SANITARY SEWER REHABILITATION 2026

MERIDIAN TOWNSHIP

DEPARTMENT OF PUBLIC WORKS & ENGINEERING

INGHAM COUNTY, MICHIGAN

SANITARY SEWER REHABILITATION 2026

FOR
MERIDIAN TOWNSHIP

TABLE OF CONTENTS

ADVERTISEMENT	AD-1
INSTRUCTIONS TO BIDDERS	IB-1 to IB-2
PROPOSAL	P-1 to P-4
CONTRACT	C-1 to C-3
NOTICE OF AWARD	NA-1
NOTICE TO PROCEED	NP-1
GENERAL CONDITIONS	GC-1 to GC-10
GENERAL SPECIFICATIONS	GS-1 to GS-5
TECHNICAL SPECIFICATIONS	
Ingham County Road Commission Permit Specifications	RC-1 to RC-6
Division 1 – Earthwork	D1-1 to D1-5
Division 2- Sanitary Sewer Collection System	D2-1 to D2-10
Cured-In-Place Pipe – Mainline Lining	ML-1 to ML-8
Pipeline Chemical Grouting and Testing	CG-1 to CG-22
Manhole Rehabilitation	MR-1 to MR-29
PAY ITEMS (DIVISION 7)	7-1 to 7-10
SPECIAL PROVISIONS	SP-1 to SP-5

APPENDICES:

Traffic Control Details	APX – A-1 to A-13
Manhole Casting Adjustment Detail	APX – B
Mainline & Manhole Treatment Indexes	APX – C-1 to C-5

PLAN SET:

Project Overview	SHEET 1
Towar Gardens Southwest	SHEET 2
Towar Gardens Middle	SHEET 3
Towar Gardens North	SHEET 4
Towar Gardens East	SHEET 5
Haslett Rd West	SHEET 6
Haslett Rd Center	SHEET 7
Haslett Rd East	SHEET 8
Carlton St	SHEET 9
Interurban Trail	SHEET 10
White Owl Way	SHEET 11
Hulett Rd	SHEET 12
Shoals Dr	SHEET 13
Manhole Rehab Center 1	SHEET 14
Manhole Rehab Center 2	SHEET 15
Manhole Rehab East	SHEET 16
Manhole Rehab Southeast	SHEET 17
Manhole Rehab Misc	SHEET 18
Manhole Rehab Misc 2	SHEET 19
Chippewa Middle School	SHEET 20

MERIDIAN TOWNSHIP

SANITARY SEWER REHABILITATION 2026

ADVERTISEMENT FOR BIDS

Sealed proposals will be received by Meridian Township, Ingham County, Michigan, at the Meridian Township Clerk's Office, Municipal Building, 5151 Marsh Road, Okemos, Michigan, 48864-1198, Ph. (517) 853-4000, up to 11:00 a.m., local time on July 24th, 2026 for the rehabilitation of sanitary sewer mains and manholes, after which time, proposals will be publicly opened and read aloud.
Bids are solicited on a unit price basis. The work involves the following major bid items:

- Approximately 12,880 feet of 8-, 10-, 12- 18- and 36-inch Cured-In-Place Pipe (CIPP) liner;
- Approximately 2,500 feet of 8-, 10-, 21- and 24-inch mainline joint grouting;
- Grouting approximately 150 lateral connections;
- Various Rehabilitation Techniques on 72 manholes; and,
- Bypass Pumping

Proposals shall include the furnishing of all labor, material, and equipment to complete the project.

Work on the project may commence any time after issuing the Notice to Proceed and shall be complete by August 1st, 2027. Sanitary Sewers crossing Railroads (Priority List 1) must be lined by November 1st 2026. No work will be permitted between November 1st 2026 and March 15th of 2027.

Each proposal shall be accompanied by a certified check or a bid bond by a recognized surety company similar to a U.S. Government Standard form bid bond, in the amount of five percent (5%) of the bid, payable to the Meridian Township, Ingham County, Michigan as security for the acceptance of the Contract.

Insurance and bonds are required from the successful bidder for this project; please see pages GC-2 thru GC-3 for those requirements. *Please note Owner/Contractors Protective Liability is required for all of our contracts*.
The contract documents may be examined at the following locations:

- Meridian Township, Dept of Public Works, 5151 Marsh Road, Okemos, MI 48864
- Builders Exchange of Lansing & Central MI, 1240 E. Saginaw St., Lansing, MI 48906-5522
- Construction Assoc of MI, 43636 Woodward, Bloomfield Hills, MI 48302
- Dodge Data & Analytics, 2521 E. Michigan Avenue, Lansing, MI 48912-4010

Copies of the contract documents for the work may be obtained from the Department of Public Works & Engineering at 5151 Marsh Road, Okemos, Michigan, for a non-refundable fee of ten dollars ($10). There is a five dollar ($5.00) fee for mailing contract documents. Contract documents may be obtained via email free of charge. Questions regarding this contract may be addressed to Meridian Township Department of Public Works & Engineering by phone at (517) 853-4440, or by email at DPW@meridian.mi.us.

The Vendor's agreement to pay prevailing wage rates is one relevant consideration that Meridian Township may make in its determination of which bidder should receive this contract. Meridian Township may thus consider in awarding this contract whether any vendor voluntarily pays employees and sub-contractors, directly upon the site of work, at least the prevailing wages and fringe benefits as determined and published by the United States Department of Labor for the Ingham County area.

In submitting this bid, it is understood that the right is reserved by the Owner to reject any or all bids, to award the Contract to other than the low bidder, to award separate contracts for each project and/or phase, to waive irregularities and/or formalities, and in general, to make award in any manner deemed by it, in its sole discretion, to be in the best interest of the Owner.

Copies of the inspection reports and videos for the project are available upon request. Please contact DPW@meridian.mi.us for a link to these items.

INSTRUCTIONS TO BIDDERS

1. PROPOSALS

Proposals must be made upon the forms provided, without modifications or changes, and all other data submitted as required.

The proposal must be enclosed in a sealed envelope marked **"Bid Proposal – Sanitary Sewer Rehabilitation 2026"** clearly indicating the name and address of the bidder, and filed at the place and by the time specified in the Advertisement.

2. BASIS OF PROPOSALS

Proposals may be submitted for any one or all of the projects or phases as may be applicable.

Proposals are solicited on the basis of unit prices for the entire work of the contract.

The right is reserved by the Owner to reject any and all bids, to award the Contract to other than the low bidder, to award separate Contracts for each project and/or phase, to waive irregularities and/or formalities, and in general, to make award in any manner deemed by it, in its sole discretion, to be in the best interest of the Owner.

3. BID DEPOSITS

Each proposal shall be accompanied by a certified check, or bid bond from a recognized surety company, in the amount of five percent (5%) of the total amount of the bid, payable to the order of the Owner, to be forfeited to the Owner in case of failure on the part of the successful bidder to enter into the attached form of Contract to do the work covered by such Proposal at the price and within the time stated therein. The bid deposit of all except the successful bidder will be returned within four weeks after opening of bids. The bid deposit of the successful bidder will be returned within 48 hours after the executed Contract has been finally approved by the Owner.

4. QUALIFICATION OF BIDDERS

It is the intention of the Owner to award the Contract(s) to contractor(s) fully capable, both financially and as regards experience to perform and complete all work in a satisfactory manner. Evidence of such competency must be furnished, including a listing of similar projects which the bidder has satisfactorily undertaken and completed.

5. INTERPRETATION OF DOCUMENTS

If the bidder is in doubt as to the true meaning of any part of the plans, specifications or Contract Documents, he may submit to the Engineer a written request for an interpretation thereof. Any interpretation made in response to such query will be mailed or duly delivered to each prospective bidder. The Owner will not be responsible for any other explanation or interpretation of the Contract Documents.

6. REQUIREMENT OF SIGNING BIDS

Bids which are not signed by the individual making them shall have attached thereto a power of attorney evidencing authority to sign the bid in the name of the person for whom it is signed.

Bids, which are signed by a partnership, shall be signed by all of the partners or by an attorney-in-fact. If signed by an attorney-in-fact, there shall be attached to the bid a power of attorney evidencing authority to sign the bid, executed by the partners.

Bids which are signed for a corporation shall have the correct corporate name thereof and the signature of the president or other authorized officers of the corporation manually written below the corporate name following the word "By". If such a bid is manually signed by an officer other than the president of the corporation, a certified copy of a resolution of the board of directors evidencing the authority of such official to sign the bid shall be attached to it. Such a bid shall also bear the attested signature of the secretary of the corporation and the impression of the corporate seal.

7. EXECUTION OF AGREEMENT

The bidder to whom an award is made will be required to enter into the written contract included herein, within ten (10) calendar days after being notified of the acceptance of his bid and receipt by him of the copies of the documents to be executed. In case of failure to comply with this requirement, he may be considered to have abandoned all his rights and interests in the award and his certified check or amount of bidder's bond may be declared to be forfeited to the Owner and the Contract may be awarded to another bidder.

8. INSURANCE (Ref. General Conditions – GC.2)

The contractor will be required to carry Worker's Compensation Insurance, Bodily Injury and Property Damage, Builder's Risk Insurance and Owner's Protective Liability in the amounts specified in the General Conditions. Certificates of such insurance must be attached to each copy of the executed Contract Documents.

9. BONDS (Ref. General Conditions – GC.1)

The successful bidder will be required to furnish for each set of executed Contract Documents and conformed copies thereof an original completed Performance Bond, and Labor and Material Bond with surety acceptable to the Owner as set forth in the General Conditions.

10. BIDDER'S RESPONSIBILITY FOR EXAMINING PLANS AND SITE

At the time of opening bids, each bidder will be presumed to have made a personal investigation of the site of the work and of existing structures, and to have read and be thoroughly familiar with the plans, specifications and Contract Documents (including all addenda). He shall determine to his own satisfaction the conditions to be encountered, the nature of the ground, difficulties involved in completing the Contract and all factors affecting the work proposed under this Contract.

The bidder to whom this contract is awarded will not be entitled to any additional compensation by reason of his failure to fully acquaint himself with the conditions at the site or by his failure to fully examine the plans, specifications and Contract Documents.

11. NON-DISCRIMINATION IN EMPLOYMENT

The Contractor shall adhere to all applicable Federal, State and local laws, ordinances, rules and regulations prohibiting discrimination with regards to employees and applicants for employment. The contractor and his/her subcontractors shall not discriminate against an employee or applicant for employment with respect to hire, tenure, terms, conditions or privileges of employment, including a benefit plan or system or a matter directly or indirectly related to employment, because of race, color, religion, national origin, sex, age, height, weight, condition of pregnancy, marital status, physical or mental limitation, disability, source of income, familial status, educational association, sexual orientation, gender identity or expression, or HIV status. Breach of this section shall be regarded as a material breach of this Contract.

PROPOSAL

TO: Meridian Township
5151 Marsh Road
Okemos, MI 48864

RE: SANITARY SEWER REHABILITATION 2026

Board of Trustees:

The undersigned, as a bidder, hereby declares that these bids are made in good faith, without fraud or collusion with any person or persons bidding on the same Contract, that he has read and examined the Advertisement, Instruction to Bidders, Proposal, Contract, General Conditions, Specifications, Special Provisions and Plans and understands all of the same; that he or his representative has made personal investigation at the site and has informed himself fully with regard to the conditions to be met in the execution of the Contract.

In submitting this bid, it is understood that the right is reserved by the Owner to reject any or all bids, to award the Contract to other than the low bidder, to award separate contracts for each project and/or phase, to waive irregularities and/or formalities, and in general, to make award in any manner deemed by it, in its sole discretion, to be in the best interest of the Owner.

It is further understood and agreed by the undersigned that any qualifying statement or conditions made to this proposal as originally published, as well as any interlineation, erasures, omissions or entered wording obscure as to its meaning, may cause the bid to be declared irregular and may be cause for rejection of the bid.

The undersigned agrees to start work within ten (10) days of issuance of the Notice to Proceed. The undersigned further agrees to complete all work covered by this Proposal to the point of use of the project by the Owner by the completion date stated in the Advertisement or within the number of calendar days stated in the Advertisement; and that for all days thereafter until final acceptance, there will be charged, as liquidated damages, the sum of $1,000.00 per calendar day per project for each and every day thereafter until final acceptance.

The undersigned hereby proposes to perform everything required to be performed and to furnish all labor, materials, tools, equipment and all utility and transportation services necessary to complete in a workmanlike manner all the work to be done under this Contract, including addenda thereto, for the sums set forth in the following Bidding Schedule:

SANITARY SEWER REHABILITATION 2026

PROPOSAL

ITEM	DESCRIPTION	QTY	UNIT	UNIT PRICE	AMOUNT
1.	Traffic Control	1	LSum	$_____	$_____
10.	Mobilization	1	LSum	$_____	$_____
20a.	Sewer, CIPP, 8 inch	6625	Ft	$_____	$_____
20b.	Sewer, CIPP, 10 inch	2980	Ft	$_____	$_____
20c.	Sewer, CIPP, 12 inch	290	Ft	$_____	$_____
20d.	Sewer, CIPP, 18 inch	2550	Ft	$_____	$_____
20e.	Sewer, CIPP, 36 inch	435	ft	$_____	$_____
20f.	Sewer, Sectional CIPPR, 8 inch	4	Ea	$_____	$_____
20g.	Sewer, Joint Air Test, 8 inch	154	Ea	$_____	$_____
20h.	Sewer, Joint Air Test, 10 inch	206	Ea	$_____	$_____
20i.	Sewer, Joint Air Test, 21 inch	36	Ea	$_____	$_____
20j.	Sewer, Joint Air Test, 24 inch	26	Ea	$_____	$_____
20k.	Sewer, Joint Grouting, 8 inch	139	Ea	$_____	$_____
20m.	Sewer, Joint Grouting, 10 inch	186	Ea	$_____	$_____
20n.	Sewer, Joint Grouting, 21 inch	33	Ea	$_____	$_____
20p.	Sewer, Joint Grouting, 24 inch	24	Ea	$_____	$_____
20q.	Sewer, Material, Grout	2600	Gal	$_____	$_____
21a.	Manhole, Grouting, Fully Sealed	18	Ea	$_____	$_____
21b.	Manhole, Liner, Cementitious	372	VFt	$_____	$_____
21c.	Manhole, Grout Pipe Connection	4	Ea	$_____	$_____
21d.	Manhole, Rebuild Chimney, Pavement	8	Ea	$_____	$_____
21e.	Manhole, Rebuild Chimney, Offroad	4	Ea	$_____	$_____
22a.	Sewer, Lateral Connection, Air Test	25	Ea	$_____	$_____
22b.	Sewer, Lateral Connection, Grouting	153	Ea	$_____	$_____
23a.	Bypass Pumping, Residential	1	LSum	$_____	$_____
23b.	Bypass Pumping, Railway Crossing, Short	3	Ea	$_____	$_____
23c.	Bypass Pumping, Railway Crossing, Long	1	Ea	$_____	$_____
54.	Site Restoration	1	LSum	$_____	$_____

TOTAL BID:$_____

Give the name of the Owners and dates of other projects which the Bidder has constructed or has had responsible charge of construction:

NAME	**DATE**

The Bidder acknowledges that his bid is in accordance with the information contained in Addendum No. _____, _____, _____, _____.

The Bidder is hereby reminded that the Pay Items listed under the Bidding Schedule are the only items for which he will receive payment under this Contract. In the event that lesser or greater quantities of specific Pay Items are required to complete the work and place the system in operation, the total amount bid for the specific item will be adjusted by the unit price bid to the actual quantities utilized. In the event that an error is made in extending the unit prices, the Bidder is hereby notified that the unit prices as bid, will govern in determining the Total Base Bid. It is expressly understood and agreed that the Total Base Bid is the basis for establishing the amount of Bid Security on this Proposal and for comparison of bids only and is not to be constructed as a lump sum Proposal.

The undersigned attaches hereto a certified check or bidder's bond in the sum of not less than five percent (5%) of the Total Base Bid as required by the Advertisement and Instructions to Bidders and the undersigned agrees that in case he shall fail to fulfill his obligations under this Proposal and/or shall fail to furnish bonds, as specified, the Owner may, at its option determine that the certified check or amount of said certified check or bidder's bond accompanying this Proposal has been forfeited to the Owner, but otherwise the said certified check or bidder's bond shall be returned to the undersigned upon the execution of the Contract and acceptance of the bond.

The undersigned further agrees that this proposal shall be effective for a period of sixty (60) days from the date established for opening of all bids.

Date _____ Company Name _____

By _____ Address _____
Signature

_____ _____
Printed Name

Title _____ Phone Number _____

SANITARY SEWER REHABILITATION 2026

THIS CONTRACT, dated _____, by and between _____, hereinafter called the "CONTRACTOR", and Meridian Township, 5151 Marsh Road, Okemos, MI 48864, hereinafter called the "OWNER".

WITNESSETH, that the CONTRACTOR and the OWNER for the consideration herein agree as follows:

ARTICLE I. SCOPE OF WORK.

The CONTRACTOR shall perform everything required to be performed and shall provide and furnish all labor, materials, necessary tools, expendable equipment and all utility and transportation services required to perform and complete in a workmanlike manner all the work required for constructing the project as described in the Advertisement and Proposal and for performing all related work for the OWNER, required by and in strict accordance with the plans and specifications, including any and all addenda, and other Contract Documents mentioned and made a part hereof.

ARTICLE II. THE CONTRACT PRICE.

The OWNER shall pay for constructing the project complete with all labor, materials, equipment, appurtenances, surface restoration and related work in strict accord with the Plans and Specifications, ready for use, the unit prices as listed in the Proposal and herein made a part of this Contract. Payment shall be made to the CONTRACTOR in accordance with and subject to the conditions specified under General Conditions.

ARTICLE III. TIME.

Time is of the essence in the performance of this contract. The CONTRACTOR agrees to start work within ten (10) days of issuance of the Notice to Proceed and to fully complete the work so as to permit use of the project by the OWNER by the completion date stated in the Advertisement or within the number of calendar days listed in the Advertisement.

ARTICLE IV. DELAYS AND DAMAGES.

If the CONTRACTOR refuses or fails to prosecute the work, or any separate part thereof, with such diligence as will insure its substantial completion, ready for use by the OWNER by the completion date stated in the Advertisement or within the number of consecutive calendar days stated in the Advertisement, or any extension thereof, or fails to complete said work within such time, the OWNER may, by written notice to the CONTRACTOR, terminate the CONTRACTOR's right to proceed with the work or such part of the work as to which there has been delay. In such event, the OWNER may take over the work and prosecute the same to completion by contract or otherwise, and the CONTRACTOR and his sureties shall be liable to the OWNER for any excess cost occasioned thereby. If the CONTRACTOR's right to proceed is so terminated, the OWNER will take possession of and utilize in completing work such materials, appliances, and plant as may be on the site of the work and necessary therefore.

If the OWNER does not terminate the right of the CONTRACTOR to proceed, the CONTRACTOR shall continue to work, in which event the actual damages for the delay will be impossible to determine and in lieu thereof the CONTRACTOR shall pay the OWNER the sum of one thousand dollars ($1,000.00) per day as fixed, agreed, and liquidated damages for each calendar day of delay until the work is substantially completed, ready for operation and the CONTRACTOR and his sureties shall be liable for the amount thereof. However, the right of the CONTRACTOR to proceed shall not be terminated or the CONTRACTOR charged with liquidated damages because of any delays in the completion of the work due to unforeseeable causes beyond control and without the fault or negligence of the CONTRACTOR, including, but not restricted to acts of God, or of the public enemy, acts of the OWNER, fires, floods, epidemics, quarantine restrictions, delays of subcontractors due to such causes, if the CONTRACTOR shall, within ten (10) days from the beginning of any such delay (unless the OWNER shall grant a further period of time prior to the date of final settlement of the Contract) notify the OWNER in writing of the cause of delay and extend the time for completing the work when, in OWNER's judgement, the finding of fact justify such an extension and OWNER's findings of fact thereon shall be final and conclusive on the parties thereto. In no event shall bankruptcy or labor disputes, or the like, either of CONTRACTOR or any of its subcontractors or suppliers, be considered as an unforeseeable cause beyond the control and without the fault or negligence of the CONTRACTOR.

ARTICLE V. COMPONENT PARTS OF THIS CONTRACT.

This Contract consists of the following component parts, all of which are as fully a part of the Contract as if herein set out verbatim, or, if not attached:

1. Advertisement
2. Instructions to Bidders
3. Proposal
4. Addenda
5. Contract
6. Bonds and Insurance
7. General Conditions
8. General Specifications
9. Ingham County Road Commission Specifications
10. Standard Specifications
11. Special Provisions
12. Plans
13. Notice of Award
14. Notice to Proceed

IN WITNESS WHEREOF, the parties hereto have caused this instrument to be executed in three (3) original counterparts the day and year first above written.

CONTRACTOR

WITNESS:

By:_____ _____

Title: _____

Date: _____

CHARTER TOWNSHIP OF MERIDIAN
OWNER

WITNESS:

By: _____ _____
Scott Hendrickson Name:

Title: Supervisor

Date: _____

NOTICE OF AWARD
Sanitary Sewer Rehabilitation 2026

Dated: _____

TO: _____
_____

ADDRESS: _____
_____

CONTRACT: **SANITARY SEWER REHABILITATION 2026**

You are notified that your Bid dated _____ for the above Contract has been considered. You are the apparent Successful Bidder and have been awarded a Contract for **Sanitary Sewer Rehabilitation 2026.**

The Contract Price of your Contract is: **$_____.**

Three copies of each of the proposed Contract Documents accompany this Notice of Award.

You must comply with the following conditions within 10 days of the date you receive this Notice of Award.

1. Deliver to the OWNER **three** fully executed counterparts of the Contract Documents. (Each of the Contract Documents must bear your signature on page C-3.)

2. Deliver with the executed Contract Documents the Contract security (Bonds and Insurance) as specified in General Conditions (GC).

Failure to comply with these conditions within the time specified will entitle OWNER to consider your Bid in default, to annul this Notice to Award and to declare your Bid security forfeited.

Within ten days after you comply with the above conditions, OWNER will return to you one fully executed counterpart of the Contract Documents.

MERIDIAN TOWNSHIP

By: _____
Dan Opsommer
Assistant Township Manager
Director of Public Works & Engineering

NOTICE TO PROCEED

Dated: _____--___

TO: _____
_____

ADDRESS: _____
_____

CONTRACT: **SANITARY SEWER REHABILITATION 2026**

You are notified that the Contract Times under the above Contract will commence to run on _____ In accordance with Article III of the Contract, the date of Completion for the project is _____.

Deliver to **OWNER** an acknowledged copy of this Notice to Proceed.

MERIDIAN TOWNSHIP

By: _____
Younes Ishraidi, P.E.
Township Engineer/
Deputy Director of Public Works & Engineering

ACKNOWLEDGEMENT OF ACCEPTANCE OF NOTICE TO PROCEED

CONTRACTOR acknowledges acceptance of this Notice to Proceed this _____ day of _____.

By: _____

GENERAL CONDITIONS

INDEX

GC.1 CONTRACT SECURITY
GC.2 CONTRACTORS' AND SUBCONTRACTORS' INSURANCE
- A. Policies, Coverages and Endorsements
- ~~B. Builder's Risk Insurance (Fire and Extended Coverage)~~
- C. Owner's Protective Liability
- D. Insured Parties
- E. Acceptable Insurance Companies
- F. Indemnification and Hold Harmless

GC.3 QUALIFICATION FOR EMPLOYMENT
GC.4 PROGRESS SCHEDULE
GC.5 ACCIDENT PREVENTION
GC.6 CONTRACT PRICE SCHEDULE
GC.7 PAYMENT TO CONTRACTOR
GC.8 SUBCONTRACTING
GC.9 ASSIGNMENTS
GC.10 EXTRAS
GC.11 CHANGES IN WORK/PAYMENT ADJUSTMENTS
GC.12 TIME OF MAKING CLAIMS
GC.13 MATERIALS, SERVICES, AND FACILITIES
GC.14 TERMINATION FOR BREACH
GC.15 OWNER'S RIGHT TO WITHHOLD CERTAIN AMOUNTS AND MAKE APPLICATION THEREOF
GC.16 SUPERINTENDENCE
GC.17 NOTICE AND SERVICE THEREOF
GC.18 COMPLIANCE WITH LAW
GC.19 PERMITS
GC.20 ROYALTIES AND PATENTS
GC.21 INSPECTIONS
GC.22 CORRECTION OF WORK AFTER FINAL PAYMENT
GC.23 PROTECTION OF WORK
GC.24 USE OF JOB SITE
GC.25 "OR EQUAL" CLAUSE
GC.26 PLANS AND SPECIFICATIONS
GC.27 OWNER'S RIGHT TO DO WORK
GC.28 CLEANING UP
GC.29 REPORTS, RECORDS AND DATA
GC.30 NON-DISCRIMINATION IN EMPLOYMENT
GC.31 DEFINITIONS

GC.1 CONTRACT SECURITY

The Contractor shall furnish a surety bond, by a duly authorized surety company satisfactory to the Owner, in an amount equal to 100 percent (100%) of the Contract price as security for the faithful performance of this Contract. The Contractor shall also furnish a separate surety bond, by a duly authorized surety company satisfactory to the Owner, in an amount equal to 100 percent (100%) of the Contract price as security for the payment of all persons performing labor and/or furnishing materials.

The surety company writing the bid, performance, labor and material, and maintenance bond shall be: 1) acceptable to the Owner, 2) be listed in the Federal Register as published by the U.S. Department of Treasury under most recently revised Circular 570; 3) have an A.M. Best Company's Insurance reporting rating of no less than A- (Excellent); and 4) authorized to do business in the State of Michigan by the Michigan Department of Licensing & Regulatory Affairs Office of Financial and Insurance Regulations. Upon request, the Contractor shall submit evidence of such insurance.

GC.2 CONTRACTORS' AND SUBCONTRACTORS' INSURANCE

The Contractor shall not commence work under this Contract until he/she has obtained all the insurance required under this section and such insurance has been approved by the Owner, nor shall the Contractor allow any subcontractor to commence work on his/her subcontract until all similar insurance required of the subcontractor has been so obtained and approved. Contractors and subcontractors are required to file with the Owner completed certificates of insurance, as evidence that they carry adequate insurance to comply with the requirement of this section. New Certificates of Insurance shall be furnished to the Owner at the renewal date of all policies named on these certificates.

A. <u>Policies, Coverages, and Endorsements</u>

The Contractor agrees to maintain, or to cause its personnel providing services under this Contract to maintain, at its sole cost and expense or the cost and expense of his personnel, the following insurance policies, with the specified coverages and limits, to protect and insure the Owner and Contractor against any claim for damages arising in connection with Contractors responsibilities or the responsibilities of Contractors personnel under this Contract and all extensions and amendments thereto.

1. Commercial General Liability

a.	General Aggregate	$2,000,000
b.	Each Occurrence	$1,000,000

Such insurance shall include, but not be limited to, coverage for:
Comprehensive form, Premises-operations, Explosion and collapse hazard, Underground hazard, Products/completed operations hazard, Contractual insurance, Broad form property damage, Independent contractor, Personal injury

2. Workers' Compensation & Employer' Liability (if applicable)

a.	Medical & Indemnity	Statutory Requirements
b.	Bodily Injury by Accident	$500,000 Each Accident
c.	Bodily Injury by Disease	$500,000 Each Employee
d.	Bodily Injury by Disease	$500,000 Policy Limit
e.	Employers Liability	$500,000

3. Automobile Liability

Including hired and non-owned Automobiles $1,000,000 (Combined Single Limit)
Such insurance shall include, but not be limited to, coverage for:
Comprehensive form, Owned vehicles, Hired vehicles, Non-owned vehicles

GC.2 CONTRACTORS' AND SUBCONTRACTORS' INSURANCE (Cont'd.)

