabricated Geocellular interlocking system and collector piping.
- c. A synthetic grass system with 1.75" long 100% polyethylene fibers, tufted on a 3/8" -1/2" tufting machine. A minimum of 10,800 denier monofilament yarn, and 10,000 denier low friction parallel slit film yarn specifically designed to reduce abrasion, with a fiber weight of not less than 46 ounces per square yard. The turf shall be of dual fiber construction with multi-structured monofilament and slit-film fibers tufted together in same needle stitching of 1/2" gauge, or AB tufting configuration if 3/8" gauge. The system shall include a single, dimensionally stable, three-component backing, and have a minimum of 20 ounces of urethane secondary backing per square yard and a total weight of 74 ounces per square yard. The finished product shall also include perforations (1/4" holes on 4" centers) to ensure maximum drainage. Systems that are tufted on larger than 1/2" gauge tufting machines, are not perforated or include any type of nylon fiber "thatch zone" shall not be acceptable. **(Alternate #2)**
- d. A resilient infill system, consisting of Envirofill (Minimum total weight of 7 lbs. per square foot) Infill shall be installed to a minimum height of 1 1/4 inches providing no more than 1/2 inch exposed fiber. **(Alternate #2)**
- e. A resilient infill system, consisting of Safeshell. (Minimum total weight of 1.5 lbs. per square foot) and raw rounded sand (Minimum total weight 5.0 lbs. per square foot) Infill shall be installed to a minimum height of 1 1/4 inches providing no more than 1/2 inch exposed fiber. **(Alternate #3)**
- f. The installation and operating performance of an athletic field synthetic base underlayment material needed for a synthetic turf field. Primary system requirements for insuring optimum safety of the playing surface (impact attenuation/surface playability) and high capacity subsurface drainage of the installed playing field. **(Alternate #2)**
- g. Or an Engineer approved equivalent.

(3.) APPROVED MANUFACTURERS

- a. Sprinturf
- b. Fieldturf
- c. Astroturf
- d. Act Global
- e. Sportex

1.02 QUALIFICATIONS AND SUBMITTALS

(1.) Prospective Bidders and / or installers of the turf shall be required to comply with the following:

- a. The successful turf contractor must be a member of the Synthetic Turf Council (STC) and Sports Turf Managers Association (STMA).
- b. The turf contractor and / or the turf manufacturer must be experienced in the manufacture and installation of this specific type of sand and rubber infill synthetic grass system, for at least five (5) years and provide references of ten (10) specific installations in the last five (5) years.
- c. The turf manufacturer shall have a minimum of ten (10) installations in the State of New Hampshire.
- d. The turf manufacturer shall have a minimum of Ten (10) game and/or practice fields installed for football or soccer.
- e. The turf contractor and/or turf manufacturer must provide in-house competent workmen skilled in this specific type of synthetic grass installation with a minimum of 10 fields installed. The designated supervisory personnel on the project must be certified in writing by the turf manufacturer as competent in the installation of this material, including the gluing of seams and the proper installation of the infill mixture. The manufacturer shall have a representative on site to certify the installation and warranty compliance.
- f. All designs, marking, layouts, materials shall conform to current National Federation of High School (NFHS) rules and other standards that may be applicable to this type of synthetic grass installation unless there is a specific exception identified. Submit a full color rendering/drawing indicating all field markings for final approval prior to placing turf order. Failure to do so shall be at the contractors risk and cost.

(2.) All bidders of the turf contract must submit to the Engineer the following information:

- a. The Contractor shall submit to the Engineer, prior to the bid, a 1' x 1' minimum sample of the exact synthetic turf and infill system that is specified for this project. A sample of the Resilient Performance Base material shall also be submitted.

- b. The turf contractor / manufacturer shall submit with the bid, a sample copy of the material warranty demonstrating compliance with the warranty requirements.
- c. The turf contractor shall provide evidence - direct from the turf manufacturer corporate headquarters- that the installer is certified by the manufacturer to install this type of synthetic grass installation.
- d. Certified copies of independent (third-party) laboratory reports on ASTM tests as follows:
 - i. Pile Height, Face or Pile Weight & Total Fabric Weight, ASTM D418 or D5848
 - ii. Primary & Secondary Backing Weights, ASTM D418 and D5848
 - iii. Tuft Bind, ASTM D1335
 - iv. Grab Tear Strength, ASTM D1682 or D5034
 - v. Infill Materials, ASTM F3188-16
- e. List of Ten (10) similar existing installations that have been installed in the United States including, Owner representative and telephone number(s).
- f. The Turf Contractor and Turf Manufacturer (if different from the company) shall provide evidence that their turf system does not violate any other manufacturer's patents, patents allowed or patents pending. Evidence shall be in the form of a written document stating such and signed by the Turf Manufacturers Corporate Headquarters.
- g. The Turf Contractor and Turf Manufacturer (if different from the company) shall provide a sample copy of insured, non-pro-rated warranty and NON-CANCELABLE warranty insurance policy with a policy minimum claim limits of at least \$350,000 and annual aggregate limit of at least \$10,000,000 in order to fully cover the full replacement of the turf system in the event of total failure.
- h. Letter stating the products anticipated lifespan.
- i. A letter and specifications sheet certifying that the products in this section meet or exceed specified requirements including certification from the turf manufacturer that lead or lead chromate are not used in the manufacturing of the specified system.
- j. Warranty must cover full 100% of replacement value of total square footage installed. Minimum \$10.00 per square foot.

(3.)The General Contractor / Site Contractor shall be defined as the contractor who is responsible for the construction of the site components related to and located

beneath the turf product, inclusive of but not limited to all cuts and fills as needed to establish an approved subgrade, the dynamic stone drainage system, prefabricated Geocellular system, and the perimeter collection system. The turf supplier / installer is a subcontractor to the general contractor. The General Contractor / Site Contractor shall have installed a minimum of five (5) Turf Fields in the last three (3) years and shall provide documentation and contact information for such.

1.03 SHOCK ATTENUATION EVALUATION:

- (1.) Near the completion of the turf, hire an independent testing laboratory to perform ten (10) in place G max tests in compliance with ASTM F1936 and F355. If any test results exceed 125, modify the infill material ratios as necessary to achieve satisfactory results. Perform additional testing to verify the results as required by the Owner's Representative.
- (2.) Guarantee: During the eight (8) year guarantee period, the G max rating shall remain less than 165. The Contractor shall contract with an independent testing laboratory to perform three (3) in place G max tests each on site during the first, third, fifth, seventh and eighth years. If any test results meet or exceed 165, modify the infill material ratios as necessary to achieve satisfactory results. Perform additional testing to verify the results as required by the Architect. If the G max rating exceeds 165 after three attempts to repair the high rating, replace the field within 90 calendar days at no cost to the Owner.

1.04 PRE-INSALLATION MEETING:

- (1.) Convene One (1) Week After Bid Opening:
 - a. An interview shall take place at a time and date to be determined by the Engineer at the district office or other location determined by the Engineer and Owner. Present at this meeting shall be the Engineer, Owner's Representative(s), the Project Manager and Site Superintendent for the Prime Contractor and the Project Manager and Project Foreman for the Turf Installer. The purpose of this meeting will be to review turf product and installation means and methods, to interview and ascertain the experience and competence of the Turf Installer, as well as, the onsite Project Foreman for this project and to review the project schedule. The basis of choosing this particular product shall be in part due to the results of this interview process. Contractor shall submit all required submittals before this meeting.
- (2.) Convene One (1) Week Prior to Stone Blanket Completion:
 - a. A second meeting shall take place at a location, time and date to be determined by the Engineer. Present at this meeting shall be the Engineer, Owner's Representative(s), and the Project Manager for the Site Contractor. The purpose of this meeting shall be to review and confirm schedule. (with

particular attention on the turf installation) and to confirm that the turf product has been ordered by way of notarized copies of the original confirmed Purchase Order and guaranteed delivery date.

1.05 DELIVERY, STORAGE, AND INSTALLATION

- (1.) Convene Deliver products to project site in wrapped condition.
- (2.) Store products under cover and elevated above grade.
- (3.) Protect all products and installation area from vandalism, theft, other construction, etc.

1.06 WARRANTIES

- (1.) The Turf Manufacturer shall provide a Warranty to the Owner that covers defects in materials and workmanship of the turf for a period of eight (8) years from the date of Substantial Completion. The turf manufacturer must verify that their onsite representative has inspected the installation and that the work conforms to the manufacturer's requirements. The turf fabric shall not lose more than an average 2% per year. The manufacturer shall guarantee the availability of replacement material for the synthetic turf system installed for the life of the warranty.
- (2.) The Manufacturer's Warranty shall include general wear and damage caused from UV degradation. The warranty shall specifically exclude vandalism, and acts of God beyond the control of the Owner or the manufacturer.
- (3.) The Turf Manufacturer's Warranty must be supported by an insurance policy of the full eight (8) year period.
- (4.) The Turf Contractor shall provide a Warranty to the Owner that covers defects in the installation workmanship, and further warrant that the installation was done in accordance with both the Manufactures' recommendations and any written directives of the Manufacturer's onsite representative.
- (5.) The synthetic grass turf must maintain an ASTM F355 and ASTM F1936 G-max between 125-165 for the life of the Warranty. Refer to 1.3, B.
- (6.) Any repairs or service to the field requested by the Owner or Owner's representative shall be addressed within 14 days from the date of written notification.

The Turf Manufacturer shall be 100% responsible for and warranty all products installed as part of his system inclusive of the fibers whether the fibers are manufactured by the turf company or by others.

1.07 MAINTENANCE SERVICE

(1.)The Turf Contractor will train the Owner's facility maintenance staff in the use of the specified maintenance attachments and equipment to routinely groom and sweep the field. Equipment shall be in good working condition.

1.08 ADA HANDICAP ACCESSIBLE

(1.)Synthetic turf system shall be approved as ADA compliant as determined by Test-Method ASTM 1951-99.

(2.)Proof of passing must be submitted for approval.

PART 2. PRODUCTS

2.01 BASE STONE AND DRAINAGE SYSTEM

Sieves	Base Stone-Type ₁	Base Stone-Type ₂	Finishing Stone
3"			
2"	100		
1 ½"	90-100		
1"	75-100	100	
¾"	65-95	90-100	
½"	55-85	80-100	100
⅜"	40-75	70-100	85-100
¼"	25-65	60-90	75-100
US#4	15-60	50-85	60-90
US#8	0-40	30-65	35-75
US#16	0-20	10-50	10-55
US#30	0-10	0-35	0-40
US#60	0-8	0-15	0-15
US#100	0-6	0-8	0-8
US#200	0-5	0-2	0-2

PLEASE NOTE THAT THE BASE STONE AND DRAINAGE STONE SYSTEM IS A SPECIAL MANUFACTURED PRODUCT AND ANY DEVIATION FROM THIS MATERIAL SHALL REQUIRE WRITTEN APPROVAL FROM THE TURF MANUFACTURER'S CORPORATE HEADQUARTERS. THE BASE STONE AND FINISHING STONE PRODUCT IS A 100% CLEANED WASHED QUARRY STONE MIXTURE. GRAVEL AND SAND MIX MATERIAL SHALL NOT BE

ALLOWED (NO EXCEPTIONS)

RESTRICTIONS:

1. To ensure structural stability: $D_{60}/D_{10} > 5$ and $1 < D_{30}^2 < 3$
 $D_{10} D_{60}$ Fragmentation must be 100%.
2. To ensure separation of both stones: D_{85} of finishing stone > 2
 D_{15} of base stone and $3 < D_{50}$ of base stone < 6
 D_{50} of finishing stone
3. To ensure proper drainage: Permeability of base stone > 50 in/hr (3.5×10^{-2} cm/sec)
Permeability of finishing stone > 10 in/hr (7.0×10^{-3} cm/sec)
Porosity of both stones $> 25\%$
(When stone is saturated and compacted to 95% Proctor.)

B. Perimeter Edge: Concrete curb (see Contract Drawings).

C. Underdrain System

1. ADS AdvanEdge
 - a. 12 inch diameter perforated collector drain pipe.
 - b. 12 inch diameter solid wall HDPE cleanout with 8 inch by 8 inch by 8 gauge aluminum plate with synthetic surface glued directly to plate.
2. Approved equivalent.

D. Pre-Fabricated Geocellular Unit

As supplied by: SportsEdge®
259 Murdock Rd. Troutman, NC 28166
Phone: 800-334-6057
info@sportsedge.com or www.sportsedge.com

Components

1. Geocellular Unit: Model # SEPV85-EIS manufactured of high strength polypropylene interlocking modules, with the following attributes as the minimum standard:

- a. Dimensions
 - 1) Length: 27.88" (708mm)
 - 2) Width: 13.94" (354mm)
 - 3) Depth: 3.35" (85mm)
- b. Material: Polypropylene
- c. Void Ratio: 92%
- d. Weight: 4.96 lbs.
- e. Compressive Yield Strength
 - 1) Vertical: 103.7 psi
 - 2) Lateral: 22.6 psi
- f. Deflection Strength
 - 1) Vertical: 58.0 psi
 - 2) Lateral: 6.9 psi

2. Accessories:

- a. Perma-Tie
- b. Permavoid Shear Connector

3. Hydraulic Performance (GPM / SF²)

- a. 0.0% Slope: 74.0 GPM / SF²
- b. 1.0% Slope: 119.3 GPM / SF²
- c. 2.0% Slope: 138.8 GPM / SF²
- d. 3.0% Slope: 157.2 GPM / SF²

E. Sub-Base System – Shock Pad (**Alternate #2**)

1. General Requirements – An impact energy absorbing sub-base drainage system designed specifically for use with synthetic turf is required. The quality of standard, design, and function of the Shock Pad is based on SP 17 manufactured by Brock USA, 781-883-9663 (Eric Hughes) or engineer approved equal. The specified material must have physical, drainage and performance properties that meet the following requirements:

- 1.1 Minimum material nominal thickness 0.67 inches or 17mm – material thickness must be within +/- 1.5mm
- 1.2 Tensile Strength >45 psi (ASTM D3574-08 Test E)
- 1.3 Tensile Elongation >10% (ASTM D3574-08 Test E)
- 1.4 Compression Strength >25psi @ 25% strain (ASTM 3575-08 Test D)
- 1.5 Linear Thermal Expansion < 0.10 mm /m /° C (ASTM D696)
- 1.6 Water Absorption <=1% after 24 hrs (ISO 62:2008 / DIN 52 438)
- 1.7 Water Permeability >500"/hr (ASTM 1551 DIN 18-035, Part 6)
- 1.8 Head Injury Criterion <1,000 from >0.5m drop height (ASTM F355-16, E)
- 1.9 Gmax <160 G's (ASTM 355-16 Missile A)
- 1.10 Shock Absorption >50% (ASTM 3189-17)
- 1.11 Vertical Deformation <5.0mm (ASTM 3189-17)
- 1.12 Surface system must provide maximum average Gmax of 110G's upon initial testing of installed field (ASTM F1936-10)

- 1.13 Surface system must provide maximum average Gmax of field of 135G's during warranty period of artificial turf. (ASTM F1936-10)
- 1.14 Resistance to Chemicals ≤ 2 (ASTM F925)
- 1.15 Resistance to Bacteria - no growth (ASTM G22)
- 1.16 Resistance to Fungi – no growth (ASTM G21)

2.02 SYNTHETIC GRASS INFILL SYSTEM MATERIALS

1. Manufacturer: Subject to compliance with all specified requirements,
 - a. THE CONTRACTOR SHALL PROVIDE WITH HIS BID, IN THE BID FORM, THE SYNTHETIC GRASS INFILL SYSTEM MANUFACTURER AND SYSTEM HIS/HER BID IS BASED ON.
2. The Synthetic Grass Material and resilient infill shall be in strict accordance with the following:
 - b. The fiber shall be an 10,800 denier 260 micron minimum thickness monofilament, and 10,000 denier 100 micron minimum thickness parallel slit film 100% polyethylene, low-friction fiber, measuring not less than 2.5 inches high, with a +1/8" height tolerance after tufting, as manufactured by Bonar Yarns & Fabrics, Tencate, or ITS/Sprinturf, or approved equal. The low friction fiber shall be specifically designed to virtually eliminate abrasion. The fiber shall be a multi-structured monofilament tufted together per General specification part A-1-c.
 - c. The tufted fiber weight shall not be less than 46 ounces per square yard. The fiber shall be tufted on a 3/8" to 1/2" tufting machine. Tuft Bind strength shall be greater than 8 lbs. The Breakload shall be a minimum of 18 PSI per ASTM D 2256 and Elongation at Break shall be a minimum of 47% per ASTM D 2256. The overall product weight must not be less than 74 ounces per square yard. The low friction non-abrasive fiber shall be 100% polyethylene, treated with a UV inhibitor. The turf backing shall provide dimensional stability as specified by the manufacturer. Systems that use polyethylene/ polypropylene blended fibers and systems that include any type of nylon fibers are unacceptable.
 - d. The carpet shall be delivered in 15' wide rolls. The rolls shall be of sufficient length to go from edge of track to edge of track. Head seams will not be acceptable.
 - e. All field lines, numbers and markings indicated on the plans shall be permanently inlaid.
 - f. The fiber shall be Field Green/Rye Green in color to simulate natural grass as closely as possible and treated with UV inhibitor, guaranteed a minimum of eight (8) years.

- g. The infill system shall consist of a non-compacting mixture of specifically graded, coarse, rounded, uniformly sized silica sand and coarse, ambiently recycled SBR crumb rubber. SBR rubber shall conform to all STC regulation standards for safety. The contractor shall submit to the engineer for approval all SBR product data inclusive of material size and content. Failure to do so shall be at the contractors risk and cost.

Typ. Part. Size Distr.
*Mesh (ASTM E-11)

8 -----
12 0.3%
16 57.8%
20 32.6%
30 5.1%
40 -----
50 -----
PAN 0.4%

Typ. Part. Size Distr.
*Mesh (ASTM E-11)

8 -----
10 Trace
12 20%
16 80%
20 100%
PAN 0%

Minimum total weight of infill to be 7 lbs./square foot with a 50/50 sand and rubber ratio by weight. (NO EXCEPTIONS)

*Represents the typical mean percentage (%) retained on individual sieves. Sand shall meet the following Particle Size Distribution:

Sieve Size Mesh	Min % Retained	Max % Retained
8	0	0
10	0	0
12	0	0.1
14	0	0.5
16	0	15
20	10	60
30	10	90
40	0	40
50	0	5
60	0	0.5
70	0	0.5
100	0	0.5
	0	

pan		0.5
Total – 50M		<1

- Krumbein # must be \geq to 0.4.
- API Crush – 50M fines generation at 80 psig: \leq 0.4%.

h. The infill system shall consist of the following: **(Alternate # 2)**

1. The synthetic turf infill material shall be specifically designed and manufactured for athletic use. It shall be a rounded and highly uniform quartz sand pigmented and sealed with an acrylic polymer and have the following properties:
2. The silica sand shall have a Coefficient of Uniformity of \leq 1.3.
3. 98% of the particles retained on US standard sieves 12 through 20.
4. The coated particles shall be smooth to resist mounding and compaction and have an angle of repose of 30° or less.
5. The finished product shall be 100% coated, shall repel water, be non-flammable and have $<.001\%$ dust content.
6. When placed in the synthetic turf, the system shall have an Abrasion Index of 26 ± 2 .
7. Installed homogeneously, without any additional infill materials.
8. A 16 year product warranty.
9. Color: Green
10. Product to be Envirofill ® manufactured by USGreentech, L.L.C. or approved equal.

i. The infill system shall consist of the following: **Alternate # 3**

1. The synthetic turf infill material shall be specifically designed and manufactured for athletic use.
2. It shall be a product consisting of organic walnut shells and have the following properties:
 - a. A proprietary blend of Black Walnut shells and English Walnut shells with 98% retained between the 8/20 sieves.
 - b. Walnuts must be grown in the USA.
 - c. The finished product shall be non-flammable
 - d. Dust content must be $<.001\%$.
 - e. The allergen content must be below 2.5ppm as tested by an ISO-certified food grade laboratory.
3. Product to be Safeshell ® by USGreentech, L.L.C. or approved equal.

j. Turf Data

Pile Weight:	46 oz/sy minimum
Face Yarn Type:	100% Polyethylene
Yarn Size:	
Monofilament	10,800 Denier (260 micron minimum thickness)
Slit Film	10,000 Denier (100 micron minimum thickness)
Pile Height (Finished)	2.5" or (1.75" - Alternate #2)
Color:	Field Green
Construction:	Broadloom Tufted
Stitch Rate:	10/3"
Tufting Gauge:	3/8" to 1/2"
Primary Backing:	Woven and non-woven, fiber reinforced backing (three component system)
Secondary Backing:	20 oz/sy Urethane
Total Product Weight:	73 oz/sy (± 2 oz) Min.
Finished Roll Width:	15'
Finished Roll Length:	Up to 220'
Perforation (Outdoors):	3/16" Holes on Staggered 4" (approximate)
Center Permeability:	20" ± Per Hour

Turf contractor shall provide independent study data on permeability requirements

Infill Composition:	Rounded, Uniformly-Sized Silica Sand and Ambient SBR Rubber Mixture (50% rubber / 50% sand by weight)
Infill Composition: Alt. #2	Rounded, uniformly sand pigmented with acrylic polymer.
Infill Composition: Alt. #3	Organic, uniformly sized, Black Walnuts
Field Lines & Markings:	Tufted, Inlaid and Painted

- k. An Engineered approved equivalent.

PART 3 INSTALLATION

3.01 Subgrade / Subbase Approvals

- a. Prior to the installation of the Synthetic Grass Infill System, the General/Site Contractor shall provide written certification that all subgrade, subbase, and slopes and elevations are in compliance with the Contract Documents and meets or exceeds all manufacturer's requirements. This certification shall be prepared by an approved Installer. The finished grade of the subbase shall not vary more than 3/16" in ten (10) feet. A laser grader must be used to meet the requirements.
- b. Compaction requirements shall be in conformance with Section 31 00 00 – Earthwork.
- c. The General/Site Contractor shall also **provide an as-built survey of the finished subgrade with spot grades** every 25 feet on center each way for approval.
- d. The General/Site Contractor shall prepare a minimum **25'x25' (twenty five foot by twenty five foot) mock-up of the approved materials for the subbase** in order to evaluate porosity and stability prior to installing material over the entire field. If acceptable the mock-up may become part of the finished field.

3.02 Synthetic Grass Infill System

- (1.) Verification of Conditions (by Installer): Examine conditions under which synthetic grass surfacing is to be installed in coordination with Installer of materials and components specified in this Section and notify affected Prime Contractors and Architect in writing of any conditions detrimental to proper and timely installation. Do not proceed with installation until unsatisfactory conditions have been corrected in a manner acceptable to Installer.
 - a. When Installer confirms conditions as acceptable to ensure proper and timely installation and to ensure requirements for applicable warranty or guarantee can be satisfied, submit to Architect written confirmation from applicable Installer. Failure to submit written confirmation and subsequent installation will be assumed to indicate conditions are acceptable to Installer.
 - b. Synthetic Grass Infill System: Provide manufacturer's inspection and certification that surface to receive synthetic turf is ready for installation of synthetic turf system, is perfectly clean in accordance with manufacturer's standards, and will be maintained in acceptable clean condition throughout installation.
- (2.) Installation: Install in strict accordance with manufacturer's written specifications and recommendations.
 - a. Unless otherwise recommended by turf and base manufacturer, lay turf

loosely across field, stretched, and attached to perimeter edge detail with sufficient length to permit full cross-field installation without head or cross-seams. **(Head and cross-seams shall not be permitted)**

- b. Unless otherwise recommended by the turf and base manufacturer, this shall be a 100% sewn installation. **(Gluing of seams shall not be permitted)**
- c. Provide Infill material, as specified on site and applied/spread evenly with a large fertilizer type spreader (minimum six (6) foot wide) in strict accordance with manufacturer recommendations. Between each application of infill, the field area shall be brushed with a motorized rotary nylon broom. Minimum infill depth shall be 2.0 inches or 1.25" **(Alternate #2)** Comply with manufacturer's recommendations regarding environmental requirements for installation such as dryness and absence of moisture. Please note that prior to final approval of the field the Engineer shall perform field infill height measurements and also infill weight tests throughout the field to ensure the proper infill height and weight have been met. The infill weight tests shall include removing a square foot of material and weighing accordingly, in the presence of the turf manufacturer / turf installer, at 8 chosen areas throughout the field of play. Upon completion of the test, the turf manufacturer shall replace the extracted material accordingly. If it is deemed the proper infill weight is not in compliance with the contract documents, the turf manufacturer, at his/her cost, shall import and install added infill material (in the presence of the Engineer) throughout the field until it has been deemed the infill weight is acceptable.
- d. Field markings: Apply and install fixed markings as indicated herein and in accordance with the Contract Drawings. White lines shall be the primary color where conflicts with soccer lines occur.
 - i. Football: All lines/markings shall be inlaid white.
 - ii. Soccer: All lines/markings shall be inlaid yellow.
 - iii. Boys Lacrosse: Tick marks/markings shall be inlaid black.

All markings can be sheared/shaved or cut and glued.

- e. Provide final cleaning of synthetic grass surfacing installations and maintain area clean and free from debris during installation. Clean surfaces, recesses, enclosures, and similar areas as required leaving area of installation in clean, immaculate condition ready for immediate occupancy and using by Owner.
- f. Protect installed synthetic grass from subsequent construction operations. Do not permit traffic over unprotected surfacing.
- g. The turf manufacturer shall provide training for the Owner's facility

maintenance staff in use of grooming equipment recommended by the manufacturer.

3.03 MAINTENANCE AND WARRANTY

(1.)The turf installer and/or the turf manufacturer must provide the following:

- a. The turf manufacturer shall provide a warranty to the Owner that covers defects in materials and workmanship of the turf for a period of eight years from the date of Substantial Completion. The turf manufacturer must verify that their on-site representative has inspected the installation and that the work conforms to the manufacturer's requirements. The polyethylene yarn manufacturer shall provide an eight (8) year "UV stabilization" warranty.
- b. The manufacturer's warranty shall include general wear and damage caused from UV degradation. The warranty shall specifically exclude vandalism, acts of War and acts of God beyond the control of the Owner of the manufacturer.
- c. The turf contractor shall provide a warranty to the owner that covers defects in the installation workmanship, and further warrant the installation was done in accordance with both the manufacturer's recommendations and any written directives of the manufacturer's on site representative.
- d. All turf warranties shall be limited to repair or replacement of the affected areas and shall include all necessary materials, labor, transportation costs, etc. to complete said repairs. All warranties are contingent on the full payment by the Owner of all pertinent invoices.

END OF SECTION - 32 18 13

SECTION 32 30 00
SITE IMPROVEMENTS

PART 1 - GENERAL

A. Related Documents: Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Work Included:

The work of this Section consists of all site improvements and related items as indicated on the Drawings and/or as specified herein and includes, but is not limited to, the following:

1. Fottball Goal Post and Pad
2. Scoreboard (**Alternate #7**)
3. Port a John Shade Shelter (**Alternate #6**)
4. Shade Shelter (**Alternate #4**)
5. Bike Rack
6. Drinking Fountain

C. Related Sections

(1.)Division 31 00 00 - EARTHWORK

(2.)Section 03 30 00 – CAST-IN-PLACE CONCRETE

(3.)Section 32 18 13 - SYNTHETIC GRASS INFILL SYSTEM

D. Submittals:

(1.)Contractor shall submit catalog information on site improvements for review by Owner's Representative.

PART 2 - PRODUCTS

A. Light Fixtures and Accessories

(1.)Pedestrian Light Fixture:

- a. Model: Saturn Cutoff LED (SACL) as manufactured by Selux Corporation, www.selux.us, shall comply to University Design Standards or approved equal

Model: SACL-R5-1-LG4105-35-120. Color: Black

Pole type: Single (1), Model: S35-12-BK, 3 ½" diamter strait steel pole–

Round Strait Steel with aluminum die-cast fitter base secured to pole with Allen head set screws or approved equal. Color: Black.

(2.)Football Goal:

- A. Provide and install football goal posts in the locations shown on the Drawings and per manufacturer's recommendations. Submit manufacturer's product data and installation details for approval before ordering materials.
- B. Football goal posts shall be one of the following or Landscape Architect approved equal:
 - 1. Model # GP-4380PL, "Football Goal Post – 6' Offset", as manufactured by SportsField Specialties, P.O. Box 231, 41155 St. Hwy 10, Delhi, NY 13753, (888) 975-3343.
 - 2. Model # ASG-HS-Y "6' Offset Goal Posts", as manufactured by AAE Sports, 1000 Enterprise Drive, Royerford, PA 19468, (610) 825-6565
 - 3. Model # SEF300, "6.5 Ft. Offset Football Goals", as manufactured by Sports Edge, P.O. Box 837, Troutman, NC, 28166, (800) 334-6057. Ground sleeves Model No. SEF30005.
- C. Football Goal Support Post and Crossbar shall consist of 6 to 6 5/8-inch O.D. Schedule 40 aluminum gooseneck and cross bar, 4" Schedule 40 aluminum uprights, and 6-foot to 6 1/2-foot offset. Uprights to be 20-feet high. Finish to be powder coated white.
- D. Goal post shall be installed with galvanized hardware, set level and square, with ground sleeve embedded in a concrete footing 5'-6" deep by 3' wide, according to the Detail. Ground sleeves to be galvanized steel.
- E. Top of concrete footing shall be 8" below finish grade. Measurement from finish grade to the top of crossbar shall be 10'-0".
- F. All nuts and bolts should be firmly tightened and covered with heavy grease. Protect with heavy poly and wrap with tape.
- G. Football Goal Post Pads shall be manufactured by one of the following or Landscape Architect approved equal:
 - 1. Model No Model No GP-4590RFULL, "Round Goal Post Pad, Fully Encapsulated", as manufactured by SportsField Specialties, P.O. Box 231, 41155 St. Hwy 10, Delhi, NY 13753, (888) 975-3343.
 - 2. Model No F302, "Football Goal Post Pads", as manufactured by Gill Athletics, 2808 Gemini Court, Champaign, IL 61822, (800) 637-3090.

3. Model No SEF302, "Goal Post Pads" (entire coverage), as manufactured by Sports Edge, P.O. Box 837, Troutman, NC, 28166, (800) 334-6057.

- H. Pads shall be for 6 to 6 1/2-inch O.D. posts, constructed of min. 5-inch thick cylindrical high-density polyurethane foam filler with rear cutout. Heavy coated vinyl cover shall completely enclose foam filler. Vinyl cover shall have full-length Velcro closure flap. Pads to be 6' high. Color to be maroon with white vinyl lettering spelling "PORTSMOUTH" vertically on each goal post pad. Submit color sample for approval.

(3.) Scoreboards (2) (**Alternate # 7**)

- a. Model: Daktronic MS-2002 as manufactured by Daktronics, 201 Daktronics Drive, PO Box 5128, SD 57006 or approved equal.

4. Port a John Shade Shelter (**Alternate #6**)

- A. Shade Structure shall be Model # PLE-HC2 as manufactured by The Poligon Park Architecture, 420 N. 136th Avenue, Holland, MI 49424, 800-354-7721, www.poligon.com, represented locally by Site Specific, P.O. Box 325, Rochester, MA. Cindy Maak, 1-508-763-0207 or approved equal. Note that new structure installations (as indicated on the drawings) shall be constructed on a cement concrete pad, eleven (11') feet wide x nineteen (19') feet in length and six (6") inches in depth and reinforced with welded wire fabric as directed.
- B. Shade structure shall be furnished with the anchor attachment and concrete footings, such that each column is connected to each concrete footing in conformance with manufacturer's recommendations. Contractor shall include footing and anchor information as part of the submittal application.
- C. Shade structure shall be furnished with a structural panel understanding seam roof (SPSS) and galvanized frame structure and associated components.
- D. Colors shall be determined through the shop drawing submittal application and approved by the owner and or owner's representative prior to fabrication and installation.

5. Shade Shelter (**Alternate #4**)

- A. Shade Structure shall be Model #REK-16X24TGAS, as manufactured by Poligon, or approved equal. Shade Structure shall be 24' x 16'.
- B. Shade structure columns shall be embedded in concrete footings within the concrete foundations. Refer to manufacturers recommendations for the column installation.

C. Stamped engineered drawings for NH registered PE shall be required.

6. Bike racks

A. The bike racks shall be "Cycle Sentry" series by Secure Site Design, LLC (www.securesitedesign.com) Model No. BRWS-101, or approved equal to be installed in concrete footings embedded/direct bury. Surface mounting will not be accepted. Receptacles shall be powder coated in standard color to be selected by Owner.

7. Drinking Water Fountain

A. Fountains shall be Murdock-Super Secur M-43 or approved equal.

B. Fountain plumbing shall be complete, for connection from the meter/backflow preventer, to drainage connections to drywell and 3/8 inch water service line.

C. Shall be stainless steel finish.

Execution:

A. Include all necessary transportation, shipping, handling and installation, per code requirements.

drinking B. Construct all piping, fittings, and couplings as necessary to extend/reconnect fountain water and drain feeds.

D. Test all equipment per Section 01450 of these Specifications

3. Execution

A. Light Fixtures and Accessories shall be permanently installed in concrete anchorages unless otherwise indicated by manufacturer specifications. See Section 03 33 00 CAST-IN-PLACE CONCRETE for Bases and Anchorages.

B. Sports Equipment shall be installed in accordance with the manufacturers requirements.

C. Any site improvement materials which are constructed of steel and not galvanized or factory coated with a finish system shall be painted in the field in accordance with Division 09 90 00 Painting and Finishes. Colors by Owner's Representative.

D. All Sports Equipment shall be installed ready for use.

END OF SECTION

SECTION 32 31 00

CHAIN LINK FENCE

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. The Contractor shall provide all labor, materials and appurtenances necessary for the installation of a complete chain link fence systems and shall meet or exceed the standards of the Chain Link Fence Manufacturer's Institute, New York, NY except as otherwise indicated on the Drawings and as herein specified.
- B. The manufacturer shall supply a complete hot dipped galvanized chain link fence system of the height, fabric type, fabric gauge, framework strength, and galvanized coating specifications contained herein. The manufacturer shall supply a total vinyl PVC coated chain link fence system of the height, fabric type, fabric gauge, framework strength, color and coating specifications contained herein. All fence materials unless specifically stated otherwise, shall be extrusion bonded polyvinyl chloride (PVC) coated.
- C. The Contractor shall provide all labor, materials and appurtenances necessary for the installation of a complete safety netting system and shall meet or exceed the standards indicated on the drawings and as herein specified.

1.02 RELATED WORK:

- A. Section 01 33 00, SUBMITTALS
- B. Section 03 30 00, CAST IN PLACE CONCRETE
- C. Section 31 00 00, EARTHWORK
- D. Section 03 00 01 MOW CURB

1.03 REFERENCES:

- A. The following standards form a part of this specification as referenced.

American Society for Testing and Materials (ASTM)

ASTM	A53	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM	A121	Zinc-Coated (Galvanized) Steel Barbed Wire
ASTM	A392	Zinc Coated Steel Chain Link Fence Fabric

ASTM	A123	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM	A153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM	F567	Installation of Chain Link Fence
ASTM	F626	Fence Fittings
ASTM	F668	Specification for Poly Vinyl Chloride (PVC) - Coated Steel Chain-Link Fence Fabric.
ASTM	F1043	Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework.

Federal Specifications (FS)

FS	RR-F-191	Fencing Wire and Post, Metal (and Gates, Chain-Link Fabric, and Accessories)
----	----------	------------------------------------------------------------------------------

1.04 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

- A. Six sets of manufacturers literature of the materials specified herein shall be submitted to the Engineer for review.
- B. Six sets of shop drawings of the fence and safety netting shall be submitted to the Engineer for review.
- C. Stamped Engineered structural drawings for the safety netting system.

1.05 WARRANTY:

- A. Prior to installation, the fence contractor shall provide the fence manufacturer's notarized certification that all components are fully warranted by the manufacturer for 15 years against rust and corrosion.

PART 2 - PRODUCTS - PVC COATED

2.01 STEEL FRAMEWORK (GENERAL):

- A. All posts, gate frames, braces and horizontal rails shall be Type I round post, hot dipped galvanized with a minimum average coating of 1.8 oz/ft², meeting ASTM F 1083 for Standard Weight Galvanized Pipe and shall be of the sizes and weights given below or other approved equivalent sections of steel having a minimum tensile strength of 50,000 pounds per square inch and a minimum yield strength of 25,000 pounds per square inch.

- B. Minimum cross-section dimensions for line posts of specified shape shall be: either 2-3/8-inch (2.375-inch) outside diameter steel pipe weighing not less than 3.65 pounds per linear foot; or 2.25 by 1.95 by 9/64-inch steel H section weighing not less than 4.10 pounds per linear foot.
- C. Minimum cross-section dimensions for end, corner, and pull posts of specified shape shall be: 2-7/8-in. (2.875-in.) outside diameter steel pipe weighing not less than 5.79 pounds per linear foot; 2-1/2 by 2-1/2-inch square tubes weighing not less than 5.70 pounds per linear foot; or 3-1/2 by 3-1/2-inch rolled-formed sections weighing not less than 8.14 pounds per linear foot.
- D. All tubular and pipe posts shall be capped to prevent precipitation from entering the post, unless a barbed wire extension arm assembly acts as a cap.
- E. Posts, other fence framework, accessories, fittings, and miscellaneous items shall be galvanized and have a extrusion bonded polyvinyl chloride (PVC) coating. The PVC coating on posts shall be a minimum of 10 mils thick. Framework color coating shall match fabric. Galvanized finish shall have not less than the following weight of zinc per square foot:
 - 1. Pipe: 1.8 oz, complying with ASTM A53.
 - 2. H-sections and square tubing: 2.0 oz, complying with ASTM A123.
 - 3. Hardware and accessories: Comply with Table I of ASTM A153.
- F. For top railings and top, middle and bottom braces between terminal posts and adjacent lines posts, the minimum cross-section dimensions for the specified shall be 1-5/8-inch outside diameter steel pipe weighing not less than 2.26 pounds per linear foot.
- G. Diagonal truss braces between terminal and adjacent line posts and for gauge framework shall not be less than either 3/8-inch diameter steel rod or double No. 9 AWG steel wire stranded together.
- H. Fittings shall be galvanized press steel, malleable or cast steel as specified in ASTM F626 and Federal Specification RR-F-191.
- I. Where posts do not have provisions for weaving fence fabric to posts, tension or stretcher bars for attaching fabric to terminal posts such as end, corner, gauge and pull posts, shall be flat bar with nominal dimensions no less than 3/16 by 3/4-inch for use with fence fabric having mesh larger than 1-inch, of a length equal to full height of the fence fabric, and used with bar bands, bolts and nuts. Bar bands shall be no thinner than No. 11 gauge coated sheet steel. Bolt diameters shall be not less than 3/8-inch for use with bar bands.
- J. Ties for fastening fence fabric to line posts and rails shall be not less than No. 9 AWG steel wire with the same coating as the fence fabric or other approved bands.

2.02 CHAIN LINK FENCE FABRIC – PVC COATED:

- A. Vinyl coated fabric shall be supplied with Class 2A (extrusion bonded) vinyl coating. The coating shall be applied over a galvanized steel core wire and be manufactured in accordance with Federal Specifications RR-F-191 and ASTM F668. The PVC coating shall have a final coating thickness of 0.015-0.025-inch and a core wire size diameter of 0.148-inch.
- B. Wire size: The finished wire size shall be 6 gauge.
- C. Height and Mesh Size: The fabric height shall be 4' & 6' feet high with a mesh size of 2-inches.
- D. Selvage: Top edge and bottom edge of the fabric shall be knuckled for 4' fence height and twisted for 6' height.
- E. The tension wires shall either be No. 9 gauge steel-core wire. PVC coating shall conform to ASTM F668 Class 2a or 2b. Also, a 7-strand galvanized steel ½-inch guy wire with PVC coating may be supplied.
- F. The polyvinyl chloride (PVC) coating shall be free of voids, shall be dense and impervious, shall be of a plasticized or epoxy modified, high specific gravity polyvinyl chloride with high resistance to tear and suitable hardness. The PVC coating shall not support combustion and shall withstand an accelerated aging and weathering test a minimum of 2,000 hours at 145 degrees F with ultraviolet and salt spray without cracking or peeling the PVC coating and without corrosion of the base metal. The PVC coating shall withstand a mandrel bending test of ten times the thickness of the base metal at minus 25 degrees F without cracking. The PVC coating shall not separate from the metal or shrink. Color used in PVC coating shall be stabilized so that it will not fade under long exposure to sunlight. Color shall be approved by the Engineer as selected from the manufacturer's standard colors.

2.03 SWING GATES – PVC COATED:

- A. Gate leaf frames shall be amply braced and trussed for rigidity. Truss rods shall be adjustable. Gate leaf framework shall be pipe or other approved suitable cross-section of the size recommended by the fencing manufacturer for the size of gate leaf, but shall be no smaller than 2-inch outside diameter steel pipe weighing not less than 2.72 pounds per linear foot. If bolted or riveted corner fittings are not used, the gate frame shall have the corrosion-resistant finish applied after welding.
- B. Gates, gate posts, fabric and associated hardware shall be thermally coated with PVC, 10 mils thick, to match the fence.
- C. Gate hinges shall be 180 degree, heavy pattern, of adequate strength for the gate size, with large bearing surfaces for clamping or bolting in position, and with hinge action such that the gates may be opened and closed easily.
- D. Gates shall be provided with accessible, suitable latches and provisions for padlocking.

- E. Double leaf gates shall have center bolts and center stops. Unless indicated otherwise on the drawings, the gates shall have automatic backstops to hold the leaves in open position.
- F. For gate openings, up to and including 12-feet, with double leaf gates, minimum cross-section dimensions for the gate posts of specified shape shall be the same as specified above for end posts.
- G. For gate openings larger than 12 feet, the minimum outside diameter for the gate posts shall be 6-5/8-inches, weighing not less than 18.97 pounds per linear foot.

2.04 SAFETY NETTING

A. Safety Netting

- (1.) Model #TFBSS630P-SG, 6.625" O.D., 6" schedule 40 aluminum straight pole ball stopper system with standard coated black pole finish. Model TFBSS-NET-ULTRACROSS, 4 ply ultra-cross dyneema knotless UHMWPE netting, 1 3/4" square mesh with sewn rope binding on perimeter edges as manufactured by Sportsfield Specialties, Inc., 41155 State Highway 10, PO Box 231, Delhi, NY 13753, 1-888-3343, www.sportsfieldspecialties.com or approved equal.
- (2.) Model MBS-20, 6" O.D. aluminum tube ball stopper system with model M400, 1 3/4" square, knotless HTPP, DBB, net, 1/4" MFP rope border, UV protected and 1/4" cable hog tied to top of net as manufactured by Aluminum Athletic Equipment, or approved equal.
- (3.) Model SEBS20 straight ball stop, 6" O.D. aluminum poles. 1 3/4" square mesh, knotless HTPP nets with extra UV stabilizers, supported by a vinyl coated galvanized steel 7x7 aircraft cable as manufactured by SportsEdge or approved equal.

2.05 CHAIN LINK SLATTING:

- A. Fence slatting is to be extruded high density virgin polyethylene, containing color pigmentation and U.V. inhibitors to resist the effects of ultraviolet radiation from sunlight and extend the colorfastness of the materials for a minimum of 15 years service without visible degradation as manufactured by the PDS Fence Products, Yakima, WA; or approved equal.
- B. Slats are to be of flat tubular shape with a profile depth of 0.312-inch (5/16-inch) and a wall thickness of .020-inch. The slat width shall be as required for the size of wire mesh being used. The slat height shall be fabricated 3-1/2-inches shorter than the overall fence height specified. Fence slats shall be installed using the self-locking horizontal bottom channel system.

- C. The color of the slats shall be selected by the Engineer from samples submitted by the Contractor prior to the start of the fence installation.
- D. The manufacturer of the slats must provide a 15-year limited warranty against either color fading or breakage of slats and locking channel used under normal climatic extremes.
- E. Install in locations as shown on the Contract documents.