~~**B. Builder's Risk Insurance (Fire and Extended Coverage)**~~

~~Until the project is completed and accepted by the Owner, the Contractor is required to maintain Builder's Risk Insurance (fire and extended coverage) on a 100 percent completed value basis on the insurable portion of the project for the benefit of the Owner, the Contractor, and subcontractors as their interests may appear.~~

C. Owner's Protective Liability

The Contractor shall procure and shall maintain during the life of this Contract Owner's/Contractor's Protective Liability Insurance, listing the Owner as the named insured. The minimum limit of liability shall be not less than $1,000,000.00 per occurrence/aggregate.

D. Insured Parties

All policies shall contain a provision naming the Owner (and its officers, agents and employees) as Additional Insured parties on the original policy and all renewals or replacements during the term of this Contract.

E. Acceptable Insurance Companies

All insurance companies required by this section shall be: 1) acceptable to the Owner; 2) authorized to do business in the State of Michigan by the Michigan Department of Licensing & Regulatory Affairs Office of Financial and Insurance Regulations, and 3) have an A.M. Best Company's Insurance reporting rating of no less than A- (Excellent). Upon request, the Contractor shall submit evidence of such insurance.

F. Indemnification and Hold Harmless

The Contractor shall, at its own expense, protect, defend, indemnify and hold harmless the Owner and its elected and appointed officers, employees, and agents from all claims, damages, costs, lawsuits and expenses, including, but not limited to, all costs for administrative proceedings, court costs and attorney fees that they may incur as a result of any acts, omissions, or negligence of the Contractor, its subcontractors, sub-subcontractors or any of their officers, employees, or agents. This includes but is not limited to injury or death to any person or persons, including the contractors employees, and damage to property. The furnishing by the Contractor of any insurance required by this Contract, or the acceptance or approval thereof by the Owner as provided in this Contract, or otherwise, shall not diminish the Contractor's obligation to fully indemnify the Owner, its elected and appointed officers, employees, and agents as required in this section.

The Contractor shall not cancel or reduce the coverage of any insurance required by this section without providing 30-day prior written notice to the Owner. All such insurance must include an endorsement whereby the insurer shall agree to notify the Owner immediately of any reduction by the Contractor. The Contractor shall cease operations on the occurrence of any such cancellation or reduction, and shall not resume operations until new insurance is in force.

GC.3 QUALIFICATION FOR EMPLOYMENT

The Contractor shall employ competent laborers and mechanics for the work under this Contract, and shall comply with all applicable regulations of the United States Department of Labor and any other agencies having jurisdiction.

GC.4 PROGRESS SCHEDULE

The Contractor, if requested by the Owner, immediately after being awarded the Contract, shall prepare and submit to the Owner and its representative an estimated progress schedule for the work in relation to the entire project. This schedule shall indicate the dates for the starting and completion of the various stages of construction.

GC.4 PROGRESS SCHEDULE (Cont'd.)

If the Contractor chooses to work overtime, they will be backcharged for inspection. Overtime is any Township recognized holiday and/or any time other than 8:00 a.m. to 5:00 p.m., local time, Monday through Friday. No work will be allowed at the site prior to 7:00 a.m. or after 7:00 p.m., or dusk, of any working day. No work will be allowed on Sundays with the exception of work necessitated by an emergency.

GC.5 ACCIDENT PREVENTION

Precaution shall be exercised at all times for the protection of persons (including employees) and property, and hazardous conditions shall be guarded against or eliminated. The Contractor is entirely responsible for all aspects of job safety and shall execute the work under this Contract in strictest conformance with all state and local safety codes, rules and regulations.

GC.6 CONTRACT PRICE SCHEDULE

The Contractor, if requested by the Owner, shall submit to the Owner a cost breakdown for the various items of the work. The schedule shall be prepared in a manner acceptable to the Owner as to both form and completeness and supported by data as necessary to substantiate its correctness.

GC.7 PAYMENT TO CONTRACTOR

The Contractor shall submit semi-monthly, or at longer intervals, if he so desires, an invoice covering work previously performed for which he believes payment, under the Contract terms, is due, and shall deliver said invoice to the Owner. Each request for payment shall be accompanied by a statement certifying that all bills for labor and materials have been paid up for all previous pay requests.

Each progress payment request shall be paid within one of the following time periods, whichever is later:

A. Thirty (30) days after the Owner has certified that the work is in place in the portion of the facility covered by the applicable request for payment in accordance with the documents.

B. Fifteen (15) days after the Owner has received the funds with which to make the progress payment from a department or agency of the federal or state government, if any funds for the facility are to come from either of these sources.

To assure proper performance of the Contract by the Contractor, the Owner shall retain ten percent (10%) of the dollar value of all work in place~~ until the work is fifty percent (50%) in place. After the work is fifty percent (50%) in place, additional retainage shall not be withheld unless the Owner determines that the Contractor is not making satisfactory progress, or for other specific cause relating to the Contractor's performance under the Contract. In the event of such a determination the Owner may retain up to but not to exceed ten percent (10%) of the dollar value of the work more than fifty percent (50%) in place~~.

Any funds retained by the Owner shall not exceed the prorated share of the Owner's matching requirement if the project is funded, in part, with federal or state funds. Any retained funds shall not be commingled with other funds of the Owner and shall be deposited in an interest-bearing account in a regulated financial institution.

At any time after ninety-four percent (94%) of the work under the Contract is in place, and at the request of the Contractor, the Owner shall release the retainage plus interest, only if the Contractor provides to the Owner an irrevocable letter of credit in the amount of the retainage plus interest, issued by a bank authorized to do business in the State of Michigan, containing terms mutually acceptable to the Contractor and Owner.

Retainage shall be released to the Contractor together with the final progress payment.

GC.7 PAYMENT TO CONTRACTOR (Cont'd.)

Owner and Contractor agree that disputes concerning retainage, at the option of the Owner, shall be submitted to the decision of the agent as provided in Section 4 of Act 524 of the Michigan Public Acts of 1980 (MCLA 125.1564; MSA 5.2949 (104)) and that interest earned on retainage shall be released to the Contractor together with the final progress payment except as provided in said Section 4 of 1980 PA 524.

The final progress payment request by the Contractor shall include:

A. A final invoice in a form satisfactory to the Owner.

B. A sworn statement certifying that all bills for labor and materials have been paid by the Contractor.

C. A sworn statement waiving any further claims (other than the final payment, retainage and interest, if any) by the Contractor against the Owner.

D. A certificate from Contractor's bonding company approving issuance of final payment.

All payments shall take due account of additions to or deductions from the Contract price as herein provided.

The acceptance by the Contractor of payment on the final progress payment request shall be conclusive evidence of Contractor's acceptance and approval of estimates, accounting and deductions, and of full payment by the Owner for all work, labor, materials and services done or furnished hereunder, and a full satisfaction, discharge, release and waiver of all claims and demands of or on behalf of the Contractor, its agents or employees against the Owner arising out of this agreement.

GC.8 SUBCONTRACTING

The Contractor shall not award any work to any subcontractor, supplier, manufacturer or fabricator without prior written approval of the Owner, which approval will not be given until the Contractor submits a written statement to the Owner concerning the proposed award to the subcontractor. Said statement shall contain such information as the Owner may require.

The Contractor shall be as fully responsible to the Owner for the acts and omissions of his subcontractors and of persons either directly or indirectly employed by them, as he is for the acts and omissions of persons directly employed by him.

The Contractor shall cause appropriate provisions to be inserted in all subcontracts relative to the work to bind subcontractors to the Contractor by the terms of the General Conditions and other Contract documents insofar as applicable to the work of the subcontractors, and to give the Contractor the same power of terminating any subcontract that the Owner may exercise over the Contractor under any provision of the Contract documents.

Nothing contained in this Contract shall create any contractual relation between any subcontractor and the Owner.

GC.9 ASSIGNMENTS

The Contractor shall not assign the whole or any part of this Contract or any monies due or to become due hereunder without written consent of the Owner. In case the Contractor assigns all or any part of any monies due or to become due under this Contract, the instrument of assignment shall contain a clause substantially to the effect that it is agreed that the right of the assignee in and to any monies due or to become due to the Contractor shall be subject to prior liens of all persons, firms and corporations for services rendered or materials supplied for the performance of the work called for in this Contract.

GC.10 EXTRAS

Except as otherwise herein provided, no charge for any extra work or materials will be allowed unless the same has been ordered in writing by the Owner and the price stated in such order.

GC.11 CHANGES IN WORK/PAYMENT ADJUSTMENTS

Adjustments, if any, in the amounts to be paid by the Contractor by reason of changes in, additions to, or deductions from the work to be performed or the materials to be furnished under this Contract, shall be made on the basis of the acceptable unit prices or lump sums submitted by the Contractor covering such changes, additions or deductions.

Failing an acceptable lump sum or unit price basis for extra work caused by changes or additions, the Contractor may be directed to proceed with extra work on the basis of actual total cost of:

A. Labor, including foremen (including fringe benefits);

B. Materials entering permanently into the work;

C. The ownership or rental cost of construction plant and equipment during the time of use on the extra work at a rate not to exceed AGC rates;

D. Power and consumable supplies for the operation of power equipment;

E. Insurance;

F. Social Security and unemployment contributions.

To the cost of the six items above, there shall be added a fixed fee, to be agreed upon but not to exceed fifteen percent (15%) of the actual cost of the work. The single fee shall be compensation to both the Contractor and/or subcontractor to cover the cost of supervision, overhead, bond, profit and any other general expenses.

Failing an acceptable lump sum or unit price basis for adjustment for any decrease in work caused by changes or deductions, the amount of such adjustment may be determined on a similar basis to that described for extra work, with the Contractor furnishing all pertinent cost data from his/her books and records that may be available and necessary for determination of the amount of adjustment.

All changes in, additions to, or deductions from the work specified shall be made only by written order by the Owner or by an authorized representative of the Owner. No claim for extra work will be allowed, unless ordered in writing as above stated, and the claim therefore presented in writing by the Contractor on or before the fifth (5th) day of the month following that in which the work was done.

GC.12 TIME OF MAKING CLAIMS

If the Contractor shall claim compensation or extension of time for any losses, damages, or delays sustained by reason of the acts of the Owner or its agents or other causes, he/she shall make a written statement of the nature of the loss, damage, or delay sustained to the Owner, within ten (10) days after the sustaining of such loss, damage, or delay. At the time of delivery and as a part of the Contractor's Declaration as hereinafter provided, the Contractor shall file with the Owner an itemized statement of the details and amounts of the loss, damage, or delay, and unless the statement shall be made as thus required, the Contractor's claim for compensation or extension of time shall be forfeited and invalidated, and he/she shall not be entitled to payment or extension of time on account of any such loss, damage or delay.

GC.13 MATERIALS, SERVICES, AND FACILITIES

It is understood that except as otherwise specifically stated in the Contract documents, the Contractor shall provide and pay for all materials, labor, tools, equipment, water, light, power, transportation, superintendence, temporary construction of every nature and all construction facilities whatsoever necessary to execute, complete, and deliver the work within the specified time.

Any work necessary to be performed after regular working hours, or Sundays and legal holidays, shall be performed without additional expense to the Owner.

GC.14 TERMINATION FOR BREACH

In the event that any of the provisions of this Contract are violated by the Contractor or by any of his subcontractors, the Owner may serve written notice upon the Contractor and the Surety of its intention to terminate the Contract, such notice to contain the reasons for terminating the Contract, and unless within ten (10) days after the serving of such notice upon the Contractor, the violation shall cease and satisfactory arrangements for correction be made, the Contract shall cease and terminate. In the event of a termination of the Contract, the Owner shall immediately serve notice thereof upon the Surety and the Contractor, and the Surety shall have the right to take over and perform the Contract.

However, if the Surety does not commence performance thereof within 30 days from the date of mailing said Notice of Termination to such Surety, the Owner may take over the work and prosecute the same to completion by contract for the account and at the expense of the Contractor. The Contractor and his Surety shall be liable to the Owner for any excess cost incurred by the Owner in completing the work, and Owner may take possession of and utilize in completing the work, all materials, appliances and plants as may be on the site of the work and necessary therefore.

GC.15 OWNER'S RIGHT TO WITHHOLD CERTAIN AMOUNTS AND MAKE APPLICATION THEREOF

The Owner may withhold a sufficient amount of any payment otherwise due to the Contractor to cover:

A. Payments that may be past due and payable for just claims for labor, materials, or equipment furnished in and about the performance of the work on the project under this Contract.

B. For defective work not remedied.

C. For failure of the Contractor to make proper payments to his subcontractors.

The Owner shall disburse and shall have the right to act as agent for the Contractor in disbursing such funds as have been withheld pursuant to this paragraph to the party or parties who are entitled to payment therefrom. Any payment so made by the Owner shall be considered as a payment made under the Contract by the Owner to the Contractor. The Owner will render to the Contractor a proper accounting of all funds disbursed in behalf of the Contractor.

GC.16 SUPERINTENDENCE

The Contractor shall give his/her personal superintendence to the work or have a competent foreman or superintendent, satisfactory to the Owner, on the worksite at all times during work progress, with authority to act for the Contractor.

GC.17 NOTICE AND SERVICE THEREOF

Where in any of the Contract documents there is any provision in respect to the giving of any notice, such notice shall be deemed to have been given; as to the Owner, when written notice shall be delivered to the Owner, or shall have been placed in United States mails with first-class postage pre-paid addressed to the chief executive officer of the Owner at the place where the bids or proposals for the Contract were opened; as to the Contractor, when a written notice shall be delivered to the chief representative of the Contractor, at the site of the project or by mailing such written notice in the United States mails with first-class postage pre-paid addressed to the Contractor at the place stated in the papers prepared by him to accompany his proposal as to the address of his permanent place of businesses; as to the Surety, when a written notice is placed in the United States mails with first-class postage pre-paid addressed to the Surety at the home office of such Surety or to its agent or agents who executed bonds in behalf of such surety.

GC.18 COMPLIANCE WITH LAW, APPLICABLE LAW, AND VENUE

The Contractor shall comply with all applicable Federal, State, County, and Municipal laws, ordinances, rules and regulations.

This contract shall be construed according to the laws of the State of Michigan.

The venue for the bringing of any legal or equitable action under this contract shall be the County of Ingham, of the State of Michigan. In the event that any action is brought under this Contract in Federal Court, the venue for such action shall be the Federal Judicial District of Michigan, Western District, Southern Division.

GC.19 PERMITS

The Township will secure and pay for the Building Permit from the Meridian Township Building Department. All other permits or licenses which may be needed for prosecution of the work are to be obtained by the Contractor at the Contractor's expense.

GC.20 ROYALTIES AND PATENTS

The Contractor shall pay for all royalties and patents, and defend all suits or claims for infringement on any patent right, and shall save and hold harmless the Owner from loss on account thereof.

GC.21 INSPECTIONS

The Owner and its representative shall at all times have access to the work wherever it is in preparation or progress and the Contractor shall provide facilities for such access and for inspection.

The Owner and/or its representative shall have the right to reject materials and workmanship which are defective, or require their correction. Work on the project may be ordered terminated until correction is made. Rejected workmanship shall be satisfactorily corrected, and rejected materials shall be removed from the premises without charge to the Owner. If the Contractor does not correct condemned work and remove rejected materials within a reasonable time, fixed by written notice, the Owner may remove them and charge the expense to the Contractor.

Should it be considered necessary or advisable by the Owner at any time before final acceptance of the entire work to make an examination of work already completed, by removing or tearing out same, the Contractor shall on request promptly furnish all necessary facilities, labor, and materials. If the work is found to be defective in any material respect, due to fault of the Contractor or their subcontractors, they shall defray all the expenses of examination and satisfactory reconstruction. If, however, the work is found to meet the requirements of the Contract, the actual cost of labor and material necessarily involved in the examination and replacement, plus 15 percent (15%) shall be allowed the Contractor.

GC.22 CORRECTION OF WORK AFTER FINAL PAYMENT

Neither the final payment nor any provision in the Contract documents nor partial or entire occupancy of the premises by the Owner shall relieve the Contractor of the responsibility for negligence or faulty materials or workmanship within the extent and period provided by law, and, upon written notice, he/she shall repair any defects due thereto and pay for any damage due to other work resulting therefrom, which shall appear within **one year** after date of completion and acceptance.

GC.23 PROTECTION OF WORK

The Contractor shall continuously maintain adequate protection of all his/her work from damage and shall protect the Owner's and adjacent property from injury arising in connection with this Contract, and shall be responsible for all damage and/or injury caused by or arising out of his operations.

GC.24 USE OF JOB SITE

The Contractor shall confine his/her equipment apparatus, the storage of materials and operations of his/her workmen to limits indicated by law, ordinances, permits or directions of the Owner and shall not encumber the premises with his materials.

GC.25 "OR EQUAL" CLAUSE

Whenever in any of the Contract documents an article, material or equipment is defined by describing a proprietary product, or by using the name of a manufacturer or vendor, the term "or equal" if not inserted, shall be implied. The specific article, material or equipment mentioned shall be understood as indicating the type, function, minimum standard of design, efficiency, and quality desired and shall not be construed in a manner so as to exclude manufacturer's products of comparable quality, design and efficiency. The Contractor shall comply with the requirement of the Contract documents relative to the Owner's approval of materials and equipment before they are incorporated in the project.

GC.26 PLANS AND SPECIFICATIONS

The Contractor shall keep on the worksite a copy of the drawings and specifications and shall at all times give the Owner access thereto. Anything mentioned in the specifications and not shown on the drawings, or shown on the drawings and not mentioned in the specifications, shall be of like affect as if shown or mentioned in both. In case of difference between drawings and specifications the specifications shall govern. In any case of discrepancy in the figures, drawings or specifications, the matter shall be immediately submitted to the Owner, without whose decision said discrepancy shall not be adjusted by the Contractor, save only at his/her own risk and expense.

The Owner shall furnish from time to time such detail drawings and other information as he/she may consider necessary, unless otherwise provided. The Contractor shall keep such drawings at the site of the work.

GC.27 OWNER'S RIGHT TO DO WORK

If the Contractor should neglect to prosecute the work properly or fail to perform any provision of this Contract, the Owner three (3) days after given written notice to the Contractor and his/her Surety may, without prejudice to any other remedy the Owner may have, make good such deficiencies and may deduct the cost thereof from the payment due to the Contractor.

GC.28 CLEANING UP

The Contractor shall at all times keep the premises free from accumulations of waste material or rubbish caused by his/her employees or work, and at the completion of the work he/she shall remove all his/her rubbish from and about the work and all his/her tools, equipment, scaffolding and surplus materials and shall leave his/her work clean and ready for use. In case of dispute, the Owner may remove the rubbish and surplus materials and charge the cost to the several Contractors in proportion to the amounts as shall be determined to be just.

GC.29 REPORTS, RECORDS AND DATA

The Contractor and each of his/her subcontractors shall submit to the Owner such schedules of quantities, costs, progress schedules, payrolls, reports, estimates, records, and other data as the Owner may request concerning work performed or to be performed under this Contract.

GC.30 NON-DISCRIMINATION IN EMPLOYMENT

The Contractor shall adhere to all applicable Federal, State and local laws, ordinances, rules and regulations prohibiting discrimination with regards to employees and applicants for employment. The Contractor, as required by law, shall not discriminate against an employee or applicant for employment with respect to hire, tenure, terms, conditions or privileges of employment, or a matter directly or indirectly related to employment because of race, color, religion, national origin, age, sex, height, weight, marital status, or handicap that is unrelated to the individual's ability to perform the duties of a particular job or position. Breach of this section shall be regarded as a material breach of this Contract.

GC.31 DEFINITIONS

The following terms as used in these Contract documents are respectively defined as follows:

(a)	"Contractor"	The person, firm or corporation to whom the within Contract is awarded by the Owner and who is subject to the terms hereof.
(b)	"Subcontractor"	A person, firm or corporation other than a Contractor, supplying labor and materials or labor for work at the site of the project.
(c)	"Project"	The total construction proposed by the Owner to be constructed in part or in whole pursuant to the within Contract.
(d)	"Work on the Project"	Work to be performed, including work normally done, at the location of the project.
(e)	"Surety"	Any person, firm or corporation that has executed, as surety, the Contractor's performance and/or labor and material bonds securing the attached Contract.
(f)	"Owner"	The public body or authority for whom the work is to be performed and as identified in the advertisement and proposal.
(g)	"Engineer"	The Director of Public Works and Engineering for the Meridian Township or their authorized representative.

GENERAL SPECIFICATIONS

INDEX

GS.1 Definition
GS.2 Elevations
GS.3 Quality of Materials and Equipment Furnished
GS.4 Care of Existing Structures
GS.5 Care of New Structures
GS.6 Existing Public Utilities
GS.7 Protection of Trees and Shrubs
GS.8 Safety Precautions
GS.9 Sanitary Requirements
GS.10 Utilities
GS.11 Pumping and Drainage
GS.12 Winter Construction
GS.13 Use of Facilities before Final Completion
GS.14 Test of Materials
GS.15 Other Work
GS.16 Lines and Grades
GS.17 Complete Work Required
GS.18 Property Markers
GS.19 Records and Measurements
GS.20 Guarantee

GS.1 DEFINITION

The Contractor shall furnish all materials specified herein, shown on the plans, and required to be incorporated in the work of the Contract. They shall furnish all labor, construction equipment, tools, supplies and facilities required to construct the elements designated by the Contract documents and shall construct all of the designated elements complete and in full conformance with the requirements of these documents. They shall comply with all regulatory provisions of the Contract, General Conditions and the Specifications.

GS.2 ELEVATIONS

All the elevations shown on the plans or referred to herein are in feet above mean sea level datum as established by the United States Geological Survey, unless otherwise noted. The Contractor shall verify all the existing structure locations and elevations at points of connection or possible interference between their work and the existing structures and shall report at once to the Engineer any interference's or discrepancies discovered.

GS.3 QUALITY OF MATERIALS AND EQUIPMENT FURNISHED

All materials and equipment furnished by the Contractor hereunder shall be new and conform to specifications herein.

Materials, supplies, and equipment, whether furnished by the Contractor or the Owner, shall be stored at the site of the work in such manner as not to interfere with traffic, convenience to public or other Contractors on the site or in the vicinity. The Contractor shall be responsible for any damage caused to new or existing structures by reason of such storage or handling of materials, supplies, or equipment.

Flammable materials in portable containers are not to be stored overnight on the site. This includes, but is not limited to, gasoline and diesel fuel for use in construction machinery. Portable containers suitably protected, will be allowed overnight at the site, if confined to permanent tanks which are a normal part of the construction machinery.

GS.3 QUALITY OF MATERIALS AND EQUIPMENT FURNISHED (Cont'd.)

Where the Contractor is required to do work within rights of way under the jurisdiction of governmental bodies, they shall meet the requirements of said governmental bodies for work and storage within their jurisdiction. Such requirements must be met as a minimum requirement, and if the specifications given herein impose further limitation on the work, they shall also be met as the required work standard.

The Contractor's attention is directed to the Ingham County Road Department permit specifications, Section 5. Restoration and Maintenance of Right-Of-Way (e.), for dust control requirements.

GS.4 CARE OF EXISTING STRUCTURES

The Contractor shall be solely responsible for any damage to any existing underground services or structures, or to structures and roadway above ground caused by their operations or those of their subcontractors and suppliers.

GS.5 CARE OF NEW STRUCTURES

The Contractor shall use every reasonable precaution to prevent injury to the new structures being constructed hereunder. They shall be responsible to correct all injury or damage resulting from their operations and/or occurring while the work is under their supervisory control. They shall furnish and install such guards, coverings and other protection as may be needed to insure that the structures remain undamaged prior to completion of the entire work.

In the event damage does occur to the finished portions of the work, or to the work in progress, the Contractor shall take such corrective action and measures as may be necessary to repair the damage to the satisfaction of the Engineer.

GS.6 EXISTING PUBLIC UTILITIES

Existing public utilities and underground structures such as pipelines, electric conduits and sewers are shown on the drawings from available information. The Contractor shall, through Miss Dig and any other reasonable measures, verify the exact location of underground utilities for themselves.

The Contractor shall conduct their operations so as not to damage any existing utility whether or not shown on the plans. The Contractor shall correct, at their own expense, any damage or injury that may be caused by them during their operations or damage or injury caused during the operations of their subcontractors or suppliers.

The Contractor shall be responsible for coordinating relocation or repair of existing public and private utilities with the appropriate utility or owner. No extra payment will be allowed for repairs.

If the Contractor desires, or is required by the utility companies, to relocate any power or telephone poles to facilitate their work, any expense encountered from such relocation shall be borne by the Contractor.

GS.7 PROTECTION OF TREES AND SHRUBS

All trees and shrubs encountered along the route of the project shall be protected from damage by the Contractor and saved from harm resulting from any of their operations or operations of their subcontractors and suppliers. Only those trees and shrubs marked for removal on the plans shall be removed. All others will be saved from damage by tunneling or by slightly adjusting the alignment of the project as directed by the Engineer.

GS.8 SAFETY PRECAUTIONS

During the progress of the work, the Contractor shall maintain adequate facilities for the protection and safety of all persons and property. The Contractor and all their subcontractors and suppliers shall comply with the "Construction Safety and Health Standards" as published by the Michigan Occupational Safety and Health Administration, and to all other local, state and federal laws, ordinances, rules and regulations pertaining to safety of persons or property.

GS.9 SANITARY REQUIREMENTS

The Contractor shall provide adequate sanitary facilities for all persons employed on this Project. The sanitary facilities shall conform in every way to the requirements of the "Construction Health and Safety Standards" as published by the Construction Safety Standards Commission of the State of Michigan.

GS.10 UTILITIES

The Contractor shall make all necessary arrangements for the provision of all utility services required to prosecute the work under this Contract. The Contractor shall pay the costs for such connections and service. Where the Owner has utility service at the site, the Contractor may obtain service by connection to the Owner's service, subject to reasonable regulation of its use and satisfactory agreement as to charges. In the event that the Contractor's use of any or all of the Owner's utility services causes the Owner to have an inadequate supply of such service, the Contractor shall disconnect said service and provide their own separate supply at no cost to the Owner.

All utility services shall be inspected by and meet the requirements of the applicable local codes and governmental bodies.

GS.11 PUMPING AND DRAINAGE

Adequate pumping and drainage facilities shall be provided and water from whatever sources entering the work during any stage of construction shall be removed promptly and disposed of. All pumping and drainage shall be done with no damage to property or structures and without interference with the right of the public, owners of private property, pedestrians, vehicular traffic, or the work of other contractors. Dewatering shall be done in such a manner that the soil under or adjacent to existing structures shall not be disturbed, removed or displaced.

The overloading or obstructing of existing drainage facilities shall not be permitted, and the Contractor shall be solely responsible for damages caused to such existing drainage facilities by their operations. Additionally, sufficient measures shall be utilized to prevent migration of soil from the site due to any pumping or drainage activities.

GS.12 WINTER CONSTRUCTION

The Engineer has authority over approving the prosecution of work which is proposed to be done during the winter months. The Contractor shall provide adequate weather protection, temporary heating and take any other measures which are necessary to ensure that work performed during the winter months is properly installed and protected against damage from freezing.

Reference is made in Division 4 of the Technical Specifications to the requirements for performing concrete construction and masonry construction in cold weather.

GS.13 USE OF FACILITIES BEFORE FINAL COMPLETION

The Owner shall have the right to make use of, during construction, such portions of completed and acceptably tested facilities as it finds practicable. Such use by the Owner shall not relieve the Contractor from responsibility for any defective work which may be subsequently discovered.

GS.14 TEST OF MATERIALS

All laboratory tests, except as otherwise noted, are to be made at the expense of the Contractor as specified in the Technical Specifications. The Contractor shall furnish satisfactory containers for taking and shipping samples. The name of the laboratory making the test must be submitted by the Contractor to the Engineer for approval.