PART 3 - EXECUTION

3.01 FENCE ERECTION:

- A. The fence and gates shall be erected by skilled mechanics in accordance with the recommendations of the manufacturer and these specifications. These specifications shall take precedence over the recommendations of the manufacturer if any discrepancy exists between them.
- B. Maximum post spacing shall be 10-feet. Post spacing shall be uniform and posts shall be plumb. All end, corner, pull and gate posts must be set in concrete. Line posts may be secured by driven blades.
- C. Concrete post foundations in earth shall be concrete cylinders with a minimum diameter of 18-inches, crowned at grade to shed water, and shall extend not less than 3.5-feet into the ground. Posts shall be set in the full depth of the foundations except for 3-inches of concrete under the posts. If foundation holes are excavated in unsuitable material, the Engineer shall be notified for determination of suitable construction precautions.
- D. If solid rock is encountered without an overburden of soil, poles shall be set into the rock a minimum depth of 12-inches for line posts and 18-inches for terminal posts, such as end, corner, gate and pull posts, and grouted into solid rock with the post hole diameter a minimum of one inch larger than that of the post.
- E. Where solid rock is covered by an overburden of soil or loose rock, the posts shall be set into the rock as specified above. The total pole setting depth shall not exceed the depths required for setting in earth.
- F. Any change in direction of fence line of 30 degrees or more shall be considered as a corner. Pull posts shall be used at all abrupt changes in grade. Maximum area of unbraced fence shall not exceed 1,500 square feet.
- G. Terminal posts such as end, corner, gate and pull posts shall be braced to the adjacent post(s) with horizontal rail braces used as compression members and diagonal truss braces with truss tighteners for tension members, with the lower ends at the terminal post in each panel of fence framework as indicated in detail on drawings.

- H. The top railing shall pass through intermediate or line post tops, form a continuous brace with all splices made by approved couplings, and shall be fastened to terminal posts.
- I. Fabric shall be stretched taut, with the bottom edge following the finished grade, and shall be a continuous mesh between terminal posts. Each span of fabric shall be attached independently at terminal posts. Where terminal posts do not have provisions for weaving fabric to posts, stretcher bars shall be placed through the end weave of the fabric and secured to the post with bar bands spaced not more than 15-inches apart on the post.
- J. Fabric shall be attached with ties to line posts at intervals of not more than 14-inches (and to the top railing and braces at intervals not exceeding 24-inches).
- K. The bottom tension wire shall be interlaced in the weave of the fabric, pulled taut and fastened to terminal posts.

3.02 SAFETY NETTING ERECTION:

A. Safety Netting

- (1.)The Contractor shall layout the Safety Netting and place wood stakes as required at post locations and then notify the Owner's Representative that the unit has been laid out. It shall be the Contractor's responsibility to offset the stakes installed by his Engineer and take extreme care not to disturb these stakes before incorporating them into his work. Layout shall include setting of wood stakes at each post location in the field.
- (2.)The Contractor shall excavate for proposed post footings and shall inspect the excavation to ensure that surrounding areas of footing are stable and holding vertically.
- (3.)Pour footings against undisturbed subsoil and onto compacted bottom of void. Set posts plumb and to the proper heights for assembly and place foundations.
- (4.)Allow footings to cure sufficiently prior to assembly of netting, and brace and stay all posts sufficiently until curing is adequate.
- (5.)Under mow curbs, pitch tops of footings one (1) inch away from posts.
- (6.) Backfill and compact in no greater than eight (8) inch layers around footings.

END OF SECTION

SECTION 32 32 23
SEGMENTAL RETAINING WALL

1. GENERAL

A. General Provisions

- (1.) Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all sections within DIVISION 01 – GENERAL REQUIREMENTS which are hereby made a part of this Section of the specifications.

B. Work Included:

- (1.) Work shall consist of designing, furnishing all materials, labor, equipment, and installation of the segmental retaining wall system in accordance with these specifications and to the lines, grades, and dimensions shown on the plans.

C. Related Work:

- (1.) Section 01 33 00, SUBMITTALS
(2.) Section 31 00 00, EARTHWORK

D. Reference Standards:

- (1.) The New Hampshire Department of Transportation.
(2.) Segmental Retaining Wall Units
- a. ASTM C 1372- Standard Specification for Segmental Retaining Wall Units.
 - b. ASTM C 140 - Standard Test Methods of Sampling and Testing Concrete Masonry Units.
- (3.) Geosynthetic Reinforcement
- a. ASTM D 4595 - Tensile Properties of Geotextiles by the Wide-Width Strip Method
 - b. ASTM D 5262 - Test Method for Evaluating the Unconfined Creep Behavior of Geosynthetics
 - c. GRI:GG1 - Single Rib Geogrid Tensile Strength
 - d. GRI:GG5 - Geogrid Pullout

(4.)Soils

- a. ASTM D 698 - Moisture Density Relationship for Soils, Standard Method
- b. ASTM D 422 - Gradation of Soils
- c. ASTM D 424 - Atterberg Limits of Soil

(5.)Drainage Pipe

- a. ASTM D 3034 - Specification for Polyvinyl Chloride (PVC) Plastic Pipe
- b. ASTM D 1248 – Specification for Corrugated Plastic Pipe

(6.)Engineering Design

- a. “NCMA Design Manual for Segmental Retaining Walls”, Second Edition
- b. Where specifications and reference documents conflict, the Engineer shall make the final determination of applicable document.

E. Design Criteria:

- (1.)The following soil parameters shall be assumed for the final design unless otherwise shown on the plans or specified by the Engineer:

	Unit Weight (pcf)	Internal Friction Angle, degrees	Cohesion
Reinforced Fill	120	30	0
Retained Soil	120	30	0
Foundation Soil	120	30	0

- (2.)Precast sections shall be designed to withstand earth loads due to soil plus live loads due to vehicular traffic (H20 loading). Design and construction of each section shall meet the requirements of ACI 318 and the AASHTO Load Factor.
- (3.)Should the actual soil conditions observed during construction differ from those assumed for the design, design shall be reviewed by the Wall Design Engineer at the Engineer's direction.

(4.) The design for the final retaining wall plans shall be prepared and sealed by a professional Civil Engineer licensed in the State of New Hampshire. The design analysis shall consider the external stability against sliding and overturning, internal stability, facial stability of the reinforced soil mass, and external global stability and shall be in accordance with acceptable engineering practice and these specifications. The internal and external stability analysis shall be performed in accordance with the “NCMA Design Manual for Segmental Retaining Walls”, using the recommended minimum factors of safety in this manual.

(5.) The design of the geosynthetic reinforcement shall take into consideration the effects from obstructions.

(6.) Minimum embedment: the minimum wall embedment shall be the greater of 0.5 feet or the following:

Level Slope in Front $H'/20$

3H:1V Slope in Front $H'/10$

2H:1V Slope in Front $H'/10$

where H' is the exposed height of the wall.

(7.) While vertical spacing between geosynthetic reinforcement layers may vary, it shall not exceed 2.0 feet maximum in the wall design.

(8.) The geosynthetic reinforcement placement in the wall design shall have 100 percent continuous coverage parallel to the wall face. Gapping between horizontally adjacent layers of geosynthetic (partial coverage) will not be allowed.

F. Submittals: In accordance with requirements of General Specifications, submit the following:

(1.) Material Submittals: The Contractor shall submit one (1) electronic copy or six (6) sets manufacturers' literature and certifications two weeks prior to start of work stating that the SRW units and geosynthetic reinforcement meet the requirements of Section 2 of this specification.

(2.) Design Submittal: The Contractor shall submit six (6) sets of detailed design calculations and final retaining wall plans for approval at least two weeks prior to the beginning of wall construction. All calculations and drawings shall be prepared and sealed by a professional Civil Engineer licensed in the State of New Hampshire.

G. Delivery and Storage:

- (1.) Contractor shall check materials upon delivery to assure that specified type and grade of materials have been received and proper color and texture of SRW units have been received.
- (2.) Contractor shall store and handle materials in accordance with manufacturer's recommendations and in a manner to prevent deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping or other causes.
- (3.) Contractor shall protect materials from damage. Damaged materials shall not be incorporated into the retaining wall.

2. PRODUCTS

A. Concrete Segmental Retaining Wall Units (**Re-use of units on site**)

- (1.) If connectors are used by the SRW supplier to interconnect the SRW units, they shall meet the requirements of the manufacturer.
- (2.) SRW units shall be sound and free of cracks or other defects that would interfere with the proper placing of the unit or significantly impair the strength or permanence of the structure. Cracking or excessive chipping may be grounds for rejection. Units showing cracks longer than 1/2" shall not be used within the wall. Units showing chips visible at a distance of 30 feet from the wall shall not be used within the wall.
- (3.) SRW units' molded dimensions shall not differ more than + 1/8 inch from that specified, in accordance with ASTM C1372.

B. Geosynthetic Reinforcement

- (1.) Geosynthetic reinforcement shall consist of geogrids or geotextiles manufactured as a soil reinforcement element. The type, strength, and placement location of the reinforcing geosynthetic shall be determined by the Engineer providing the wall design and as shown on the approved segmental retaining wall plans.
- (2.) Detailed test data shall be submitted to the Engineer for approval and shall include the following:
 - a. Tensile strength in accordance with ASTM D 4595 or GRI GG-1.
 - b. Creep in accordance with ASTM D 5262.
 - c. Site damage and durability in accordance with GRI GG-4.

- d. Pullout in accordance with GRI GG-5 or GRI GT-6
- e. Connection test data in accordance with NCMA SRWU-1.

C. Leveling Pad

- (1.) Material for the leveling pad shall consist of gravel meeting the requirements of the New Hampshire Department of Transportation and shall be a minimum of 6 inches in depth unless otherwise shown on the Contract Drawings. The leveling pad must extend a minimum of 6 inches from both the front and back faces of the block unless otherwise shown on the Contract Drawings. Lean concrete with a strength of 200-300 psi and three inches thick maximum may also be used as a leveling pad material with approval by the Engineer.

D. Drainage Aggregate

- (1.) Drainage aggregate shall be crushed stone meeting the requirements of New Hampshire Department of Transportation

E. Drainage Pipe

- (1.) The drainage collection pipe shall be a perforated or slotted PVC, or corrugated HDPE pipe. The drainage pipe may be wrapped with a geotextile to function as a filter.
- (2.) Drainage pipe shall be manufactured in accordance with ASTM D 3034 and/or ASTM D 1248.

F. Reinforced Backfill

- (7.) The reinforced backfill shall be free of debris. Unless otherwise noted on the approved segmental retaining wall plans prepared by the Civil Engineer, the reinforced material shall consist of Type B Gravel Borrow in accordance with The New Hampshire Department of Transportation.

G. Geotextile Fabric

- (1.) Geotextile fabric shall meet the requirements of Type II in accordance with The New Hampshire Department of Transportation.

3. EXECUTION

A. Inspection

(1.) Contractor shall have demonstrated experience and be qualified to direct all work at the site.

B. Excavation

(1.) Contractor shall excavate to the lines and grades shown on the project grading plans. Contractor shall take precautions to minimize over-excavation. Over-excavation shall be filled with compacted backfill material as directed by the Engineer, at the Contractor's expense.

(2.) Contractor shall verify location of existing structures and utilities prior to excavation. Contractor shall ensure all surrounding structures are protected from the effects of wall excavation. Excavation support, if required, is the responsibility of the Contractor

C. Foundation Preparation

(1.) Following the excavation, the foundation soil shall be examined by the Engineer to assure actual foundation soil strength meets or exceeds the assumed design bearing strength. Soils not meeting the required strength shall be removed and replaced with material, as directed by the Engineer.

(2.) Foundation soil shall be proof rolled and compacted to 95% standard Proctor density and inspected by the Engineer prior to placement of leveling pad materials.

D. Leveling Pad Construction

(1.) Leveling pad shall be placed as shown on the final, approved P.E. sealed retaining wall drawings. The leveling pad shall have a minimum thickness of 6 inches. The leveling pad should extend laterally at least a distance of 6 inches from the toe and heel of the lower most SRW unit unless shown otherwise on the Contract Drawings.

E. SRW Unit Installation

(1.) All SRW units shall be installed at the proper elevation and orientation as shown on the final, approved P.E. sealed wall drawings or as directed by the Wall Design Engineer. The SRW units and geosynthetic reinforcement shall be installed in accordance with the manufacturer's recommendations.

(2.) First two courses of SRW units shall be placed below finish grade on the leveling pad with the aesthetic surface facing out. The units shall be leveled side-to-side,

front-to-rear and with adjacent units, and aligned to ensure intimate contact with the leveling pad.

- (3.) Prior to placement of next course, the level and alignment of the units shall be checked and corrected, where needed.
- (4.) Layout of corners shall be installed in accordance with the wall plan details or in general accordance with SRW manufacturer's installation guidelines. Walls meeting at corners shall be interlocked by overlapping successive courses.
- (5.) Broken, chipped, stained or otherwise damaged units shall not be placed in the wall unless they are repaired and the repair method and results are approved by the Engineer.

F. Geosynthetic Reinforcement Placement

- (1.) All geosynthetic reinforcement shall be installed at the proper elevation and orientation as shown on the final, approved P.E. sealed retaining wall drawings, or as directed by the Wall Design Engineer.
- (2.) At the elevations shown on the final plans, (after the units, drainage material, and backfill have been placed to this elevation) the geosynthetic reinforcement shall be laid horizontally on compacted infill.
- (3.) Geosynthetic reinforcement layers shall be one continuous piece for their entire embedment length. Overlapping of the geosynthetic in the design strength direction (perpendicular to the wall face) shall not be permitted. Along the length of the wall, horizontally adjacent sections of geosynthetic reinforcement shall be butted in a manner to assure 100 percent coverage parallel to the wall face.
- (4.) Tracked construction equipment shall not be operated directly on the geosynthetic reinforcement. A minimum of 6 inches of backfill is required prior to operation of tracked vehicles over the geosynthetic. Turning should be kept to a minimum. Rubber-tired equipment may pass over the geosynthetic reinforcement at slow speeds (less than 5 mph).
- (5.) The geosynthetic reinforcement should be installed under tension. The nominal tension shall be applied to the reinforcement and secured in place with staples, stakes or by hand tensioning until reinforcement is covered by six inches of fill.

G. Drainage Materials

- (1.) Drainage aggregate shall be installed to the line, grades, and sections shown on the final P.E. sealed retaining wall drawings. Drainage aggregate shall be placed

to the minimum thickness shown on the Contract Drawings between and behind units.

- (2.) Drainage collection pipes shall be installed to maintain gravity flow of water outside the reinforced soil zone. The drainage collection pipe shall daylight at an elevation lower than the lowest point of the pipe within the aggregate drain.
- (3.) The main collection drain pipe, just behind the block facing, shall be a minimum of 3 inches in diameter. The secondary collection drain pipes should be sloped a minimum of 2% to provide gravity flow into the main collection drain pipe. Drainage laterals shall be spaced at a maximum 50 feet spacing along the wall.

H. Backfill Placement

- (1.) The reinforced backfill shall be placed as shown in the final, approved wall drawings in the maximum compacted lift thickness of 10 inches and shall be compacted to a minimum of 95% of standard Proctor density (ASTM D 698) at a moisture content within 2% of optimum. The backfill shall be placed and spread in such a manner as to eliminate wrinkles or movement of the geosynthetic reinforcement and the SRW units.
- (2.) Only hand-operated compaction equipment shall be allowed within 3 feet of the back of the wall units. Compaction within the 3 feet behind the wall units shall be achieved by at least three (3) passes of a lightweight mechanical tamper, plate, or roller.
- (3.) At the end of each day's operation, the Contractor shall slope the last level of backfill away from the wall facing and reinforced backfill to direct water runoff away from the wall face.
- (4.) At completion of wall construction, backfill shall be placed level with final top of wall elevation. If final grading, paving, landscaping, and/or storm drainage installation adjacent to the wall is not placed immediately after wall completion, temporary grading and drainage shall be provided to ensure water runoff is not directed at the wall nor allowed to collect or pond behind the wall until final construction adjacent to the wall is completed.

I. Construction Adjacent to Completed Wall

- (1.) The Contractor is responsible for ensuring that construction adjacent to the wall does not disturb the wall or place temporary construction loads on the wall that exceed design loads, including loads such as water pressure, temporary grades, or equipment loading. Care should be taken by the Contractor to ensure water runoff

is directed away from the wall structure until final grading and surface drainage collection systems are completed.

END OF SECTION

SECTION 32 91 13
LOAM BORROW AND TOPSOIL

PART 1 - GENERAL

1.01 SCOPE OF WORK:

- A. Under this Section, the Contractor shall furnish all labor, materials, equipment and transportation required to furnish and place 6" Loam Top Soil as shown on the drawings and as specified. Where proposed tree and shrub planting mix and/or sod or seed is noted on the drawings, it shall be composed of Loam Borrow, or Topsoil in compliance with this specification.
- B. Prospective bidders are advised that significant quantities of topsoil are present at the property and presumably available for reuse if compatible with the requirements of this specification. The Contractor shall be responsible for amending topsoil, as required to comply with this specification.

1.02 SAMPLES/TESTS:

- A. The Contractor shall furnish a Certified Laboratory Report showing the soils classification and nutrient analysis of representative samples of the proposed Loam to be used, including the extent of lime and fertilizer required. Samples submitted for approval must be representative of the total volume to be furnished, taken in the presence of the Engineer, and delivered to a certified laboratory by the Contractor; all costs for such shall be borne by the Contractor.
- B. At least ten (10) days prior to shipment/delivery of materials, the Contractor shall submit to the Owner a one (1) cubic foot representative sample, certifications, certified test results for materials as specified below. The Contractor shall provide a listing of the addresses (locations) identifying the origin of the soil to be delivered. If the origin is from multiple locations, all locations shall be provided at the time of submission of required information specified above. No materials shall be ordered or delivered until the required submittals have been reviewed and approved by the Owner. Delivered materials shall closely match the approved samples. Approval shall not constitute final acceptance. The Owner shall reserve the right to reject, on or after delivery, any material that does not meet these Specifications.
- C. If the material does not conform to the above requirements it shall be rejected and additional sources shall be found. Sampling and testing shall be accomplished as specified herein until an approved material is found, all at the Contractor's expense.
- D. To assure that materials fulfill specified requirements regarding textural analysis, organic matter content, pH, and fertility testing may be undertaken:
 - 1. Prior to site delivery; at source;

2. At time of delivery; on-site; and/or
3. Immediately following spreading on site. Soil sampling shall also indicate if specified soil was supplied uniformly to the minimum specified depth.

1.03 STANDARDS:

- A. ASTM - American Society for Testing and Materials.

1.04 NOTIFICATION:

- A. The Contractor shall notify the Owner in writing at least ten (10) days in advance of the time he intends furnishing Screened Loam Borrow stating the location and amount of such deposit, the name and address of the supplier and also shall furnish such facilities, transportation and assistance as the Owner may require for collecting and forwarding samples.

PART 2 - MATERIALS

2.01 LOAM TOPSOIL:

- A. In accordance with the specific requirements of this project, existing on-site soil may be re-used as Loam Borrow only if it meets this Specification. Existing topsoil that does not meet this Specification may be re-used only up to the subgrade elevation within the limits of areas to receive new Loam Borrow. The Contractor shall furnish all required Loam Borrow, from off site sources, as necessary, to complete the project.
- B. Screened Loam shall be “fine sandy loam” or “sandy loam” determined by mechanical analysis (ASTM D-422) and based on the “USDA” Classification System”. Screened Loam has the following mechanical analysis:

<u>Textural Class</u>	<u>Percentage of Total Weight</u>	<u>Average Percentage</u>
Sand (0.05 – 2.0mm)	45 – 75	60
Silt (0.002 – 0.05mm)	15 – 35	25
Clay (Less than 0.002mm)	5 – 20	15

- C. Screened Loam shall be a natural product consisting primarily of natural topsoil, free from subsoil, and obtained from an area that has never been stripped, as noted above, the location of the source of the loam must be submitted to the Owner.

Loam shall not contain less than five percent (5%) nor more than ten percent (10%) organic matter as determined by the loss on ignition of oven-dried samples, at 100°C ± 5°C. To adjust organic matter content, the soil may be amended, prior to site delivery, by the addition of composted leaf mold or peat moss. Use of organic amendments is accepted only if random soil sampling indicates a through incorporation of these materials. No mixing or amending of Loam will be permitted on site. The Loam shall not be delivered when in a wet or frozen condition.

- D. Loam shall consist of fertile, friable, natural loam capable of sustaining vigorous plant growth. Loam shall be without admixture of subsoil, and refuse, resulting in a homogeneous material free of stones greater than ½” in the longest dimension, be free of lumps, plants, glass, roots, sticks, excessive stone content, debris, and extraneous matter as determined by the Owner. Loam shall be within the pH range of 6.0 to 6.5 except as where noted on plans and details. It shall be uncontaminated by salt water, foreign matter and substances harmful to plant growth. The maximum soluble salt index shall be 100. Screened Loam shall not have levels of aluminum great than 200 parts per million.
- E. If limestone is required to amend the screened loam to bring it within a pH range of 6.0 to 6.5 no more than 200 pounds of limestone per 1,000 square feet of loam, incorporated into the soil, or 50 pounds of limestone per 1,000 square feet of loam, surface application, within a single season.
- F. The Owner will reject any material delivered to the site that does not meet these Specifications after post-delivery testing. If the delivered screened loam does not meet the specifications stated in this document, the delivered screened loam will be removed by the Contractor at the Contractor’s expense and at the time of rejection.
- G. The topsoil shall not be handled or moved when in a wet or frozen condition.
- H. Topsoil structure shall not be destroyed through excessive and unnecessary handling or compaction. Inappropriate handling leading to the compaction or deterioration of soil structure will result in rejection of topsoil for use.
- I. At no time should equipment or material rest on the soil.
- J. Loam Topsoil shall be free of plants and their roots, debris and other extraneous matter. It shall be uncontaminated by salt water, foreign matter and substances harmful to plant growth. The electrical conductivity (EC2) of a 1:2 soil-water suspension shall be equal to, or less than, 1.0 millimhos/cm. (test material passing #4 sieve).

PART 3 - EXECUTION

3.01 PLACEMENT:

- A. The Contractor shall furnish and spread Loam topsoil to the depths shown on the contract drawings, which depth shall be the minimum required depth after settlement. No compaction shall be required beyond that extent necessary to place sod or to plant trees and shrubs to ensure against unevenness or settling below accepted growth lines.

3.02 ADDITIVES:

- A. The Contractor shall apply all necessary fertilizer and lime to the soil in accordance with the manufacturer and laboratory's recommendations and as required by the sodding, seeding and/or planting specifications referenced elsewhere.

END OF SECTION

SECTION 32 92 19
TYPICAL SEEDING

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. This Section includes furnishing all labor, materials, equipment, seed and incidental materials necessary to accomplish all grass seeding and related work, complete in place, maintained, and accepted, in accordance with the Contact Drawings and Specifications. All grassed areas disturbed by the Contractor's operations shall be repaired as herein specified.
- B. The Contractor shall bear the responsibility and cost of furnishing and applying water or any other substances, as necessary to ensure the sustainability of grass seeded areas, as part of the work of this contract.

1.02 RELATED WORK:

- A. Section 32 91 13, LOAM BORROW AND TOPSOIL

1.03 SUBMITTALS:

In accordance with requirements of general specifications, the Contractor shall submit the following to the Engineer for review and approval:

- A. Six copies of information for seed mixes including the following:
 - 1. Name and address of the seed supplier.
 - 2. Source of origin and dates of harvest for each of the various types of seed
 - 3. Certification of seed mix composition and proportion, indicating named seed varieties by percent, percent germination, purity, and percent crop seed, percent inert matter, and percent weed seed content.
 - 4. Estimated number of seeds per pound of each type of seed in the mix
 - 5. Ingredients that comprise the hydroseed mix
- B. Six copies of information detailing proposed limestone, fertilizers, herbicide, mulch materials, hydroseeding materials (as required), and slope protection material (as required) to be applied to seeded areas.
- C. Six copies of watering, fertilizing and maintenance schedule.

- D. Six copies of marked up prints indicating the square footage of all proposed seeded areas with quantities of various soil additives and amendments, and quantities of seed for each area prior to beginning work.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. LOAM BORROW;

- 1. Loam Borrow shall be as specified in Section 32 91 13, LOAM BORROW AND TOPSOIL.

B. LIMESTONE:

- 1. Lime shall be an approved agricultural limestone containing at least 50 percent total oxides (calcium oxide and magnesium oxide). The material will be ground such that 50 percent of the material will pass through a No. 100 mesh sieve and 98 percent will pass a No. 2 mesh sieve. Lime shall be uniform in composition, dry and free-flowing and shall be delivered to the site in the original sealed containers, each bearing the manufacturer's guaranteed analysis.

C. FERTILIZER:

- 1. Fertilizer shall be a complete, standard commercial fertilizer, homogenous and uniform in composition, dry and free-flowing, and shall be delivered to the site in the manufacturer's original sealed containers, each bearing the manufacturer's guaranteed analysis and marketed in compliance with State and Federal Laws. All fertilizer shall be used in accordance with the manufacturer's recommendations.
- 2. The analysis for supplemental maintenance fertilizer shall have a ratio of Nitrogen (N) – Phosphorous (P) – Potassium (K) of approximately 4 – 1 – 2 and shall be applied to deliver 1 pound of Nitrogen per 1000 square feet, or as approved by the Engineer. At least 50 percent of nitrogenous elements shall be Urea-form or derived from organic sources and contain no less than 3 percent water soluble Nitrogen.

D. SEED:

- 1. Seed shall be of an approved perennial variety mixture, the previous year's crop, clean, and high in germinating value. Weed seed content shall be less than 0.5 percent and include no noxious weeds. Seed shall be obtained from a reliable seed company and shall be accompanied by certificates of compliance relative to mixture purity and germinating value. Seed shall be furnished and delivered in new, clean, sealed and properly labeled containers. All seed shall comply with applicable State

and Federal laws. Seed that has become wet, moldy or otherwise damaged shall not be accepted.

2. Grass seed for lawn areas shall conform to the following requirements:

Botanical and Common Names	Proportion by Weight	Germination Rate	Purity Minimum
Chewing’s Fescue (Festuca rubra commutata)	30%	70%	97%
‘Kentucky 31’ Tall Fescue (Festuca arundinacea ‘Kentucky 31’)	30%	90%	98%
Kentucky Bluegrass (Poa pratensis)	20%	80%	85%
Perennial Ryegrass (Lolium perenne)	20%	90%	98%

E. MULCH

1. Materials to be used in mulching seeded areas shall be free of weed seed and shall conform to the following requirements:
 - a. Hay Mulch shall consist of mowed and properly cured grass, clover or other acceptable plants. No salt hay shall be used.
 - b. Straw Mulch shall consist of stalks or stems of grain after threshing.

F. HYDROSEED MULCH, TACKIFIERS AND WATER RETENTION AGENTS:

1. Wood fiber mulch for Hydroseed application shall be a manufactured product of natural wood cellulose fibers with a non-toxic green marking dye incorporated to ensure uniform distribution. Mulch shall be packed in sealed original containers, clearly labeled with brand name and manufacturer. It shall have delivered moisture content less than 12 percent.
2. Hydroseed tackifier shall be a powdered starch-based product approved by the Engineer. Hydroseed tackifier shall be applied in conjunction with the hydroseed slurry in accordance with the manufacturer’s recommendations.

1. Moisture retention agent shall be a powdered starch-based product, approved by the Engineer, and shall be capable of retaining up to 400 times their weight in water. Moisture retaining agents shall be added to the hydroseed slurry in accordance with the manufacturer's recommendations. Moisture retention agent shall be 'Hydro-Gel', as manufactured by Finn Corporation, Fairfield, OH.
3. Contractor to submit mix ingredients prior to installation of hydroseed.

I. SLOPE EROSION PROTECTION:

1. Erosion control blanket shall be 100 percent biodegradable mesh with 100 percent biodegradable straw or straw/coconut fill. Fill shall be held together by biodegradable fastening. Weight shall be 0.50 pounds per square yard. Erosion control blankets shall be applied parallel to direction of water flow. The erosion control blankets shall be by North American Green, Evansville, IN or approved equal. For slopes 4:1 or greater, erosion control blanket shall be composed of 70 percent straw 30 percent coconut fiber, Model SC150. For slopes less than 4:1, erosion control blanket shall be high velocity straw matting, Model S150.
2. Six-inch wire staples shall be placed in accordance with the manufacturer's recommendations to anchor the mesh material. Staples shall be biodegradable.

J. WATER:

1. Water shall be furnished by the Contractor, unless otherwise specified, and shall be suitable for irrigation and free from ingredients harmful to plant growth and viability. The delivery and distribution equipment required for the application of water shall be the furnished by the Contractor, at no additional cost to the Owner.

PART 3 - EXECUTION

3.01 GENERAL:

- A. All work shall be performed by skilled workers with a minimum of 2 years of seeded lawn construction and establishment experience and under the full-time supervision of a qualified foreman.
- B. Seeding operations shall not begin less than 4 days after the application of lime and fertilizer and the seedbed areas are reviewed and approved by the Engineer.
- C. Seeding shall be done when soil and weather conditions permit in early spring, until June 15, or from September 10 to October 15, unless otherwise approved. If it becomes necessary for seed to be sown after June 15, provisions shall be made for supplementary water and using mulch cover over lawn areas.

- D. If there is a delay in seeding, during which weeds grow, or soil is washed out, the Contractor shall eliminate the weeds by physical means, or replace the soil before sowing the seed, without additional compensation. Immediately before seeding is begun, the soil shall be lightly raked.
- E. Seed shall be sown at the approved rate, on a non-windy day by machine, or as approved by the Engineer.
- F. The surface shall be kept moist by a fine spray until the seed shows uniform germination over the entire area. Wherever poor germination occurs in areas larger than 3 square feet, the Contractor shall reseed, roll, straw and water as necessary to obtain proper germination.
- G. If there is insufficient time in the planting season to complete soil preparations, fertilizing, and seeding, permanent seeding may be left until the following planting season, at the option of the Contractor, or on order of the Engineer. In that event, a temporary cover crop shall be sown. This cover crop shall be cut and watered as necessary until the beginning of the following planting season, at which time it shall be plowed or harrowed into the soil, the area shall be fertilized and the permanent seed crop shall be sown as specified.
- H. Protection of all newly loamed and graded areas is required and shall be accomplished by whatever means necessary such as mulch applied with a tackifier, or by other means approved by the Engineer. The Contractor shall be responsible for the prevention of siltation in areas beyond the limit of work and for all means of protection throughout the maintenance period at no additional cost to the Owner.

3.02 LOAM TESTING REQUIREMENTS

- A. Loam (vegetative support layer) samples shall be collected from in-place loam at a minimum of every 1000 cubic yards and analyzed for grain size (ASTM D422), pH (Astm D6276) and organic content (ignition test).

3.03 BROADCAST SEEDING, PLACING MULCH AND SLOPE EROSION PROTECTION:

- A. The seed mix shall be broadcast at 6 pounds per 1000 square feet, as recommended by the seed supplier, or as directed by the Engineer. Seed shall be divided into 2 equal amounts and uniformly distributed in 2 applications at right angles to each other. Seed shall then be raked lightly into the soil to a depth of 1/4 inch.
- B. If mulch is not necessary the seed shall be directly firmed into the soil with a roller that will apply pressure between 75 and 100 pounds per linear foot of width.
- C. Hay or Straw Mulch shall be used based on time of seeding as previously specified over all seeded areas, as designated on the plans, or as otherwise directed. If mulch is to be used, it shall be loosely spread to a uniform depth at a rate of 4-1/2 tons per acre to provide 1/4 inch

of cover, or as otherwise directed. The seed and mulch shall then be firmed into the soil with a roller that will apply a pressure between 75 and 100 pounds per foot of width.

- D. Hay or Straw Mulch may be applied by mechanical apparatus, if in the judgment of the Engineer, the apparatus spreads the mulch uniformly and forms a suitable mat to control slope erosion. The apparatus shall be capable of spreading at least 80 percent of the hay or straw in lengths of 6-inches or more, otherwise it shall be spread by hand without additional compensation.
- E. Slope erosion control blankets shall be placed as indicated on the plans or as directed by the Engineer.

3.04 HYDROSEEDING:

- A. The application of lime, fertilizer, grass seed and mulch may be accomplished in a single operation with the use of approved hydroseeding equipment. The materials shall be mixed with water in the machine and kept in an agitated state in order that the materials may be uniformly suspended in the water. The slurry shall be of such consistency that it can be sprayed from a hydroseed gun or through at least 200 feet of 1 ½ inch diameter hose. The spraying equipment shall be so designed that when the solution is sprayed over an area, the resulting deposits of lime, fertilizer, grass seed, and mulch shall be equal to the specified quantities.
- B. Prior to the start of hydroseeding, the Contractor shall furnish to the Engineer, in writing, the weights of limestone, fertilizer, grass seed, mulch, tackifier (as required) and moisture retention agent (as required) per 100 gallons of water to be used. This statement should also specify the number of square yards of seeding that can be covered with the solution specified above. If the results of hydroseeding operations are unsatisfactory, the Contractor will be required to abandon this method and to apply the lime, fertilizer, grass seed and mulch by other means.
- C. Seed shall be incorporated with the mulching material to obtain a minimum hydroseeded sown coverage of 200 pounds of the specified seed mix per acre, as recommended by the seed suppliers, or as directed by the Engineer.
- D. Wood fiber mulch shall be uniformly spread over certain selected seeded areas at the minimum rate of 1,400 pounds per acre unless otherwise directed. Mulch shall be placed by spraying from an approved spraying machine with pressure sufficient to cover the entire area in a single operation.
- E. The Contractor shall immediately cleanup hydroseed oversprays from plant materials, pavements, furnishings, etc., to the satisfaction of the Engineer.

3.05 MAINTENANCE:

- A. The Contractor shall maintain and protect the entire seeded area, as necessary to ensure dense healthy growth, until completion of the guarantee period and final acceptance of the project, or for 60 days, whichever is longer. If lawns are planted in late summer or during the fall, maintenance shall continue through the following spring for at least 30 days. Maintenance shall include watering as specified, liming, fertilizing, removal of stones, control of weeds, insect pests and fungal pathogens, and regular mowing. Defective work shall be corrected as soon as possible after it becomes apparent and weather and season permit.
- B. The first cutting of lawn areas shall be done when the grass is between 2 ½ - 3 inches in height. The lawn shall be cut no shorter than 2 inches in height and shall be regularly mowed as necessary to maintain the above-prescribed conditions. All cuttings shall be removed from the lawn during the maintenance period and disposed of off-site.
- C. The Contractor shall be responsible to regularly water seeded areas with the equivalent of 1-inch minimum of rainfall per week, or as necessary to develop and sustain dense, green growth.
- D. Six weeks after turf has established, and only during the months of April, May, or September, the Contractor shall apply fertilizer as specified above, at one half the rate recommended by the initial soils laboratory tests, or as directed by the Engineer.
- E. The Contractor shall be responsible for securing all seeded areas from physical damage as necessary, including warning signs, barriers, temporary fencing, or other means of protection, through the guarantee period until final acceptance. All damaged areas shall be repaired to reestablish healthy vigorous growth of turf to the satisfaction of the Engineer, at no additional cost to the Owner. All temporary barriers shall remain the property of the Contractor and shall be removed by the Contractor upon final acceptance by the Engineer.
- F. Pavement shall be kept clean and clear of cuttings and debris at all times during the maintenance period to the satisfaction of the Engineer.

3.06 INSPECTION AND PRELIMINARY ACCEPTANCE:

- A. At the beginning of the planting season following that in which the permanent grass crop is sown, seeded areas will be inspected. Any section not showing dense, vigorous growth shall be promptly reseeded by the Contractor at no additional cost to the Owner. The seeded areas shall be watered, weeded, cut and otherwise maintained by the Contractor, as many times as necessary, in accordance with these specifications, until they are accepted.
- B. The Contractor shall provide written notice to the Engineer not less than 10 days before the anticipated date of inspection for preliminary acceptance. The Engineer shall recommend preliminary acceptance of the work of this Section only after completion and re-inspection of all necessary repairs, renewals, or replacements.

- C. Inspection and acceptance of seeded areas may be requested and granted in part, provided the areas for which acceptance is requested are relatively substantial in size, and with clearly definable boundaries. Acceptance and use of these areas by the Owner shall not waive any other provisions of this Contract.

3.07 GUARANTEE:

- A. Seeded areas shall be guaranteed until final acceptance of the project, or, in the case of late summer or fall planting, the guarantee period shall extend through the following spring.
- B. When the work is accepted in part, the guarantee period shall extend from each partial acceptance to the terminal date of the last guarantee period. All guarantee periods terminate at one time.
- C. Guarantee shall not apply to the replacement of seeded lawns resulting from the removal, loss, or damage due to occupancy of the project in any part; vandalism or acts of neglect on the part of others; physical damage by animals, vehicles, etc.; and Acts of God, including but not limited to, catastrophic fire, hurricanes, riots, war, etc.
- D. In the instance of curtailment of water by local water authorities (when supply was to be furnished by the Owner), the Contractor shall furnish all necessary water by water tanker, the cost of which will be approved and paid for by the Owner.

3.08 FINAL INSPECTION AND FINAL ACCEPTANCE:

- A. At the end of the guarantee period, the Contractor shall provide written notice to the Engineer not less than 10 days before the anticipated date of final inspection for final acceptance.
- B. The Engineer shall recommend final acceptance of the work of this Section only after completion and re-inspection of all necessary repairs, renewals or replacements.

END OF SECTION –

SECTION 32 93 00
TREES, SHRUBS, GROUNDCOVERS, AND LANDSCAPING

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. This Section includes furnishing all labor, materials, equipment, plants, and incidental materials necessary to perform all operations related to the planting of all trees, shrubs, vines, herbaceous plants, ground covers, and for all appurtenant work, complete in place, maintained, and accepted, in accordance with the Contract Drawings and Specifications.
- B. The Contractor shall bear the responsibility and cost of furnishing and applying water or any other substances, as necessary to ensure the sustainability of plant materials, as part of the work of this contract.

1.02 RELATED WORK:

- A. Section 32 91 13, LOAM BORROW AND TOPSOIL
- B. Section 32 92 19, SEEDING

1.03 SUBMITTALS:

In accordance with requirements of the general specifications, the Contractor shall submit the following:

- A. Prior to planting, State nursery inspection certificates for all plant materials shall be submitted to the Engineer for review.
- B. Samples and six copies of the manufacturer's product data, as applicable, shall be submitted to the Engineer for review and approval for the following materials:
 - 1. Limestone.
 - 2. Fertilizer.
 - 3. Sphagnum Peat Moss.
 - 4. Humus.
 - 5. Organic Compost.
 - 6. Manure.
 - 7. Mulch.

8. Guying and Staking Apparatus.
9. Crepe Wrapping for tree trunks.
10. Anti-transpirant/Anti-desiccant.

PART 2 - PRODUCTS

2.01 PLANT MATERIALS:

- A. The Contractor shall furnish and plant all plant materials as shown on the plans and in the quantities and sizes listed thereon. No substitutions shall be permitted without the written approval of the Engineer.
- B. Plants larger than those specified in the Plant List may be used if approved by the Engineer. However, use of such oversized plants shall not be considered grounds for any increase in the contract price. If the use of larger plants is approved, the required spread of roots or ball of earth shall be increased in proportion to the size of the plant and plant pits shall be increased as necessary.
- C. All plants shall be certified to have passed all required Federal and State inspection laws requiring ensuring freedom from plant diseases and insect infestations. The Contractor shall obtain clearance from applicable governing agencies, as required by law, before planting any plants delivered from outside the state in which they are to be planted.
- D. All plants shall be nursery-grown under climatic conditions and environmental stresses similar to those in the locality of the project. All plants shall originate from nurseries that are no more than one Hardiness Zone higher (as established by the Arnold Arboretum, Jamaica Plain, MA) than where the plant is to be installed. Plants also shall conform to the botanical names and standards of size, culture, and quality for the highest grades and standards as adopted by the American Association of Nurserymen, Inc. in the American Standard for Nursery Stock, ANSI-Z60.1, latest edition. All plants shall be legibly tagged with their proper botanical name.
- E. No heeled-in plants or plants from cold storage shall be used. All plants shall be typical of their species or variety and shall have a normal habit of growth. Plants shall be sound, healthy, and vigorous, well branched and densely foliated when in leaf; shall be free of disease, insects, eggs or larvae; and shall have healthy, well-developed root systems. All parts of the plant shall be moist and shall show active green cambium when cut.
- F. All nursery plants shall be balled and burlapped or container-grown and shall have been acclimatized for at least one growing season. Container-grown stock shall have been grown in a container long enough for the root system to have developed sufficiently to

hold its soil together, firm and whole, after removal from the container. No plants shall be loose in the container. Container-grown plants shall have no girdling roots and shall not be in a root-bound condition. Plants shall remain in their container until planted.

- G. Care shall be exercised in digging and preparing field-grown plants for shipment and planting. Balled and burlapped materials shall have solid unbroken balls of earth of sufficient size to encompass all fibrous feeding roots necessary to ensure successful recovery and development of the plants. Balls shall be firmly wrapped in untreated biodegradable burlap and tied securely with wire cages and/or jute twine. Roots or balls of plants shall be adequately protected at all times from sun and drying winds. No plant shall be accepted when the ball of earth surrounding its roots has been badly cracked or broken preparatory to or during planting, or after the burlap, staves, wire cage, rope, or platform in connection with its transplanting have been removed. Soil characteristics (i.e., composition, texture, pH, etc.) of all field-grown plants shall closely match those of the soil where plant materials are to be planted.
- H. The height of the trees, measured from the crown of the roots to the top of the top branch, shall not be less than the minimum size designated in the Plant List in the Drawings. The branching height for deciduous trees installed adjacent to or within walks shall be 7 feet minimum, having been pruned to this height at least 1 year prior to transplanting. Except when a clump is designated, the trunk of each tree shall be a single trunk growing from a single, unmutated crown of roots. No part of the trunk shall be conspicuously crooked as compared with normal trees of the same variety. The trunk shall be free from sunscald, frost cracks, or wounds resulting from abrasions, fire, or other causes. All pruning cuts shall comply with acceptable horticultural practices. No pruning wounds having a diameter of more than 1½-inches shall be present. Any such wounds must show vigorous bark growth on all edges. Evergreen trees shall be branched to within 1 foot of the ground. No tree that has had its leader cut or die shall be accepted.
- I. Caliper measurements for tree trunks shall be taken 6-inches above ground for trees up to and including 4-inch caliper size and at 12-inches above ground for larger sizes.
- J. Shrubs shall meet the requirements for spread and/or height stated in the Plant List on the Drawings. The measures for height are to be taken from the crown or root flare to the average height of the top of the shrub mass (not the longest branch). The fullness of each shrub shall correspond to the trade classification "No. 1". Single stemmed or thin plants will not be accepted. The side branches must be generous, well-twigged and the plant as a whole must be well-bushed to the ground. The plants must be in a moist, vigorous condition, free from dead wood, bruises or other root or branch injuries.
- K. Herbaceous plants, vines and groundcovers shall be of the size, age and/or condition designated in the Plant List on the Drawings.
- L. Plants shall be delivered only after preparations for planting have been completed. Plants shall be handled and packed in a horticulturally approved manner and all necessary precautions shall be taken to ensure that plants arrive on-site in a healthy

vigorous condition. Trucks used for transporting plants shall be equipped with covers to protect plants from windburn, desiccation, and overheating during transport. Plants that have not been thoroughly watered shall not be accepted at the planting site. Any plants delivered to the site in a dry or wilted condition shall be rejected and replaced at no expense to the Owner. All plant materials shall be protected, watered and otherwise maintained prior to, during, and upon delivery to the site.

- M. Plants shall be subject to inspection and approval by the Engineer at the place of growth, or upon delivery, for conformity to specification requirements as to quality, size, variety, and condition. Inspection and selection of plants before digging shall be at the option of the Engineer. The Contractor, or his representative, shall be present, if requested by the Engineer, for inspection of plants at the Nursery. Such approval shall not impair the right of inspection and rejection upon delivery at the site or during the progress of work, for size and condition of balls and roots, disease, insects and latent defects or injuries. Rejected plants shall be removed immediately from the site. Certificates of inspection of plant materials shall be furnished as may be required by Federal, State and other authorities to accompany shipments.