In all cases "laboratory" refers to an independent laboratory of recognized standing. Acceptance of materials tested shall be based upon compliance with the specifications hereinafter stated for the various items. Where no particular tests are specified, the tests shall be those normally made for determination of the fitness of the particular material. Certificates of tests shall be furnished by the testing laboratory or producer, in triplicate, to the Engineer.

The Owner may require, at its own option and expense, additional mill and/or shop inspection by competent parties. The Owner may require, at its own option and expense, additional field inspection by a qualified inspector.

All materials failing to meet the requirements of the specifications, as determined by test or otherwise, shall be rejected and not used in the work. The cost of testing materials which fail to meet requirements shall be paid by the Contractor. All follow-up testing required shall also be paid by the Contractor. Materials, if rejected at the site, shall be immediately removed therefrom and shall not be used in the work.

GS.15 OTHER WORK

The Contractor shall cooperate with other Contractors on the site or adjoining work to the end that the entire Project may proceed with the utmost harmony and with a minimum of delay.

Where the work under this Contract is to involve work completed under other contracts or existing facilities or structures, the Contractor shall investigate the condition of such other work or facility to determine its suitability for incorporation into the work of this Contract. Any defect or discrepancy in other work of facility making it unsuitable for proper execution of this Contract shall be immediately reported to the Owner who shall order such adjustments in the work of the project as necessary for proper completion, and unless such defect or discrepancy is reported promptly, the Contractor shall be solely responsible for any adjustments in the work as shall be found necessary to properly complete the work on this project.

GS.16 LINES AND GRADES

General control lines and grades will be established by the Owner. The Contractor shall notify the Engineer no less than 48 hours prior to requiring such control. The Contractor shall furnish all stakes and labor for driving them and rodmen to assist the Owner in this work. The Contractor shall carefully preserve the general control lines and grades established by the Engineer. The cost of replacement of stakes which are damaged or lost shall be borne by the Contractor.

Construction lines and grade shall be transferred and set by the Contractor from the control lines and grades established by the Engineer, and the Contractor shall furnish necessary instruments and competent personnel for performing such work, and they shall be responsible for the accuracy of the transferred line and grade. The Owner will check the work at intervals, as it deems necessary, and the Contractor shall make correction of error, if any, at their own expense, as may be required for the proper function and performance of the structure and installed equipment.

GS.17 COMPLETE WORK REQUIRED

It is the intent of the Contract documents to provide that the Project to be constructed under this Contract will be complete and ready for use. Any minor items not specifically called for on the plans or specifications, but which are clearly necessary, are to be included.

GS.18 PROPERTY MARKERS

The Contractor shall take precautions not to move or destroy any monuments or stakes marking the boundaries of property along or near the work. A licensed surveyor shall reestablish property irons in the proper location if disturbed. Buried property irons shall be extended 1/2" diameter rods. The Contractor shall pay for reestablishment.

GS.19 RECORDS AND MEASUREMENTS

The Contractor shall keep careful records showing measured overall length of underground facilities installed and distances of such from any available line as may be designated by the Engineer. Such records shall be turned over to the Engineer as the work progresses and the records must be accurate and complete.

GS.20 GUARANTEE

The Contractor shall guarantee and shall secure from the manufacturer of each item of manufactured equipment used in the project a written guarantee that all materials and equipment furnished by them shall be first class and free from defects, and the guarantor agrees that they will, upon notice and without delay, make good or repair without expense to the Owner the whole or any part of the equipment furnished by them hereunder, which within a year from date of acceptance of that portion of completed work incorporating such equipment shall fail or develop unfitness for the purpose for which it is intended as a result of any defect in design, material, workmanship, erection or construction.

INGHAM COUNTY ROAD DEPARTMENT
SUPPLEMENTARY PERMIT SPECIFICATIONS
FOR UTILITY INSTALLATIONS

As referred to herein:
"Board" shall denote the Board of Ingham County Road Commissioners or its duly appointed agents.
"Utility" shall denote any cable, conduit, pipe, structure, or similar facility installed within the road right-of-way.
"Contractor" shall denote an individual or legal entity contracted to perform a proposed utility's installation.

1. GENERAL

a. All proposed utility installations within county road right-of-way shall be reviewed and approved by means of a permit issued by the Board, regardless of the type, size, location, or installation method. The Board shall have absolute authority over any work to be performed within the county road right-of-way and shall exercise said authority at its discretion. The Board reserves the right to impose, at its discretion, cash bond requirements for any permit granted. The cash bond may be used to reimburse the Board for work not performed by the Contractor, restoration of roadways caused by Contractor activities, costs associated with detour signing, and other reasonable expenses incurred by the road commission.

b. The Board shall have the authority to direct any work or stop any work, permitted or not permitted, that in its opinion is not being performed to the Board's satisfaction. All costs for corrective work or work stoppages shall be the responsibility of the Contractor.

c. To issue a utility installation permit, the applicant must provide drawings that illustrate all the work to be performed, the method of installation, and materials to be used. If road or lane closures are proposed, along with the information required below, the approximate start and completion date shall be provided on the permit application.

2. ROAD CROSSINGS

a. All proposed utility crossings of county roads shall be performed using methods other than open cut methods unless otherwise permitted by the Board. The following are general specifications or provisions to be followed when installing utilities using methods other than open cut methods.

1. The methods of utility installation described in this section include, but are not limited to, tunneling, bore and jacking, and directional boring. These methods represent preferred installation methods and are employed to allow installation of utility road crossings without closing the road to through traffic or damaging the existing road pavement. The Board, at its discretion, may require that a particular installation method be employed by the Contractor.

2. When a utility is to be installed by tunneling methods, the tunnel shall be adequately sheeted and shored to prevent the tunnel walls from collapsing and the road pavement from settling or cracking.

3. When a utility is to be installed by bore and jacking methods, a casing pipe will be required with the utility to be installed inside the casing pipe. The annular space between the utility and the casing pipe shall be filled and sealed using pressure grouting or other approved methods.

4. All shafts or pits not sheeted and shored shall be located, at least, 10 feet off the edge of road pavement in rural sections and 6 feet behind the back of curb in urban sections.

5. If any settlement or other changes in grade occur in the vicinity of the utility crossing within one year of the work, upon notification the road shall be immediately reconstructed to the proper grade at the Contractor's expense. In addition, damage to the roadway embankment, shoulder, and pavement shall also be immediately repaired to the Board's satisfaction.

6. Unless otherwise approved by the Board, all utilities shall have a minimum cover of 4 feet below the road surface. Where approved construction plans indicate cover greater that 4 feet, the plan depth shall govern.

7. All costs for maintaining traffic, including flagging operations, shall be the responsibility of the permitted party. Traffic control shall be erected in accordance with the current edition of the Michigan Manual of Uniform Traffic Control Devices (MMUTCD) or as directed by the Board. Modifications to traffic control measures may be ordered by the Board, at its discretion, and the cost of any modifications shall be the responsibility of the Contractor. Once work is completed for the day, traffic control signs which are not appropriate shall be covered or removed so that the motoring public is made aware of the road's condition and how to safely traverse through the work zone.

8. If, in the opinion of the Board, traffic conditions warrant suspension of utility installation operations and restoration of a road's full capacity, the Contractor shall comply immediately. All costs associated with such an action shall be borne by the Contractor.

b. If the Board permits a proposed utility crossing of a county road using open cut methods, the following general specifications or provisions shall be followed:

1. Large projects that involve many utility crossings and or may extend for several months shall be completed in "sections". The intent being, that once a particular crossing, of many, is completed or a 1/4 mile "section" of a multi-mile utility has been installed, the Contractor shall restore the road and right-of-way to the satisfaction of the Board before moving on to the next crossing or section of utility installation.

2. In general, open cut utility crossings will not be allowed during winter months.

3. Open cut utility crossings shall be performed during off-peak traffic hours unless specifically permitted by the Board. Off-peak hours vary, but they are typically between the hours of 9:00 am to 3:00 pm.

4. Unless otherwise approved by the Board, all utilities shall have a minimum cover of 4 feet between the utility and the road surface. Where approved construction plans indicate cover greater that 4 feet, the plan depth shall govern.

5. All costs for maintaining traffic, including flagging operations, shall be the responsibility of the permitted party. For road closures intended to last one or two days, the contractor will submit a deposit with the permit application, the Ingham County Road Department will set up, maintain, and dismantle the road closure, the actual costs incurred will be subtracted from the deposit and the remainder returned to the contractor. If incurred costs exceed the deposit, the contractor will be billed for the overage. For road closures intended to last an extended period of time, the Contractor shall set up, maintain, and dismantle the closure per the approved detour plan. Regardless, traffic control shall be erected in accordance with the current edition of the Michigan Manual of Uniform Traffic Control Devices (MMUTCD) or as directed by the Board. All traffic control schemes are to be approved prior to the beginning of work. Modifications to traffic control measures may be ordered by the Board, at its sole discretion, and the cost of any modifications shall be the responsibility of the Contractor.

6. If a proposed road closure is not permitted, at least one lane of traffic shall be maintained with proper flagging operations in effect throughout the work day. Road cuts shall be backfilled, flush with the driving surface at the end of each working day, appropriately signed, and opened for overnight traffic. Depending on traffic volumes and other conditions, the Board may require the permit applicant to provide by-pass lanes (either paved or unpaved) to maintain traffic.

7. Maintenance of open cut work zones is the responsibility of the Contractor and shall be in effect 24 hours a day for the duration of the work.

3. PAVEMENT AND GRAVEL SURFACE REMOVAL AND REPLACEMENT

a. All proposed open cut utility installations or existing utility installations needing corrective reconstruction shall conform to the following specifications or provisions:

1. All pavement to be removed shall be saw cut, full depth, to its removal limit and carefully removed as to not damage the saw cut edge. All damaged edges shall be subsequently saw cut and removed back to sound pavement. The pavement removal limit shall extend, at least, 1 foot beyond both sides of the open cut trench.

2. Both bituminous and concrete pavement removal shall have a minimum width of 6 feet, be perpendicular to the centerline of the road, and extend the full width of existing lanes. Diagonal pavement removal and replacements will not be allowed unless approved by the Board.

3. Concrete pavement removal limits are to utilize existing joints whenever possible. The minimum distance between a concrete replacement slab and an existing pavement joint shall be 5.5 feet unless approved by the Board. The Contractor shall verify concrete pavement removal limits with the Board prior to pavement replacement.

b. Pavement replacement and gravel road surface restoration shall conform to the following specifications or provisions:

1. Aggregate base material under pavement shall be a minimum of 8-inches thick and meet MDOT 21AA or 22A aggregate specifications, as determined by the Board. The proposed aggregate base material shall conform to the characteristics of the insitu aggregate base material as much as possible. Bituminous pavement replacement shall either match the existing pavement thickness or be 5-inches thick, whichever is greater, and utilize hot mix asphalt materials that meet or exceed MDOT 13A bituminous mix specifications. Concrete pavement replacement shall either match the existing pavement thickness or be 7-inches thick, whichever is greater, and utilize 4500 psi strength concrete that meets or exceeds MDOT specifications. Concrete pavement patch size and geometry shall be determined by the Board and shall be doweled into adjacent concrete pavement. Aggregate surfaced roads and shoulder material shall be a minimum of 6-inches thick and meet MDOT 22A or 23A aggregate specifications. Aggregate base shall be compacted to 95% of its maximum density, hot mix asphalt is to be compacted to 97% of its maximum density, and aggregate shoulder material shall be sufficiently graded and compacted to prevent standing water and erosion problems.

2. The finished driving surface shall be installed to conform to the vertical profile of the existing roadway and not exhibit “dips” or “humps” that are noticeable to the motoring public. “Mounding” over excavations to allow for future settlement will not be permitted. If settling or upheavals occur at pavement replacement locations, the Contractor may be required to remedy the situation. Failure to do so may result in a stoppage of subsequent work or denial of subsequent permits.

3. Bituminous pavements shall not be replaced using lifts that exceed 250 lbs/syd (2 1/4 inches thick). A tack coat emulsion shall be applied between successive lifts of bituminous paving.

4. Replacement concrete pavement shall be doweled into adjacent pavement using 18-inch long by #9 and #5 epoxy coated deformed bars. The dowels shall be drilled, inserted 9-inches, and grouted in accordance with current MDOT specifications. Dowels installed along the pavement edge, parallel to the lane lines (#9), shall be spaced at 18-inches on center. Dowels installed along the pavement edge, perpendicular to the lane lines (#5), shall be spaced at 24-inches on center.

5. Composite pavements, such as asphalt overlaying concrete pavement shall be replaced to match the existing pavement structure using the same provisions described above. If approved by the Board, composite pavements may be replaced with full depth asphalt equal in thickness to the existing pavement structure.

4. BACKFILLING AND COMPACTION

a. All utility trenches, holes, bore pits, and other excavations within the county road right-of-way shall be backfilled with granular material that meets or exceeds MDOT class II material. Excavation backfill shall be placed and compacted to 95% of its maximum density in successive layers that are no more than 12-inches thick. In-place backfill density shall be verified and reported to the Board by an independent testing laboratory. The cost of said verification and reporting shall be the responsibility of the Contractor. The above backfilling and compaction provisions shall apply to that portion of the subgrade that is within the influence of the roadway pavement structure, including the shoulder. Refer to MDOT Trench Detail "B". Failure to meet said backfill and compaction requirements may result in a stoppage of subsequent work, replacement of deficient backfill, and denial of subsequent permits.

b. All under drain systems and similar facilities destroyed or disturbed due to the utility installation shall be rebuilt using similar materials and in a manner that completely restores their function.

5. RESTORATION AND MAINTENANCE OF RIGHT-OF-WAY

a. All drainage courses shall be restored with topsoil, seed, and mulch immediately after completion of utility installations. The Contractor shall employ and maintain soil erosion and sedimentation measures to stabilize all disturbed grounds per the Ingham County Drain Commissioner's (ICDC) standards. Disturbed drainage courses or backslopes that have steep grades, as determined by the Board, shall be stabilized with mulch blanket, rock check dams, or both. The Contractor shall follow ICDC and Michigan Department of Environmental Quality (MDEQ) Best Management Practices (BMS) for soil erosion and sedimentation control.

b. All existing storm sewer, drainage structures, culverts, and similar facilities shall be protected during utility installation. If permitted by the Board and the structure owner, the Contractor may remove and replace said facilities if needed for utility installation. All replacement facilities shall be in accordance with current agency (owner) requirements for materials and construction standards, regardless of existing condition. Any damaged facilities left in place during utility installation shall be fully repaired to the satisfaction of the Board, or be replaced in accordance with current agency (owner) requirements. It is the responsibility of the contractor to research and obtain permission from the appropriate "owner" for the proposed work.

c. All traffic signs requiring replacement or that need to be relocated due to utility installation shall be replaced or relocated by Ingham County Road Department personnel and their costs reimbursed by the Contractor.

d. Encroachments (private installations) within the road right-of-way, such as fences, mailboxes, and hedges that must be removed due to utility installation may be replaced or re-installed, within the right-of-way, upon approval of the Board. In general, removed objects, other than mailboxes, cannot be re-installed within the road right-of-way. Please be aware that the Ingham County Road Department will not become involved with negotiations between the utility owner and property owners relative to encroachment removal and replacement, but the Board will ultimately approve or disapprove whether replacements are allowed, and their subsequent locations.

e. The Contractor shall maintain a safe work area, free from dust and free from dirt and mud being tracked onto the adjacent roadway. The Contractor shall make arrangements to have paved roads swept and gravel roads treated with dust palliative for the duration of installation activities. If requested by the Board, the Contractor shall sweep roads or apply dust palliative within 4 hours of the request. Failure to do so may result in a stoppage of work.

6. MANHOLE CASTING, VALVE, AND FIRE HYDRANT LOCATIONS

a. Permitted utility manhole structures and vaults shall conform to the following specifications or provisions:

1. In general, proposed manhole castings and valve boxes shall be located outside the paved road surface and somewhere other than in the roadside ditch. If approved by the Board, manhole castings and valve boxes installed within a paved surface or parkway shall be located flush with the existing surface, manhole castings and valve boxes installed within the traveled portion of a gravel road shall be located 6-inches below the road's surface, and manhole castings and valve boxes installed in a ditch bottom shall be located, at least 12-inches below the ditch bottom. The contractor may be required to re-route the ditch around manhole castings and valve boxes, at the discretion of the Board.

2. Manhole castings and valve boxes shall not protrude from the backslope of the road or above the normal ground contour by more than 6-inches. The contractor may be required to adjust a manhole casting or regrade the area, to the Board's satisfaction, at their expense.

3. Proposed manhole casting and valve box type shall be approved by the Board prior to the start of installation. If at any future time it is determined that the type of casting or valve box must be changed due to road reconstruction, widening, resurfacing, etc., the utility owner agrees, by performing under permit, to bear all costs for the change

4. Proposed fire hydrant installations shall be approved by the Board prior to the start of installation. If at any future time it is determined that the fire hydrant must be moved due to road reconstruction, widening, resurfacing, etc., the utility owner agrees, by performing under permit, to bear all costs for moving the fire hydrant.

7. TREE REMOVAL, TRIMMING, AND TUNNELING

a. All tree removals, trimming, and tunneling within county road right-of-way shall be reviewed and approved by means of permit by the Board of Ingham County Road Commissioners. Any trees, regardless of their location, that cannot be protected due to utility installation or are in eminent danger of dying as a result of utility installation shall be removed by the Contractor. All stumps shall either be removed or ground flush with the average ground surface in the vicinity of the stump.

b. Proposed tree removals, trimming, and tunneling shall be sufficiently illustrated on construction plans along with the tree's species and size so that a proper review and site visit can be performed.

c. Trees that are located close to proposed utility installations, in the county road right-of-way, and reside within maintained lawn areas shall be protected from above ground and below ground

damage. Any trees, as described above, that are to be removed due to utility installation, shall only be removed after the Contractor has given notice to the adjacent property of the intent to remove the tree(s) and offered replacement trees. In general, the Board will require the Contractor to replace "lawn" trees removed due to utility installation. Replacement trees shall be planted outside the road right-of-way or at locations approved by the Board.

d. All stumps, logs, limbs, and litter shall become the property of the utility installation contractor and be properly disposed of. The adjacent property owners have the right of ownership of wood felled within the right-of-way, therefore the Contractor shall offer to leave the felled wood for the property owners use. Wood requested by the property owner shall be left outside of the county road right-of-way.

8. CONDUCT OF OPERATIONS

a. The Contractor shall control and ensure that trucking operations related to utility installations adhere to the current Michigan Vehicle Code and restrictions imposed by the Board, including spring weight restrictions. Failure to do so will result in the truck operator being ticketed and may also result in a stoppage of work.

b. Contractors, permitted or not permitted, who conduct utility installation operations in a manner detrimental to the Board's statutory obligation to maintain county roads reasonably safe for the public will be required to cease utility installation activities and correct all detrimental conditions immediately. If deemed necessary by the Board, cash deposits to cover the cost of a full-time ICRD inspector to ensure proper operations may have to be submitted to the Board before utility installation continues.

d. Dewatering water disposed of by the Contractor within the county road right-of-way must be approved by the Board in advance of any discharge and conform to Michigan Department of Environmental Quality (MDEQ) Best Management Practices (BMS) for soil erosion and sedimentation control. In general, discharge of water into roadside ditches for more than a couple of hours will not be allowed. If the Board deems it necessary that dewatering activities be modified or discontinued altogether, the Contractor shall comply and devise another method to complete their work. The Contractor, by performing under permit, accepts the responsibility of restoring the road right-of-way and affected drainage system to the satisfaction of the Board and the Ingham County Drain Commissioner after dewatering system removal.

e. The Contractor shall store construction materials as far off the road so that the materials do not pose a hazard nor block the vision of the traveling public and those seeking egress and ingress to private property. Only materials to be installed immediately can be stored within the right-of-way. All other materials and equipment shall be stored outside of the right-of-way.

e. For location of underground utilities, the Contractor shall call Miss Dig at 1-800-482-7171 a minimum of three working days prior to utility installation.

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MERIDIAN TOWNSHIP TECHNICAL SPECIFICATIONS
DIVISION 1

EARTHWORK

INDEX

1.01 SCOPE

1.02 CONSTRUCTION METHODS

1. CLEARING THE SITE
2. PROTECTION OF TREES
3. EROSION CONTROL
4. EXCAVATION
5. BACKFILLING & ROUGH GRADING
6. EXTRA SAND BACKFILL
7. EXTRA STONE BEDDING
8. RESTORATION & CLEAN UP

1.01 SCOPE

The Contractor shall furnish all labor, materials, tools and equipment for all excavation and backfilling required for work under this contract, including all sheeting, shoring and bracing, dewatering of excavation, and other work as herein specified. All work shall be done in accordance with the current Michigan Department of Transportation Standard Specifications for Construction, except as stated within this specification.

1.02 CONSTRUCTION METHODS

1. Clearing the Site

The Contractor shall clear the site of all brush and debris which may be present and interfering with construction operations and shall remove and dispose of the same. No trees or shrubs are to be removed unless shown on the plans or permitted by the Engineer. Concrete, asphalt, trees, and shrubs shown on the plans to be removed shall be disposed of at a suitable location off the site of the work.

2. Protection of Trees

All trees which are to be preserved or which, in the opinion of the Engineer, might be subject to damage by the Contractor's operations, shall be adequately protected against damage to the bark by 2-inch thick vertical planking securely wired or tied completely around the tree trunk. Such protection shall not be removed until authorized by the Engineer.

No excavation greater than 1 foot in depth shall be made by machine within 5 feet of any tree. If the excavation cuts within the canopy (dripline) of a tree, the Contractor shall tunnel under roots and protect them from injury throughout the work. All roots greater than 2" shall be cleanly cut, if removed.

Trees which interfere with the work, and the removal of which is permitted, shall be removed by the Contractor in a safe manner and incidental to construction unless otherwise noted on plans and proposal. No trees are to be removed without the expressed approval of the governmental body or property owner having jurisdiction thereof, and of the Engineer.

Trees, trunks, and limbs to be removed that are greater than six inches in diameter shall be trimmed and cut into lengths less than eight feet and piled outside of the right of way for use if the abutting property owner so desires. If the property owner does not desire the timber, the timber becomes the property of the Contractor. All other timber, brush, limbs, and stumps shall be disposed of by the Contractor. Onsite burning will not be allowed.

1.02 CONSTRUCTION METHODS (Cont'd.)

3. Erosion Control

Erosion Control devices shall be installed as shown on the plans and as needed to eliminate the migration of soil from the worksite. Typical devices include catch basin fabric drops (silt sacks) and silt fence. Additional requirements, as necessary, can be found in the Special Provisions.

Fabric drops shall be designed and constructed for use in the specified structure. Drops shall be installed prior to construction, cleaned and maintained in a working state for the duration of the project, and removed and disposed of upon final completion and restoration of the construction site.

Silt fence shall be a product in accordance with the MDOT 2012 SSC, Section 910.

Grass shall be growing before the erosion control measures are removed. Retainage will not be released until all erosion control measures are removed.

4. Excavation

A. General

Trench excavation shall be by open cut, except as otherwise shown or permitted. Excavation may be performed by any practical method consistent with the integrity and protection of the work, adjoining structures, and the protection of workers and the public.

Excavation of trenches for piping shall provide a minimum net clearance of six inches outside the barrel of the pipe and, in all cases, shall be of sufficient width to permit the convenient placing of pipe and making of joints. The bottom of the trench shall be shaped so as to conform as nearly as possible to the outside of the pipe, particular care being taken to recess the bottom of the trench in such a manner as to relieve the bell of all load and to provide continuous soil bedding under the lower quadrant of the pipe.

Excavation for structures shall be extended sufficiently beyond the limits of the structure to provide ample room for practical construction methods to be followed.

If excess excavation is made or the material becomes disturbed so as to require removal beyond the prescribed limits, the resulting space shall be refilled with selected material. It shall be thoroughly tamped into place in not more than six inch layers, to the satisfaction of the Engineer, before the construction work proceeds. Alternatively it may be filled with Class B Concrete or Flowable Fill.

Foreign materials such as slabs of wood, boulders, etc. which obstruct the excavation, shall be removed with other excavation; and where such obstructions occur at or near the bottom, requiring excavation below grade for their removal, the excavated area shall be brought back to grade as in the previous paragraph, and incidental to construction. Unnecessary excavation below grade by the Contractor shall be refilled to grade as in previous paragraph, and at the Contractor's expense.

B. Existing Utilities and Structures

The Contractor shall cooperate with all utility firms, in advance, to locate and avoid interference with and damage to existing facilities, insofar as possible. Means for elimination of interference and correction of damage shall be subject to the instruction or approval of the Engineer. Where any apparent conflicts with underground utilities become evident, the Contractor shall excavate the utility in advance of working in the area. The Engineer shall then determine if any conflict exists and, if so, shall determine the action to be taken. Exploration for underground utilities is incidental to the other work performed.

Underground pipes or structures encountered in excavation shall be adequately supported during the Contractor's operations. Before backfilling, the structure shall receive a permanent support of a suitable material approved by the Engineer, extending from the bottom of the excavation to the underside of the pipe or other structure.

1.02 CONSTRUCTION METHODS

4. Excavation

B. Existing Utilities and Structures (Cont'd.)

The Contractor shall use care not to damage adjoining structures and existing underground utilities. Existing underground pipes and cables are shown on the plans insofar as information is reasonably available. The Contractor shall be responsible to ascertain the locations of all utilities, whether shown on the plans or not.

Work within MDOT and Ingham County Road Department (ICRD) rights of way is done under separate permit from the agency involved. In addition, to these specifications, the Contractor shall adhere to all conditions contained in such permits.

When excavating along paved roads, extreme care shall be taken that the existing pavement and structures will not be damaged or undermined. All sheeting, bracing, and other equipment necessary to prevent damage shall be furnished by the Contractor. Where a trench must be cut through a roadway or driveway, particular care shall be taken not to unnecessarily damage adjoining areas of pavement. Existing pavement shall be sawcut prior to excavation.

Sheeting or other suitable protection, as required, shall be provided wherever excavation is performed adjacent to an existing structure. Any material removed from beneath the foundation of an existing structure shall be replaced with Class B concrete. Sheeting, bracing, and shoring required to support the sides of excavation shall be removed with care after completion of the work. Any injury to the work or to adjacent property resulting from the removal shall be repaired by the Contractor.

The Contractor shall be responsible for any damage caused by their operations to pipes, structures, poles and accessories, and the like above or below ground, whether shown on the plans or not. They shall make good and repair any such damage to the satisfaction of the Engineer. Particular care shall be exercised where excavation or other work is being prosecuted near electric or telephone lines.

C. Ground Water

Excavations shall be kept dry during placing of pipe and initial backfill. The Contractor shall supply stone sumps and pumps as necessary to maintain satisfactory conditions. This work is considered incidental to the pipe cost.

The Contractor shall take all necessary precautions to prevent the accumulation of water to such a level as might cause damaging uplift pressure to partially completed structures. The Contractor shall be responsible for any damage to partially completed structures because of inadequate or improper protection from uplift pressure, and shall repair or remove and replace at their own expense, to the satisfaction of the Engineer, all work so damaged.

D. Dewatering

The Engineer may direct the installation of a dewatering system if they deem it necessary to lower the adjacent water table. This is a pay item which includes all costs to furnish and operate the system, including down-time and remobilization. Only use this method when normal methods, outlined in above paragraph (4C), prove to be insufficient.

5. Backfilling and Rough Grading

A. Bedding and Initial Backfill

The backfilling and bedding of utilities shall not incorporate frozen materials. Trench backfill shall be carefully placed such that pipeline and grade are not disturbed. Bedding and initial backfill shall be as specified for ductile iron, plastic, and concrete pipe in Division 2 and for ductile iron pipe in Division 3 of the Technical Specifications.