2.02 LOAM BORROW:

Loam Borrow shall be as specified in Section 32 91 13, LOAM BORROW AND TOPSOIL.

2.03 SOIL ADDITIVES AND AMENDMENTS:

A. LIMESTONE:

Lime shall be an approved agricultural limestone containing at least 50 percent total oxides (calcium oxide and magnesium oxide). The material will be ground such that 50 percent of the material will pass through a No. 100 mesh sieve and 98 percent will pass a No. 2 mesh sieve. Lime shall be uniform in composition, dry and free-flowing and shall be delivered to the site in the original sealed containers, each bearing the manufacturer's guaranteed analysis.

B. FERTILIZER:

1. Fertilizer shall be a complete, standard commercial fertilizer, homogeneous and uniform in composition, dry and free-flowing, and shall be delivered to the site in the manufacturer's original sealed containers, each bearing the manufacturer's guaranteed analysis and marketed in compliance with State and Federal Laws. All fertilizer shall be used in accordance with the manufacturer's recommendations.
2. Fertilizer for tree, shrub and groundcover plantings shall contain all major plant nutrients and minor trace elements essential to sustain plant growth and shall have the following analysis:

Nitrogen (N)	Phosphorous (P)	Potassium (K)
10%	10%	10%

3. As approved by the Engineer, a slow release root contact fertilizer installed at the time of planting, may be used in place of the above, at the discretion of the Contractor.

- C. Organic Compost shall be a standard commercial product comprised of fully decomposed, 100 percent plant-derived, natural organic matter. Its composition shall furnish ample water holding capacity and cation exchange capacity for the retention of plant nutrients. Compost shall be free of sticks, stones, weed seeds, roots, mineral or other foreign matter and delivered air dry. It shall be free from excessive soluble salts, heavy metals, phytotoxic compounds, and/or substances harmful to plant growth and viability. Organic compost shall have an acidity range of 4.5 to 7.0 pH.
- D. Sphagnum Peat Moss shall be a standard commercial product. Its composition shall furnish ample water holding capacity and cation exchange capacity for the retention of plant nutrients. Peat moss shall be free of sticks, stones, weeds or weed seeds, roots, mineral or other foreign matter. It shall be free from toxic substances and/or compounds harmful to plant growth and viability. It shall be delivered air dry in standard bales and shall have an acidity range of 3.5 to 5.5 pH.
- E. Humus shall be natural humus, reed peat, or sedge peat. Its composition shall furnish ample water holding capacity and cation exchange capacity for the retention of plant nutrients. Humus shall be free of sticks, stones, weeds, roots, mineral or other foreign matter and/or toxic substances harmful to plant growth and viability. It shall be low in wood content, free from hard lumps and excessive amounts of zinc and delivered air dry in a shredded or granular form. The acidity range for humus shall be 5.5 to 7.5 pH, and the organic matter content shall be not less than 85 percent, as determined by loss on ignition. The minimum water holding capacity shall be 200 percent by weight on an oven-dry basis.
- F. Manure shall be well-rotted, leached, cow manure not less than 8 months or more than 2 years old. It shall be free of sawdust, shavings, or refuse of any kind and shall not contain more than 25 percent straw. It shall contain no substances harmful to plant growth. The Contractor shall furnish information regarding chemical disinfectants, if any, that may have been used in storage of the manure.

2.04 PLANTING MIXTURE:

Planting mix shall consist of 7 parts loam borrow and 1 part organic compost, humus, sphagnum peat moss, or manure, thoroughly blended.

2.05 WATER:

Water shall be furnished by the Contractor, unless otherwise specified, and shall be suitable for irrigation and free from ingredients harmful to plant growth and viability. The delivery and distribution equipment required for the application of water shall be furnished by the Contractor, at no additional cost to the Owner.

2.06 MULCH:

Mulch shall be fibrous pliable shredded black organic softbark mulch, not exceeding ½-inch in width. It shall be 98 percent organic matter with a pH range between 3.5 and 4.5 and a moisture content not to exceed 35 percent. It shall be free of weeds, weed seeds, debris, and other materials harmful to plant growth and viability. Organic mulch shall be aged no longer than 2 years.

2.07 MATERIALS FOR STAKING, GUYING, AND WRAPPING:

- A. Tree stakes shall be sound, untreated 2 x 3 (nominal) x 8-foot length Douglas Fir reasonably free of knots. No paint or stain shall be used in conjunction with tree stakes. Tying material shall be flexible braided nylon webbing, ¾-inch wide and have a tensile strength of 900 pounds. Webbing shall be 'ArborTie', or approved equal.
- B. Drive anchors and guy wire assemblies shall be suitable for protecting trees and shall be sized in accordance with the manufacturer's recommendations. No materials shall be used for guying that will girdle, chafe, or otherwise injure trees.
- C. Tree wrap shall be duplex, waterproof kraft paper crinkled to 33-1/3 percent stretch, 4- to 6-inch wide strips. Tying materials shall be jute twine, 2-ply for shrubs and trees less than 3-inch caliper; 3-ply for larger plants.

2.08 TREE PAINT:

Tree paint shall not be used.

2.09 ANTI-TRANSPIRANT/ANTI-DESICCANT:

Anti-transpirant or anti-desiccant shall be 'Wilt-Pruf', as manufactured by Nursery Specialty Products, Inc., Groton Falls, NY, or approved equal. It shall be delivered in original sealed manufacturer's containers and used in accordance with the manufacturer's instructions.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. All plants shall be subject to inspection and approval by the Engineer upon delivery to the site. No materials shall be planted until approval is received.

- B. All work shall be performed by skilled workers with a minimum of 2 years planting experience, in accordance with accepted horticultural/nursery practices, under the full-time supervision of a Certified Nurseryman or Arborist.
- C. All balled and burlapped plants that cannot be planted immediately upon delivery shall be set on the ground and the root balls shall be well protected with soil, wet moss, or other acceptable material. All foliage shall be protected and covered with perforated shade materials.
- D. The planting season for evergreen trees and shrubs shall extend from the time the soil becomes workable in the spring until new growth appears, and from September 15 until November 30 in the fall. Deciduous trees and shrubs shall be planted only when dormant, either prior to bud break and/or before leaves appear in the spring, or subsequent to their leaf drop in the fall. Ground covers shall be planted only after the last frost in the spring through mid-May. Planting season periods may be extended if weather and soil conditions permit only with the written approval of the Engineer. Extended or out-of-season planting requirements shall include application of antitranspirant and extra water as needed. Plant guarantee periods shall remain as stated below. Planting shall not be permitted in frozen ground.
- E. All plant locations and outlines for planting beds shall be staked out for review and potential adjustment by the Engineer before any excavation is begun. In the event that rock, underground construction work or obstructions are encountered in any proposed planting pit or bed, the Engineer may select alternate locations. Where locations cannot be changed, the obstruction shall be removed, subject to the Engineer's approval, to a depth of not less than 3 feet below grade and not less than 6-inches below the bottom of the root ball when plant is properly set at the required grade. Removal of boulders or obstructions greater than 1 cubic yard in size shall be subject to approval and will be paid for by the Owner. No ledge will be removed to create planting pits or beds
- F. All planting pits shall be excavated with sloped walls, wider at the top than at the bottom, and scarified to eliminate glazing. Tree pits shall be at least 2 feet greater in diameter than the root ball of earth or root system. Shrub pits shall be at least 1 foot greater than the diameter of the root ball. Planting pits shall not be deeper than the height of the root ball.
- G. When excavation occurs in areas of heavily compacted earth, stones, concrete chunks or other foreign matter, pits shall be dug at least 3 times the width of the rootball. Excavated material from plant pits shall be disposed of as required.
- H. Container plants shall be removed from their growing container before planting. If roots are densely matted, the outer root mass shall be scored, sliced vertically, with a sharp knife to separate roots. All herbaceous plants and groundcovers shall be evenly spaced to produce a uniform effect and staggered in rows at intervals designated on the contract drawings.

- I. Shrubs and trees shall be set in the center of planting pits, plumb and straight, and at such a level that after settlement the crown of the roots will be 1-inch above the surrounding finished grade. Root ball masses shall not be loosened, broken or damaged. When balled and burlapped plants are set, planting mixture shall be compacted around bases of balls to fill all voids. All tying materials, twine and rope shall be cut and removed. Biodegradable burlap shall be laid back or cut away from the top half of the ball. If a wire basket is present, the upper 2/3 of the basket shall be cut away and removed. Do not remove the entire basket. Roots or bare root plants shall be properly spread out and planting mixture carefully worked in among them. Broken or frayed roots shall be cleanly cut.
- J. Backfill plant pits with planting mixture in layers of not more than 9-inches and firmly tamp each layer and water to sufficiently settle the backfilled soil before the next layer is put in place. When the planting pit is 2/3 backfilled, the hole shall be flooded and watered thoroughly so that the water level reaches the top of the planting pit. Allow water to soak in, then complete the backfilling operation. Immediately after planting pit is backfilled, a shallow basin 3-inches deep and slightly larger than the pit shall be formed with a ridge of soil for water retention. Form a common basin for plant materials throughout mass planting beds. After planting, lightly till the soil in planting beds between planting pits and rake smooth to eliminate compaction of soils.
- K. All planting hole basins shall be flooded with water twice within the first 24 hours of planting, and watered not less than twice per week until final acceptance of the work.
- L. All thin barked deciduous trees shall be wrapped after they are planted and before they are staked. Prior to wrapping, inspect trees for injury to trunks or improper pruning. Take corrective measures as necessary. Wrap trunks of all trees spirally from bottom to top with tree wrap and secure top and bottom at 2-foot intervals with jute twine. The wrapping shall overlap and entirely cover the trunk from the ground to the height of the second branches and shall be neat and snug. Overlap shall be approximately 2-inches.
- M. Stake trees immediately after planting as detailed. All staking apparatus shall be adequate to hold the tree in a vertical position under severe weather conditions. All staking apparatus and tree trunk wrapping shall be removed and disposed of off-site by the Contractor at the end of one growing season.
- N. Immediately after planting and staking operations are complete, all plant pit basins and plant beds shall be covered with approved mulch to the depths designated on the plans. Mulch shall not contact tree bark, cover tree root flares, or shrub crowns. No mulch shall be applied prior to the first watering.
- O. The pruning of trees and shrubs shall only be permitted to remove dead or dying branch limbs and tips, sucker growth, water sprouts, crossing or rubbing branches, broken or damaged branches, diseased or insect infested limbs, and to preserve the natural character of the plant. Plant materials shall be pruned in accordance with American Nurserymen Association Standards and as required by the Engineer. Questionable weak limbs and branch removals that may disfigure the plant shall be left to the discretion of

the Engineer. The tree leader shall never be permitted to be cut. Pruning shall be done with clean, sharp tools. All large pruning cuts that are ½-inch in diameter or larger shall be made along the bark branch ridge. Pruning cuts shall not breach or otherwise interfere with the branch collar. All pruning cuts less than ¼-inch diameter shall be made with hand pruners as close to the main stem as possible without damaging the cambium or bud. Tree paint shall not be used to cover pruning cuts.

- P. As the work proceeds, the Contractor shall remove all debris from the site, including but not limited to branches, rock, paper, and rubbish. All areas shall be kept clean, neat and in an orderly condition at all times. Prior to final acceptance, the Contractor shall cleanup the entire area to the satisfaction of the Engineer.

3.02 MAINTENANCE:

- A. Maintenance shall begin immediately after each plant is planted and shall continue until completion of the guarantee period and final acceptance of the project. Plants shall be watered, pruned, sprayed, fertilized, cultivated and otherwise maintained and protected. Tree guys and stakes shall be tightened and repaired. Defective work shall be corrected as soon as possible after it becomes apparent and weather and season permit.
- B. Settled plants shall be reset to proper grade and position, planting pits and common basins restored, and dead materials removed and replaced. Planting beds and individual basins shall be neat in appearance, maintained to their original layout lines and kept free of weeds. Mulch shall be replaced as required to maintain proper depths.
- C. Contractor shall make arrangements to provide sufficient water to maintain all trees, shrubs and plant materials until final acceptance. Plants shall be sprayed with anti-transpirant or anti-desiccant if required by seasonal conditions or as required by the Engineer.
- D. Planting areas shall be protected against trespass and damage of any kind during the maintenance period. This shall include the furnishing and installation of approved temporary fencing if necessary. If any plants become damaged during the maintenance period, they shall be treated or replaced as required by the Engineer at no additional cost to the Owner.

3.03 INSPECTION AND PRELIMINARY ACCEPTANCE:

- A. Contractor shall provide written notice to the Engineer not less than 10 days before the anticipated date of inspection for preliminary acceptance. The Engineer shall recommend preliminary acceptance of the work of this Section only after completion and re-inspection of all necessary repairs, renewals or replacements.
- B. Inspection and acceptance of plantings may be requested and granted in part, provided the areas for which acceptance is requested are relatively substantial in size, and with clearly definable boundaries. Acceptance and use of these areas by the Owner shall not waive any other provisions of this Contract.

3.04 GUARANTEE:

- A. All plant materials shall be guaranteed for a period of one year after the date of completion of the specified maintenance period and preliminary acceptance of the project by the Owner.
- B. When the work is accepted in part, the guarantee period shall extend from each partial acceptance to the terminal date of the last guarantee period. All guarantee periods terminate at one time.
- C. Plants shall be healthy, free of pests and disease. Plants shall exhibit vigorous growth, shall bear foliage of normal density, size and color and shall have no less than seventy-five percent (75%) of their branches alive at the end of the guarantee period. If the leader of any single-leader species is dead, the entire plant shall be considered dead.
- D. Any plant required under this Contract that is dead or unsatisfactory, as determined by the Engineer, shall be removed from the site. These shall be replaced as soon as weather permits during the specified planting season, at no additional cost to the Owner, until the plants live through one year.
- E. All replacements shall be plants of the same kind and size as specified on the Plant List. They shall be furnished and planted as specified above.
- F. The guarantee of all replacement plants shall extend for an additional one-year period from the date of their acceptance as replacement.
- G. Guarantee shall not apply to the replacement of unacceptable plants resulting from the removal, loss, or damage due to occupancy of the project in any part; vandalism or acts of neglect on the part of others; physical damage by animals, vehicles, etc.; and Acts of God, including but not limited to, catastrophic fire, hurricanes, riots, war, etc.
- H. In the instance of curtailment of water by local water authorities (when supply was to be furnished by the Owner), the Contractor shall furnish all necessary water by water tanker, the cost of which will be approved and paid for by the Owner.

3.05 FINAL INSPECTION AND FINAL ACCEPTANCE:

- A. At the end of the guarantee period, the Contractor shall provide written notice to the Engineer not less than 10 days before the anticipated date of final inspection for final acceptance.
- B. The Engineer shall recommend final acceptance of the work of this Section only after completion and re-inspection of all necessary repairs, renewals or replacements.

END OF SECTION

SECTION 33 00 00
TRACER TAPE

PART 1 - GENERAL

1.01 WORK INCLUDED:

This section covers the furnishing, handling and installation of tracer tape, as called for on the drawings.

1.02 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

- A. Six sets of manufacturer's literature on the materials, colors and printing specified herein, shall be submitted to the Engineer for review.
- B. Tape samples shall also be submitted to the Engineer for review.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

Tracer tape shall be by Reef Industries, Houston, TX; Empire Level, Mukwonago, WI; Pro-Line Safety Products Co., W. Chicago, IL; or approved equal.

2.02 TRACER TAPE:

- A. Tracer tape shall be at least 3-inches wide.
- B. Tracer tape for non-ferrous pipe or conduit shall be constructed of a metallic core bonded to plastic layers. The metallic tracer tape shall be a minimum 5-mil thick and must be locatable at a depth of 18 inches with ordinary pipe locaters.
- C. Tracer tape for ferrous pipe or conduit shall consist of multiple bonded plastic layers. The non-metallic tracer tape shall elongate at least 500% before breaking.
- D. The tape shall bear the wording: "BURIED DRAIN LINE BELOW" (with "DRAIN" replaced by "WATER", "SEWER", "ELECTRICAL", "GAS", "TELEPHONE", or "CHEMICAL" as appropriate), continuously repeated every 30 inches to identify the pipe.
- E. Tape colors shall be as follows, as recommended by the American Public Works Association (APWA):

Electric	Red
Gas & Oil	Yellow
Communications	Orange

Water	Blue
Sewer & Drain	Green
Chemical	Red (not APWA)

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Tracer tape shall be installed directly above the pipe or conduit it is to identify, approximately 12 inches below the proposed ground surface.
- B. The Contractor shall follow the manufacturer's recommendations for installation of the tape, as approved by the Engineer.

END OF SECTION - 33 00 00

SECTION 33 11 13

SERVICE CONNECTIONS (WATER SERVICES)

PART 1 - GENERAL

1.01 WORK INCLUDED:

This section covers the furnishing and installation of new water service connections and the repair, replacement, and/or transfer of existing water service connections as shown on the drawings, as specified herein, and as required by the Engineer.

1.02 RELATED WORK:

- A. Section 32 12 00, PAVING
- B. Section 32 91 19, LOAMING AND SEEDING
- C. Section 33 11 13.13, DUCTILE IRON PIPE AND FITTINGS FOR WATER MAINS

1.03 REFERENCES:

- A. The following standards form a part of this specification:

American Society for Testing and Materials (ASTM)

- | | | |
|------|-------|-----------------------------------------------------|
| ASTM | B88 | Seamless Copper Water Tube |
| ASTM | B584 | Copper Alloy Sand Castings for General Applications |
| ASTM | D2737 | Polyethylene (PE) Plastic Tubing |

American Water Works Association (AWWA)

- | | | |
|------|------|--------------------------------------------------------------------------------|
| AWWA | C800 | Water-Service Line Fittings |
| AWWA | C651 | Disinfecting Water Mains |
| AWWA | C901 | Polyethylene Pressure Pipe & Tubing, 1/2-inch through 3-inch for Water Service |

Federal Specifications (FS)

- | | | |
|----|-----------|------------------------|
| FS | WW-T-799C | Tube, Copper, Seamless |
|----|-----------|------------------------|

1.04 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF THE GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

Six sets of manufacturer's literature of the materials of this section for review.

PART 2 - PRODUCTS

2.01 SERVICE PIPING:

- A. Piping for buried copper water services shall be continuous Type K annealed seamless copper water tubing conforming to ASTM B88 Standard Specification for Seamless Copper Water Tube or U.S. Federal Specification WW-T-799C for Tube, Copper, Seamless. Tubing shall be 1-inch diameter unless otherwise indicated.
- B. Couplings, if required, for existing to new service pipe connections shall have compression connections on the inlet and compression connections on the outlet. Couplings shall be made of brass as specified in AWWA C800. All brass components that come into contact with potable water shall be made from either CDA/UNS Brass Alloys C89520 or C89833 and shall not contain more than twenty five hundredths of one percent (0.25% or less) total lead content by weight. The lead leach limit of the coupling shall be 5 parts per billion (ppb). Couplings shall be NSF/ANSI 61 Annex F and Annex G and NSF/ANSI 372 certified by an ANSI accredited organization and shall be stamped or embossed with a mark or name indicating that the product is manufactured from a low-lead alloy, as specified above.

2.02 CORPORATION STOPS:

- A. Corporation stops shall be made of brass as specified in AWWA C800. All brass components that come into contact with potable water shall be made from either CDA/UNS Brass Alloys C89520 or C89833 and shall not contain more than twenty five hundredths of one percent (0.25% or less) total lead content by weight. The lead leach limit of the corporation stops shall be 5 ppb. Corporation stops shall be NSF/ANSI 61 Annex F and Annex G and NSF/ANSI 372 certified by an ANSI accredited organization and shall be stamped or embossed with a mark or name indicating that the product is manufactured from a low-lead alloy, as specified above.
- B. The inlet shall have AWWA taper thread (CC) connections and the outlet shall have compression connections.
- C. Service clamps shall be installed with all corporation stops 2-inches and larger in size and with all corporation stops installed in PVC pipe. Clamps shall be all bronze, ductile iron or stainless steel, single strap, AWWA taper thread (CC) with O-ring seal.
- D. Corporation stops shall be by Ford Meter Box Co., Inc., Wabash, IN; Red Hed Manufacturing Co., Lincoln, RI; Mueller Co., Decatur, IL; or approved equal.

2.03 CURB STOPS:

- A. Curb stops shall be of brass as specified in AWWA C800. All brass components that come into contact with potable water shall be made from either CDA/UNS Brass Alloys C89520 or C89833 and shall not contain more than twenty five hundredths of one percent (0.25% or less) total lead content by weight. The lead leach limit of the curb stops shall be 5 ppb. Curb stops shall be NSF/ANSI 61 Annex F and Annex G and NSF/ANSI 372 certified by an ANSI accredited organization and shall be stamped or embossed with a mark or name indicating that the product is manufactured from a low-lead alloy, as specified above.
- B. Curb stops shall be ball style and the inlet and the outlet shall have compression connections.
- C. Curb stops shall be by Red Hed Manufacturing Co., Lincoln, RI; Ford Meter Box Co., Inc., Wabash, IN; Mueller Co., Decatur, IL; or approved equal.

2.04 CURB BOXES:

- A. The cast iron box shall be the sliding Buffalo type with Arch pattern base. Minimum inside diameter of the upper section shall be 1-1/2-inch for 3/4-inch and 1-inch curb stops and 2-inch for 1-1/2-inch and 2-inch curb stops. Curb box lid shall have brass pentagonal nut.
- B. Boxes shall be equipped with 30-inch stationary extension rods with pinned connections to the curb stop.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Where new water mains are being installed and existing water services are to be transferred to the new main, the Contractor shall discontinue the existing water services by shutting down the corporation stop at the old water main, unless specifically otherwise required by the Engineer. The Contractor shall take special care to minimize the interruption of existing water service.
- B. The Contractor shall tap a new corporation stop, cut the existing service piping and connect the new service piping to the old service piping using an approved coupling at a point between the main and the existing curb stop and box.
- C. Where transfers are to be made and the existing curb stop and box cannot be utilized or a new curb stop and box is required, the Contractor shall connect the new service piping to the existing service piping using an approved coupling approximately 12-inches from the curb stop on the building side of the stop.

- D. Where transfers are being made and the existing service is of lead, galvanized steel, or iron, the service shall be replaced to the curb stop and box unless otherwise required. If required, the curb stop and box shall be replaced as specified above.
- E. Curb stops and boxes shall be set plumb, flush with the ground or paved surface, and centered with the box located directly over the stop. The box shall be set on a concrete block or flat stone. Earth fill shall be carefully tamped around the boxes to a distance of 4 feet on all sides of the box or to the undisturbed face of the trench, if less than 4 feet.
- F. Curb stops shall be operational and accessible at all times during construction and warranty period. The Contractor shall verify the proper operation of all curb stops in the presence of the Engineer and/or Owner following completion of the project and prior to the acceptance of substantial completion.
- G. All services shall be installed at 5 feet 0 inches of cover unless otherwise required by the Engineer.
- H. Service connections shall be tested and disinfected in accordance with AWWA standards.

END OF SECTION

\\wse03.local\WSE\Projects\NH\Portsmouth, NH\RTE 33 Recreational Field\Specs\Division 33\33 11 13
Water Service Connections.docx

SECTION 33 40 01
DUCTILE IRON PIPE AND FITTINGS FOR WATER MAINS

PART 1 - GENERAL

1.01 WORK INCLUDED:

This Section covers the furnishing, handling, hauling, laying, jointing, testing and disinfecting of all ductile iron pipe, including fittings and appurtenant work as indicated on the drawings and as specified.

1.02 RELATED WORK:

- A. Section 31 23 00.01, EARTHWORK
- B. Section 33 11 13, VALVES
- C. Section 33 11 16, CONNECTIONS TO EXISTING WATER MAINS

1.03 QUALITY ASSURANCE:

- A. All pipe and fittings shall be inspected and tested at the foundry as required by the standard specifications to which the material is manufactured. The Contractor shall furnish in duplicate to the Engineer sworn certificates of such tests.
- B. In addition, the Owner reserves the right to have any or all pipe, fittings and special castings inspected and/or tested by an independent service at either the manufacturer's plant or elsewhere. Such inspection and/or tests shall be at the Owner's expense.

1.04 REFERENCES:

- A. The following standards, latest revision thereof, form a part of this specification as referenced:

American Water Works Association (AWWA)

AWWA	C104	Cement-Mortar Lining for Ductile- Iron Pipe and Fittings
AWWA	C105	Polyethylene Encasement for Ductile Iron Pipe Systems
AWWA	C110	Ductile-Iron and Gray-Iron Fittings
AWWA	C111	Rubber Gasket Joints for Ductile- Iron Pressure Pipe and Fittings
AWWA	C116	Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings

AWWA	C150	Thickness Design of Ductile-Iron Pipe
AWWA	C151	Ductile-Iron Pipe, Centrifugally Cast
AWWA	C153	Ductile-Iron Compact Fittings for Water Service.
AWWA	C600	Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA	C651	Disinfecting Water Mains

1.05 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

- A. Six sets of all shop drawings shall be submitted to the Engineer for review.
- B. Shop drawings shall consist of manufacturer's scale drawings, cuts or catalogs including descriptive literature and complete characteristics and specifications, and code requirements. Shop drawings shall be submitted for the ductile iron pipe, type of joint, fittings, couplings, filling rings, restrained joints, and lining and coating in accordance with specifications.

PART 2 - PRODUCTS

2.01 PIPE:

- A. The Contractor shall use push-on joint type ductile iron pipe unless otherwise indicated on the plans or specified herein.
- B. All ductile iron pipe shall be designed in accordance with AWWA C150 and shall be manufactured in accordance with AWWA C151.
- C. Unless otherwise indicated or specified, ductile iron pipe shall be Thickness Class 52.

2.02 JOINTS:

- A. Joints for ductile iron pipe shall conform to AWWA C111.
- B. Pipe and fittings shall be furnished with approved joint restraining appurtenances as specified herein, or within the limits as indicated on the drawings, to keep the piping from pulling apart under pressure.

2.03 FITTINGS:

- A. Fittings shall conform to the requirements of AWWA C110 or C153 as appropriate and shall be of a pressure classification at least equal to that of the pipe with which they are used.
- B. The Contractor shall use ductile iron fittings. Cast-iron, Class 250 fittings may be substituted, upon approval of the Engineer, for ductile iron fittings.
- C. Unless otherwise indicated, fittings shall have all bell mechanical joint ends.

2.04 GASKETS, GLANDS, NUTS AND BOLTS:

- A. Gaskets, glands, nuts, bolts and accessories shall conform to AWWA C111 or C153 as appropriate.
- B. Gaskets shall be of plain tipped rubber, suitable for exposure to the liquid within the pipe.
- C. Glands shall be ductile or cast iron.
- D. Bolts and nuts shall be high strength alloy.

2.05 LINING AND COATING:

- A. The inside of pipe and fittings shall be given a cement lining and asphaltic seal coat in accordance with AWWA C104. The thickness of the lining shall be double that specified in AWWA C104.
- B. The outside of pipe and fittings shall be coated with the standard asphaltic coating specified under the appropriate AWWA Standard Specification for pipe and fittings.
- C. Machined surfaces shall be cleaned and coated with a suitable rust preventative coating at the shop immediately after being machined.

2.06 FLEXIBLE COUPLINGS:

- A. The Contractor shall use solid sleeve coupling fittings for joining pipe. Sleeve-type flexible couplings may be substituted only with the approval of the Engineer.
- B. All couplings and accessories shall be of a pressure rating at least equal to that of the pipeline in which they are to be installed.
- C. Couplings shall be cast or ductile iron and shall be provided with gaskets of a composition suitable for exposure to the liquid within the pipe.
- D. Sleeve-type couplings shall be made by Dresser Mfg. Div., Bradford, PA; Smith-Blair, Inc., San Francisco, CA; Romac Industries Inc., Seattle, WA; Ford Meter Box Co., Wabash, IN; or be an approved equal.

- E. Couplings for buried pipe shall be Dresser 153; Smith-Blair Type 441 or 443; Romac Style 501; Ford Style FC1 or FC2; or approved equal.

2.07 JOINT RESTRAINTS:

- A. Where indicated or necessary to prevent joints or sleeve couplings from pulling apart under pressure, anchoring and joint restraint methods shall be utilized. Methods shall be restrained joint systems. The number of joints to be restrained shall be determined in accordance with Table 1, as shown on the construction plans or provided by the Engineer.
- B. Restrained joint systems for standard mechanical joint fittings or push on joint pipe shall be restraining glands (Megalug by EBAA Iron Sales Inc., Eastland, TX; StarGrip by Star Pipe Products, Houston, TX; RomaGrip by Romac Industries, Inc., Sultan, WA; Sigma One-Lok by Sigma Corporation, Cream Ridge, NJ; or approved equal) and restraining gaskets (Fast-grip joint by American Cast Iron Pipe Company, Birmingham, AL; Field Lok 350 Gasket by United States Pipe and Foundry Company, Birmingham, AL; Sure Stop 350 Restrained Joint Gaskets by McWane Ductile, Phillipsburg, NJ; or approved equal). Methods that rely on the use of friction clamps and/or retainer glands with set screws alone are not acceptable.
- C. Restrained joint systems for non-standard or modified joints shall be Flex-Ring or Lok-Ring by American Cast Iron Pipe Company, Birmingham, AL; T.R. Flex Joint by McWane Ductile, Phillipsburg, NJ; TR-Flex Joint by United States Pipe and Foundry Company, Birmingham, AL; Snap-Lok or Bolt-Lok by United States Pipe and Foundry Company, Birmingham, AL; or approved equal.
- D. Concrete thrust blocks may only be used for 6-inch, 8-inch, 10-inch, or 12-inch pipe where use of a joint restraint system is not feasible. Use of concrete thrust blocks shall be installed with the minimum bearing area (in square feet) against undisturbed material in accordance with the following:

Size of Main	90° Bends, Tees, Caps and Plugs	45° Bends and Wyes	22-1/2° Bends	11-1/4° Bends
6- & 8-inch	5	4	2	2
10- & 12-inch	12	9	5	2

- E. Tie rods may only be used for 6-inch, 8-inch, 10-inch, or 12-inch pipe where use of a joint restraint system is not feasible. Bolts shall have adequate length to allow nuts on both sides of the gland. Tie bolts shall have the same diameter as the tie rods and be in accordance with the following:

Pipe Size	Tie Rod	
	Number	Diameter
6	2	1/2"

8	2	3/4"
10	2	3/4"
12	4	3/4"

- F. Location of restrained joints shall be based on Table 1, as shown on the construction plans or provided by the Engineer. All joints that occur within the restrained length listed in Table 1, for the specific application, shall be restrained. For example, for a 90° bend, 8-inch unwrapped pipe, the restrained length required is 33 feet. Therefore, all joints within 33 feet of the 90° bend must be restrained.

PART 3 - EXECUTION

3.01 INSPECTION BEFORE INSTALLATION:

Pipes and fittings shall be subjected to a careful inspection just before being laid or installed.

3.02 HANDLING AND CUTTING:

- A. Any pipe or fitting which has a damaged lining, scratched or marred machine surface and/or abrasion of the pipe coating or lining shall be rejected and removed from the job-site.
- B. Any fitting showing a crack and any fitting or pipe which has received a severe blow that may have caused incipient fracture, even though no such fracture can be seen, shall be marked as rejected and removed at once from the work.
- C. In any pipe showing a distinct crack and in which it is believed there is no incipient fracture beyond the limits of the visible crack, the cracked portions, if so approved, may be cut off by and at the expense of the Contractor before the pipe is laid so that the pipe used will be perfectly sound. The cut shall be made in the sound barrel at a point at least 12-inches from the visible limits of the crack.
- D. Except as otherwise approved, all cutting shall be done with a machine suitable for cutting ductile iron pipe. Hydraulic squeeze cutters are not acceptable for cutting ductile iron pipe. Travel type cutters or rotary type abrasive saws may be used. All cut ends shall be examined for possible cracks caused by cutting.
- E. Lined and coated pipe and fittings shall be assembled and installed with approved packing or gaskets of the type recommended by the pipe manufacturer for the particular lining used.

3.03 INSTALLATION:

- A. DEPTH:

1. The pipe shall be installed with a minimum of 5'-0" of cover, unless specifically indicated otherwise on the plans or required by the Engineer.
2. Where pipe is installed at less than the required cover, the Contractor shall furnish and install insulation in accordance with , or as required by the Engineer.

B. PIPE AND FITTINGS:

1. No defective pipe or fittings shall be laid or placed in the piping, and any piece discovered to be defective after having been laid or placed shall be removed and replaced by a sound and satisfactory piece.
2. Each pipe and fitting shall be cleared of all debris, dirt, etc., before being laid and shall be kept clean until accepted in the complete work.
3. Pipe and fittings shall be laid accurately to the lines and grades indicated on the drawings or as required. Care shall be taken to ensure good alignment both horizontally and vertically.
4. In buried pipelines, each pipe shall have firm bearing along its entire length.
5. Castings to be encased in masonry shall be accurately set, with the bolt holes, if any, carefully aligned.
6. Immediately prior to being set, castings shall be thoroughly cleaned of all rust, scale and other foreign material.
7. Fittings shall not be used to clear beneath or above an existing structure or pipeline unless approved by the Engineer. The water main shall be brought to a depth sufficient to clear the structure or pipeline without the use of bends.

C. TEMPORARY PLUGS:

At all times when pipe laying is not actually in progress, the open ends of pipe shall be closed by temporary watertight plugs or by other approved means. If water is in the trench when work is resumed, the plug shall not be removed until all danger of water entering the pipe has passed.

D. PUSH ON JOINTS:

1. Joining of push-on joint pipe shall conform to AWWA C600.
2. If effective sealing of the joint is not attained, the joint shall be disassembled, thoroughly cleaned, a new gasket inserted and joint reassembled.
3. Deflection of alignment at a joint shall not exceed the appropriate permissible deflection as specified in AWWA C600. The tables in AWWA C600 indicate the

maximum permissible deflection for 18 and 20-foot pipe lengths. Maximum permissible deflections for other lengths shall be in proportion to such lengths.

E. MECHANICAL JOINTS:

1. Assembling of fittings with mechanical joint ends shall conform to AWWA C600.
2. If effective sealing of the joint is not attained at the maximum torque indicated in the above standard, the joint shall be disassembled and thoroughly cleaned, then reassembled. Bolts shall not be overstressed to tighten a leaking joint.
3. The deflection of alignment at a joint shall not exceed the appropriate permissible deflection as specified in the following table. These values indicate the maximum permissible deflection for 18-foot lengths. Maximum permissible deflections for other lengths shall be in proportion to such lengths.

Pipe Deflection Allowances
Maximum permissible deflection, inches

<u>Diameter of Pipe (inches)</u>	<u>Mechanical-Joint</u>
6	27
8-12	20
16	13.5
20	11
24	9

F. RESTRAINED JOINTS:

1. Joining of restrained joint piping shall conform to the manufacturer's recommendations.
2. If effective sealing of the joint is not attained, the joint shall be disassembled, thoroughly cleaned, a new gasket inserted and joint reassembled.
3. Deflection of alignment at a joint shall not exceed the appropriate permissible deflection recommended by the manufacturer.
4. All restraining appurtenances (and tie rods) shall be coated with an approved bituminous paint after assembly. The completed joint shall be inspected and the paint repaired/touched-up as necessary.

G. SLEEVE-TYPE COUPLINGS:

1. Pipe ends shall be cleaned thoroughly prior to installation. After the bolts have been inserted and all nuts have been made up finger tight, diametrically opposite nuts shall be progressively and uniformly tightened all around the joint, preferable by use of a torque wrench of the appropriate size and torque for the bolts. The correct torque as indicated by a torque wrench shall not exceed 90 foot-lb. for joints up to 24-inches.

3.05 TESTING:

- A. Prior to the hydrostatic pressure test, the piping shall be thoroughly flushed clean of all dirt, dust, oil, grease and other foreign material. This work shall be done with care to avoid damage to linings and coatings. Flushing velocity shall be a minimum of 2.5 ft./sec.

- B. The installed pipe shall be pressure tested in accordance with AWWA Standard C600.

C. HYDROSTATIC PRESSURE TEST:

1. Unless otherwise approved, all pipelines shall be given a hydrostatic pressure test between line valves. The Contractor shall furnish and install suitable temporary testing plugs or caps; all necessary pressure pumps, pipe connections, meters, gates, and other necessary equipment; and all labor required. The Owner or Engineer shall have the privilege of using its own gauges.
2. Subject to approval and provided that the tests are made within a reasonable time considering the progress of the project as a whole, and the need to put the section into service, the Contractor may make the tests when desired.
3. Pipelines intended for buried service shall be tested after backfill and compaction of the trench.
4. The section of pipe to be tested shall be filled with water of approved quality and all air shall be expelled from the pipe. The Contractor shall follow established procedures for filling the pipe and expelling trapped air to avoid exposing the piping system to water-hammer. If blowoffs are not available at high points for releasing air, the Contractor shall excavate as required and install the necessary taps. If the Contractor changes the grade of pipe installation, he will be responsible for locating the taps at the correct location in the system for testing. Taps shall be installed at the beginning and end of each disinfection run. After completion of the test, if so required by the Engineer, the Contractor shall remove corporations used for testing; plug the holes; and backfill as necessary.
5. The section under test shall be maintained full of water at working pressure for a period of 24 hours prior to the hydrostatic pressure test being applied to stabilize the pipeline with respect to movement under pressure, water absorption by the

lining, etc. The pipeline may require several cycles of pressurizing and bleeding trapped air prior to beginning the test.

6. When hydrants are in the pipeline test section, the hydrostatic test shall be made against the main valve in the hydrant. The hydrostatic test shall not be conducted against the branch valve.
7. The hydrostatic test shall consist of raising the water pressure within the test section to a pressure not less than 1.25 times the working pressure of the pipeline measured at the highest elevation along the test section and not less than 1.5 times the working pressure of the lowest elevation of the test section. The specified test pressure shall be corrected to the elevation of the test gauge.
8. The hydrostatic test shall be of at least a 2 hour duration. The test pressure shall not vary by more than +/- 5 psi for the duration of the test. Test pressure shall be maintained within this tolerance by adding makeup water through the pressure test pump into the pipeline test section.
9. The amount of makeup water (testing allowance) added to the test section shall be accurately measured by suitable methods and shall not exceed the maximum allowable quantity of makeup water. No pipe installation will be accepted if the quantity of makeup water is greater than that determined by the following formula:

$$L = \frac{S D \sqrt{P}}{148,000}$$

Where:

- L = makeup water, in gallons per hour
- S = length of test section, in feet
- D = nominal diameter of pipe, in inches
- P = average test pressure, in psi (gauge)

10. If the section fails to pass the hydrostatic pressure test, the Contractor shall do everything necessary to locate, uncover, and repair or replace the defective pipe, fitting, or joint, all at his own expense and without extension of time for completion of the work. Additional tests and repairs shall be made until the section passes the specified hydrostatic test.

3.06 DISINFECTION AND FLUSHING:

- A. The Contractor shall disinfect the lines carrying potable water.
- B. The Contractor shall furnish all equipment and materials necessary to do the work of disinfecting, and shall perform the work in accordance with the procedure outlined in AWWA C651 and all amendments thereto.

- C. In general, the procedure of disinfecting the main shall be to apply the chlorine through a tap in one end of the section and bleed it off through a tap at the other end. Powdered chlorine placed in each length of pipe during installation is not an acceptable method of disinfection.
- D. The applied dosage shall be such as to produce a chlorine concentration of not less than 10 mg/l after a contact time of not less than 24 hours.
- E. During the disinfection period, care shall be exercised to prevent contamination of water in existing mains.
- F. Any temporary connection to the mains or other facilities required to accomplish the disinfection of the mains shall be at the Contractor's expense.
- G. After treatment, the main shall be flushed with clean water until the residual chlorine concentration is less than 0.2 mg/l. The flushing rate shall be 3.0 ft. /sec to achieve full scour of sand particles.
- H. Before disposing of the water used in disinfecting and flushing water mains the Contractor shall thoroughly neutralize it through the application of a reducing agent, as referenced in AWWA C651 and C655.
- I. Bacteriological sampling and testing shall be done in accordance with AWWA C651 (Option A – One sample taken after flushing is complete followed by another sample taken 16 hours after the first sample or Option B – Two samples taken 15 minutes apart after a 16 hour post flushing rest period) for each main and each branch. Sampling shall be accomplished with sterile bottles treated with sodium thiosulfate, as required by Standard Methods. No hose or fire hydrants shall be used in collection of samples. A corporation stop installed on the main, with a removable copper tube gooseneck assembly, is the recommended method.
- J. Bacteriological sampling and testing shall be conducted by a state certified laboratory certified for total and fecal coliform analyses of potable water.
- K. Testing shall be done by a laboratory approved by the Engineer, in accordance with Standard Methods, and shall show the absence of coliform organisms. A standard plate count may be required at the option of the Engineer.

END OF SECTION

SECTION 33 41 13

CORRUGATED POLYETHYLENE [HDPE] DRAINAGE PIPE

PART 1 – GENERAL

1.01 WORK INCLUDED:

- A. This section includes furnishing all materials, labor and equipment and installing corrugated polyethylene [HDPE] drainage pipe, structures, and fittings as shown on the drawings and as specified herein.

1.02 RELATED WORK:

- A. Section 31 00 00 – EARTHWORK
- B. Section 31 50 00 – SUPPORT OF EXCAVATION

1.03 REFERENCES:

- A. The following standards form a part of this specification, as referenced:

American Society for Testing and Materials (ASTM)

ASTM D2321	Standard for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity Flow Applications
ASTM F405	Standard Specification for Corrugated Polyethylene Pipe and Fittings
ASTM F667	Standard Specification for Large Diameter Corrugated Polyethylene Pipe and fittings

American Association Of State Highway and Transportation Officials

AASHTO M294	Standard Specification for Corrugated Polyethylene Pipe
AASHTO MP6	Standard Specification for Corrugated Polyethylene Pipe 42” and 48” Diameter

1.04 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

- A. Six sets of manufacturer’s literature on the materials of this Section shall be submitted to the Engineer for review.
- B. Manufacturer’s certification that the product was manufactured, tested, and supplied in accordance with this specification shall be furnished.

1.05 DELIVERY, STORAGE AND HANDLING:

- A. Pipe shall be packaged to withstand shipment without damage and handled carefully on the jobsite. Pipe shall be stored so that it is not exposed to sunlight.

PART 2 – PRODUCTS:

2.01 MATERIALS:

- A. This Section applies to corrugated polyethylene pipe with an integrally formed smooth interior.
- B. The nominal size for the pipe and fittings is based on the nominal inside diameter of the pipe.
- C. The pipe and fittings shall be free of foreign inclusions and visible defects. Fittings may be either molded or fabricated. Fittings supplied by manufacturers other than the supplier of the pipe shall not be permitted without the approval of the Engineer. The ends of the pipe shall be cut squarely and cleanly so as not to adversely affect joining.

2.02 PVC DRAINAGE STRUCTURES AND DRAIN INLETS:

- A. PVC drain inlets, Manholes and catch basins shall conform to the following specification:
- B. PVC drainage structures shall be of the inline drain type as indicated on the contract drawings and referenced within the contract specification. Ductile iron grates for each of these fittings are to be used. The surface drainage inlets shall be as manufactured by Nyloplast a division of Advanced Drainage Systems, Inc., or approved equal. The drainage manholes and catch basins required for this contract shall be manufactured from PVC pipe stock, utilizing a thermo-molding process to reform the pipe stock to the furnished configuration. The drainage pipe connection stubs shall be manufactured from PVC pipe stock and formed to provide a watertight connection with the specified pipe system. The joint tightness shall conform to ASTM D3212 for joints or drain and sewer plastic pipe using flexible elastomeric seals. The pipe bell spigot shall be joined to the inline drain body by use of the swage mechanical joint. The pipe stock used to manufacture the inline drain body and pipe bell spigot of the surface drainage inlets shall meet the mechanical property requirements for fabricated fittings as described by ASTM D3034, Standard for Sewer PVC Pipe and Fittings; ASTM F1336, Standard for PVC Gasketed Sewer Fittings.
- C. The grates furnished for all surface drainage inlets shall be ductile iron. Grates and covers for drains shall be capable of supporting H-25 wheel loading for heavy-duty traffic. Metal used in the manufacture of the castings shall conform to ASTM A536 grade 70-50-05 for ductile iron.