1.02 CONSTRUCTION METHODS

5. Backfilling and Rough Grading (Cont'd.)

B. Final Backfill Outside Right of Way

The remainder of the trench, if not in a roadway, may be backfilled with excavated material unless it contains peat, muck, cinders, stones larger than 6" in diameter, or other undesirable material as determined by the Engineer. This undesirable material shall, upon written order of the Engineer, be removed and replaced with Extra Sand Backfill or material approved by the Engineer.

In a field, above a point 12-inches over the pipe, water main trenches may be backfilled completely with loose material and compacted from the top of the trench. Sewer trenches shall be backfilled and compacted in layers of 3'. In lawn areas the layers in each case shall not exceed 12".

Excavated material, above a point 12-inches over the top of the pipe, shall be compacted by running the wheel or track of excavation equipment along the trench or by methods and equipment approved by the Engineer. At least 30" cover over the top of pipe is required for wheeled or tracked vehicles and 48" cover for machine mounted compactors. Temporary mounding of excess material over the trench will be allowed only until such time as lawn repairs are completed.

C. Backfill within Roadway Zone of Influence

Where excavation cuts through a road, drive, or sidewalk, or is in the zone of influence of a pavement, the trench shall be backfilled with granular material and compacted in accordance with MDOT or ICRD specifications, whichever is applicable. Road crossings are incidental to pipe installation. Longitudinal trenches will be paid as the bid item Extra Sand Backfill, unless otherwise specified.

D. Rough Grading

At the end of each working day, all excavations shall be completely backfilled up to existing grade with all excess excavated material being removed from the site. The excavation at the point where pipe installation is to start on the next working day need not be backfilled if it is greater than 6 feet deep, adequately protected, fenced, and lighted. However, in all cases, roadways and driveways should be made accessible overnight.

Excessive soil settlement and any resulting damage which occurs within one year of final approval shall be repaired by the Contractor at no cost to the owner.

6. Extra Sand Backfill

When the Engineer deems the native backfill material above the pipe to be unsuitable (such as rocks, peat or landfill outside the right of way or clay within the right of way) they may order extra sand backfill.

The unsuitable material shall be removed from the site and replaced with an approved granular material. This granular material shall be compacted as previously specified for excavated material.

Sand used under paved driveways, for road crossings, for pavement sub-base or for pipe bedding and backfill to a point 12" over the pipe is considered incidental to the project and does not qualify as Extra Sand Backfill, unless it is the result of a plan change.

7. Extra Stone Bedding

This item is used, as directed by the Engineer, to replace any unsuitable earth foundation, (such as muck, landfill or rubble), below the pipe bedding or trench bottom. The unsuitable material shall be removed from the site and replaced with one-inch crushed stone.

Stone used for dewatering purposes and for pipe bedding and backfill is considered incidental to the project and does not qualify as Extra Stone Bedding.

1.02 CONSTRUCTION METHODS (Cont'd.)

8. Restoration & Clean-Up

As construction operations proceed, the Contractor shall follow their operations with a general clean-up which shall include rough grading, removal of debris, temporary replacement of mailboxes, temporary restoration of driveways, etc. The general clean-up shall follow construction such that no more than 1000 feet shall remain uncompleted at any time. Access to individual homes and parcels shall remain uninterrupted during construction operations with all driveways temporarily restored to use at the end of each working day. Temporary driveways and roads shall be maintained by the Contractor during the period of construction.

After all construction has been completed, the Contractor shall finish, grade and rake all areas disturbed by construction. Topsoil shall then be spread on the prepared areas to a depth of 3-inches. All stones and lumps larger than 1-inch diameter plus all roots, litter and other foreign material shall be raked out prior to seeding or sodding.

Lawn areas and vacant land shall be repaired with seeding, fertilizer and mulch. 12-12-12 fertilizer shall be evenly applied at a rate of 200 lbs./acre. Seed shall be MDOT "THM" mixture and shall be sown following or in conjunction with the fertilizer and while topsoil is in a friable condition. Seed shall be evenly sown at a rate of 220 pounds per acre and shall not be sown through mulch. Mulch blankets shall be installed immediately after seeding and shall be pinned in place, unless otherwise specified.

If called for, lawn areas shall be repaired with first-quality commercial lawn sod. The existing sod in the excavated areas shall be cut, trimmed and removed as necessary to accept a minimum 12-inch width of new sod without overlapping new sod onto the existing or without leaving gaps between the new sod and existing. Watering of new sod shall be the responsibility of individual property owners.

Driveways and approaches shall be repaired with material of the same quality, width and thickness as that which existed prior to construction, but shall not be less than the following:

i. Concrete shall be 6-sack, transit-mixed; formed, jointed and finished to match existing. Slabs less than 24-inches wide shall be removed and replaced with new concrete – see Division 4 of the Technical Specifications for additional requirements.

ii. Asphalt shall be MDOT HMA 13A, three inches compacted thickness and rolled to a uniform, dense surface. Prior to placing of new asphalt, the existing asphalt shall be trimmed with a concrete saw to straight edges which are parallel with the adjoining roadway. Overlays shall be preceded by an asphalt primer. Thicknesses greater than two inches shall be placed in two layers that have cooled between courses.

It is the intent that upon completion of the work all surfaces will be returned to the standard of profile and conditions that existed prior to this work. All gravel, top soil, seeding, sodding, surface restoration, paving, etc., shall be performed under this contract. Surface restoration shall include replacement of mailboxes, posts, fences, signs, culverts, ditches and other miscellaneous improvements. No deviations from existing conditions will be allowed without the written permission of both the Engineer and the affected property owner.

MERIDIAN TOWNSHIP TECHNICAL SPECIFICATIONS
DIVISION 2

SANITARY SEWER COLLECTION SYSTEM

INDEX

2.01 SCOPE

2.02 PIPE MATERIALS
- **A. Sanitary Service Pipe**
  - **1. House Service**
  - **2. Stubs, Risers, and House Services**
- **B. Sanitary Main Pipe**
  - **1. Polyvinyl Chloride (PVC)**
  - **2. Reinforced Concrete**
  - **3. Ductile Iron (DI)**

2.03 INSTALLATION OF MAINS
- **A. Trenching**
- **B. Installation of Pipes**

2.04 BUILDING SERVICES
- **A. Stub or Service Connections**
- **B. Riser Pipe**
- **C. House Service Line**
- **D. Tapping Existing Main**
- **E. Guarantee**

2.05 MANHOLES
- **A. Precast Sections**
- **B. Manhole Steps**
- **C. Castings**
- **D. Mortar Castings**
- **E. Adjusting Rings**
- **F. Concrete**
- **G. Installation**

2.06 CLEANING AND TESTING
- **A. Cleaning**
- **B. Testing Gravity Sewers**
- **C. Testing Pressure Sewers**

2.01 SCOPE

The Contractor shall furnish all labor, equipment and materials to completely construct, test and place in operation the sanitary sewer systems as shown on the plans and specified herein.

2.02 PIPE MATERIALS

A. Sanitary Service Pipe

The pipe used for risers and house services shall be constructed of the following material:

1. House Service
   4-inch pipe shall be one of the following:
   a) PVC conforming to ASTM D 2665 with 0.237-inch wall thickness (Schedule 40).
   b) ABS conforming to ASTM D 2751 with 0.180-inch wall thickness (SDR 23.5).

2. Stubs, Risers, and House Services
   6-inch pipe shall be one of the following:
   a) PVC conforming to ASTM D 3033 or D 3034 with 0.180-inch wall thickness (SDR-35) or ASTM D2729 with a 0.280" wall thickness (schedule 40).
   b) ABS conforming to ASTM D 2751 with 0.180-inch wall thickness (SDR-35).

Joints for PVC and ABS shall be either glued or bell and spigot with a rubber gasket. Glue shall be as recommended by the manufacturer of the pipe.

B. Sanitary Main Pipe

1. Polyvinyl Chloride (PVC) Pipe

   a) Pipe and Fittings – All PVC sewer pipe and fittings shall be manufactured in accordance with one of the following Standard Specifications:
      i. ASTM D3034, "Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings"
      ii. ASTM F679, "Standard Specification for Poly (Vinyl Chloride) (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings"

      All fittings shall be compatible with the pipe to which they are attached.

   b) Joints – All PVC pipe joints shall be gasketed, bell-and-spigot, push-on type conforming to ASTM D3212, "Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals." Since each pipe manufacturer has a different design for push-on joints, gaskets shall be part of a complete pipe section and purchased as such. Gaskets may be factory installed or field installed as recommended by the pipe manufacturer. Lubricant shall be as recommended by the pipe manufacturer.

   c) Pipe Stiffness – All PVC sewer pipe shall have a minimum pipe stiffness that equals or exceeds 46 lbs / in-in.

   d) Acceptance – Pipe or fittings may be rejected for failure to comply with any requirement of this specification.

2. Reinforced Concrete Pipe

   Sewers 15" and larger shall be reinforced concrete, of a class heavy enough to withstand live and dead loads imposed. This class shall be as shown on the plans.

2.02 PIPE MATERIALS

2. Reinforced Concrete Pipe (Cont'd.)

All reinforced concrete pipe used in this work shall be made by or under the direct supervision of some well-known and reputable manufacturer, whose type of pipe has been used for at least three years. It shall be furnished in sections not less than eight feet in length.

All reinforced concrete pipe shall conform to ASTM C76 or latest revision of Reinforced Concrete Culvert, Storm Drain and Sewer Pipe.

The joints for reinforced concrete sewer pipe shall be of the rubber gasket type meeting the requirements of ASTM C443, latest revision.

3. Ductile Iron (DI) Pipe

Ductile iron pipe used for sanitary sewers shall be equal to the following:
General - All pipe used shall meet the requirements of ANSI/AWWA C151/A21.51 except as stated below.

a) Joints - The bell of each length of pipe shall provide for the seating of a single rubber gasket, suitable for use with sanitary sewage. The gasket shall be self-centering when the plain end of a pipe enters the bell. Sufficient lubricant shall be furnished to provide a coating on each plain end of pipe. The lubricant shall be non-toxic and have no deleterious effect on the rubber gasket. The lubricant shall be of a consistency that can be easily applied to the pipe in any weather and shall adhere to either wet or dry pipe.

b) Cement Mortar Lining - Cement mortar lining of pipe shall conform to ANSI/AWWA C151/A21.4, except for the following items. The minimum thickness of lining shall be 3/21-inch. Care shall be taken to insure that no mortar remains in the joint surface of the bell. If mortar is found in the joint surface or lining of greater thickness than allowed, the pipe will be returned.

c) Length of Pipe - Because of the need to provide uniform spacing of any piling, all pipe furnished shall have a nominal laying length of 18 feet.

d) Pipe Class - The pipe shall be Class 54. Tolerances will be as allowed in ANSI/AWWA C151/A21.51.

e) Coating - The inside and outside of the pipe shall be coated with a bituminous coating of either coal-tar or asphalt base one mil thick.

f) Independent Tests - The supplier shall furnish reports of all tests and inspections as required in ANSI/AWWA C151/A21.51.

g) Polyethylene Encasement - All ductile iron pipe shall be encased with an eight mil thick polyethylene tube conforming to ANSI/AWWA C105/A21.5. Installation shall be in accordance with manufacturers recommendations. Closures and damaged areas shall be sealed with 1-1/2" by 12 mil polyethylene adhesive tape.

2.03 INSTALLATION OF MAINS

A. **Trenching** (Ref sec 1.02)

The trench shall be dry during the pipe laying operation. The trench bottom shall be prepared as stated in Division 1 and as hereinafter specified. Bell holes shall be excavated so that after placement, the barrel of the pipe will have full bearing on the trench bottom.

The installation, handling, and storage of all pipe shall be in accordance with manufacturer's recommendations. Pipe shall be protected at all times against impact shocks and free fall. Stock piling of pipe at the job site shall be in such a location as to minimize handling.

Trenches shall be excavated so that there will be a minimum clearance of six inches on each side of the barrel of the pipe and a maximum width of trench at the top of the pipe of not more than sixteen inches greater than the O.D. of pipe thirty inch I.D. or smaller and not more than twenty-four inches greater than the O.D. of pipe thirty inch I.D. or larger. They shall be at all times of sufficient width to permit the pipe to be laid and to permit first-class construction methods to be used. Sufficient space shall be provided in the trench to permit the joint to be properly made.

The trench bottom shall be undercut four inches below the final location of the pipe barrel and the trench then filled with sharp sand, fine gravel, or crushed stone bedding compacted with hand tampers to provide a cushion for bedding the pipe. The Contractor shall provide sand, gravel, or stone from off the site, except when the trench passes through well-defined strata of sand, gravel, or both.

Excavation for structures shall be extended sufficiently beyond the limits of the structure to provide ample room for other construction as necessary.

In case unsuitable material, in the opinion of the Engineer, is encountered in the bottom of a sewer trench or underneath a structure, the Engineer may order the removal of this material and its replacement as stated in Division 1 (Earthwork).

B. **Installation of Pipes**

The laying of the pipe shall commence at the outlet and proceed upgrade with spigot ends pointing in the direction of flow.

The socket of the pipe last laid shall be wiped clean and the spigot end of the pipe to be laid shall then be centered and pushed home against the base of the socket. The pipe shall be centered so that they will form a sewer with a uniform invert.

Joints shall be made in accordance with the manufacturer's requirements. All surfaces of the joint shall be clean and dry before the lubricant is applied. Care shall be taken in laying, that the pipe does not shift and it must remain in a home position after assembling.

All pipe shall be laid to the line and grade called for on the plans, utilizing an in-line laser beam system for vertical and horizontal control. Each pipe, as laid, shall be checked by the Contractor with a suitable target to insure that this result is obtained. Vertical and horizontal alignment shall, at any point, be within 0.04 foot (½-inch) of plan location.

2.03 INSTALLATION OF MAINS

B. **Installation of Pipes** (Cont'd.)

After the pipe is laid, sharp sand, fine gravel, or crushed stone shall be placed the entire width of the trench up to the springline of the pipe. Backfill shall be carefully tamped under the haunches of the pipe. Care shall be taken during backfilling and tamping so that the line and grade of the pipe are not disturbed. If concrete is being laid, additional fill shall then be placed until the entire width of the trench is not less than one foot above the top of the pipe. If sand is used for backfill around and over the pipe, it shall be thoroughly compacted with a vibratory compactor; hand compaction will not be acceptable.

If concrete pipe is being laid, fine excavated material free of large stones or lumps may be used for backfill above the springline. The remainder of the backfilling may be done as previously specified in Division 1 (Earthwork).

All pipe shall be so laid that the center of the pipe shall not depart from a straight line from manhole to manhole, by more than twelve inches, or one half the diameter of the pipe, whichever is the smaller.

Main sewer line stubs for future connections shall be furnished and placed by the Contractor according to details shown on the drawings and as directed by the Engineer.

The end of the stub for future connections shall be properly supported on crushed stone and braced when not resting on original ground so that any settlement will not disturb the connection. The end of the main sewer line stub shall be witnessed and marked in the manner described for sanitary sewer leads.

2.04 BUILDING SERVICES

A. **Stub or Service Connections**

Stub is defined as that portion of the service between the main and the property line. Stubs to the property line fitted with suitable stoppers shall be provided at such points as are shown on the plans or as directed by the Engineer. The connection shall be made using standard "Y", where no riser is present, or "T" fittings, where a riser is present, as shown on the plans. On vacant lots, the stub connections will generally be located at approximately the mid-point of the front lot line, unless the Owner requests another location.

In order to properly record the locations, the Contractor shall make accurate measurements of all "Y" or "T" fittings before the sewer trench is completely backfilled.

The measurements shall indicate the distance from each "Y" or "T" to the center of the nearest downstream manhole. The Contractor shall furnish the Engineer with a copy of these measurements immediately upon the completion of any block of sewer.

In addition to measurements, the Contractor shall furnish and place a two inch by four inch (2x4) marking stick at each stub of such length that it will reach from the pipe up to a minimum of six inches above the ground surface. Each marker shall be set in a vertical position and held vertical while backfilling the trench.

2.04 BUILDING SERVICES (Cont'd.)

B. **Riser Pipe**

Where shown on the plans or where directed by the Engineer, the Contractor shall put in 6-inch pipe risers extending from the stub connection in the sewer up to within 9 feet of the ground surface or to a depth adequate to serve the house service elevation shown at the property line. These pipes shall be laid up with a joint as specified and the top pipe shall be closed with a stopper. All risers shall be laid up and held securely in place and the backfill shall be carefully placed around them so as not to disturb them. Crushed stone or concrete six inches thick shall be placed under and around the T or Y fitting and over it to a height of six inches above the sewer main to furnish an adequate support for the riser pipe.

The top of each riser pipe shall be measured and marked by the Contractor in the same manner as specified in paragraph (A) above.

C. **House Service Line**

House services shall be installed at the locations and elevations as are shown on the plans or as directed by the Engineer. The house services shall connect to the 6-inch stub or riser and generally extend to the house. Fernco® style flexible couplings shall be used when extending a house service from the stub.

Clean-outs shall be installed in a straight run of pipe at a maximum spacing of 90 feet and at all pre-formed bends. Standard wyes must be used to construct clean-outs. Clean-outs must extend to within six inches of finish grade and be securely capped. Clean-outs shall be marked with a minimum 36" length of ½" diameter steel pipe or reinforcing rod or shall have a cast iron cap.

In order to properly mark the location of every house service, the Contractor shall make accurate measurements of each installation. The measurements shall indicate the distance from each house service to the side property line and to two fixed reference points, i.e. power poles, fire hydrants, manholes, or buildings. The Contractor shall furnish the Engineer with a copy of these measurements immediately upon the completion of each street.

D. **Tapping Existing Mains**

Where existing main sewer lines are to be tapped, the Contractor shall use a preformed saddle approved by the Engineer. A hole shall be cut to the proper size in the main line and all rough edges smoothed to prevent obstructions. The exterior of the main line pipe shall be thoroughly cleaned in order to provide a prepared surface for gluing the saddle onto the main line. Glue shall meet manufacturer requirements. The Contractor shall clean the main line of all debris which may have entered during their tapping operation.

The Contractor shall notify the Township Engineer prior to making any connection to the main line and shall not backfill the connection prior to approval of the Township Engineer. If the pipe becomes covered with water or backfill material, the Contractor shall remove the water or material to facilitate the inspection.

2.04 BUILDING SERVICES (Cont'd.)

E. **Guarantee**

The Contractor shall be responsible indefinitely for the correct elevation and measurements of stub connections and house services. If a stub connection or house service cannot be found, is not at the correct elevation, or has not been installed properly, the Contractor will be notified of the situation. They will then be required to pay for finding the stub connection or house service and fixing or reinstalling, as necessary.

2.05 MANHOLES

A. **Precast Sections**

Manholes shall be constructed of circular precast concrete units with circular reinforcement and shall conform to the requirements of the current Specifications for Precast Reinforced Concrete Manhole Risers and Tops ASTM C478, with the following exceptions and additions:

Standard cylinders for compression tests will be required during the manufacturing of the manhole sections. Tests results from the cylinders will be the basis for determining the strength requirements of that days' output of manhole sections and depending on the results, may lead to additional testing of manhole sections.

Marking of the sections shall be done within six days after manufacture.

Cone sections shall be the eccentric type.

Joints between sections shall use a rubber O-ring gasket and a layer of one (1) inch butyl rope. The interior and exterior of the joints shall be treated with a non-shrink cement mortar with a smooth brushed finish. Additionally, the exterior of the joints shall be sealed with a product such as Boa Tape™, Infi-Shield®, EZ WRAP, or approved equal.

Pipe connections into manholes shall be made with an integrally-cast seal boot such as "Kor-N-Seal", "Lock-Joint Flexible Manhole Sleeve" or an approved equal.

B. **Manhole Steps**

Manhole steps shall be plastic-coated steel. They shall be placed sixteen inches apart unless otherwise shown and shall be cast in the manhole walls. It will not be acceptable to grout more than one step in place after the manhole section is poured.

Plastic-coated steel steps shall consist of a 3/8-inch diameter deformed steel reinforcing rod covered with a copolymer polypropylene plastic. The steel rod shall be grade 60 and conform to ASTM-615. The plastic shall conform to ASTM 2146-68, Type II, Grade 49108. The steps shall also conform to ASTM C478.

2.05 MANHOLES (Cont'd.)

C. **Castings**

1. The joints between the casting and cone shall be treated as shown on the Meridian Township Sanitary Sewer Detail Sheet.

2. Bolt-down covers and frames are required when not in a pavement surface. They shall be Neenah R-1916-F or East Jordan Iron Works 1045-ZPT. Covers shall have "Sanitary" cast into the surface and shall be equipped with (4) stainless steel cap screws. Base flange shall be furnished with (4) anchor bolt holes.

3. Standard frames and cover shall be East Jordan Iron Works 1045 or approved equal with solid, gasketed, self-sealing cover with concealed pick holes. Covers shall have "Meridian Sanitary Sewer" with the tree logo cast into the surface.

4. Top of casting shall be set as follows:
   (a) Flush with paved or grass surfaces
   (b) 6-inches below gravel road surface
   (c) 6-inches above ditch grade

D. **Mortar Castings**

Mortar for block and brick work in manholes and other appurtenances shall be mixed in the proportion of one part Portland Cement to three parts sand. Hydrated lime may be added in proportions not to exceed 10 percent of the volume of the cement.

Mortars mixed by hand shall be prepared in a suitable clean water tight box. The ingredients, except water, shall first be thoroughly mixed dry until of uniform color; then water added and the mixing continued until mortar of proper consistency and uniform texture is produced.

No re-tempered mortar or mortar that has been mixed for more than thirty minutes shall be used in the work. No cement mortar shall be mixed when temperature is below 32 degrees Fahrenheit without properly heating the sand and water. New placed mortar shall be protected from freezing for the first 72 hours.

E. **Adjusting Rings**

Casting adjustment shall be accomplished with pre-cast concrete grade rings conforming to ASTM C478. Each ring shall have an ID not less than 24-inches nor greater than 25-inches, a minimum thickness of 2-inches and a minimum OD of 40-inches. A 1" butyl rope gasket shall be used between all rings and the top ring & casting. Total ring adjustment shall not exceed 12". Longer cone sections shall be used if more than a 12" adjustment is needed.

F. **Concrete**

Class A concrete used in manhole flow line construction shall be transit-mixed with a minimum 28-day compressive strength of 3,500 psi. The approximate proportions of the mix shall be 1 part cement, 2 parts fine aggregate and 3 parts coarse aggregate. The mix shall contain six sacks of cement per cubic yard with a maximum allowable slump of 3 ½ inches.

2.05 MANHOLES (Cont'd.)

G. **Installation**

Sanitary sewer manholes are to be constructed as shown on the detailed drawings. Precast concrete manhole sections shall be installed in a plumb position.

All manholes shall be finished so that all visible leakage is repaired. The interior and exterior joints between manhole sections and adjusting rings shall be plastered with at least 1/2 inch thick mortar. All plastered areas shall have a brushed finish. All lift holes shall be mortared and finished. The bottom of the manhole, the flow line of the sewer and the steps shall be clean of all mortar, concrete, dirt and other debris.

The flow channels shall be constructed with a minimum depth of one-half the pipe diameter. The flow channel and manhole bottom shall be sloped to prevent accumulation of sewage and shall have a brushed finish.

No sanitary sewer services shall be connected to a sanitary manhole, unless specified on the plans. Standard sanitary sewer services shall connect to the main sewer line.

Where shown on the plans, new sewers shall be connected into existing manholes. In such cases, new channels shall be constructed using concrete. Where required, existing manholes shall be demolished. This work is incidental to the project, unless a separate pay item is explicitly detailed.

2.06 CLEANING AND TESTING

A. **Cleaning**

Before the sewer may be tested, the Contractor shall clean the sewer with a hydraulic system consisting of a high pressure pump feeding water to a nozzle which directs the water against the walls and flowline of the pipe, dislodging the debris and flushing it toward a manhole. All debris shall be removed at the nearest downstream manhole.

B. **Testing Gravity Sewers**

The Contractor shall furnish all equipment and personnel to conduct an acceptance test using low pressure air. The test shall be conducted under the supervision of the Engineer.

All house services shall be securely plugged with suitable stoppers that will withstand the internal test pressures. The section of line being tested shall also be securely plugged at each manhole. All stoppers shall be adequately braced.

Air shall be slowly supplied to the plugged pipe line until the internal air pressure reaches 4.0 pounds per square inch greater than the average back pressure of any ground water that may submerge the pipe. At least two minutes shall be allowed for temperature stabilization before proceeding further.

The rate of air loss shall be determined by measuring the time interval for the 1.0 psi pressure drop is not less than the holding time as specified in ASTM F1417 (PVC) or ASTM C924 (DI).

2.06 CLEANING AND TESTING

B. **Testing** (Cont'd.)

If the sewer installation fails to meet these requirements the Contractor shall determine the source or sources of the leakage and they shall repair or replace all defective materials or workmanship. The completed sewer installation shall meet the requirement of this test.

For plastic sewer main, the Contractor shall test the pipe for deflection by pulling a mandrel through the sewer after all backfill has been placed and compacted over the pipe. The maximum allowable deflection shall not exceed 5% of the pipe's inside diameter. The outside diameter of the test mandrel shall be equal to the inside diameter of the pipe less 5%. The initial test shall be performed at least 30 days after pipe installation. A second test shall be performed after 10 months of pipe installation or just before line's intended use.

Inspection and testing of the sanitary system shall also include video inspection by CCTV method of sanitary main, air testing of sanitary gravity main, hydrostatic testing of sanitary pressure main , and vacuum testing of sanitary manholes. All inspections and testing shall be performed in the presence of Township inspectors.

D. Testing Pressure Sewers

For pressure sewers, also known as Force Mains, the sewer will be cleaned then tested before being placed into service. Perform the test before connecting to the downstream existing manhole. The test shall be made at 110 pounds per square inch hydrostatic pressure and shall be maintained for at least two (2) hours with the leakage not exceeding 1.58 gallons. The contractor shall furnish all labor and equipment to make the test. The Contractor shall run a preliminary test to determine that all air has been expelled and to check for any leakage. If any leakage should exist the Contractor shall make the necessary repairs and perform the preliminary testing until satisfactory results are obtained. The final test shall be made in the presence of the Engineer. The Contractor shall notify the Engineer in advance of the testing a minimum of 48 hours.

The Contractor shall provide the equipment necessary to add and measure the water necessary to maintain the hydrostatic pressure within 5 psi of the required test pressure for the duration of the test. When the testing period is complete the Contractor shall add and measure the water to bring the final pressure reading to the initial pressure reading. The total gallons added during the duration of the test shall not exceed the allowable leakage.

SPECIFICATIONS
FOR

CURED-IN-PLACE PIPE – MAINLINE LINING

INDEX

1. SCOPE
2. REFERENCED SPECIFICATIONS
3. DESCRIPTION OF THE REHABILITATION PROCESS
4. LINER MATERIAL
   A. Engineering Properties of Lining
   B. Corrosion
   C. Impregnation Tube
   D. Resin
5. ENGINEERING DESIGN
6. MANUFACTURING AND QUALITY CONTROL
7. INSTALLATION PROCEDURES
   A. General
   B. Preparation of Existing Sewer
   C. Resin Impregnation
   D. Bypassing
   E. Insertion & Curing
      1. Insertion
      2. Curing
   F. Lateral Reinstatement
   G. Video Inspection
   H. Maintenance Hole Termination
8. WORK SCHEDULE
9. INSPECTION, TESTING, AND ACCEPTANCE
   A. Inspection
   B. Testing
   C. Acceptance
10. PAYMENT
11. EXPERIENCE/ HISTORY
12. WARRANTY
13. PUBLIC NOTIFICATION

1. SCOPE

This specification covers the general and specific requirements for trenchless sewer rehabilitation by the installation of a cured-in-place pipe (CIPP) liner. The CIPP installation work includes:

- Cleaning and preparation of existing sewer;
- Video inspection and recordings of the pre- and post-lined pipes;
- Bypass pumping;
- Design and engineering of the CIPP liner;
- Insertion and curing of the CIPP liner;
- Testing;
- Lateral Tap Connection grouting
- Lateral locating, and reinstatement;
- All necessary labor, materials and equipment;
- All necessary and specified safety equipment, procedures and traffic control;
- Project supervision; and
- Any other items incidental, but necessary, to the installation of the CIPP liner.

2. REFERENCED SPECFICATIONS

This specification references the following American Society for Testing of Materials (ASTM) standard specifications, which are made part hereof by such reference and shall be the latest edition and revision thereof:

D790 Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electric Insulating Materials

F1216 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Inversion and Curing of a Resin Impregnated Tube

D5813 Standard Specifications for Cured-in-Place Thermosetting Resin Sewer Pipe

3. DESCRIPTION OF THE REHABILITATION PROCESS

Following preparation of the section of the existing sewer to be rehabilitated, a felt tube uniformly impregnated with resin shall be inverted into the existing sewer over the entire length by using sufficient hydrostatic pressure. Once inversion is complete, the resin impregnated tube shall be cured by heating and re-circulating water to form a rigid liner. The liner shall be in place directly and uniformly against the interior surface of the existing sewer. When necessary in the rehabilitation process, existing sewer flow shall be controlled or diverted by bypassing the section being rehabilitated.

Immediately following the cure, service laterals shall be reinstated into the CIPP liner, by internal remote, without excavation.

On completion of the rehabilitation, inspection videos shall be provided to the Owner, along with cure records and test reports.

4. LINER MATERIAL

The liner material shall have the following minimum characteristics:

A. Engineering Properties of Lining

Minimum Short-Term Flexural Modulus (ASTM D 790):

- 250,000 psi

Minimum Long-Term Flexural Modulus (ASTM D 790)

- 125,000 psi

Minimum Flexural Strength (ASTM D 790)

- 4,500 psi

B. Corrosion

The finished CIPP liner shall be fully resistant to all chemicals and agents normally found in municipal sewage.

C. Impregnation Tube

The tube shall consist of one or more layers of absorbent fabric capable of carrying resin, and capable of withstanding installation pressures and curing temperatures. The tube shall be compatible with the resin system used. The tube material shall be able to stretch to fit irregular pipe sections and negotiate bends. The outside layer of the tube shall be plastic coated with a material that is compatible with the resin system used. The tube shall be fabricated to a size that, when installed, will fit the internal circumference and length of the existing pipe. Allowance shall be made for circumferential stretch during installation. The outside of the tube shall be marked along its full length at regular intervals not to exceed five (5) feet. Such markings shall include the Manufacturer's name or identifying symbol, manufacturing lot, and production footage. The tubes must be manufactured in the USA.

D. Resin

The resin shall meet the requirements of ASTM F 1216. Allowed resins shall be polyester, vinyl ester, or epoxy. The resin used shall be a thermoset resin system that is compatible with the cured-in-place pipe installation. The resin shall be able to cure in the presence of water and the initiation temperature for cure shall be less than 180°F.

5. ENGINEERING DESIGN

The CIPP liner design shall be in accordance with ASTM F 1216.

The design shall be based on observed pipe conditions of varying defects. See Appendix C for CCTV reports. Videos are available upon request.

Parameters for Design:

Design Life:	50 years
Safety Factor:	2 (on external load)

5. ENGINEERING DESIGN (Continued)

The design for the lining shall be provided to the Owner prior to installation. Engineering properties used in the design shall be the appropriate long-term material properties. The design calculations shall show technical assumptions, identify the design formulas used and show the wall thickness and finished inside diameter. The ovality condition used in the calculations shall be identified. The Engineering design shall graphically illustrate the installation (depth of the sewer, water table, invert and crown) and shall provide full details of the parameters used.

6. MANUFACTURING AND QUALITY CONTROL

Detailed information describing the method of manufacturing and the final composition of the rehabilitation materials shall be provided. This information must also include descriptions of any major components not directly provided by the Manufacturer.

Documentation shall be submitted as to all components used to produce the final installed product. Detailed quality control procedures for rehabilitation materials, manufacturing and installation shall be submitted. This shall include inspection requirements, testing procedures, and allowable manufacturing tolerance levels. All related ASTM standards, or any nationally recognized standards, for product manufacturing must be submitted.

7. INSTALLATION PROCEDURES

A. General

The installation and all related work shall comply with the requirements of Federal, State, and Municipal regulations as applicable. Installer shall submit evidence of being trained to install the Product. All related ASTM standards, or any nationally recognized standards, for installation of the product shall be submitted. An itemized list detailing the installation procedures shall be submitted including the estimated time for each task, and any other items unique to each process.

B. Preparation of Existing Sewer

The sewer to be rehabilitated shall be prepared in accordance with the requirements for CIPP installation. Debris, grease, roots, calcite, and other deposits shall be removed without damaging the existing sewer walls. Any and all detritus produced thereby shall be removed from the sanitary sewer system, not flushed downstream.

The Contractor is responsible for all aspects of removal and proper disposal of material from the sanitary sewer system. The Owner does not have a designated disposal facility. The Contractor shall independently verify a disposal location prior to mobilizing to the site.

Where service laterals protrude into the sewer, these protrusions shall be removed without damage to the lateral or sewer pipe wall. Flail type equipment will not be permitted for the removal of protruding laterals. Lateral protrusions greater than ¼" will not be permitted.

If significant groundwater infiltration is present in the existing sewer, such as PACP infiltration gusher or multiple runners, the Contractor shall install a pre-liner tube or perform chemical grouting to control resin loss and contamination, maintain CIPP thickness, prevent physical property reduction and prevent inadequate curing of the CIPP resulting from water or other contamination of the resin during installation.

7. INSTALLATION PROCEDURES (Continued)

The prepared sewer shall be videotaped using a pan & tilt inspection unit and the video reviewed and approved by the Engineer before insertion of the lining. Closed circuit television (CCTV) inspection shall be in accordance with the Owner's requirements.

C. Resin Impregnation

The tube shall be inspected for tears and frayed sections. The tube, in good condition, shall be vacuum-impregnated with resin (wet-out) under controlled conditions. The volume of resin used shall be sufficient to fill all voids in the tube material at nominal thickness and diameter. The volume shall be adjusted to compensate for the change in resin volume due to polymerization and allow for any migration of resin into the cracks and joints in the original pipe. A roller system shall be used to uniformly distribute the resin throughout the tube. All air in the tube shall be removed by vacuum allowing the resin to thoroughly impregnate the tube. All resin shall be contained to ensure no public property or persons are exposed to the liquid resin. A resin impregnated sample (wick) shall be retained by the installer to verify the curing process taking place in the host pipe.

The installer shall designate a location where the CIPP will be vacuum-impregnated prior to installation. The installer shall allow the Owner's representative to inspect the materials and procedures used to vacuum-impregnate the tube.

D. Bypassing

If bypassing of the flow is required around sections of pipe designated for lining, the bypass shall be made by plugging the line at a point upstream and pumping the flow to a downstream point or adjacent system. The bypass pumps and bypass lines shall be sufficiently sized for peak flow conditions. The Contractor shall have adequate standby equipment available and ready for immediate operation and use, including an extra pump and generator. The maximum effluent level in the influent sewer cannot exceed the crown of the influent sewer. Generators used to provide the electrical service shall be housed in sound attenuating enclosures with critical-area-type silencers. Additionally, a backup generator must be provided. The backup generator must be installed and ready for immediate use, including all cabling, disconnect panels, and switch gear. The Contractor shall submit a detailed bypass procedure for review and approval by the Township prior to construction.

The upstream manhole shall be monitored at all times and an emergency deflate system shall be incorporated so that the plugs may be removed at any time without requiring confined space entry. An automatic call box is required for all overnight bypass pumping.

Services within the bypassed area will be temporarily out of service. The Contractor will be required to notify all parties whose service laterals will be out of commission and to advise against water usage until the mainline is back in service.

E. Insertion & Curing

1. Insertion

Before the installation begins, the tube manufacturer shall provide the minimum pressure required to hold the tube tight against the existing conduit, and the maximum allowable pressure so as not to damage the tube. Once the installation has started, the pressure shall be maintained between the minimum and maximum pressures until the installation has been completed.

The wet-out tube shall be inserted through an existing manhole or approved access point by means of an inversion process and the application of a hydrostatic head sufficient to extend it to the next designated manhole or termination point.

Tube installation forces or pressures shall be limited so as not to stretch the tube longitudinally by more than 5% of the original length. The maximum inversion rate shall be 32 feet-per-minute, with a maximum hoop tension in the felt liner of 8,000 psi.

7. INSTALLATION PROCEDURES

E. Insertion & Curing (Continued)

2. Curing

Curing shall be accomplished utilizing hot water under hydrostatic pressure. A suitable heat source and water recirculation equipment shall be required to circulate heated water throughout the pipe. The equipment shall be capable of delivering hot water throughout the liner at the temperature required to properly cure the resin. Water temperature in the line during the cure period shall be as recommended by the resin manufacturer. The heat source shall be fitted with suitable monitors to gauge the temperature of the incoming and outgoing water supply. Another gauge shall be placed between the impregnated tube and the pipe invert at the termination to determine the temperature during cure. Readings shall be taken every 15 minutes. A record of the readings shall be provided to the Engineer.

Initial cure will occur during temperature heat-up and is complete when exposed portions of the new pipe appear to be hard and sound and the remote temperature sensor indicates that the temperature is of a magnitude to realize a cure in the resin. After initial cure is reached, the temperature shall be raised to the post-cure temperature recommended by the resin manufacturer. The post-cure temperature shall be held for a period as recommended by the resin manufacturer, during which time the recirculation of the water and cycling of the boiler to maintain the temperature shall continue. The curing of the CIPP must take into account the existing pipe material, the resin system, and ground conditions (temperature, moisture level, and thermal conductivity of soil).

The CIPP shall be cooled to a temperature below 100°F (38°C) before relieving the hydrostatic head. Cool-down may be accomplished by the introduction of cool water into the CIPP to replace water being drained from a small hole made in the downstream end. Care shall be taken in the release of the static head so that a vacuum will not be created that could damage the newly installed pipe.

The curing process shall be monitored by qualified personnel and written records (including boiler monitor graph) shall be maintained throughout the curing process. Records shall be kept on file and made available to the Engineer upon request.

Alternatively, steam or UV-light curing and air inversion will be allowed if they are performed under current ASTM and NASSCO standards with corresponding documentation from the liner's manufacturer regarding their recommended installation and curing methods. Those documents should include their procedures for installation speed and pressure, and for maintaining a curing temperature log on their cure schedule. Provided that the manufacturer's specifications are followed, those methods will be acceptable.

F. Lateral Reinstatement

Where service lateral flow has been interrupted, reinstatement of the lateral shall proceed immediately. Laterals may be partially reinstated sufficient to restore flow, with a full reinstatement within 12 hours. Lateral reinstatement shall be made internally with the appropriate remotely operated equipment. The Contractor shall have a minimum of two (2)

complete working monitoring units and cutters plus spare key components on site before each inversion. Restored lateral openings shall be cut neatly to full size without over-cutting. Cuts shall be smooth and without residual material left around the lateral or its opening. No ragged edges or attached material shall be allowed. All materials cut from the liner shall be removed from the sewer. No excavation of laterals will be allowed without the written approval of the Engineer. No added payment shall be made for excavations necessary for reopening service connections. The Contractor will be responsible for all costs associated with such excavation and restoration work.

Following the removal of the lining from the lateral the connection between the lateral and the main shall be grouted, if a lateral liner is not specified.

7. INSTALLATION PROCEDURES (Continued)

G. Video Inspection

Video inspection shall occur immediately prior to insertion of the liner, and at the completion of the rehabilitation. All videos and reports, in PACP and LACP format, as appropriate, shall be provided to the Engineer on either a flash drive or an external hard drive.

Video equipment shall be color and include the capability to view all surface areas of the pipe ("pan & tilt" capability). When required, pipe flow and visibility shall be controlled so that video inspections produce complete visual coverage of the circumference sufficient to properly access conditions and features.

H. Maintenance Hole Termination

The liner termination at maintenance holes shall be neat and free of obstructions. If a hydrophilic o-ring is not used at the manhole connection, or if said ring fails to produce a watertight seal, the end shall be sealed with a resin mixture compatible with the CIPP.

8. WORK SCHEDULE

Work shall progress and continue as required to minimize downtime on sewers and out of service periods on laterals. Night work shall be allowed only if approved by the Owner. If night work is allowed, silenced equipment shall be required to minimize disruption to residents.

9. INSPECTION, TESTING, AND ACCEPTANCE

A. Inspection

The Owner shall be provided access to all stages of the rehabilitation process and notified a minimum of 72 hours in advance prior to wet-out. All records shall be available for inspection by the Owner and copies shall be provided upon request.

B. Testing

Samples of the cured liner shall be taken for third party testing as directed by the Engineer. Testing shall be in accordance with the requirements of ASTM F 1216. Samples shall be taken from the cured liner overt at a manhole, sufficient in size to meet the requirements of ASTM D790 (Test Method I Procedure A). The testing of the samples shall be done by an independent testing laboratory.

C. Acceptance

The finished pipe shall be continuous over the entire length of an installation run and be free of dry spots, lifts, and delaminations. If these conditions are present, the contractor shall remove and replace the CIPP in these areas.

If the CIPP does not fit tightly against the original pipe at its termination point(s) and at lateral connections, the space between the pipes shall be sealed by filling with a resin mixture compatible with the CIPP.

The installation shall be inspected by CCTV. All service connections shall be accounted for and be unobstructed. The liner shall be visually inspected (at the manholes and on the video) for its fit to the inside surface of the existing sewer. As all liner design calculation and corresponding liner thickness are based on close contact with the existing pipe, proper fit shall be verified prior to acceptance of the liner. A lining interior surface that appears to mirror the host pipe shall not necessarily be considered an indication of a proper fit.

The maximum allowed annulus space between the liner and the sewer shall be no more than 1% of the liner outside diameter for diameters up to and including 18 inch. For diameters greater than 18 inch, the annulus space shall not exceed ¼".

10. PAYMENT

The work on main segments to be fully lined will be paid by the linear foot, as measured along the ground surface, between manholes. The work for sectional liners will be paid by each installation.

11. EXPERIENCE/ HISTORY

The licensed installer must have a minimum of three (3) years of experience and 500 installations.

12. WARRANTY

All materials and workmanship shall be warranted to be free from defects for one year after completion of installation. The Owner shall hold in retainage an amount equal to 10% of the final contract cost, until performance warranty inspections have been satisfactorily completed, as determined by the Engineer. Warranty inspections consist of a CCTV review of all CIPP work. The Owner's inspector shall be present during all warranty inspections. Warranty inspections shall begin 10 months after all work has been completed. All cost for the warranty inspections, and any resulting repairs shall be the responsibility of the Contractor.

13. PUBLIC NOTIFICATION

The Contractor shall make every effort to maintain service usage throughout the duration of the project. Property owners who may be affected by the rehabilitation process shall be advised in writing concerning the nature and duration of any interruption in sewer or drain service. Advance notice shall be provided at least one week prior to any interruption. Additionally, verbal or written notice shall be provided 24-48 hours prior to any interruption. When the interruption is ended, residents are to be advised either verbally, or in writing immediately. During the course of the rehabilitation and any associated service interruption, the residents shall be kept regularly informed regarding any matters that affect them.

SPECIFICATIONS FOR PIPELINE CHEMICAL GROUTING AND TESTING

Adapted from *NASSCO Master Specification Section 33 01 30.61 Version 1.0 Oct 2021*

Index

PART 1 - GENERAL 2
1.1 DESCRIPTION 2
1.2 REQUIREMENTS: 3
1.3 QUALIFICATIONS 3
1.4 WARRANTY 4
1.5 SUBMITTALS 4
1.6 REFERENCE STANDARDS 5
1.7 PAYMENT 5
1.8 PUBLIC NOTIFICATION 5
1.9 INSPECTOR TRAINING 6
PART 2 - PRODUCTS 6
2.1 EQUIPMENT 6
2.2 GROUTS - GENERAL 7
2.3 GROUTS 8
2.4 ADDITIVES 8
PART 3 - EXECUTION 9
3.1 CONTROL TESTS 9
3.2 PIPE PREPARATION 11
3.3 GENERAL PRE-TEST AND GROUT REQUIREMENTS 11
3.4 ROOTS AND OBSTRUCTIONS IN LATERALS 12
3.5 GROUT PREPARATION 12
3.6 GROUT VOLUME GOALS AND GEL TIME 12
3.7 TESTING AND GROUTING DEFECTS 13
3.8 JOINT TESTING PROCEDURES 13
3.9 LATERAL TAP CONNECTION TESTING PROCEDURE 15
3.10 LONGITUDINAL DEFECT AND ANNULAR SPACE TAP TESTING PROCEDURES 16
3.11 GROUTING - GENERAL 16
3.12 JOINT GROUTING 18
3.13 LATERAL TAP CONNECTION GROUTING 19
3.14 VERIFICATION TESTING 20
3.15 POST-CONSTRUCTION INSPECTION 20
3.16 WARRANTY TESTING GENERAL 21
3.17 MAIN LINE JOINT WARRANTY TESTING 21
3.18 LATERAL CONNECTED TO MANHOLE WARRANTY TESTING 21
3.19 LATERAL TAP CONNECTION WARRANTY TESTING 22

PART 1 - GENERAL

1.1 DESCRIPTION

A. Packer injection grouting shall be used to reduce groundwater and rainfall induced infiltration flow into the pipeline, seal annular space between liners and host pipes at lateral tap connections, seal pipe joints and tap connections that have failed the test criteria, seal certain defects, prevent further loss of pipe bedding into the pipe, impede the migration of groundwater in the pipe trench, and stabilize the pipe and pipe bedding. This type of grouting, installed per the industry standard of care and these specifications, has an anticipated service life of 25 years or more.

B. Packer injection grouting shall be accomplished by pressure injection of chemical grout into the soils outside the pipe. Grouts shall be designed to be injected into the soil surrounding the pipe, which stabilizes the pipe bedding and forms an impermeable seal, and into the annular space between close fit liners and host pipes. Adequate volumes of grout must be injected to form an effective seal. This application will be through joints and penetrations from within the pipe (packer method) and through certain defects in the pipe wall in tandem with a closed- circuit television inspection system. This method may only be used on sewer pipe sections in sound physical condition. Longitudinally cracked or broken pipe will not be sealed.

C. The various pipeline component items subject to these test and seal methods include:

1. Main Line Joint (MLJ) - joints in mainline segment connected to a manhole at each end. Main Line Joint is defined by the “J” or Joint field in the Pipeline Assessment Certification Program (PACP) Details Section inspection form.
2. Lateral Tap Connection (LTC) – Tap connection of lateral to mainline sewer, including a defined length of lateral from the tap and any annular space that might be present between a liner and the host pipe in situations where the main line has been lined. Lateral Tap Connection is defined within the Tap group of PACP. Appropriate descriptors and modifiers need to be applied per PACP definitions to further define the asset. The Manhole Assessment Certification Program (MACP) and Lateral Assessment Certification Program (LACP) define Tap differently than PACP. Consult a certified PACP/MACP/LACP user for information on providing the appropriate observation code for these applications.
3. Laterals Connected to Manholes (LCM) – Lateral pipe directly connected to and reached from manhole. Laterals Connected to Manhole are defined within MACP. Consult a certified PACP/MACP/LACP user for information on providing the appropriate observation code for these applications.

D. Grout Volume Goal: The calculated volume of grout to be pumped outside the pipe defect to stabilize the pipe bedding and provide a long-lasting seal against groundwater and pipe bedding fine infiltration.

E. Provide all labor, materials, tools, equipment, and incidentals as shown, specified, and required for testing sewer pipe joints, taps, lateral pipe joints, and other features by hydraulically applying a positive pressure to the joints and monitoring the pressure in the void. The test medium shall be air.

F. Provide all labor, materials, tools, equipment, and incidentals as shown, specified, and required to grout mainline pipe joints, select defects in pipe body, joints in laterals

connected to manholes and lateral tap connections using solution grouts using various packer injection grouting methods and tools.

G. Site Environmental Conditions

1. All pipes are active sewers and have continuous moisture levels to promote consistent hydration of hydrophilic chemical grouts.

1.2 REQUIREMENTS:

A. This Work requires work in active sewers. Follow all federal, state, and local requirements for safety in confined spaces.

B. Conduct worker safety training prior to and within one year of start of work that includes reviewing the hazards associated with hoses, pumps, tanks, couplers, compressors, bottles, motors, and all other related application apparatus. Additional safety considerations including safely handling, mixing, and transporting of chemical grouts should be provided by the grout manufacturer or supplier or both, and should include safe operating practices and procedures, appropriate personal protective equipment (PPE) for the various grouting operations, and proper storage, transportation, mixing, and disposal of grouts, additives, and their associated containers.

C. This work shall be performed in accordance with American Society for Testing of Materials (ASTM) standard specification F-2304 and F-2454, “Standard Practice for Sealing of Sewers Using Chemical Grouting” and “Practice for Sealing Lateral Connections and Liners from the Mainline Sewer Systems by the Lateral Packer Method Using Chemical Grouting” respectively. If there is a conflict between said standards and this specification, this specification will govern.

1.3 QUALIFICATIONS

A. All Main Line Joint work shall be supervised by a technician. A technician is required for each crew. Technician qualifications shall include:

a. Previously performed pressure testing and injection grout sealing of a minimum of 3,000 Main Line Joints and 250 Lateral Tap Connections.

b. Successfully completed safety training recommended by grout material and grout equipment suppliers.

c. Successfully completed a 16 hour minimum pipeline packer capital grouting field training conducted by a multi-vendor consortium of packer, rig, and grout material vendors.

B. Lateral Connected to Manhole work shall be supervised by a foreman having the following qualifications in addition to those listed in paragraph A above. A foreman is required for each Lateral Connected to Manhole crew. Foreman qualifications are:

a. Previously performed pressure testing and chemical grout sealing of a minimum of 30 Laterals Connected to Manholes.

b. Successfully completed safety training recommended by grout material and grout equipment suppliers.

c. Successfully completed a 16 hour minimum pipeline packer capital grouting field training conducted by a multi-vendor consortium of packer, rig, and grout material vendors.

1.4 WARRANTY

A. Testing and grouting work shall be warrantied for materials and workmanship guaranteed by the CONTRACTOR to be free of visible leakage per PACP Infiltration definitions for a period of 1 year from the date of Final Completion unless otherwise stipulated in writing by the OWNER prior to the date of Conditional Acceptance. During this period, actionable defects documented by OWNER from video or photographic documentation or from warranty testing per Paragraphs 3.17 - 3.19, pipe segments on that inspection reach that were originally tested will be retested and, if necessary, resealed by CONTRACTOR at no additional cost to OWNER. In addition to the Warranty Inspections specified under Paragraph 3.16, the OWNER may conduct independent inspections, at its own expense, of the grouting work at any time prior to the completion of the guarantee period.

   The Owner shall hold in retainage an amount equal to 10% of the final contract cost, until performance warranty inspections have been satisfactorily completed, as determined by the Engineer.

1.5 SUBMITTALS

A. Documentation of required qualifications of personnel.

B. Documentation of grouting safety training of all field staff.

C. Equipment operating procedures and systems.

D. Grout information:

   a. Third party testing grout component chemical composition, including primary chemical percentages.

   b. Grout mixture ratio (including additives).

   c. Procedure for adjusting grout gel time during initial preparation.

   d. Procedures for adjusting grout gel time as temperature changes.

   e. Curves of grout gel time versus temperature.

   f. Instructions for addition of components.

   g. Safety Data Sheets.

E. Equipment operating procedures and systems to be used, including manufacturer's literature on grout pumps (including pump curve demonstrating compliance with required pumping rates), operating pressures, packers, skins, packer mounted gauges, pressure readings on screen, and lateral blockage clearing equipment.

F. Packer to pipe void volume between the packers and host pipe and maximum packer end element inflation pressure when new.

G. Spare parts list.

H. Documentation of Joint Testing Observations, in accordance with Grout and Seal codes and reporting per PACP Manual, latest version. All videos and reports, in PACP and LACP format, as appropriate, shall be provided to the Engineer on either a flash drive or an external hard drive.

I. List and corresponding digital images, in accordance with Paragraph 3.3, of lateral taps containing roots or other obstructive conditions.

J. Upon completion of grouting each segment, submit to ENGINEER a report showing the following data for each item tested, grouted, or attempted to be grouted.

1. Location of the pipeline segment/lateral address in which the testing was done.
2. Stationing.
3. Location of any items not tested and the reason for not testing.
4. Time, date, and temperature.
5. Grout mixture formulation, including additives.
6. End seal pipe-packer contact pressure and seal pressure.
7. Test pressure achieved and the duration of test maintained for each item passing the air test.
8. End-of-hoses pump rates.
9. In situ packer pumping rate
10. Gel time(s) from cup testing.
11. Quantity of grout used to seal each item.
12. Step grouting practice, including pump on and off cycle times and volumes, if applicable.
13. Post-grout pressure test results.
14. Regrouting and retesting giving above data as required.
15. Video recording cross-reference index.

K. Documentation of Post-Construction Inspection in accordance with Grout and Seal codes and reporting per PACP Manual, latest version. All videos and reports, in PACP and LACP format, as appropriate, shall be provided to the Engineer on either a flash drive or an external hard drive.

L. Documentation of Warranty Inspection in accordance with Grout and Seal codes and reporting per PACP Manual, latest version. All videos and reports, in PACP and LACP format, as appropriate, shall be provided to the Engineer on either a flash drive or an external hard drive.

1.6 REFERENCE STANDARDS

A. NASSCO, Inc. prepared Pipeline Assessment and Certification Program (PACP) Reference Manual, latest version.

B. Section 33 01 30.16, Television Inspection of Sewers.

1.7 PAYMENT

A. Payment for the work shall be in accordance with the prices as set forth in the proposal for the scope of the work performed.

1.8 PUBLIC NOTIFICATION

A. The CONTRACTOR shall make every effort to maintain service usage throughout the duration of the project Property Owners who may be affected by the rehabilitation process

shall be advised in writing concerning the nature and duration of any interruption in sewer or drain service. Advance notice shall be provided at least one week prior to any interruption. Additionally, verbal or written notice shall be provided 24-48 hours prior to any interruption. When the interruption is ended, residents are to be advised either verbally, or in writing immediately. During the course of the rehabilitation and any associated service interruption, the residents shall be kept regularly informed regarding any matters that affect them.

1.9 INSPECTOR TRAINING

A. The Contractor shall provide training by a manufacturer's approved trainer for the Owner's representatives/inspectors on the specific product being installed.

B. The inspector training shall include a sufficient amount of time to instruct the inspectors on the basic concepts of the technology and what aspects are important to review and inspect in the field while the Grouting is being performed by the Contractor. This may include a demonstration of the equipment and process. The inspector training shall also include a sufficient amount of time to instruct the inspectors on what documentation is needed to verify that the grout has been installed in accordance with the contract documents.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. The basic equipment shall consist of a remotely operated color television camera capable of pan and tilt, testing and grouting devices (referred to hereafter as packers), grout preparation tanks (Tank A –Base Chemical and Additives and Tank B – Oxidizer Only) and monitoring equipment. The equipment shall be constructed in such a way as to provide means for introducing air under pressure into the void area created by the expanded ends of the packer and a means for continuously measuring the actual static pressure of the test medium and grout within the void area only. Packers shall be expanded by air pressure.

B. All packers shall be fitted with a void pressure sensor (either a transducer or gauge) mounted on the packer. If using a void gauge as the pressure sensor, the maximum top range shall be 15 psi and readable using the television camera. There can be no check valve between the void space and the pressure sensor. Packer void pressure shall be shown either on-screen or captured on-video. The air test gauge in the control panel in the studio may not be used for air testing or post-grouting pressure confirmation because the length of hose and the presence of check valves renders this technique unreliable and inaccurate at pressures below 12 psi.