2.03 MANUFACTURERS:

- A. Pipe and fittings shall be manufactured by Ipex, Inc.; Plexco, Division of Chevron Chemical Co.; J-M Pipe Co.; Advanced Drainage Systems, Inc. (ADS) or approved equal.

PART 3 – EXECUTION

3.01 INSTALLATION:

- A. Pipe interiors, fitting interiors, and joint surfaces shall be thoroughly cleaned before installation. Pipes and fittings shall be maintained clean.
- B. Pipes shall be installed in the locations and to the required lines and grades shown on the drawings and provided in these Specifications, using an approved method of control.
- C. Excavations shall be maintained free of water during the progress of the Work. No pipes shall be laid in water, nor shall there be any joints made up in water.
- D. If any defective pipe is discovered after being placed, removal and replacement with sound pipe will be required at no additional cost to the Owner.

END OF SECTION

\\wse03.local\WSE\Projects\NH\Portsmouth, NH\RTE 33 Recreational Field\Specs\Division 33\33 41 13 Corrugated HDPE Drain Pipe.docx

SECTION 33 44 00

RAISING AND/OR RESETTING OF MANHOLE FRAME AND COVER

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. This Section covers raising and/or resetting of sewer manhole frame and cover. The work includes raising, resetting, and/or adjusting of structures to line and grade.

1.02 RELATED WORK

- A. Section 01 33 39, SUBMITTALS
- B. Section 33 44 13, PRECAST MANHOLES AND CATCH BASINS

PART 2 - PRODUCT

2.01 MANHOLE COVER:

- A. The Manhole cover shall be supplied by East Jordan Iron Works, Brockton, MA., Catalog Number (frame and cover) 1056Z UND Frame LC239 or approved equal (approximate weight of frame and cover = 450 pounds).

PART 3 - EXECUTION

3.01 RAISING AND/OR RESETTING OF MANHOLE FRAME AND COVER:

- A. In areas where bituminous pavement exists, existing manhole castings shall be raised to the proper grade where indicated on the contract drawings or as required by the Engineer.
- B. Cut around manhole castings a minimum of 8-inches from casting. Excavate and remove old masonry to such a depth as required by the Engineer and rebuild masonry below the bottom of the casting. Backfill with mortar or bituminous concrete. Place high, early strength concrete or bituminous concrete collar, as required, to approximately 1-1/2-inches below the raised casting grade.
- C. Masonry work shall conform to the applicable provisions of Section 02630, BUILD MANHOLE INVERT.
- D. The Contractor shall provide a top course approximately 1-1/2-inches thick and shall match existing surrounding grades and pavement materials. The Contractor shall provide a watertight seal between the masonry work and the casting.

3.02 INSTALLATION OF MANHOLE FRAME AND COVER:

- A. Where necessary, replacement covers and frames shall be furnished and installed in-place by the contractor. The cover and frame shall provide a watertight seal.

END OF SECTION

SECTION 33 44 13
PRECAST MANHOLES AND CATCH BASINS

PART 1 - GENERAL

1.01 WORK INCLUDED:

This Section covers all precast manholes and catch basins complete, including, but not limited to, bases, walls, cones, mortar, inverts, frames and covers.

1.02 RELATED WORK:

- A. Section 31 23 00, EARTHWORK
- B. Section 32 12 16, PAVING
- C. Section 03 30 00, FIELD CONCRETE

1.03 SYSTEM DESCRIPTION:

- A. Precast sections shall conform in shape, size, dimensions, materials, and other respects to the details indicated on the drawings or as required by the Engineer.
- B. All manholes and catch basins shall have concrete bases. Concrete bases shall be precast unless otherwise specified. Invert channels shall be formed of brick and mortar upon the base.
- C. Catch basins shall have a 4-foot deep sump unless otherwise specified. Leaching basins shall have a bottom opening as shown on the drawings.
- D. Riser and cone sections shall be precast concrete.

1.04 REFERENCES:

- A. The following standards form a part of this specification as referenced:

American Society for Testing and Materials (ASTM)

ASTM A48	Gray Iron Castings
ASTM C32	Sewer and Manhole Brick
ASTM C144	Aggregate for Masonry Mortar
ASTM C207	Hydrated Lime for Masonry Purposes

- ASTM C478 Precast Reinforced Concrete Manhole Sections
- ASTM C923 Specification for Resilient
Connectors Between Reinforced
Concrete Manhole Structures and Pipes
- ASTM C1244 Standard Test Method for Concrete Sewer Manholes by the
Negative Air Pressure (Vacuum) Test.

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO M198 Joints for Circular Concrete Sewer and Culvert Pipe Using
Flexible Watertight Gaskets

Occupational Safety and Health Administration

OSHA 29 CFR 1910.27 Fall Prevention Protection

1.05 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL
SPECIFICATIONS, SUBMIT THE FOLLOWING:

- A. Six sets of manufacturer literature of the materials of this section shall be submitted to the Engineer for review.
- B. Test reports as required shall be submitted to the Engineer.

PART 2 - PRODUCTS

2.01 PRECAST CONCRETE SECTIONS:

- A. All precast concrete sections shall conform to ASTM C478 with the following exceptions and additional requirements:
 - 1. The wall thickness of precast sections shall be as designated on the drawings, meeting the following minimum requirements:

<u>Section Diameter (Inches)</u>	<u>Minimum Wall Thickness (Inches)</u>
48	5
60	6
72	7
84	8

- 2. Type II cement shall be used except as otherwise approved.
- 3. Sections shall be steam cured and shall not be shipped until at least five days after having been cast.

4. Minimum compressive strength of concrete shall be 4000 psi at 28 days.
 5. No more than two lift holes may be cast or drilled in each section.
 6. The date of manufacture and the name or trademark of the manufacturer shall be clearly marked on the inside of each precast section.
 7. Acceptance of the sections will be on the basis of material tests and inspection of the completed product.
 8. Circumferential steel reinforcement in walls and bases shall be a minimum of 0.12 sq. in./lin. ft. for 4-foot diameter sections and 0.15 sq. in./lin. ft. for 5- and 6-foot diameter sections. Reinforcing shall extend into tongue and groove.
- B. Conical reducing sections shall have a wall thickness not less than 5-inches at the bottom and wall thickness of 8-inches at the top. Conical sections shall taper from a minimum of 48-inches diameter to 24 or 30-inches diameter at the top, as shown on the drawings.
- C. Except where insufficient depth of cover dictates the use of a shorter base, bases shall be a minimum of 4 feet in height.
- D. Slab top sections and flat riser sections (Grade Rings) shall conform to the contract drawings, with particular attention focused upon the reinforcing steel and be designed to meet or exceed an HS-20 Loading requirement.
- E. The tops of the bases shall be suitably shaped by means of accurate ring forms to receive the riser sections.
- F. Precast sections shall be manufactured to contain wall openings of the minimum size to receive the ends of the pipes, such openings being accurately set to conform with line and grade of the sewer or drain. Subsequent cutting or tampering in the field, for the purpose of creating new openings or altering existing openings, will not be permitted except as required by the Engineer.
- G. "Drop-over" manholes shall be placed where indicated on the drawings. The Contractor shall accurately measure the diameter of the existing outlet pipe and inform the manufacturer of its size, so that the "Drop-over" type opening can be cut into the precast manhole base. The bottom shall be cast in place by the Contractor in accordance with Section 03 30 02, FIELD CONCRETE. The invert channel shall be formed of brick and mortar, as specified in this specifications section. The sub-base shall be a compacted, level foundation of crushed stone, at least 6-inches thick, as specified in Section 31 00 00 EARTHWORK, but shall vary to the depth necessary to reach sound undisturbed earth.
- H. The exterior surfaces of all precast manhole bases, walls, and cones shall be given a minimum of one shop coat of bituminous dampproofing.

- I. The Engineer reserves the right to reject any unsatisfactory precast section and the rejected unit shall be tagged and removed from the job site immediately.
- J. The Engineer may also require the testing of concrete sections as outlined under Physical Requirements in ASTM C478 with the Contractor bearing all testing costs.

2.02 BRICK MATERIALS:

- A. Brick shall be sound, hard, and uniformly burned brick, regular and uniform in shape and size, of compact texture, and satisfactory to the Engineer. Bricks shall comply with ASTM C32, for Grade SS, hard brick, except that the mean of five tests for absorption shall not exceed 8 percent by weight.
- B. Rejected brick shall be immediately removed from the work and brick satisfactory to the Engineer substituted.
- C. Mortar shall be composed of portland cement, hydrated lime, and sand in which the volume of sand shall not exceed three times the sum of the volumes of cement and lime. The proportions of cement and lime shall be as required by the Engineer and may vary from 1:1/4 for dense hard-burned brick to 1:3/4 for softer brick. In general, mortar for Grade SS Brick shall be mixed in the volume proportions of 1:1/2:4-1/2; portland cement to hydrated lime to sand.
- D. Cement shall be Type II portland cement as specified for concrete masonry.
- E. Hydrated lime shall be Type S conforming to ASTM C207.
- F. The sand shall comply with ASTM C144 specifications for "Fine Aggregate," except that all of the sand shall pass a No. 8 sieve.

2.03 FRAMES, GRATES, AND COVERS:

- A. Castings shall be of good quality, strong, tough, even-grained cast iron, smooth, free from scale, lumps, blisters, sandholes, and defects of every nature which would render them unfit for the service for which they are intended. Contact surfaces of covers and frame seats shall be machined to prevent rocking of covers.
- B. All castings shall be thoroughly cleaned and may be subject to a careful hammer inspection at the Engineer's discretion.
- C. Castings shall be ASTM A48 Class 30B or better.
- D. The surface of the manhole covers shall have a diamond pattern with the cast words "WATER," "DRAIN" or "SEWER," whichever is appropriate.
- E. Manhole frames with 32-inch covers for 30-inch openings shall be 500 pounds minimum by East Jordan Iron Works, No. LC328; Quality Water Products, Style 47; Neenah

Foundry Co., R1740B or approved equal.

- F. Watertight type manhole frames with 32-inch diameter covers (bolted and gasketed) shall be 4 bolt, 556 pounds minimum by East Jordan Iron Works, No. LCB328; Quality Water Products, Style C47WT; Neenah Foundry Co., R-17550-H or approved equal.
- G. Manhole frames with 26-inch covers for 24-inch openings shall be 475 pounds minimum by East Jordan Iron Works No. LK110A; Neenah Foundry Co. R1720; Quality Water Products, Style 40; or approved equal.
- H. Watertight type manhole frames with 26-inch diameter covers (bolted and gasketed) shall be 4 bolt, 475 pounds minimum, and shall be East Jordan Iron Works No. LBB268; Mechanics Iron Foundry Type A2073; Quality Water Products, Style 40WT; or approved equal.
- I. Frostproof manhole frames, with 26-inch diameter covers and inner lids, 435 pounds minimum, shall be R-1758 series by Neenah Foundry Co., Neenah, WI; LBF series by East Jordan Iron Works, Brockton, MA; B-3045 (or similar) by Mechanics Iron Foundry, Boston, MA; or approved equal.
- J. 2-inch thick polystyrene insulation shall be firmly adhered to all frostproof inner lids.
- K. Catch basin frames and 23-7/8-inch square grates with 2-inch square openings shall be 8-inches in height minimum. They shall be Neenah Foundry Co. No. R3588-A; Quality Water Products No. 45-600; East Jordan Iron Works 5548Z 5520M; or approved equal.
- L. Catch basin frames with bar grate openings and 23-7/8-inch square grates shall be 8-inches in height minimum. Bar grates shall not be used in areas where bicycle traffic could be present. They shall be Neenah Foundry Co. No. R-3589; Quality Water Products No. 45; East Jordan Iron Works LK121; or approved equal.
- M. Catch basin frames with cascade grate openings and 23-7/8-inch square grates shall be 8-inches in height minimum. They shall be Neenah No. R-3589; Quality Water Products LK121; East Jordan Iron Works 5548Z 5520M; or approved equal.
- N. Catch basin frames set against curbing shall have three flanges only.

2.04 MANHOLE ACCESSORIES:

- A. Gasket materials shall be top grade (100% solids, vulcanized) butyl rubber and shall meet or exceed AASHTO M-198.
- B. Couplings at the manhole-pipe interface shall be made with a rubber seal system (with or without stainless steel straps) meeting the requirements of ASTM C923 and recommended for this type of connection.
- C. Stubs installed as specified and indicated on the drawings shall be short pieces of the

same class pipe as that entering the manhole and shall have either stoppers or end caps as shown on the drawings. Stoppers or end caps shall be especially designed for that application.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. PRECAST SECTIONS:

1. Precast bases shall be supported on a compacted level foundation of crushed stone, as specified in Section 31 00 00EARTHWORK, at least 6-inches thick, but shall vary to the depth necessary to reach sound undisturbed earth.
2. Precast reinforced concrete sections shall be set vertical and with sections in true alignment.
3. Butyl rubber joint sealant shall be installed between each concrete section. Catch basin sections do not require joint sealant if so indicated on the drawings.
4. All holes in sections used for handling the sections shall be thoroughly plugged with mortar. Mortar shall be one part cement to 1-1/2 parts sand, mixed slightly damp to the touch (just short of "balling"), hammered into the holes until it is dense and an excess of paste appears on the surface, and then finished smooth and flush with the adjoining surfaces.

B. BRICK WORK:

1. Bricks shall be moistened by suitable means, as required, until they are neither so dry as to absorb water from the mortar nor so wet as to be slippery when laid.
2. Each brick shall be laid as a header in a full bed and joint of mortar without requiring subsequent grouting, flushing or filling, and shall be thoroughly bonded as directed.
3. The brick inverts shall conform accurately to the size of the adjoining pipes. Side inverts shall be curved and main inverts (where direction changes) shall be laid out in smooth curves of the longest possible radius which is tangent to the centerlines of adjoining pipe.

C. CASTINGS:

1. Cast iron frames, grates and covers shall be as specified. The frames and covers shall be set by the Contractor to conform accurately to the grade of the finished pavement, existing ground surface, or as indicated on the drawings. Frames shall be adjusted to meet the street surface.

2. Cast iron manhole frames and covers not located in paved areas shall be set 6-inches above finished grade, at a height as required by the Engineer, or as indicated on the drawings. The top of the cone shall be built up with a minimum of 1 course and a maximum of 5 courses of brick and mortar used as headers for adjustment to final grade.
3. Frames shall be set concentric with the top of the concrete section and in a full bed of mortar so that the space between the top of the concrete section or brick headers and the bottom flange of the frame shall be completely filled and made watertight. A thick ring of mortar extending to the outer edge of the concrete shall be placed all around the bottom flange. The mortar shall be smoothly finished to be flush with the top of the flange and have a slight slope to shed water away from the frame.
4. Covers and/or grates shall be left in place in the frames, for safety reasons, except while work is being performed.

D. ACCESSORIES:

1. Accessories shall be installed in accordance with manufacturer's instructions.
2. Stubs shall be set accurately to the dimensions indicated on the drawings. Stubs shall be sealed with suitable watertight plugs.

3.02 LEAKAGE TESTS:

- A. Leakage tests shall be made by the Contractor and observed by the Engineer on each manhole. The test shall be by vacuum or by water exfiltration as described below:

B. VACUUM TEST:

1. The vacuum test shall be conducted in accordance with ASTM C1244. Test results will be judged by the length of time it takes for the applied vacuum to drop from 10 inches of mercury to 9 inches. If the time is less than that listed in Table 1 of ASTM C1244, the manhole will have failed the test. Test times from Table 1 are excerpted below.

TABLE 1

Minimum Test Times for Various Manhole Diameters

Depth (Feet)	Diameter (Inches)		
	48	60	72
	<u>Times (Seconds)</u>		
0-12	30	39	49
12-16	40	52	67
16-20	50	65	81

20-24	59	78	97
26-30	74	98	121

2. If the manhole fails the initial test, the Contractor shall locate the leaks and make proper repairs. Leaks may be filled with a wet slurry of accepted quick setting material. If the manhole should again fail the vacuum test, additional repairs shall be made, and the manhole water tested as specified below.

C. WATER EXFILTRATION TEST:

1. After the manhole has been assembled in place, all lifting holes shall be filled and pointed with an approved non-shrinking mortar. All pipes and other openings into the manhole shall be suitably plugged and the plugs braced to prevent blow out. The test shall be made prior to placing the shelf and invert. If the groundwater table has been allowed to rise above the bottom of the manhole, it shall be lowered for the duration of the test.
2. The manhole shall be filled with water to the top of the cone section. If the excavation has not been backfilled and observation indicates no visible leakage, that is, no water visibly moving down the surface of the manhole, the manhole may be considered to be satisfactorily water-tight. If the test, as described above, is unsatisfactory as determined by the Engineer or if the manhole excavation has been backfilled, the test shall be continued. A period of time may be permitted if the Contractor so wishes, to allow for absorption by the manhole. At the end of this period, the manhole shall be refilled to the top of the cone, if necessary, and a measuring time of at least 8 hours begun. At the end of the test period, the manhole shall be refilled to the top of the cone, measuring the volume of water added. This amount shall be extrapolated to a 24-hour loss rate and the leakage determined on the basis of depth. The leakage for each manhole shall not exceed one gallon per vertical foot for a 24-hour period. If the manhole fails this requirement, but the leakage does not exceed 3 gallons per vertical foot per day, repairs by approved methods may be made as required by the Engineer to bring the leakage within the allowable rate of one gallon per foot per day. Leakage due to a defective section or joint or exceeding the 3 gallon per vertical foot per day, shall be cause for rejection of the manhole. It shall be the Contractor's responsibility to uncover the rejected manhole as necessary and to disassemble, reconstruct or replace it as required by the Engineer. The manhole shall then be retested and, if satisfactory, interior joints shall be filled and pointed.
3. No adjustment in the leakage allowance will be made for unknown causes such as leaking plugs, absorption, etc. It shall be assumed that all loss of water during the test is a result of leaks through joints or through the concrete. Furthermore, the Contractor shall take any steps necessary to assure the Engineer that the water table is below the bottom of the manhole throughout the test.
4. If the groundwater table is above the highest joint in the manhole, and there is no

leakage into the manhole, as determined by the Engineer, such a test can serve to evaluate water-tightness of the manhole. However, if the Engineer is not satisfied with the results, the Contractor shall lower the water table and carry out the test as described hereinbefore.

3.03 CLEANING:

All new manholes shall be thoroughly cleaned of all silt, debris and foreign matter of any kind, prior to final inspection.

END OF SECTION

SECTION 33 44 14
CONNECTIONS TO EXISTING STRUCTURES

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. The Contractor shall furnish materials, tools, labor and equipment to cut suitable openings into the existing manholes, make connections to existing and all other work necessary to direct the existing flow as indicated on the drawings and as herein specified.

1.02 RELATED WORK:

- A. Section 33 44 13.13, PRECAST MANHOLES AND CATCH BASINS

1.03 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF THE GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

- A. Prior to start of work, submit details of the methods proposed for doing the work and for maintaining the sewage flow as herein specified.

PART 2 - PRODUCTS - NOT APPLICABLE

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. The Contractor shall provide temporary plugs or provide other suitable means for maintaining the new free of flow until such time as it can be inspected and tested for leakage.
- B. Connections to the new structure shall be made when required by the Engineer and only after the new pipeline has been inspected and has successfully passed the leakage test.
- C. The Contractor shall modify each existing structure for installation of the necessary piping, but in so doing shall confine the cutting to the smallest amount possible consistent with the work to be done.
- D. All new piping connected to existing structures shall be encased in concrete in a manner satisfactory to the Engineer.
- E. All work shall be done with the proper tools and by careful workmen competent to do work.

- F. The Contractor shall cut, reshape and fill the existing manhole tables and plug existing outlets as indicated on the drawings and as directed by the Engineer, to accommodate the new connections. Reshaped manhole invert channels shall be smoothly shaped to permit the flow of sewage. Manhole invert channels shall be reconstructed as specified under Section 33 44 13, PRECAST MANHOLES AND CATCH BASINS.

END OF SECTION

SECTION 33 46 00
POLYVINYL CHLORIDE GRAVITY PIPE AND FITTINGS
(SDR-35)

PART 1 - GENERAL

1.01 WORK INCLUDED:

This section covers the furnishing and installation of Polyvinyl Chloride (PVC) pipe and fittings, as indicated on the drawings and as specified herein.

1.02 RELATED WORK:

- A. Section 31 50 00, SUPPORT OF EXCAVATION
- B. Section 31 00 00, EARTHWORK
- C. Section 33 00 00 TRACER TAPE
- D. Section 33 44 13, PRECAST MANHOLES AND CATCH BASINS

1.03 REFERENCES:

- A. The following standards form a part of these specifications as referenced:

American Society for Testing and Materials (ASTM)

ASTM	D2321	Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe
ASTM	D3034	Specification for Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings
ASTM	D3212	Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM	F679	Specification for Polyvinyl Chloride (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings

1.04 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

Six sets of manufacturer's literature of the materials of this section shall be submitted to the Engineer for review.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. PVC nonpressure sewer pipe 4-inches through 15-inches diameter shall conform to ASTM D3034, 18-inches through 60-inches diameter to ASTM F679, all with SDR of 35 unless noted, and shall meet the specific requirements and exceptions to the aforementioned specifications that follow.
- B. PVC nonpressure sewer pipe shall be furnished in standard lengths.
- C. One pipe bell consisting of an integral wall section with a solid cross section rubber ring, factory assembled, shall be furnished with each standard, random and short length of pipe. Rubber rings shall be provided to the requirements of ASTM D3212.
- D. The rubber ring shall be retained within the bell of the pipe by a precision formed groove or recess designed to resist fish mouthing or creeping during assembly of joints.
- E. Spigot pipe ends shall be supplied with bevels from the manufacturer to ensure proper insertion. Each spigot end shall have an "assembly stripe" imprinted thereon to which the bell end of the mated pipe will extend upon proper jointing of the two pipes.
- F. PVC fittings shall be provided with bell and/or spigot configurations with rubber gasketed joints compatible with that of the pipe. Bend fittings with spigot ends shorter than the pipe recess bells will not be allowed. The shorter spigot end would not allow proper seating of the spigot in the mating bell and would permit undesired contact between the mating bell and the outside of the fitting bell.
- G. All pipe delivered to the job site shall be accompanied by independent testing laboratory reports certifying that the pipe and fittings conform to the above-mentioned specifications. In addition, the pipe shall be subject to thorough inspection and tests, the right being reserved for the Engineer to apply such of the tests specified as he may from time to time deem necessary.
- H. All cutting of pipe shall be done with a machine suitable for cutting PVC pipe. Cut ends shall be beveled when recommended by the pipe manufacturer.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Except as modified herein, installation of the PVC pipe shall be in accordance with ASTM D2321.
- B. Each pipe length shall be inspected before being laid to verify that it is not cracked. Pipe shall be laid to conform to the lines and grades indicated on the drawings or given by the Engineer. Each pipe shall be so laid as to form a close joint with the next adjoining pipe and bring the inverts continuously to the required grade.
- C. The pipe shall be supported by compacted crushed stone. Crushed stone shall be as specified under Section 31 00 00, EARTHWORK.
- D. The pipe shall not be driven down to grade by striking it with a shovel handle, timber, rammer, or other unyielding object. When each pipe has been properly bedded, enough of the backfill material shall be placed and compacted between the pipe and the sides of the trench to hold the pipe in correct alignment.
- E. Before a joint is made, the pipe shall be checked to assure that a close joint with the next adjoining pipe has been maintained and that inverts are matched and conform to the required line and grade.
- F. For pipe placed on crushed stone, immediately after the joint is made, the jointing area shall be filled with suitable materials so placed and compacted that the ends of either pipe will not settle under backfill load.
- G. No pipe or fitting shall be permanently supported on saddles, blocking, or stones.
- H. Branches and fittings shall be laid by the Contractor as indicated on the drawings, and/or as required by the Engineer. Open ends of pipe and branches shall be closed with PVC caps secured in place with premolded gasket joints or as required by the Engineer.
- I. All pipe joints shall be made as nearly watertight as practicable. There shall be no visible leakage at the joints and there shall be no sand, silt, clay, or soil of any description entering the pipeline at the joints. Where there is evidence of water or soil entering the pipeline, connecting pipes, or structures, the defects shall be repaired to the satisfaction of the Engineer.
- J. The Contractor shall build a tight bulkhead in the pipeline where new work enters an existing sewer. This bulkhead shall remain in place until the Engineer authorizes its removal.
- K. Care shall be taken to prevent earth, water, and other materials from entering the pipe, and when pipe laying operations are suspended, the Contractor shall maintain a suitable stopper in the end of the pipe and also at openings for manholes.

- L. As soon as possible after the pipe and manholes are completed on any street, the Contractor shall flush out the new pipeline using a rubber ball ahead of the water, and none of the flushing water or debris shall be permitted to enter any existing sewer.

3.02 QUALITY ASSURANCE

A. LEAKAGE TESTING:

1. On completion of a section of sewer, including building connections installed to the property line, the Contractor shall install suitable bulkheads as required, dewater and test the sewer for leakage.
2. Unless otherwise approved, the section shall be tested using low pressure air test procedures. If circumstances permit, the Engineer may allow testing by infiltration or exfiltration in lieu of air testing.
3. The air test procedures shall conform to the Uni-Bell Recommended Practice for Low Pressure Air Testing of Installed Sewer Pipe, UNI-B-6. The starting air pressure for the test shall be 4 psig (greater than the average groundwater back pressure of any groundwater above the pipe, but not greater than 9.0 psig). The minimum duration permitted for the prescribed low pressure air exfiltration pressure drop between two consecutive manholes shall not be less than provided in Table I or Table II of UNI-B-6. The two tables are reproduced on the following pages.
4. Using the air pressure test, if there has been no leakage (zero psig drop) after one hour of testing, the section undergoing test shall have passed.
5. If either infiltration or exfiltration testing is permitted by the Engineer, the test shall be conducted for at least 24 hours. The amount of infiltration or exfiltration shall not exceed 100 gallons per inch-diameter per mile of sewer per 24 hours.
6. The infiltration test measures leakage into a section of sewer and may be used only where the groundwater level is one foot or more above the crown of the section of sewer pipe at its upper end and at least one foot above the top of building connections and chimneys. For making the infiltration tests, underdrains, if used, shall be plugged and other groundwater drainage shall be stopped to permit the groundwater to return to its normal level insofar as practicable. Allowances shall be made for water that may enter the sewer through pipe connections and inlets during the infiltration test.
7. Where the groundwater level is less than 1 foot above the top of the pipe at its upper end, the exfiltration test may be used. The sewers shall be subjected to an internal pressure by plugging the pipe at the lower end and then filling the pipelines and manholes with clean water to a height of 2 feet above the highest point in the system to be tested, including main pipeline, service connections and chimneys. When slopes between manholes are steep, the Contractor shall insure that this test can be accomplished without danger of forcing stoppers from wye or tee branches.

8. The rate of exfiltration from the sewers shall be determined by measuring the amount of water required to maintain the water level at the elevation established at the beginning of the test.
9. The Contractor shall construct such weirs or other means of measurements as may be required, shall furnish water and shall do all necessary pumping to enable the test to be properly made.
10. The Contractor shall be responsible for the satisfactory watertightness of the entire section of sewer. Should the sections under test fail to meet the requirements, the Contractor shall do all work of locating and repairing leaks and retesting as the Engineer may require without additional compensation. A plan of the method of repairing any leaks that are found shall be submitted to the Engineer for review.

B. PIPE DEFLECTION MEASUREMENT:

1. In accordance with ASTM D3034, no less than 30 days after completion of the PVC sewer pipe installation, the Contractor shall test the pipeline for deflection using a "go/no-go" deflection mandrel having a minimum of nine evenly spaced arms or prongs. The "go/no-go" gauge shall be hand pulled through all sections of the pipeline by the Contractor. The Contractor shall submit drawings of the "go/no-go" gauge to the Engineer for approval prior to testing. Complete dimensions of the gauge for each diameter of pipe to be tested shall be in accordance with ASTM D3034.
2. Any section of pipe found to exceed 7.5 percent deflection shall be deemed a failed pipe and shall be excavated and replaced by the Contractor at his own expense.

TABLE I

MINIMUM SPECIFIED TIME REQUIRED FOR A 1.0 PSIG PRESSURE DROP
FOR SIZE AND LENGTH OF PIPE INDICATED FOR Q=0.0015

Pipe	Minimu	Length	Time for	Specification Time for Length (L) shown (min:sec)
------	--------	--------	-------------	---------------------------------------------------

Diameter (in)	m Time (min:sec)	for Min. Time (ft)	Longer Length (sec)	<u>100</u> <u>ft</u>	<u>150</u> <u>ft</u>	<u>200</u> <u>ft</u>	<u>250</u> <u>ft</u>	<u>300</u> <u>ft</u>	<u>350</u> <u>ft</u>	<u>400</u> <u>ft</u>	<u>450</u> <u>ft</u>
4	3:46	597	0.380 L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	0.854 L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.52 L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	239	2.374 L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	199	3.418 L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	114	10.470 L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:40	99	13.674 L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33
27	25:30	88	17.306 L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48
30	28:20	80	21.366 L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15
33	31:10	72	25.852 L	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53
36	34:00	66	30.768 L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46
42	39:48	57	41.883 L	69:48	104:42	139:37	174:30	209:24	244:19	279:13	314:07
48	45:34	50	54.705 L	91:10	136:45	182:21	227:55	273:31	319:06	364:42	410:17

54	51:02	44	69.236 L	115: 24	173: 05	230:4 7	288:2 9	346:1 1	403:5 3	461:3 4	519:1 6
60	56:40	40	85.476 L	142: 28	213: 41	284:5 5	356:0 9	427.2 3	498:3 7	569:5 0	641:0 4

TABLE II

MINIMUM SPECIFIED TIME REQUIRED FOR A 0.5 PSIG PRESSURE DROP
FOR SIZE AND LENGTH OF PIPE INDICATED FOR Q=0.0015

Pipe Diameter (in)	Minimum Time (min:sec)	Length for Min. Time (ft)	Time for Longer Length (sec)	Specification Time for Length (L) shown (min:sec)							
				<u>100</u> <u>ft</u>	<u>150</u> <u>ft</u>	<u>200</u> <u>ft</u>	<u>250</u> <u>ft</u>	<u>300</u> <u>ft</u>	<u>350</u> <u>ft</u>	<u>400</u> <u>ft</u>	<u>450</u> <u>ft</u>
4	1:53	597	0.190 L	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53
6	2:50	398	0.427 L	2:50	2:50	2:50	2:50	2:50	2:50	2:51	3:12
8	3:47	298	0.760 L	3:47	3:47	3:47	3:47	3:48	4:26	5:04	5:42
10	4:43	239	1.187 L	4:43	4:43	4:43	4:57	5:56	6:55	7:54	8:54
12	5:40	199	1.709 L	5:40	5:40	5:42	7:08	8:33	9:58	11:24	12:50
15	7:05	159	2.671 L	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02
18	8:30	133	3.846 L	8:30	9:37	12:49	16:01	19:14	22:26	25:38	28:51
21	9:55	114	5.235 L	9:55	13:05	17:27	21:49	26:11	30:32	34:54	39:16
24	11:20	99	6.837 L	11:24	17:57	22:48	28:30	34:11	39:53	45:35	51:17
27	12:45	88	8.653 L	14:25	21:38	28:51	36:04	43:16	50:30	57:42	64:54
30	14:10	80	10.683 L	17:48	26:43	35:37	44:31	53:25	62:19	71:13	80:07
33	15:35	72	12.926 L	21:33	32:19	43:56	53:52	64:38	75:24	86:10	96:57
36	17:00	66	15.384 L	25:39	38:28	51:17	64:06	76:55	89:44	102:34	115:23
42	19:54	57	20.942 L	34:54	52:21	69:49	87:15	104:42	122:10	139:37	157:04
48	22:47	50	27.352 L	45:3	68:23	91:11	113:5	136:4	159:3	182:2	205:0

				5			8	6	3	1	9
54	25:31	44	34.618 L	57:4 2	86:33	115:2 4	144:1 5	173:0 5	201:5 6	230:4 7	259:3 8
60	28:20	40	42.738 L	71:1 4	106:5 1	142:2 8	178:0 5	213:4 1	249:1 8	284:5 5	320:3 2

END OF SECTION – 33 46 00

SECTION 33 49 13
BUILD MANHOLE INVERT

PART 1 - GENERAL

1.01 WORK INCLUDED:

This Section covers all manholes complete, including, but not limited to, bases, mortar, and inverts.

1.02 RELATED WORK:

- A. Section 01 33 39, SUBMITTALS

1.03 SYSTEM DESCRIPTION:

- A. Invert channel shall be formed of brick and mortar upon the base.

1.04 REFERENCES:

- A. The following standards form a part of this specification as referenced:

American Society for Testing and Materials (ASTM)

ASTM C32 Sewer and Manhole Brick

ASTM C144 Aggregate for Masonry Mortar

ASTM C207 Hydrated Lime for Masonry Purposes

ASTM C923 Specification for Resilient
Connectors Between Reinforced
Concrete Manhole Structures and Pipes

ASTM C1244 Standard Test Method for Concrete Sewer
Manholes by the Negative Air Pressure (Vacuum)
Test.

1.05 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

- A. Six sets of manufacturer literature of the materials of this section shall be submitted to the Engineer for review.

- B. Tests reports as required shall be submitted to the Engineer.

PART 2 – INVERT MATERIALS

- 2.01 The invert shall be formed of brick and mortar, as specified in this specification section.
- 2.02 BRICK MATERIALS:
 - A. Brick shall be sound, hard, and uniformly burned brick, regular and uniform in shape and size, of compact texture, and satisfactory to the Engineer. Bricks shall comply with ASTM C32, for Grade SS, hard brick, except that the mean of five tests for absorption shall not exceed 8 percent by weight.
 - B. Rejected brick shall be immediately removed from the work and brick satisfactory to the Engineer substituted.
 - C. Mortar shall be composed of portland cement, hydrated lime, and sand in which the volume of sand shall not exceed three times the sum of the volumes of cement and lime. The proportions of cement and lime shall be as required and may vary from 1:1/4 for dense hard-burned brick to 1:3/4 for softer brick. In general, mortar for Grade SS Brick shall be mixed in the volume proportions of 1:1/2:4-1/2; portland cement to hydrated lime to sand.
 - D. Cement shall be Type II portland cement as specified for concrete masonry.
 - E. Hydrated lime shall be Type S conforming to ASTM C207.
 - F. The sand shall comply with ASTM C144 specifications for "Fine Aggregate," except that all of the sand shall pass a No. 8 sieve.

PART 3 - EXECUTION

- 3.01 INSTALLATION:
 - A. INVERT BRICK WORK:
 - 1. All debris shall be removed from the bottom of the manhole before the invert is constructed.
 - 2. Bricks shall be moistened by suitable means, as required, until they are neither so dry as to absorb water from the mortar nor so wet as to be slippery when laid.
 - 3. Each brick shall be laid as a header in a full bed and joint of mortar without requiring subsequent grouting, flushing or filling, and shall be thoroughly bonded as required.

4. The brick inverts shall conform accurately to the size of the adjoining pipes. Side inverts shall be curved and main inverts (where direction changes) shall be laid out in smooth curves of the longest possible radius which is tangent to the centerlines of adjoining pipe.

3.02 CLEANING:

All manholes shall be thoroughly cleaned of all silt, debris and foreign matter of any kind, prior to final inspection.

END OF SECTION

SECTION 02630

DRAINAGE STRUCTURES

PART 1 - GENERAL

1.01 SCOPE OF WORK:

- A. The work to be done under this section shall include the installation of standard drainage structures as shown on the plans and specified under this item. The Contractor shall provide all material, labor, tools, equipment and transportation to complete these items. A grate or cover shall be provided for each structure.
- B. Drainage structures shall be installed in the quantities and locations identified on the Contract Drawings. Contact the Project Representative if obstructions or conflicts are encountered.

1.02 REFERENCE STANDARDS AND SPECIFICATIONS:

- A. Reference to the standards, specifications and tests of technical societies, organizations, and governmental bodies is made in the Contract Documents.
 - 1. AASHTO - American Association of State Highway and Transportation Officials (tests or specifications).
 - 2. ASTM - American Society for Testing and Materials.
 - 3. New Hampshire Department of Transportation, Standard Specification for Road and Bridge Construction
 - 4. Municipal Standard Specifications and Procedures, as applicable.
 - 5. ADA – Americans with Disabilities Act

1.03 CODES, ORDINANCES AND PERMITS:

- A. All work shall be performed in strict accordance with local and state codes and regulations.
 - 1. Site utility work shall be done in strict accordance with state and local codes and requirements.
 - 2. The Contractor shall secure all permits deemed necessary in connection with the installation of this equipment and pay fees required for same. He

shall include the cost and back charge of installing any portion of the work where performed by municipal departments or utility companies.

1.04 SUBMITTALS/SHOP DRAWINGS:

- A. Shop drawings shall be submitted to the engineer for all equipment. Copies shall be submitted and shall include cuts, scale drawings, installation details, manufacturer's specifications, certified performance characteristics and capacity ratings.
- B. No material or equipment may be purchased or installed before the submission and written approval of the shop drawings.

PART 2 - MATERIALS

2.01 PRECAST REINFORCED CONCRETE STRUCTURES:

- A. Precast reinforced concrete structures shall comply with material, design and construction standards specified under ASTM C-478.
- B. Minimum compressive strength of concrete in bases, risers and top sections shall be 4,000 psi. at 28 days.
- C. All joints shall be made with rubber gaskets meeting the requirements of ASTM C-443 (AASHTO M198).
- D. Sumps shall be a minimum of 4 foot depth for catch basins located in paved areas.
- E. Catch basins in planted drainage swale areas shall be 4.5 foot deep with an 18 inch sump.
- F. The date of manufacture and the name or trademark of the manufacturer shall be clearly marked on the inside of the precast section.

2.02 CLAY SEWER BRICKS (FOR ADJUSTING NEW FRAMES):

- A. Clay sewer brick shall conform to the requirements of AASHTO Designation M91 with the following exceptions:
 - 1. The size of brick furnished shall be 8" x 3-3/4" x 2-1/4" nominal dimensions.
 - 2. The average of the absorption of five (5) representative samples shall not exceed fifteen percent (15%) and the individual absorption of any one sample shall not exceed seventeen and one-half percent (17-1/2%). The

average compressive strength of the five (5) representative samples shall not be less than three thousand (3,000) pounds per square inch and the compressive strength of any one sample shall not be less than two thousand-five hundred (2,500) pounds per square inch.

2.03 CEMENT MORTAR (FOR ADJUSTING NEW FRAMES):

- A. Mortar shall be composed of one (1) part of Portland cement and two (2) parts of sand by volume with sufficient water to form a workable mixture. Cement, sand and water shall conform to the applicable provisions of New Hampshire Department of Transportation, Standard Specification for Road and Bridge Construction.

2.04 CEMENT CONCRETE:

- A. Material shall comply with Section 03300 of these Specifications.

2.05 CASTINGS:

- A. Iron castings (frames, grates and covers) shall conform to the NHDOT Construction Manual standard designs and to the requirements of AASHTO Designation M105, Class No. 30, Gray Iron Castings, unless otherwise specified. Test Bar B, 1.20 inches in diameter.
- B. Beehive Frames and Grates for installation with catch basins in planted stormwater swales shall be Model R-2564 as manufactured by Neenah Foundry Company, 2121 Brooks Ave., Neenah, WI 54956, Toll Free 800-558-5075

2.06 PVC DRAINAGE STRUCTURES AND DRAIN INLETS:

- A. PVC drain inlets, Manholes and catch basins shall conform to the following specification:
- B. PVC drainage structures shall be of the inline drain type as indicated on the contract drawings and referenced within the contract specification. Ductile iron grates for each of these fittings are to be used. The surface drainage inlets shall be as manufactured by Nyloplast a division of Advanced Drainage Systems, Inc., or approved equal. The drainage manholes and catch basins required for this contract shall be manufactured from PVC pipe stock, utilizing a thermo-molding process to reform the pipe stock to the furnished configuration. The drainage pipe connection stubs shall be manufactured from PVC pipe stock and formed to provide a watertight connection with the specified pipe system. The joint tightness shall conform to ASTM D3212 for joints or drain and sewer plastic pipe using flexible elastomeric seals. The pipe bell spigot shall be joined to the inline drain body by use of the swage mechanical joint. The pipe stock used to

manufacture the inline drain body and pipe bell spigot of the surface drainage inlets shall meet the mechanical property requirements for fabricated fittings as described by ASTM D3034, Standard for Sewer PVC Pipe and Fittings; ASTM F1336, Standard for PVC Gasketed Sewer Fittings.

- C. The grates furnished for all surface drainage inlets shall be ductile iron. Grates and covers for drains shall be capable of supporting H-25 wheel loading for heavy-duty traffic. Metal used in the manufacture of the castings shall conform to ASTM A536 grade 70-50-05 for ductile iron.

PART 3 - EXECUTION

- 3.01 Structures of various types and depths shall be constructed to the line, grades, dimensions and design shown on the plans and as directed and furnished with the necessary frames, grates, covers, aluminum steps, etc., in accordance with these Specifications. Verify inverts of all utilities to remain.
- 3.02 The bricks and blocks (if required) shall be wetted as necessary before laying. All joints in brick masonry shall be thoroughly flushed full of mortar and no joints on the inside face shall be greater than one-quarter (1/4) inch. After the bricks and blocks are laid, the joints shall be pointed on the inside. As bricks or blocks are laid up, the outside of the structure shall be plastered with one-half (1/2) inch thick mortar coat.
- 3.03 Connections will be carefully made to all existing and proposed lines to the grades and elevations shown on the contract drawing.
- 3.04 All catch basins shall have an oil trap outlet of an appropriate size and material consistent with specific project requirements for drainpipe.
- 3.05 Unless otherwise directed or specified, two (2) weep holes shall be built into the walls of all new structures. Each weep hole shall consist of a section of four (4) inch pipe or equivalent opening to carry water through the wall of the structure. The outside end of the pipe or opening shall be covered with a one-quarter (1/4) inch mesh galvanized wire screen 23 gauge satisfactorily fastened against the wall. The drain to the weep hole shall be excavated and backfilled with two (2) cubic feet of broken rock or crushed stone. The crushed stone shall be placed against and over the end of the pipe or opening with a section of filter cloth to prevent the entrance of fine material. Only one (1) type of weep hole shall be used consistently throughout the project.
- 3.06 Suitable materials obtained from the excavation or from borrow shall be placed between the outside of the structure and the limits of the excavation, uniformly distributed in successive layers not exceeding 6 inches in depth and thoroughly compacted by tamping with mechanical rammers or tampers. When required, the backfill material shall be moistened during the compacting. Compaction with iron hand tampers having a tamping face not exceeding twenty-five (25) square inches may be allowed, but only after

permission has been given by the Engineer.

- 3.07 All materials removed in the excavation for catch basins, manholes, drop inlets, drywells, etc., and remaining after the filling about the finished structure has been made shall be used wherever possible within the project or removed and satisfactorily disposed of outside of the project limits without additional compensation.
- 3.08 Frame castings for structures shall be set in full mortar beds true to the lines and grades as directed.
- 3.09 Where directed, the castings shall be temporarily set at such grades as to provide drainage during the construction.
- 3.10 In general, all methods for installation of the catch basin and manhole units, brick adjustments, mortaring, and installation of frames, grates and covers, shall conform to the NHDOT Standard Specifications.
- 3.11 All manhole covers are to be painted black.
- 3.12 All exposed drains shall meet current ADA regulations for materials and installations.

END OF SECTION