C. Grout control panel shall have gauges for monitoring packer element pressure. Packer element pressure gauges shall have a range of 0-60 psi.

D. Main Line Joint packers shall have void volume less than 0.3 gallons for 8-inch packers, 0.4 gallons for 10-inch packers and 0.5 gallons for 12-inch packers.

E. Lateral Tap Connection packers shall have mainline void space volume less than 0.75 gallons and sock void space less than 0.2 gallons per foot for 4" diameter socks and 0.25 gallons per foot for 6" diameter socks.

F. Lateral Tap Connection packers shall consist of inflatable mainline end elements and a lateral grouting sock and plug that creates a void area extending beyond the tap or drop connection. Whenever possible, use a lateral sock sized to match the diameter of the lateral being grouted. Effective sealing length shall be 5 feet, unless required by transition or pipe configuration less than this, otherwise indicated on the plans, or as directed by ENGINEER. Where the lateral or drop is capped, utilize alternate lateral grouting plug or equipment sized appropriately for the capped lateral. If the lateral transitions from 6" to 4" in diameter within the view of the mainline camera and less than 2 feet from the tap, use a 4" lateral grouting plug. Maintain a variety of lengths of lateral grouting plugs and adjust length of lateral grout plug as required.

G. Lateral Connected to Manhole packers shall consist of a flexible push-pull-type packer. Lateral Connected to Manhole packers shall be sized for the diameter and pipe joint spacing found in the field, have void spaces commensurate with their duty, and be acceptable to the ENGINEER. The packer shall be able to test the items specified and be able to negotiate fittings associated with the pipe construction. If the lateral contains a transition, CONTRACTOR may change out diameters of push packer or grout using a smaller diameter packer but no relief for excess residual grout will be provided nor payment for the extra wasted grout.

H. Grouting equipment shall consist of the packer, hoses, and pumping systems capable of supplying an uninterrupted flow of sealing materials to completely fill the voids. Pump systems shall be sized to deliver a minimum of 3 gpm during end- of-hose pumping tests and achieve at least a 3 gpm uninterrupted pumping rate over a 5-minute period.

I. A tiger tail, boot, or downhole roller, manhole frame roller, and truck step grid plate or pavement tail or slide are required to protect hoses from chafing.

J. Equipment for cleaning lateral blockages shall be present on-site while any grouting work is being conducted.

2.2 GROUTS - GENERAL

A. All grout materials must have the following characteristics:

1. Able to react /perform in the presence of water (groundwater) with minimal dilution while being injected.
2. Maintain a constant viscosity during the pumping process prior to gelling.
3. Prevent the passage of water (infiltration) into the pipe.
4. Not be subject to shrinkage from water loss in conditions where relative humidity in soil is present.
5. Be moderately flexible, yet rigid enough to stand under its own weight.
6. Be chemically stable and resistant to acids, alkalis, and organics found in sewage.
7. Be easily removable from inside the sewer line after gelling.
8. Cause no upset of treatment or pumping system downstream of the grouting location.
9. Sealant formation must not be biodegradable.
10. In place, it should be able to withstand freeze/thaw cycles without adversely

affecting the seal.

B. Handle, mix, and store grout components in accordance with the manufacturer's recommendations.

C. Provide appropriate protective measures to ensure that the grout components and the chemicals produced in mixing are under the control of the CONTRACTOR always and are not available to unauthorized personnel.

D. All grout materials used shall meet the following minimum application requirements:

1. All component materials shall be transportable by common carriers.
2. Packing of component materials shall be compatible with field storage requirements.
3. Grout components shall be packed in such a fashion as to provide for maximum worker safety when handling the materials and minimize spillage when preparing for use.
4. Gel initiation shall take place at the point of injection/repair.
5. Cleanup shall be done in accordance with the manufacturer recommendations.

2.3 GROUTS

A. Acrylamide base grout, or approved equal, shall have the following, or comparative, characteristics:

1. A minimum of 10% acrylamide base material by weight in the total grout mix. A higher concentration of acrylamide base material may be used to increase strength or offset dilution during injection.
2. A viscosity of approximately 2 centipoises, which can be increased with additives.
3. A controllable reaction time from 10 seconds to 5 minutes.

2.4 ADDITIVES

A. Latex

1. Add latex additive (or equivalent) to increase compressive and tensile strength of grouts to protect against shrinkage, enhance flexibility, and strengthen the grout. Latex shall not contain any organic solvents. The quantity of latex added shall be 1-3% and shall take the place of the same volume of water normally added in a non-latex grout batch on the A Tank (grout tank). The quantity of latex shall be doubled for grouting non-circular defects. Follow manufacturer's recommendations for product handling and mixing. Latex additive shall have the following characteristics.

Solids Content	49% minimum	ASTM D-1010
Viscosity	100-130 cps @ 77^{o}F max	ASTM D-1638
Solvent	Water	

B. Freeze Inhibitor

1. Ethylene glycol may be added to the A and/or B tanks to reduce the freezing temperature of the liquid grout during winter operations when the truck interior

and hoses cannot be kept above freezing temperatures. Ethylene glycol shall replace the same volume of water normally added to the tanks. Follow manufacturer's recommendations for product handling and mixing to prevent freezing.

C. Dye

1. When not using latex, add a fluorescent blue dye to the A side grout tank and a fluorescent yellow dye to the B side tank so that pump balance issues can be discerned and so a visual residual layer of green-colored grout remains to provide confirmation that mixed grout was pumped.

D. Gel Time Extender

1. Add gel time extending agent in accordance with the manufacturer's recommendations to extend gel time as necessary. Completely dissolve chemical crystals in water before introducing to the grout tank.

E. Root Control

1. Where roots are evident, *dichlobenil* shall be added to the grout mixture per manufacturer specifications (approximately 400ppm).

PART 3 - EXECUTION

3.1 CONTROL TESTS

A. Packer Tests - Demonstrate the acceptable performance of packers in the presence of the ENGINEER or ENGINEER's representative by conducting demonstration tests.

1. Conduct this test weekly. For pipe less than or equal to 18 inches in diameter, provide a straight pipe of appropriate diameters and ovality and sufficient length to test Main Line Joint, Lateral Tap Connection, and Lateral Connected to Manhole packers of appropriate. The test cylinder shall be equipped with a void release valve to exercise a controlled release of pressurized air to test the packer under both sound and leaking conditions. The test cylinder shall also be equipped with both a local pressure gauge (0-30 psi) and a connection to the packer test control center/studio; these shall both indicate the pressure in the packer void space.
   a. With release valve sealed, inflate packer until it contacts the pipe; record this packer-pipe contact pressure. Inflate packer to 15 psi greater than the packer-pipe contact pressure. Generate a void pressure of 10 psi. The equipment shall hold at this test pressure for a period of 60 seconds with a pressure drop of less than 1 psi.
   b. If above test is passed, crack the release to simulate a very small leak. After ~20 seconds, seal the release and confirm that a pressure drop has occurred and that the local gauge is within ±1.0 psi of the reading in the control center/studio.
2. Conduct this test every segment for Main Line Joint and Lateral Tap Connection packers, and every 5th lateral for Laterals Connected to Manhole packers. After entering each pipeline segment with the Main Line Joint and Lateral Tap Connection packer, but prior to the commencement of testing, position the packer on a section of sound sewer pipe between pipe joints, and perform a test. The equipment shall hold a 10-psi test pressure for a period of 30 seconds with a pressure drop of less

than 1 psi. In the event of a failed test, repair any defective equipment and re-test to verify proper operation of all equipment at no additional compensation. Should it be found that the barrel of the sewer pipe will not allow valid in situ barrel test requirements due to corrosion or other barrel defects, then the performance testing shall be waived or modified as determined by the ENGINEER.

3. If air testing equipment cannot be performed successfully, repair or otherwise modify air test equipment and repeat the tests until the results are satisfactory to the ENGINEER or ENGINEER's representative. The in-situ barrel test may be required at any other time during the performance of testing work if the ENGINEER or ENGINEER's representative suspects the testing equipment is not functioning properly.

B. Pump Tests

1. At the start of the job and once monthly or every 1000 gallons of grout pumped, whichever is more frequent, pump grout in uninterrupted flow for full 5 minutes to demonstrate the pumping system can operated continuously at a minimum 3 gpm rate and deliver a minimum of 9 gallons within 3 minutes.

2. At the beginning of each day prior to application of grout, perform a pump test to determine if equal ratios are being pumped from the grout component tanks at the proper rates and to measure pump rates. Pump 1 gallon of grout from each tank into two separate volumetric measuring containers. Take corrective action if unequal quantities are being pumped. Repeat the pump test until equal quantities are pumped from the grout tanks. Record the amount of time required to pump the two gallons and, when using air pumps, count the pump strokes to confirm the number of pump strokes required to achieve the delivery rate.

C. In situ Pumping Capacity Tests – Once inside the pipe and pumping grout through the packer into the first defect of the segment, record the in-situ pumping rate delivered, and modify the grout gel time as appropriate. Check in situ pumping rate each time the packer is reconnected to the hoses.

D. Grout Gel Time Tests - Perform a grout gel test in the presence of the ENGINEER's representative to determine the grout mixture gel time. If packer is not in the pipe, recycle into the respective tanks or properly dispose any grout remaining in the hoses. Run mixers for a minimum of 1 minute, then allow entrained air to release from the grout tanks a minimum of 5 minutes before collecting grout samples in disposable cups. Ensure equal portions of Tank A and Tank B are collected prior to mixing. If foam is present on surface of tank, collect sample from below the foam. Determine gel time by taking cup samples from each tank:

1. Prior to grouting each day.

2. Prior to grouting when a different gel time is required.

3. When new batches of grout are mixed.

4. When the temperature of the solutions in either of the tanks have changed by more than 5°F from the previous gel test.

E. Grout Concentration Tests – When grout is not mixed under the observation of the ENGINEER, perform a grout concentration test using a CONTRACTOR-provided hydrometer or refractometer, temperature gauge, and a grout

concentration:temperature chart on demand of the ENGINEER to determine the grout concentration.

3.2 PIPE PREPARATION

A. Clean sewer and remove roots in mainline sewer except minor hair roots prior to testing. Remove all debris from the Sanitary System, do not flush downstream.

B. Carefully cut back or otherwise remove any portions of laterals that protrude more than 5/8-inch into the mainline to avoid interference with the testing and sealing equipment. No flail-type equipment shall be permitted.

C. Clean all Lateral Tap Connections and Laterals Connected to Manholes in the project area that are not marked as inactive on the Drawings.

D. Following cleaning, televise all Main Line Joints, Lateral Tap Connections and Laterals Connected to Manholes that are not marked as inactive on the Drawings in accordance with Grout and Seal codes and reporting per PACP Manual, latest version. All videos and reports, in PACP and LACP format, as appropriate, shall be provided to the Engineer on either a flash drive or an external hard drive.

E. Unless otherwise specified or indicated, Lateral Tap Connection inspections will be limited to pan and tilt inspection from mainline camera.

F. Submit Pre-Construction Inspection for any Lateral Tap Connection or Lateral Connected to Manhole that is found to be inactive or in a condition that cannot be tested and grouted.

3.3 GENERAL PRE-TEST AND GROUT REQUIREMENTS

A. For any segment, Lateral Tap Connection or Lateral Connected to Manhole that CONTRACTOR, OWNER, or ENGINEER believes has issues compromising the ability to cost-effectively grout or achieve the project's longevity effectiveness goals, ENGINEER will review the Pre-Construction Inspection and direct CONTRACTOR as to which Main Line Joints, Lateral Tap Connections and Laterals Connected to Manholes are to be (a) tested and grouted without further cleaning, (b) plugged, (c) otherwise repaired, (d) additionally cleaned, or (e) to receive no further rehabilitation.

B. Confirm the inside diameter of the mainline and lateral pipes to be tested and apply the appropriate packer.

C. Confirm with ENGINEER the length of sock to be used for Lateral Tap Connections.

D. Confirm with ENGINEER what packer end element pressure to utilize for Main Line Joint work where defects originate at joints.

E. Confirm with ENGINEER what root removal must be achieved prior to grouting.

F. Confirm the inside diameter of the mainline and lateral pipes to be tested and apply the appropriate packer.

G. During testing and sealing, provide sewer flow control to provide unimpeded view of the packer.

H. Perform testing and grouting only in the presence of or with the knowledge and concurrence of the ENGINEER. Modify grouting procedures only at the concurrence of ENGINEER.

I. Record the testing procedure and grouting in accordance with Grout and Seal codes and reporting per PACP Manual, latest version. The recording shall show the location of the item and the test pressure in subtitles. Grouting and testing shall be incorporated on the same recording. Specifically note all defects and taps and ensure footage counter is accurate throughout testing and grouting to allow proper warranty testing linear referencing. All videos and reports, in PACP and LACP format, as appropriate, shall be provided to the Engineer on either a flash drive or an external hard drive.

3.4 ROOTS AND OBSTRUCTIONS IN LATERALS

A. Remove from sewer roots and debris that prohibit testing/grouting from Lateral Tap Connections and Laterals Connected to Manholes for the length of lateral to be tested/grouted.

3.5 GROUT PREPARATION

A. Follow the manufacturer's recommendations for the mixing and safety procedures to protect personnel from any adverse effects of the grouting compounds. Add and mix base components and additives at rates that will eliminate the formation of lumps within grout tanks solutions. Use accurate scale(s) or volumetric containers to measure the various non-water grout solution components as concentrations specified. Thoroughly mix all components in the appropriate tanks. Provide accurate thermometers to verify temperature of grouting components in tanks. Where practical, add majority of needed water to both grout tanks and mix the base acrylamide into Tank A the evening before to allow the endothermic reaction to complete and ambient temperature to be achieved and mix the latex to allow the surfactant to dissipate and minimize foaming before using grout.

B. Add gel time extending agent or cool the grout component tanks and/or hoses as necessary to compensate for changes in temperature in grout component tanks or hoses resulting from changes in ambient conditions. The addition of dilution water to extend gel times is only acceptable using the B (non-grout) tank so that the resulting grout still achieves minimum base material concentrations.

C. During the grouting process, monitor the grout component tanks to make sure that proper ratios are being pumped. If unequal levels are noted in the tanks, repeat the pump test, grout concentration test, and grout gel time test as described above.

3.6 GROUT VOLUME GOALS AND GEL TIME

A. Grout Volume Goal
   1. Vitrified clay pipe is prone to break/fracture and therefore requires bedding grouting as well as defect grouting to provide long- term seal stability. Grout Volume Goal for pipe diameters less than 18":
      a. Minimum 0.25 gallons per inch diameter, ie 2 gallons for an 8" pipe to each joint.

B. Gel Time: Gel times shall not be less than 20 seconds unless approved by the ENGINEER's representative. Calculators are available from NASSCO to determine an appropriate gel time as a function of Pipe Diameter, Pumping Rate, Annual and Coupling spaces and the Grout Volume Goal.

C. Where groundwater is entering the pipe from multiple locations near the point of grouting or where grout consistently enters back into the pipe from adjacent joints, lower

gel time and/or modify grouting procedures to allow faster grout set times and minimize grout wash-in through adjacent defects. Consult with ENGINEER before proceeding with any site-specific measures.

3.7 TESTING AND GROUTING DEFECTS

A. Testing and grouting will not be required on pipe exhibiting the following conditions or characteristics. Provide ENGINEER with digital image and intention not to grout any such defect.
    a. Longitudinal, spiral, or multiple fractures, as classified by PACP.
    b. Broken or partially collapsed pipe, as classified by PACP.
    c. Sections of the pipe without defects between joints.
    d. Any sections of pipe or joints that are in such poor structural condition that in the judgment of ENGINEER or CONTRACTOR, significant structural damage of the pipe would occur as a result of the pressure test.
    e. Defects in cured in place liners.

B. Attempt to test and, if needed and possible, grout any joint separated less than 1- inch or any angular or offset joint.

C. Do not test, but do grout, all circumferential cracks and fractures, visibly leaking joints, and joints with visible defects.

D. Do not test or grout any other pipe defects unless so specified or shown or directed by ENGINEER to do so.

E. Any visually structurally undamaged joint that structurally cracks, fractures, breaks, or collapses during testing and grouting that are documented on video to have been done under normal pressure conditions shall be the OWNER's responsibility and cost to repair. Promptly repair any other sewer damage resulting from the CONTRACTOR's operations at no additional compensation.

F. Any visually structurally defective joint that collapses during low pressure Main Line Joint grouting that are documented on video to have been done under proper low pressure grouting conditions shall be the OWNER's responsibility and cost to repair. Promptly repair any other sewer damage resulting from the CONTRACTOR's operations at no additional compensation.

G. Position packers over joints or defects by means of a closed-circuit television camera in the line.

H. For each joint/lateral/defect tested/grouted, record exact location and volume of grout placed in PACP Remarks field.

I. For each segment, record ambient temperature, grout tank temperature, gel set test time, and packer inflation pressure in PACP header in appropriate fields.

J. Specifically identify each tap and break location on the grout report to aid in properly locating joints during warranty testing.

3.8 JOINT TESTING PROCEDURES

A. Joint testing target pressure before grouting shall be equal to ½ psi per vertical foot of pipe depth plus 3 psi; however, target test pressure shall not exceed 12 psi nor be lower than 6 psi

unless directed by the ENGINEER. Control test equipment to ensure the specified test pressure is not exceeded by more than 2 psi.

1. If void pressure gauge is not working or not visible/readable and less than 1/3rd the remaining items to test remain, CONTRACTOR may complete segment using panel gauge but test pressures shall be increased by 5 psi and test time by 5 seconds (to overcome the check valves and regulators in the plumbing). No additional work may be conducted beyond this until the void pressure gauge is working properly.

B. Test joints on Laterals Connected to Manholes from the manhole to a location 5 feet up the lateral or to the cleanout, whichever comes first. If there is a transition in the Laterals Connected to Manhole, test the transition unless its offset prevents packer insertion and seal. Direct visual observation shall be used to position the packer.

C. Do not test joints with visible longitudinal, spiral, or multiple fractures or cracks or where the packer cannot be seated because of tap connection. Note reason for not testing on the log.

D. Individually test each Main Line Joint and Lateral Connected to Manhole joints at the above-specified pressure (and retest after sealing) in accordance with the following procedure:

1. The packer shall be positioned within the pipe in such a manner as to straddle the joint to be tested. If uncertain, pump small amount of grout to confirm the void space is properly located (spitting) before inflating the packer.
2. The packer ends shall be expanded to isolate the joint from the remainder of the pipe and create a void area between the packer and the pipe joint. The ends of the testing device shall be expanded against the pipe with sufficient inflation pressure to contain the air within the void without leakage past the expanded ends. Record end seal pipe-packer contact pressure and seal pressure used.
    a. Packer end seal pressures for visually sound Vitrified Clay pipe shall not be greater than 15 psi more than the required packer-pipe contact pressure.
    b. Packer end seal pressures for Vitrified Clay pipe with joint defects shall use low pressure Main Line Joint techniques such that the end element pressures shall not be greater than 8 psi more than the required packer-pipe contact pressure.
    c. For rough surface pipe such as corroded concrete pipe, use grout to seal the leaks around the packer end if airtight seal cannot be achieved. Gel time may be reduced to half the normally specified time under these circumstances with the approval of ENGINEER. The CONTRACTOR shall be paid the unit price for grout to seal the packer unless ENGINEER determines that the sewer was inadequately cleaned or the packer is not performing properly but will not be paid the unit price for joint grouting for this activity.
3. Air shall then be slowly introduced into the void area until a pressure equal to the required test pressure is observed on the pressure monitoring equipment. Control inflation rate of the packer to minimize over-pressurization of the void space by adjusting the quick inflate timer to stop rapid inflation before the packer contacts the pipe.
4. After the void pressure is observed to be equal to the required test pressure, the air flow shall be stopped. If the void pressure as measured at the packer decays by more than 1.0 psi below the required test pressure within 15 seconds, the joint will be deemed to have failed the test and shall be sealed.

a. If the void is over pressurized and the void pressure decays, the 15 second period shall begin once the test pressure is achieved. If the void is unavoidably but significantly over pressurized from water or residual grout (e.g., 2x the target test pressure) and the void pressure decays, use a 10 second period to determine if the joint(s) pass or fail.

b. If testing after grouting and the void pressure is unavoidably but significantly over-pressurized from water or residual grout (e.g., 2x the target test pressure) and the void pressure decays, add an additional 2 psi of pressure and use a 10 second period to determine if the joint(s) pass or fail.

5. Upon completing the successful testing of each individual joint, the packer shall be deflated with the void pressure meter continuing to display void pressure. Should the void pressure meter fail to drop to ±1 psi, clean the test equipment of residual grout material or make the necessary equipment adjustments to provide for an accurate void pressure reading.

3.9 LATERAL TAP CONNECTION TESTING PROCEDURE

A. Lateral Tap Connection void pressure shall be equal to ½ psi per vertical foot of pipe depth plus 3 psi; however, test pressure shall not exceed 10 psi nor be lower than 6 psi unless directed by the ENGINEER. Control test equipment to ensure the specified test pressure is not exceeded by more than 2 psi.

1. If void pressure gauge is not working or not visible/readable and less than 1/3rd the remaining items to test remain, CONTRACTOR may complete segment using panel gauge but test pressures shall be increased by 5 psi and test time by 5 seconds (to overcome the check valves and regulators in the plumbing). No additional work may be conducted beyond this until the void pressure gauge is working properly.

B. Air testing Lateral Tap Connections shall be accomplished by isolating the area to be tested with the packer and by applying positive pressure into the isolated void area. A pan and tilt camera shall be used to position the lateral packer. The bladder shall be inverted from the mainline assembly into the lateral pipe and inflated. The mainline elements shall then be inflated to isolate the lateral connection and the portion of the lateral to be tested. A sensing unit shall be located within the void area and will accurately and continuously transmit void pressure readout to the control panel or pressure gauge viewable with CCTV camera.

C. The test procedure will consist of applying air pressure into each isolated void area. A sensing unit shall be located within the void area and will accurately transmit continuous pressure readout to the control panel. Air shall then be slowly introduced into the void area until a pressure equal to the required test pressure is observed on the pressure monitoring equipment.

D. After the void pressure is observed to be equal to or greater than the required test pressure, the air flow shall be stopped. If the void pressure decays by more than 1.0 psi within 20 seconds, the Lateral Tap Connection will have failed the test and shall be sealed. If the void is over pressurized and the void pressure decays, the 20 second period shall begin once the test pressure is achieved.

E. After completing the air test for each individual Lateral Tap Connection specified herein, deflate the packer, with the void pressure meter continuing to display void pressure. If the void pressure does not drop to ±1 psi, clean the test equipment of residual grout

material or make the necessary equipment adjustments to provide for an accurate void pressure reading.

F. For laterals capped less than two feet from the main, CONTRACTOR may use a mainline packer to test the lateral tap.

G. Length of lateral to be tested shall be as shown or indicated.

3.10 LONGITUDINAL DEFECT AND ANNULAR SPACE TAP TESTING PROCEDURES

A. Do not test Longitudinal defects and annular space taps.

3.11 GROUTING - GENERAL

A. The pumps, meter, and packer shall be integrated so that grout component proportions, quantities, and pressures can be monitored and regulated in accordance with the type and size of the leak, percentage of voids being filled, type of soil surrounding the pipe, and the rate of flow of the grout in relation to the back pressures.

B. Grout all Main Line Joint, Lateral Tap Connection and Laterals Connected to Manhole joints that failed the pressure test, that are visibly leaking at a rate classified as ID (dripper) or greater by PACP, or that have fracture, crack, or chipped joint defects originating at the joint and terminating within 8 inches of the joint by the packer injection method. Generally, this shall be accomplished by forcing grout through a system of pumps and hoses into and through the joints of the sewer from the packer within the sewer pipe. Jetting or driving pipes from the surface shall not be allowed.

C. Record in the Additional Comments fields of the PACP header the assumed bedding depth, assumed bedding material, calculated grout volume goal, in situ pump rate, gel time entered calculated by the Grout Volume and Gel Time Calculator, actual initial gel time, and adjusted gel time and time of correction.

D. When grouting Vitrified Clay pipe joints with defects originating at the joint, use a low-end element technique (LEET) whereby the end elements are inflated to only 8 psi above pipe-packer contact pressure. Specifically note in the grouting record each joint that has a defect originating from it.

E. If less than three times the void space or less than 1 gallon of grout above the packer void space is pumped outside the pipe (i.e., not blown by the end elements), whichever is less, the joint will be marked as passing; grout used in this circumstance will not be paid for. However, note in the grouting record the volume of grout in excess of void space and blow-by utilized.

F. If a packer with a higher void space than specified is used, the additional grout used to fill this larger void space shall not be paid for.

G. After each time pumping grout at one of the above items, if the void space pressure drops faster than the allowable rate at the defined target test pressures, then continue pumping grout in accordance with these procedures. If the void space pressure does not drop, deflate the packer, purge air test line/valve, then reinflate and retest at target test pressure.

    a. When using grout to seat the packer, retest as above except do not deflate the packer first.

H. If the item fails this air test, repeat the grouting procedure at no additional cost to OWNER. Repeat this sequence of air testing, grouting, and subsequent air testing until

either the item is sealed, or it is determined that the grout consumption is too high. The final determination to stop subsequent attempts to seal an item will be made jointly between OWNER and CONTRACTOR.

I. Generally, pump to refusal or in accordance with step grouting procedures. Refusal shall mean the mixed grout has flowed through the void space, through any joint failure or defect, into any annular space or surrounding soil; gelled or filled the available void space, annular space, and soil pore space; formed a cohesive seal stopping further grout flow; and an air test as described above is successfully passed.

J. If grout is observed to enter the pipe upstream or downstream of the packer through defects, taps, liner cut, or joints, either cut pumping rate in half or adjust gel time to half the proscribed rate. Continue to adjust until grout pass-by is no longer an issue. Readjust grout time and pump rate back to proscribed rate if determined warranted by ENGINEER.

K. If blow-by occurs before achieving minimum grout volume goal, lower the pumping rate to allow a slower introduction of grout into the void space by decreasing air pressure/feed to air pumps, turning down the pump rate of electric pumps, or manually using a 5-10 second break between each pump stroke. Adjust gel time accordingly if this happens on more than half the items being grouted.

L. In the grouting record, record in the comments field for each item:

   a. Volume of grout in excess of void space and/or blow by pumped into pipe bedding at each joint

   b. Step grout increments

   c. Whether max grout volume was reached

   d. Final test pressure after completion of grouting

   e. If joint has J code defect

   f. If packer was grouted in place

   g. All taps, breaks, and fractures for the purposes of aligning grouting records during warranty testing.

M. Grouting packer in place

   a. Gel time may be reduced from the normally specified time in halves until a testable seal is achieved if pipe wall conditions do not allow a valid packer to successfully seal with the approval of ENGINEER. The gel time will be established in trials in the presence of ENGINEER using the adjacent pipe wall where no crack, fracture, or breaks are present.

   b. CONTRACTOR shall be paid the unit price for grout to seal the packer unless ENGINEER determines that the sewer was inadequately cleaned, or the packer is not performing properly but will not be paid the unit price for joint grouting for this activity.

N. If the item fails to seal, continue the grouting procedure. Repeat this sequence of grouting and testing until either the item is sealed, or it is determined that the grout consumption is too high. The final determination to stop subsequent attempts to seal an item will be made by ENGINEER after consultation with CONTRACTOR.

O. For pipes whose crowns are less than 4 feet below grade, provide an observer to monitor for grout short circuiting or piping to the surface.

P. Remove all grout from pipe that obscures the pipe wall, joint, or defect when conducting post-grouting inspections. Excess grout does not need to be removed from inactive laterals.

OR

Q. Remove excess grout from pipe by jetting pipe. Excess grout does not need to be removed from inactive laterals. Excess grout for Main Line Joints and Laterals Connected to Manholes shall be defined as: a thickness of grout greater than 1" thick at any point; an amount of grout that given its location, size and geometry in the judgment of the ENGINEER could cause a blockage; or an amount such that more than 10% of the total pipe wall is obscured by grout. Excess grout for Lateral Tap Connections shall be defined as: a thickness of grout greater than 1" thick at any point (except when 4" Lateral Tap Connection packers are used for 6" to 4" transitions near the tap, in which case the excess grout standard does not apply); an amount of grout that given its location, size and geometry in the judgment of the ENGINEER could cause a blockage. It is the CONTRACTOR'S responsibility to either remove the grout or obtain OWNER approval in writing to leave grout in place.

R. All decisions regarding excess grout shall be made by the ENGINEER based on the Post-Construction Inspection and shall be final.

OR

S. All decisions regarding excess grout shall be made in the field during the work by the ENGINEER and shall be final. It is the CONTRACTOR'S responsibility to either remove the grout or obtain ENGINEER's approval in writing to leave grout in place. If CONTRACTOR is uncertain if the amount of residual grout remaining inside the pipe is acceptable, CONTRACTOR shall contact and afford ENGINEER opportunity to view the pipe using CONTRACTOR's cameras to render a decision.

3.12 JOINT GROUTING

A. Stop pumping grout after pumping grout volume goal, wait 1 gel set cycle time (or longer at CONTRACTOR's discretion), retest, and if the joint does not pass the air test, then continue grouting by pumping additional grout in 1.5 gallon increments for pipe diameters 4-6 inches, in 2 gallon increments for 8-12, in 2.5 gallon increments for pipe diameters 14-21 inches, and in 3 gallon increments for pipe diameters greater than 21 inches, or until refusal. If necessary to prevent packer blowby, pump in smaller increments. After each step, wait 1 gel set cycle time (or longer at CONTRACTOR's discretion) before retesting, and, if needed, continuing with additional grout steps until successful test, until maximum grout volume is reached, or until directed to stop by ENGINEER.

B. Curtail grouting when grout rate exceeds twice the Grout Volume Goal.

C. Where using low end element technique (LEET) for joints with defects, increase the maximum grout per joint by 33%. Notify ENGINEER verbally and via email of intended changes before making this change.

D. If more than 16% of the joints (1 in 6) are not passing at Max Grout when using in step grouting procedure, cut your gel time in half. Notify ENGINEER verbally and via email of intended changes before making this change.

E. If more than 25% of the joints (1 in 4) need Max Grout volumes using step grouting procedures to achieve seal, cut your gel time in half. Notify ENGINEER verbally and via email of intended changes before making this change.

F. Invoke and repeat this process until a gel time of 15 seconds is reached. Do not use gel times less than 15 seconds for Main Line Joints or Laterals Connected to Manholes.

G. For any given joint that does not seal at Max Grout, move packer forward to the next joint, complete test and seal work on that second joint, then return to the joint that did not pass, retest it, and if necessary, pump additional grout using step grouting procedures for up to an additional 4 gallons of grout. This second test shall be considered a verification test.

H. If after reaching the Max Grout plus four gallons additional grout, the joint continues to fail the air test, note “Max Grout Fail” within the comments for that joint observation.

I. If after decreasing gel time it is found that grout volume goals are consistently not being met, gel time will be judged to be too short and gel times will be incrementally increased until grout volume goals are consistently achieved. Seek and follow instructions from ENGINEER on when to return to original gel times.

J. After the final post-grout pressure testing of each joint, move the packer forward, wiping away the excess grout that extends into the pipe, reduces the pipe diameter, or restricts flow. Leave the sealed joints reasonably flush with the existing pipe surface.

K. For Laterals Connected to Manhole grouting, confirm through camera inspection lateral flow after completing all sealing of each lateral. If a grout blockage is evident, clear the lateral.

3.13 LATERAL TAP CONNECTION GROUTING

A. Grout Lateral Tap Connections that do not pass the air test, shows evidence of leakage, or where CONTRACTOR has been directed to grout a tap that contains visible roots.

B. Stop pumping grout after pumping grout volume goal, wait a 1 gel cycle, retest, and if the Lateral Tap Connection does not pass the air test continue grouting by pumping additional grout in 2-gallon increments, waiting 1 gel set cycle time between steps, retesting, and, if needed, continuing with additional 2-gallon grout steps until successful test or until directed to stop by OWNER. Record the amount of grout pumped on the sealing log.

C. Curtail grouting when grout volume reaches thrice the grout volume goal.

D. If after reaching the Max Grout, the Lateral Tap Connection fails the air test, note “Max Grout Fail” within the comments for that Lateral Tap Connection observation.

E. If greater than 20% of Lateral Tap Connections won’t seal when utilizing step grouting and achieving the above maximum grout volume per Lateral Tap Connection above, cut gel time in half and maintain pump rate. Invoke this process until a gel time of 20 seconds is reached. Do not use gel times less than 20 seconds for Lateral Tap Connections without approval of ENGINEER.

F. If after decreasing gel time it is found that grout volume goals are consistently not being met, gel time will be judged to be too short and gel times will be incrementally increased until grout volume goals are consistently achieved. Seek and follow instructions from ENGINEER on when to return to original gel times.

G. Air tests after grouting Lateral Tap Connections containing roots is not required.

H. Blockages in the lateral that are not the result of grouting operations shall not be the responsibility of the CONTRACTOR.

I. Confirm lateral flow after sealing of each lateral tap. This can be accomplished by one of the below methods:

1. Visually inspecting the entire length of the grouted lateral.
2. With the lateral packer in position, retract the inversion tube and inject air pressure into the lateral. Should a pressure build in the lateral and not drop to approximately zero immediately after the pressurized air is turned off, it will be assumed that the building sewer connection is substantially blocked with grout and the CONTRACTOR shall immediately clear the lateral at no additional cost to OWNER.
3. With the camera viewing the connection point, attempt to obtain a water flush by the occupant. If no water is viewed during this procedure, it will be assumed that the building sewer connection is substantially blocked with grout and the CONTRACTOR shall immediately clear the lateral at no additional cost to OWNER.

3.14 VERIFICATION TESTING

A. Conduct verification testing as directed by ENGINEER for quality control purposes. ENGINEER will select the Main Line Joints, Lateral Tap Connections or Laterals Connected to Manholes for pull back testing.

B. Test on a given line segment or lateral:

1. 5% of the grouted Main Line Joints (minimum of two),
2. 2% of Main Line Joints that passed testing without grouting (minimum of one)
3. 5% of Laterals Connected to Manhole joints (minimum of two)
4. 10% of the grouted Lateral Tap Connections on a given segment (minimum of one, excluding taps with roots not removed).

C. Within a sewer line segment or lateral, if any tested items fail the pullback test, retest an additional 10% of said items in that sewer line segment or lateral at no additional cost to OWNER. If any of these tested items fail the pullback test, retest all the remaining said items in that sewer line segment or lateral at no additional cost to OWNER.

3.15 POST-CONSTRUCTION INSPECTION

A. Conduct Post-Construction Inspection of all pipes, taps, and laterals tested and/or grouted in accordance with Grout and Seal codes and reporting per PACP Manual, latest version. Any items found to leak that are not specifically excluded for the purposes of Warranty Testing shall be sealed prior to conducting Post-Construction Inspections. Remove from the pipe wall and bottom any excess grout. Collect and remove from the sewer all excess grout removed from the pipe wall.

B. Following grouting, televise and record all Main Line Joints, Lateral Tap Connections and Laterals Connected to Manholes that are not marked as inactive on the Drawings. Unless otherwise specified or indicated, Lateral Tap Connection inspections will be limited to pan and tilt inspection from mainline camera.

C. All videos and reports, in PACP and LACP format, as appropriate, shall be provided to the Engineer on either a flash drive or an external hard drive. Video equipment shall be color and include the capability to view all surface areas of the pipe ("pan & tilt" capability). When required, pipe flow and visibility shall be controlled so that video

inspections produce complete visual coverage of the circumference sufficient to properly access conditions and features.

3.16 WARRANTY TESTING GENERAL

A. Actual period for testing shall be determined by the ENGINEER and will be generally conducted during high groundwater conditions to ensure performance under potential leakage conditions are assessed. CONTRACTOR will be provided with 60 days' notice of the warranty testing. Conduct all warranty tests in the presence of the ENGINEER.

B. Any items impacted by acts of God (e.g., earthquake, sinkholes, floods), adverse impacts from other utilities (e.g., crossbones, water main failures) are excluded from warranty testing and assurances.

C. ENGINEER will select items for warranty testing that represent the mix of field conditions and grouting results. ENGINEER will consider impediments to warranty testing including bypass pumping, traffic control, access, and private property issues.

D. Warranty test pressure shall be 4 psi.

3.17 MAIN LINE JOINT WARRANTY TESTING

A. Conduct warranty testing on 15% of Main Line Joints regardless of whether they passed or failed the pre- or post-grouting air test or a minimum of two sewer line segments, whichever is greater, 10 to 12 months after Substantial Completion. ENGINEER will select the pipe segments to be warranty tested, with the selection of pipe segments representative of the inventory of diameters and materials originally tested.

B. If more than 10% of the warranty tested Main Line Joints fail, test an additional 15% of the pipe segments or two additional sewer line segments, whichever is greater, will be warranty tested at no additional compensation. If more than 10% of the second group of warranty tested Main Line Joints fail, test the Main Line Joints in 50% of the remaining untested pipe segments at no additional compensation. If more than 10% of the warranty tested Main Line Joints fail, test all Main Line Joints in the remaining untested pipe segments at no additional compensation.

C. Grout and retest all Main Line Joints failing warranty testing regardless of whether they passed or failed the pre- or post-grouting air test at no additional compensation. Grout gel time for warranty testing grouting shall be 30 seconds.

D. For each pipe warranty tested, perform a Warranty Inspection.

E. Main Line Joints that received maximum grout volume, regardless of whether achieved a successful post-grouting air test originally or which had joint originating defects, will be tested and, if needed, regrouted, but are exempted from the warranty testing percentages.

3.18 LATERAL CONNECTED TO MANHOLE WARRANTY TESTING

A. Conduct warranty testing on 15% of the Laterals Connected to Manhole joints regardless of whether they passed or failed the pre- or post-grouting air test 10 to 12 months after Substantial Completion. ENGINEER will select the Laterals Connected to Manholes to be warranty tested, with the selection of laterals representative of the inventory of diameters and materials originally tested.

B. If more than 10% of the warranty tested Laterals Connected to Manhole joints fail, test an additional 15% of the Laterals Connected to Manholes at no additional compensation. If more than 10% of the second group of warranty tested Laterals Connected to Manhole joints fail, test 100% of the remaining, untested, Laterals Connected to Manholes at no additional compensation.

C. Grout and retest all Laterals Connected to Manhole joints failing warranty testing regardless of whether they passed or failed the pre- or post-grouting air test at no additional compensation. Grout gel time for warranty testing grouting shall be 20 seconds.

D. Perform a Warranty Inspection of all Laterals Connected to Manhole joints that are warranty tested.

E. Laterals Connected to Manhole joints that received maximum grout volume, regardless of whether achieved a successful post-grouting air test originally or which had joint originating defects, will be tested and, if needed, regrouted, but are exempted from the warranty testing percentages.

3.19 LATERAL TAP CONNECTION WARRANTY TESTING

A. Conduct warranty testing on 15% of the Lateral Tap Connections (excluding grouted taps that contained roots) regardless of whether they passed or failed the pre- or post-grouting air test 10 to 12 months after Substantial Completion. ENGINEER will select the Lateral Tap Connections to be warranty tested, with the selection of pipe segments representative of the inventory of diameters and materials originally tested.

B. If more than 10% of the warranty tested Lateral Tap Connections fail, test an additional 15% of the Lateral Tap Connections at no additional compensation. If more than 10% of the second group of warranty tested Lateral Tap Connections fail, test 100% of the remaining, untested, Lateral Tap Connections at no additional compensation.

C. Grout and retest all Lateral Tap Connections failing warranty testing regardless of whether they passed or failed the pre- or post-grouting air test at no additional compensation. Grout gel time for warranty testing grouting shall be 45 seconds.

D. Perform a Warranty Inspection of all Lateral Tap Connections that are warranty tested.

E. Lateral Tap Connections that received maximum grout volume, regardless of whether achieved a successful post-grouting air test originally or which had joint originating defects, will be tested and, if needed, regrouted, but are exempted from the warranty testing percentages.

MANHOLE REHABILITATION

PERFORMANCE SPECIFICATION GUIDELINE

Adapted from NASSCO's December 2013 Release

Index

GENERAL DISCUSSION OF PRODUCTS AND TECHNOLOGIES 2
PART 1 - GENERAL 4
1.1 DESCRIPTION OF WORK AND PRODUCT DELIVERY 5
1.2 SCOPE OF WORK INCLUDED 6
1.3 PERFORMANCE WORK STATEMENT (PWS) SUBMITTAL 6
1.4 SUBMITTALS 7
1.5 QUALITY CONTROL PLAN (QCP) 9
1.6 SYSTEM REPAIR/REPLACEMENT 9
1.7 REFERENCES 10
1.8 DELIVERY, STORAGE AND HANDLING 10
1.9 INSPECTOR TRAINING 10
1.10 SAFETY 10
1.11 WARRANTY 11
1.12 WARRANTY INSPECTIONS 12
1.13 MEASUREMENT AND PAYMENT 12
PART 2 - REHABILITATION COMPONENT SYSTEM PRODUCTS 12
2.1 CHEMICAL GROUTS 12
2.2 CEMENTITIOUS MANHOLE RESTORATION 14
2.3 POLYMER SYSTEMS 15
2.4 MANHOLE CHIMNEY SEALS 16
2.5 REPLACE MANHOLE FRAME AND COVER 18
2.6 MANHOLE ADJUSTMENT MATERIALS 18
2.7 MANHOLE STEPS 18
PART 3 - EXECUTION 19
3.1 CHEMICAL GROUT 20
3.2 CEMENTITIOUS RESTORATION 20
3.3 POLYMER LINERS 23
3.4 MANHOLE CHIMNEY SEALS 25
3.5 REPLACE FRAME AND COVER 27
3.6 MANHOLE ADJUSTMENT MATERIALS 27
3.7 MANHOLE STEPS 27
3.8 QUALITY ASSURANCE AND TESTING 28

GENERAL DISCUSSION OF PRODUCTS AND TECHNOLOGIES

A. The rehabilitation of manholes can be complicated and the selection of the correct product or technology can, at times, be confusing. There are many methods available for the rehabilitation of manholes. Each method must be evaluated to determine its applicability to provide the correct solution for the best available price. The following steps can be taken to develop the best approach towards rehabilitation and what family of products best meet specific project requirements.
    1. Thoroughly evaluate the condition of the manhole to be rehabilitated using the Manhole Assessment Certification Program (MACP) as developed by NASSCO for providing a uniform coding for the defects typically found in a manhole structure.
    2. Define the type of defects as structural defects, operational & maintenance defects, construction features and other.
    3. Based on the defined defects classify each manhole into the general rehabilitation technology or technologies to be considered. Technologies can be classified into general rehabilitation needs including grouting, cementitious reconstruction, polymer coatings/linings, cured-in-place lining, panel liners, mechanical seals and bench and channel inserts.
    4. Select the correct solution based on the problems identified.
    5. What are the problems being addressed?
    6. Does the selected technology provide the desired long-term solution to the problem?
    7. Does the selected technology go beyond solving the immediate need and if so, is there a reasonable cost for the added benefit?
    8. Does the selected technology ensure compatibility of all materials being used to complete the repair?
    9. Is the selected technology Contractor friendly? Is it relatively well suited for the project site conditions?
    10. Select products and/or technologies that have viable, proven installation techniques.
    11. Can the Contractor capabilities and experience be quantifiable during the bid process?
    12. Can the qualifications of the personnel, working for the Contractor and applying the product be verified?
B. There are many products technologies and variations available. Only generic categories of technologies are included in these sample specifications. Technology and product applicability, to each project, should be verified by contacting the manufacturer of each product, and discussing the proposed application to verify product compatibilities. Supporting documentation and third party testing should always be reviewed prior to selection. In some cases multiple technologies will be required to totally rehabilitate the manhole structure. Products and Technologies are generally referred to herein as Rehabilitation Component Systems (SYSTEM's) and include the following:
    1. Chemical Grouting – Generally used when the existing manhole is structurally

sound but has leakage or I&I problems. Grout types and longevity in different soil conditions must be verified through the grout manufacturer.

2. Cementitious Manhole Restoration – Cementitious materials can be Portland Cement, Microsilica enhanced, Calcium Aluminate, or Geopolymer based. The Geopolymer, Calcium Aluminates and Microsilica cements typically have a higher resistance to corrosion and typically attain high structural strength after curing which facilitates top-coating in a relatively short period of time. Standard Portland cements typically require a 28 day cure before top coating. Cementitious materials can be trowelled, sprayed, spun cast or poured in place. This type of technology is generally used for structural reconstruction, elimination of I&I and prevention against low levels of corrosion. In some cases, cementitious materials are used as a base coating to level or smooth out the existing structure surface before applying a polymer top coat.
3. Polymers (Epoxy, Polyurethane, Polyurea Coatings) – Generally used for corrosion protection and to eliminate I&I. Epoxies and urethanes can have structural benefit when applied sufficiently thick. When applying multiple components to rehabilitate a manhole it is extremely important that all components are compatible with each other and each is properly cured and prepared before the application of the next product. Application of polymers on new manhole and concrete structures requires specific attention to off-gassing of the concrete causing unwanted pin-holing in the material during and immediately after application. As a general rule, cured concrete will off-gas air when the structure temperature is rising and will inhale when the concrete temperature drops. New or green concrete typically off-gasses almost continually and often requires penetrating primers to densify the surface prior to coating application. The Manufacturer of each system should be contacted to determine what the effect off-gassing has on the product and the best procedures for the application of polymers directly onto new concrete structures. The Contractor should be experienced in coating both new and old concrete structures.
4. Chimney Seals – Used for defects in the adjustable portion of the manhole. Seals can be used as a stand-alone product or in conjunction with a cementitious or polymer product. Seals can be applied both internally and externally to the manhole structure and can be comprised of polymer applied, cured-in-place or rubber mechanical composition.
5. Barrel Joint Seals – Includes joints between pre-cast manhole sections where leaking joints are contributing groundwater infiltration and no structural deficiencies are present.
6. Bench and Channel Inserts - Preformed corrosion resistant inserts installed in the bench and channel of the manhole.
7. Dish Inserts – Manhole opening cover. Prevents water from entering through the manhole cover holes.

References:

NASSCO Manhole Assessment Certification Program (MACP) - A certification program

administered by NASSCO to train manhole inspection personnel on the standard coding of defects found in the manhole structure.

PART 1 - GENERAL

A. These Specifications include the minimum requirements for the rehabilitation of manholes as shown on the plans included as part of these contract documents.

B. The rehabilitation of manholes shall be accomplished by the application or installation of rehabilitation components either individually or together. These may include grouts, protective coatings, a variety of linings, inserts, seals and mechanical devices that, when installed, shall protect the manhole structure, seal it from I & I, rebuild it structurally (if needed) and provide chemical resistance for the length of time specified. Several manhole components such as frames, covers and steps will typically be replaced rather than rehabilitated. The Contractor is responsible for the accurate and complete installation, and warranty of each manhole Rehabilitation Component System (SYSTEM) specified by the Owner.

C. The manhole SYSTEM's installed shall cause no adverse effects to any of the Owner's processes or facilities either during or after application. The use of the product, by the Contractor, shall not result in the formation or production of any detrimental compounds or by-products at the wastewater treatment plant. The Contractor shall notify the Owner and identify any by-products produced as a result of the installation operations, test and monitor the levels, and comply with any and all local waste discharge requirements. The Contractor shall cleanup, restore existing surface conditions and structures, and repair any of the manhole SYSTEM's installed and determined to be defective. The Contractor shall conduct installation operations and schedule cleanup in a manner to cause the least possible obstruction and inconvenience to traffic, pedestrians, businesses, and property owners or tenants.

D. The prices submitted by the Contractor, shall include all costs of permits, labor, equipment and materials for the various bid items necessary for furnishing and applying, complete in place, manhole SYSTEM's, in accordance with these specifications. All items of work not specifically mentioned herein which are required to make the product perform as intended and deliver the final product as specified herein shall be included in the respective lump sum and unit prices bid in the Proposal. These Specifications include the minimum requirements for the rehabilitation of manholes defined herein and as shown on the plans included as part of these contract documents.

E. The Contractor shall make every effort to maintain service usage throughout the duration of the project. Property Owners who may be affected by the rehabilitation process shall be advised in writing concerning the nature and duration of any interruption in sewer or drain service. Advance notice shall be provided at least one week prior to any interruption. Additionally, verbal or written notice shall be provided 24-48 hours prior to any interruption. When the interruption is ended, residents are to be advised either verbally, or in writing immediately. During the course of the rehabilitation and any associated service interruption, the residents shall be kept regularly informed regarding any matters that

affect them.

1.1 DESCRIPTION OF WORK AND PRODUCT DELIVERY

A. These Specifications cover all work necessary to furnish and install, a variety of protective manhole SYSTEM's. The Contractor shall deliver a finished product(s) including all materials, labor, equipment, and services necessary for traffic control, bypass pumping and/or diversion of sewage flows, cleaning equipment, product installation, all quality controls and samples for performance of required material tests, final inspection and warranty work, all as specified in these contract documents and at the quantities of each component contained in the Proposal.

B. The SYSTEM's furnished shall be complete integrated and compatible systems including all materials, manufacturer's recommended equipment and manufacturer's installation procedures. The SYSTEM manufacturer may submit to the Owner, a minimum of 14 calendar days in advance of a bid date, all required product information to obtain pre-approval SYSTEM status. Those SYSTEM's that have been pre- approved will not need to be re-submitted as required in the submittal section of these specifications unless any of the system components have changed from those pre- approved by the Owner. All other component products will be required to meet the submittal requirements as contained herein.

C. The SYSTEM's installed shall be free of all defects that will affect the design and service life and operation of the manhole.

D. The SYSTEM installed shall eliminate water leakage into the manhole and prevent water or vapors to leak out of the manhole through pin-holes or other defects. If leakage occurs either in or out of the manhole the Contractor shall seal these areas to stop all leakage using a material compatible with the SYSTEM applied and as specified by the manufacturer. If leakage occurs through any SYSTEM applied to the manhole, the SYSTEM shall be repaired or removed as recommended by the manufacturer. All repair materials shall have the same estimated life expectancy than the SYSTEM installed. Final approval of the SYSTEM installation will be based on meeting the acceptance test requirements for each SYSTEM applied/installed.

E. The SYSTEM (applied to the intended structure) shall be designed against corrosion and typical chemicals found in domestic sewage, unless otherwise specified in the detailed section of the contract documents. The manufacturer of the SYSTEM shall provide testing data that supports their SYSTEM's design and service life.

F. SYSTEM'S may be designed to rehabilitate the existing manhole against corrosion, I&I, structural build-back, or a combination of the three. In certain cases the preparation, certification and submission of design calculations by a registered professional engineer is required for manhole replacement and rehabilitation technologies. All design must be supported by third party testing and documentation for the exact product that is being submitted.

   1. A manhole is specified to be structurally replaced, being able to sustain all earth, hydrostatic and dynamic loading without support by the existing structure. Certification and submission of design calculations by a registered professional engineer is required

2. A manhole is specified to be structurally rebuilt, with build-back materials, or rehabilitated to sustain hydrostatic loading by groundwater. Certification and submission of design calculations by a registered professional engineer is required
3. A manhole is specified to receive a corrosion protective coating sufficiently thick to totally protect the existing host structure from further corrosion, deterioration and water vapor transmission. Certification and submission of design calculations by a registered engineer may be required
4. A manhole is specified to receive a coating to renew mortar or other deteriorated components of a manhole but has no specified longevity or corrosion resistance requirement. The manufacture's third party testing will be acceptable for application suitability.
5. A manhole is specified to receive patch repair materials for portions of the manhole. The manufacture's third party testing will be acceptable for application suitability.

G. All manhole steps shall be removed prior to a coating or lining application.
H. Flow from existing active service connections entering the manhole shall be maintained or bypassed if the flow will affect proper SYSTEM application/installation.
I. All component materials furnished, as part of this contract shall be marked with detailed product information, stored in a manner specified by the manufacturer and tested to the requirements of this contract.
J. Testing shall be executed by the owner or by the contractor in the presence of the owner. Warranty inspections shall be executed by the Owner or its representative. Any defects found shall be repaired or replaced by the Contractor.
K. The Contractor shall furnish all samples for product testing as required in the contract documents. The Owner shall take possession of the samples for testing and shall maintain a chain of custody, deliver the samples and pay an approved laboratory for all material and product testing performed under this contract.
L. Compensation for all work required for providing test samples shall be included in the various SYSTEM items contained in the Proposal.

1.2 SCOPE OF WORK INCLUDED

A. A detailed description of each SYSTEM included in the contract, complete with estimated quantities.

1.3 PERFORMANCE WORK STATEMENT (PWS) SUBMITTAL

A. The Contractor shall submit, to the Owner, a Performance Work Statement (PWS) at the pre-construction meeting, which clearly defines the proposed manhole SYSTEM delivery in conformance with the requirements of these contract documents. Unless directed otherwise by the Owner, the PWS shall at a minimum contain the following:

B. Clearly indicate that the SYSTEM will conform to the project requirements as outlined in

the Description of Work, Scope of Work Included and as further delineated in these contract documents.

C. Certify at the time of the bid, that the designated manholes, included in the contract documents, were visited, inspected and evaluated by the Contractor or Contractor's Representative, prior to submitting a bid.

D. Where the scope of work is specifically delineated in the contract documents, a detailed installation plan describing all preparation work, cleaning operations, pre- inspections, sewage flow maintenance, traffic control, installation procedure, method of curing, quality control, testing to be performed, final inspection, warrantees furnished and all else necessary and appropriate for a complete SYSTEM application/installation, shall be submitted.

E. A detailed installation schedule shall be prepared, submitted and conform to the requirements of these contract documents.

F. The manufacturer's description of the SYSTEM materials are to be furnished for the project. Material descriptions shall be sufficiently detailed in the submittals to verify conformance to these specifications and/or shall conform to the pre-approved SYSTEM submission.

G. The Contractor's experience for each type of rehabilitation component shall be as more specifically delineated in the detailed specifications. The name and experience of each lead individual performing work on this contract, for each component, shall be submitted with the PWS. If personnel are substituted after submittal of the PWS, the name and experience of the individual shall be submitted to the Owner for approval before starting any work.

H. Engineering design calculations may be requested for verification of structural design submittals. These calculations shall be in accordance with the applicable ASTM or industry standard for each structural design component/system to be installed. These calculations shall be performed and certified by a registered Engineer.

I. Information on the SYSTEM and all tools and equipment required for a complete application/installation, shall be submitted. The PWS shall identify which tools and equipment will be redundant on the job site in the event of equipment breakdown. The Contractor shall outline the mitigation procedure to be implemented in the event of key equipment failure during the installation process.

J. A detailed description of the Contractor's proposed procedures for cleaning and preparing the manhole structure, prior to applying/installing the SYSTEM shall be submitted as part of the PWS. The Contractor will describe in detail what substrate testing will be performed by the contractor to verify acceptability of the SYSTEM material to be applied.

K. Compensation for all work required for the SYSTEM submittal of the PWS shall be included in the Mobilization Item contained in the Proposal.

1.4 SUBMITTALS

A. Product data submittals required for all rehabilitation SYSTEM's proposed for installation under this contract shall include:

1. SYSTEM material type and manufacturer to be used including: catalog data sheets,

ASTM references, material composition, manufacturers recommended specifications, component physical properties and chemical resistance. (PWS)

2. Manufacturer's detailed description of the recommended procedures for handling and storing materials including a proposed method for monitoring temperatures of the storage location, if applicable to the specific SYSTEM material. (PWS)
3. Manufacturers detailed description of the recommended material installation/application process including mixing, additives, set time, cure time (return to service) and all equipment required for quality product delivery. (PWS)
4. Technical data sheet describing each rehabilitation component to be applied/installed, stating the expected longevity of the component in a wastewater environment. Data shall be based on independent third party tests. (PWS)
5. Manufacturer's detailed description of all required field testing processes and procedures. (PWS)
6. Copies of independent testing performed on the rehabilitation component, indicating that the product meets the requirements as specified in these contract documents and the manufacturers design. (PWS)
7. Technical data sheet and project specific data for manhole repair materials to be used in conjunction with each rehabilitation component(s) including application cure time and surface preparation procedures. (PWS)
8. Certification that backup installation equipment is available on the job site or can be delivered to the job site by the morning of the next business day. (PWS)
9. Shipping information including: (Jobsite)
    a. Shipped item, including manufacturer, stock and lot number
    b. Date shipped including origination and delivery locations
    c. Shipping method and carrier
    d. All shipping, storage and safety requirements including MSDS documents.
    e. Date delivered to project site including name and signature of receiver
10. By-Pass Pumping Plan if applicable to the SYSTEM's being installed. (PWS)
11. Traffic Control plan, if applicable for the SYSTEM's being installed.
12. Certified statement, from the manufacturer, that the contractor/installer is an approved installer of the SYSTEM with certificates of completed training for each crew member involved in each rehabilitation component. This requirement shall comply with the specific SYSTEM requirements specified in the contract documents. (PWS)
13. For each manhole rehabilitation, a complete and accurate record of all SYSTEM's installed/applied shall be prepared by the Contractor. The record shall include identifying manhole number, location, quantities of rehabilitation components installed.
14. Submittal of all quality assurance documentation and test reports for SYSTEM's installed. (After Rehabilitation Completion)
15. Refer to section 1.1.F for design requirements.

1.5 QUALITY CONTROL PLAN (QCP)

A. A detailed quality assurance plan (QCP) shall be submitted to the Owner that fully represents and conforms to the quality control requirements of these specifications. At a minimum the QCP shall include the following:
B. A detailed description of the proposed quality controls to be performed by the Contractor.
C. Defined responsibilities, of each of the Contractor's personnel, for assuring that all quality control requirements, for this contract, are met. These shall be assigned, by the Contractor, to his specific personnel.
D. Proposed procedures for quality control, product sampling and testing shall be defined.
E. Proposed methods for product performance controls, including method of and frequency of product sampling and testing both in raw material form and cured product form as applicable.
F. A scheduled performance and product test result reviews between the Contractor and the Owner at a scheduled job meeting.
G. Inspection forms and guidelines for quality control inspections shall be prepared in accordance with the standards specified in this contract and submitted with the QCP.
H. Inspector training, by a qualified trainer, for the Owner's inspectors shall be provided as further defined in Section 1.9. This training shall be prior to SYSTEM installation, include both technical and field training and include all key aspects of visual inspection and sampling procedures for testing requirements. On smaller projects having an estimated duration of less than two (2) weeks of rehabilitation work, the system manufacturer shall furnish a check list containing key elements of the SYSTEM criteria, represented in the QCP, for the Owner's representative to ensure that quality control and testing requirements are performed in accordance with the contract documents.
I. Proposed methods and procedures for SYSTEM repair or replacement, (as defined in Section 1.6) in the event of product defects or total failure.

1.6 SYSTEM REPAIR/REPLACEMENT

A. Due to mechanical damage or defects in application, SYSTEM's will occasionally need to be repaired or replace a portion of the installed product. The Manufacturer shall outline specific repair or replacement procedures for potential issues that may occur during the application of the SYSTEM. Repair/replacement procedures shall be as recommended by the SYSTEM Manufacturer and shall be submitted as part of the PWS.
B. Issues, that may not affect the operation and long term life of the product, shall be identified and defined by the Manufacturer.
C. Repairable issues that may occur in the SYSTEM shall be specifically based on Manufacturer's recommendations, including a detailed step-by-step repair procedure, resulting in a finished product meeting the estimated life cycle of the component and requirements of these contract specifications.
D. Un-repairable issues that may occur in the SYSTEM shall be clearly defined based on the Manufacturer's recommendations. The Contractor together with the manufacturer shall define the best recommended procedure for the total removal and replacement of the

SYSTEM.

E. The Contractor shall receive no additional compensation for the repair or replacement of SYSTEM's deemed non-conforming to the requirements of these contract documents and unacceptable by the Owner.

1.7 REFERENCES

A. ASTM and other applicable standard documents, that are listed in the detailed specifications, are made a part of these specifications by reference to the extent stated herein and shall be the latest edition thereof. Where there are differences between codes, standards and these specifications, these specifications shall govern.

1.8 DELIVERY, STORAGE AND HANDLING

A. Rehabilitation component materials are to be kept dry, protected from weather and stored under cover and in accordance with manufacturer's recommendations.
B. Polymer and Cementitious protective coating materials are to be stored at temperatures as recommended by the manufacturer and handled according to their material safety data sheets. Do not store near flame, heat or strong oxidants.

1.9 INSPECTOR TRAINING

A. The Contractor shall provide training by a manufacturer's approved trainer for the Owner's representatives/inspectors on the specific product being installed.
B. The inspector training shall include a sufficient amount of time to instruct the inspectors on the basic concepts of the technology and what aspects are important to review and inspect in the field while the SYSTEM is being installed by the Contractor. The inspector training shall also include a sufficient amount of time to instruct the inspectors on what needs to be inspected in the field, a demonstration of the specific process, what needs to be inspected for each SYSTEM and what documentation is needed to verify that the SYSTEM has been installed in accordance with the contract documents.

1.10 SAFETY

A. The Contractor shall conform to all work safety requirements of pertinent regulatory agencies, and shall secure the site for working conditions in compliance with the same. The Contractor shall erect such signs and other devices as are necessary for the safety of the work site.
B. The Contractor shall perform all of the Work in accordance with applicable OSHA safety standards. Emphasis shall be placed upon the requirements for entering confined spaces and with the equipment being utilized for manhole rehabilitation components. Confined space, defined as any space having one or more of the following characteristics:
   1. Limited openings for entry and exit.

2. Unfavorable natural ventilation.
3. Not designed for continuous worker occupancy.

C. The Contractor shall have on the job site at all times at a minimum the following safety equipment:
   1. Gas monitor capable of testing and detecting for combustible gas, oxygen deficiency and hydrogen sulfide.
   2. Confined space access and retrieval winch system.
   3. Ventilating fans with large diameter ventilating hose.
   4. Supplied air respirator, MSHA/NIOSH approved type.
   5. Safety harness and life lines.
   6. Other equipment as may be required for a specific project
   7. All equipment to be available for use, in sufficient quantity, by the Contractor, Engineer and Owner for the duration of the project.

D. All entries into or work within confined spaces shall be conducted in accordance with the U.S. Department of Health and Human Services/National Institute for Occupational Safety and Health [DHHS (NIOSH)] Publication No. 87-113, A Guide to Safety in Confined Spaces.

E. The Contractor shall submit a proposed Safety Plan to the Owner, as part of the PWS and prior to beginning any work, identifying all competent persons, equipment and operating procedures. The plan shall include a description of a daily safety program and daily safety meeting for the job site and all emergency procedures to be implemented in the event of a safety incident. All work shall be conducted in accordance with the Contractor's submitted Safety Plan.

F. Compensation for all work required for the submittal of the Safety Plan shall be included in the Lump Sum item for Mobilization contained in the Proposal.

1.11 WARRANTY

A. The materials used for the project shall be certified by the manufacturer for the specified purpose. The manufacturer shall warrant the SYSTEM to be free from defects in raw materials for one (1) year after installation or from the date of acceptance by the Owner, whichever is later. The Contractor shall warrant the installation of the rehabilitation component for a period of one (1) year. The Owner shall hold in retainage an amount equal to 10% of the final contract cost, until performance warranty inspections have been satisfactorily completed, as determined by the Engineer. During the one (1) year warranty period if the rehabilitation component, fails, delaminates, peels or shows any defect, which may materially affect the integrity, strength, function and/or operation of the manhole structure, it shall be immediately repaired at the Contractor's expense in accordance with procedures included in Section 1.6 Rehabilitation Component Repair/Replacement.

B. After a manhole has been renewed and for a period of time up to one (1) year following

completion and final acceptance of the project, the Owner may inspect all or portions of the renewed manholes. The specific locations will be selected at random by the Owner and will include all types of structures from this project.

C. If any of the rehabilitation components have developed defects since the time of "Quality Assurance And Testing," the defects shall be repaired and/or the component shall be replaced as defined in Section 1.6 Rehabilitation Component System (SYSTEM) Repair/Replacement. Owner may inspect all manholes where SYSTEM's have been applied/installed under this contract.

D. All verified defects shall be repaired and/or replaced by the Contractor and shall be performed in accordance with Section 1.6 Rehabilitation Component System Repair/Replacement and per the original specifications, all at no additional cost to the Owner.

1.12 WARRANTY INSPECTIONS

A. Visual inspection to determine integrity of SYSTEM materials and water-tightness will be conducted within 3 months before the expiration of the guarantee period.

B. If possible, inspection should be performed in the spring during high groundwater and frequent rainfall events.

C. All cost for the warranty inspections, and any resulting repairs, shall be the responsibility of the Contractor.

D. Ten (10) percent of manholes rehabilitated shall be inspected, at locations randomly selected, by the Owner.

1. No infiltration or inflow shall be visible in the renewed manhole.
2. If any SYSTEM fails the warranty inspection, the Owner shall inspect all SYSTEM's installed in the contract, together with Contractor.

1.13 MEASUREMENT AND PAYMENT

A. Measurements for each item furnished and installed to the satisfaction of the Owner shall be at the units of measure contained in the Proposal. Manhole coatings and linings will be measured over the entire installed length. Coating and/or lining of the channel shall be at the Lump Sum price per each bid therefore in the Proposal.

B. Payment for each SYSTEM furnished and installed, in accordance with the contract documents and to the satisfaction of the Owner, will be at the unit or lump sum prices bid therefore in the Proposal.

PART 2 - REHABILITATION COMPONENT SYSTEM PRODUCTS

The SYSTEM'S defined herein include those identified as commercially accepted methods for manhole rehabilitation. Methods or products not defined herein must be pre-approved by the Owner before use on this project under these specifications.

2.1 CHEMICAL GROUTS

A. REFERENCES

- ASTM F2414-03 Standard Practice for Sealing Sewer Manholes Using Chemical Grouting

B. CHEMICAL GROUT TYPES

1. The Contractor shall specifically define the type of chemical grout that will be furnished for the project. Depending on the specific application either Acrylic or Acrylate Based Grout or Urethane Based Grout shall be furnished. The type of grout to be used shall be in accordance with the manufacturer's recommendation for the specific application area of the project.
2. Contractor shall deliver materials to job site in undamaged, unopened containers bearing manufacturer's original labels. Materials used as chemical grout shall be transported, stored, mixed and applied in manner prescribed by the manufacturer of the specified materials, as detailed in published data provided by manufacturer.

C. MATERIALS

1. Contractor shall provide a chemical sealant solution containing principal chemical sealant constituent, initiator (trigger) and catalyst specifically recommended for the purpose of sealing leaks in manholes. Chemical sealant constituent, initiator (trigger) and catalyst shall be compatible when mixed. Solution shall have ability to tolerate dilution and react in moving water. After final reaction, it shall be a stiff, impermeable, yet flexible gel. The grout proportions shall be such that dilute aqueous solutions, when properly catalyzed will form stiff gels. Materials provided shall gel in a predetermined time period when exposed to normal groundwater pH ranges, and be capable of formula adjustments to compensate for changing conditions. Final reaction shall produce a continuous, irreversible, impermeable stiff Gel and shall not be rigid or brittle.
2. The grout shall exhibit the following properties:
3. Controllable reaction times and shrinkage through the use of chemicals supplied by the same manufacturer. The minimum set time shall be established so that adequate grout travel is achieved.
4. Resistance to chemicals, to most organic solvents, mild acids and alkali.
5. The grout shall be non-toxic in its cured form.
6. Sealing material shall not become rigid or brittle when subjected to a dry environment. The material shall be able to withstand freeze/thaw and moving load conditions as verified by third party testing.
7. The Contractor shall identify the type of grout and additives used on the contract and furnish references of successful use in similar applications. The Contractor shall select the choice of materials based on chemical and physical properties and expected performance for the requirements of the contract documents.
8. Grout conditions may be adjusted for catalyzing the reaction, inhibiting the reaction, lowering the freezing temperature the grout solution, adding fillers, providing strength or for inhibiting root growth according to the instructions of the grout manufacturer and in the specified quantities as recommended by the grout manufacturer.

D. MIXING & HANDLING

1. Mixing and handling of chemical grout, which may be toxic under certain conditions, shall be done in such a manner as to minimize any hazard to personnel and shall be in accordance with the manufacturer's recommendations. It is the responsibility of the Contractor to provide appropriate protective measures to ensure that chemicals are

handled only by trained and authorized personnel. All equipment used to install the grout shall be as recommended by the manufacturer and only personnel thoroughly familiar with all aspects of the grouting material and meeting the qualification requirements specified herein, shall perform the actual grouting operation.

2.2 CEMENTITIOUS MANHOLE RESTORATION

A. REFERENCES:

- ASTM F2551 Standard Practice for Installing a Protective Cementitious Liner System in Sanitary Sewer Manholes
- ASTM C150 Standard Specification for Portland Cement Type I ASTM C33-86 Standard Specification for Concrete Aggregates
- ASTM C78 Standard Test Method for Flexural Strength of Concrete; Using Simple Beam with Third Point Loading
- ASTM C109/C109M-05 Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens)
- ASTM C157/C157M-06 Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete
- ASTM C267 Test Methods for Chemical Resistance of Mortars, Grouts and Monolithic Surfacings and Polymer Concretes
- ASTM C293-02 Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Center-Point Loading)
- ASTM C309 Specification for Liquid Membrane-Forming Compounds for Curing Concrete
- ASTM C321-00(2005) Standard Test Method for Bond Strength of Chemical-Resistant Mortars
- ASTM C348-02 Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars
- ASTM C494-86 Standard Specification for Chemical Admixtures for Concrete
- ASTM C496/C496M-04e1 Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens
- ASTM C666/C666M-03 Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing
- ASTM C882-05 Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete by Slant Shear

B. GENERAL
1. The Contractor shall provide a cementitious restoration material designed for structural build-back, I&I abatement, corrosion resistance, and repairing inverts to design requirements. All materials applied to a structure shall be compatible, as specified by the manufacturer.

C. MANHOLE REPAIR MATERIALS
1. Infiltration Control – Cementitious Material

a. All fast setting materials furnished shall be designed specifically for leak control, to be applied in dry powder form, with no prior mixing of water, directly to active leaks under hydrostatic pressure in manholes or related structures, in accordance with the manufacturer's recommendations.

2. Infiltration Control - Oakum Water Plugs
    a. Rapid setting, oil free oakum and hydrophilic grout to seal active water leaks prior to applying other SYSTEM's
    b. Oil-free oakum meeting Federal Specification HH-P-117
    c. Two-part urethane resin.
3. Invert Repair and Patching
    a. All material furnished, by the Contractor, shall be designed to fill large voids in manhole walls and to repair or reconstruct inverts where no hydrostatic pressure exists. Material shall consist of rapid setting cements, mono-crystalline quartz aggregates, and various accelerating agents. Material shall not contain chlorides or metallic particles and shall be applied in accordance with the manufacturer's recommendations.
    b. Repair and Patching Materials shall have its bond strength tested to substrate failure according to ASTM C952 and be compatible with all other material components applied to the manhole.
4. Grouting mix:
    a. For stopping severe infiltration, the Contractor shall provide a polymer solution that reacts freely with water to form a strong film, gel, or foam of polyurethane. See specification section 2.1 Grouts.
5. Cementitious Coating Restoration Materials for manhole walls, channels, corbels, chimneys and benches. The Contractor shall install cementitious restoration materials that shall be specifically designed for the rehabilitation of manholes and other related wastewater structures. Liner materials shall be cement based, poly-fiber reinforced, shrinkage compensated, and enhanced with chemical admixtures and siliceous aggregates. Liner materials shall be mixed with water per manufacturer's written specifications and applied using equipment specifically designed for, troweling, low-pressure spray or centrifugal spin casting application. All cementitious liners shall be troweled to densify and smooth out the surfaces.
6. Refer to section 1.1.F for design requirements.

2.3 POLYMER SYSTEMS

A. REFERENCES

- ASTM D543 - Resistance of Plastics to Chemical Reagents. ASTM D638 - Tensile Properties of Plastics.
- ASTM D695 - Compressive Properties of Rigid Plastics.
- ASTM D790 - Flexural Properties of Unreinforced and Reinforced Plastics.
- ASTM D2240 - Standard Test Method for Rubber Property—Durometer Hardness ASTM D4060 - Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abrader
- ASTM D4414 - Standard Practice for Measurement of Wet Film Thickness of Organic Coatings by Notched Gages
- ASTM D7234 - Pull-off Strength of Coatings Using a Portable Adhesion Tester. SSPC SP-13/NACE No. 6 – Surface Preparation of Concrete
- NACE SP0188 - For performing holiday detection

- CIGMAT - Evaluation of Liner System for Wastewater Concrete and Clay Brick Facilities
- ASTM G210 - Severe Wastewater Analysis Test

B. EXISTING SUBSTRATE PREPARATION
   1. Standard Portland cement or new concrete (not quick setting high strength cement) must cure a minimum of 28 days prior to application of the coating product(s).
   2. Remove existing coatings prior to application of the SYSTEM which may affect the performance and adhesion of the SYSTEM.
   3. Thoroughly clean, removing all laitance and prepare existing products to effect a mechanical bond with the SYSTEM.
   4. Manufacturer shall recommend specific methods for surface preparation.

C. REPAIR AND RESURFACING PRODUCTS
   1. Repair products shall be used to fill voids, bug holes, and/or smooth transitions between components prior to the installation of the SYSTEM. Repair materials must be properly cured and must be compatible with the SYSTEM and shall be used and applied in accordance with the manufacturer's recommended requirements.
   2. Resurfacing products shall be used to fill large voids, lost mortar in masonry structures, smooth deteriorated surfaces and to rebuild severely deteriorated structures.
   3. The following products may be accepted and approved as compatible repair and resurfacing products for use within the specifications:
   4. 100% solids, solvent-free polymer grout specifically formulated for epoxy polymer top coating compatibility.
   5. Factory blended, rapid setting, high early strength, fiber reinforced, non-shrink repair mortar that can be trowelled or pneumatically spray applied maybe approved if specifically formulated to be suitable for polymer top coating with the specified polymer product. The length of resurfacing material cure required before polymer top-coating, shall be as recommended by the manufacturer.
   6. All repair and resurfacing materials should be properly cured and prepared for surface top-coat application.

D. COATING PRODUCTS
   1. Refer to section 1.1.F for design requirements.

E. SYSTEM APPLICATION
   1. Polymer System manufacturer shall provide System application procedures and requirements.
   2. Manufacturer recommended and approved application equipment.
   3. Hard to reach areas, primer application and touch-up may be performed using hand tools.

2.4 MANHOLE CHIMNEY SEALS

A. REFERENCES
- ASTM C923-07 Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals
- ASTM D412-06a Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers -Tension

- ASTM D638-03 Standard Test Method for Tensile Properties of Plastics
- ASTM D395-03 Standard Test Methods for Rubber Property - Compression Set ASTM - D790 Standard Test Methods for Flexural Properties of Un-reinforced and Reinforced Plastics and Electrical Insulating Materials
- ASTM D695-02a Standard Test Method for Compressive Properties of Rigid Plastics ASTM D2240-05 Standard Test Method for Rubber Property - Durometer Hardness ASTM D-638-03 Standard Test Method for Tensile Properties of Plastics
- ASTM D790-07 Standard Test Methods for Flexural Properties of Un-reinforced and Reinforced Plastics and Electrical Insulating Materials
- ASTM D2344/D2344M-00(2006) Standard Test Method for Short-Beam Strength of Polymer Matrix Composite Materials and Their Laminates
- ASTM: D-3039 ASTM D3039/D3039M-00(2006) Standard Test Method for Tensile Properties of Polymer Matrix Composite Materials

B. GENERAL
   1. Manhole frame sealing includes the sealing of the frame joint area and the chimney above the cone of the manhole with either a manufactured or applied internal flexible seal. See the Manhole Casting Detail in Appendix B of this contract for sealing products and details.
   2. The seal shall be designed to prevent leakage of water into the manhole.

C. MECHANICAL FRAME SEAL MATERIAL
   1. The flexible sleeve portion of the seal shall be extruded or molded from a high quality rubber compound, which conforms to the resilient material properties prescribed in ASTM C 923 Table 1.
   2. The sleeve shall have an unexpanded vertical height sufficient to seal the entire grade adjustment area and be corrugated or pleated to allow for vertical and horizontal movement.
   3. The upper and lower sections of the sleeve that compress against the frame casting, and manhole chimney or cone shall have an expansion band recess capable of restraining the band during expansion and after installation.
   4. Any extension used in conjunction with the sleeve to increase chimney coverage shall be manufactured of the same material in conformance with ASTM C923, Table 1 and be designed with an extension flap which fits into or behind the expansion band recess allowing for joining the components with an expansion band.
   5. The expansion bands used for compressing the sleeve and extensions against the manhole shall be fabricated stainless steel, conforming to the applicable section 4.2 of ASTM C 923. The manufacturers mechanism used to expand the bands shall have the capacity to develop sufficient pressure to create a watertight seal. The bands shall be permanently held in the expanded position with a positive locking mechanism that conforms to the applicable section 4.2 of ASTM C 923.
   6. The installed internal seal or its appurtenances shall not extend far enough into the manhole opening to prevent or unduly restrict manhole entry. If the seal is constructed of another flexible material, it shall have both tensile and tear strength equal to or greater than that of the natural or synthetic rubber when tested in accordance with the applicable ASTM procedures.
   7. Physical Properties
      a. Extruded or molded from a high grade rubber compound as per ASTM C923.
   8. The installed seal shall remain flexible, to allow for repeated vertical movements of the frame due to frost lift, ground movement, or other causes and/or repeated

horizontal movement of the frame due to thermal movement of pavement or other causes.

D. POLYMER CHIMNEY SEAL
1. Polymer manhole chimney seals shall be designed to prevent leakage of water into the manhole through the frame joint area and the area above the manhole cone including all extensions to the chimney area. Extensions shall include but are not limited to lifting rings, brick and/or block material that may have been used to achieve grade.
2. The polymer chimney seal material shall be corrosion resistant.
3. Mil thickness shall be determined by the manufacturer. Refer to section 1.1.F for design requirements.
4. The polymer chimney seal may require a primer resin applied to the entire surface before application. The sealing system shall line the interior of the adjustment area from the cone/top of the manhole and onto the inside of the casting. If the manhole has been relined prior to the seal installation the seal shall cover a minimum of 6 vertical inches to cover casting cone interface.

2.5 REPLACE MANHOLE FRAME AND COVER

A. REFERENCE
- ASTM A48/A48M-03 Standard Specification for Gray Iron Castings Class 35B AASHTO Standard Specifications for Highways and Bridges

B. CONDITION
1. The manhole casting shall be free from sand or blow holes and other defects. The machine bearing surfaces of the frame and cover shall have even bearing.
2. New manhole castings shall be as detailed in Appendix B.

2.6 MANHOLE ADJUSTMENT MATERIALS

A. REFERENCE
- ASTM D4976-06 Standard Specification for Polyethylene Plastics Molding and Extrusion Materials
- AASHTO Standard Specifications for Highways and Bridges

B. MATERIALS
1. Manhole frame adjustments shall be HDPE, PVC, EPP, rubber, brick, block, cement or poured concrete as shown in detail on the contract documents.
2. Measurement shall be by vertical linear foot of adjustment materials provided and/or installed.
3. Payment shall be at the price per vertical linear foot or as a lump sum as stated in the bid documents.
4. Manhole grade adjustment rings shall be as detailed in Appendix B.

2.7 MANHOLE STEPS

A. REFERENCES
- ASTM C478-07 Standard Specification for Pre-cast Reinforced Concrete Manhole Sections

- ASTM A615/A615M-07 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
- AASHTO M199

B. MATERIAL

1. Reinforcing bar manhole steps shall conform to the minimum requirements of ASTM C478, Para, 11. The reinforcing bar shall be grade 60, deformed 1/2inch reinforcing bar conforming to the requirements of ASTM A615

PART 3 - EXECUTION

A. GENERAL
   1. Maintain all flow in the manhole throughout duration of project.
   2. Provide 48 hour notice to the Owner prior to start of work for Inspector to review and document materials and equipment to be used, for Quality Assurance and testing requirements.

B. CONTRACTOR EXPERIENCE
   1. Current documentation, from the SYSTEM product manufacturer, certifying that the Contractor's training, the Contractor's personnel and equipment comply completely with their product Quality Assurance requirements.
   2. For a manhole coating or lining product to be considered for this project, a minimum of 1000 vertical feet of documented manhole rehabilitation must have been completed by the Contractor in the previous three (3) year period.
   3. For all SYSTEM products, to be considered for this project, a minimum of a three (3) year successful installation history must be documented.
   4. In all cases a minimum of five (5) recent verifiable references of the Contractor's work is required, indicating the successful application of the SYSTEM products of the same material type as specified herein or to be furnished by the Contractor and applied in a similar project environment as included in these contract specifications.

C. MANHOLE PREPARATION
   1. Bypass Pump sewage, in the manhole, as required
   2. Clean interior surfaces of manhole of debris, dirt, oil, grease, remains of old coating materials, and any other extraneous materials.
   3. Pressure wash manhole walls to remove loose mortar, concrete and debris. Pressure washing levels, used for cleaning, shall be as recommended by the manufacturer.
   4. Repair irregularities in manhole using materials, compatible with proposed resurfacing material, as recommended by the manufacturer.
   5. Repair leakage in manhole using materials, compatible with proposed resurfacing material, specified in these contract specifications.
      a. Trim and grout incoming laterals and pipes as required and/or specified.
      b. Remove debris from manhole and incoming sewer connections.
      c. Handle cleaning water to prevent water and residue from causing damage.
      d. Do not discharge debris downstream through the sanitary sewer system.
      e. Filter solids-laden water through a de-silting device.
      f. Properly dispose of debris and residue from cleaning and other construction

operations in a manner satisfactory to Owner and authority having jurisdiction over area where work site is located.

3.1 CHEMICAL GROUT

A. GENERAL
   1. Grouting should only be performed on a structurally sound manhole unless the grout is used to prevent water from entering the manhole during application of a lining or coating system. All structural repairs, adjustments to the frame and cover and installation of grade rings shall be completed prior to beginning the grouting operation. Normal grouting operations shall be performed at the temperatures as recommended by the manufacturer.

B. CHEMICAL GROUTING APPLICATION
   1. Grouting applications may include sealing a manhole from infiltration/Inflow prior to application of a coating or lining or other structural rehabilitation component or using the grout for sealing the entire manhole structure. If the entire manhole is to be sealed, grouting shall include corbel, wall, pipe connections and seals, bench and invert as recommended by the manufacturer of the grouting material.

C. DRILLING AND GROUT INJECTION
   1. Drilling grout injection holes in the manhole in strategic locations to re-direct flow coming through cracks and other defects in the wall, or to seal the entire exterior surface of the manhole, shall be in accordance with the recommendations of the grout manufacturer.
   2. Grout shall be injected through the drilled holes using the recommended probe and applying pressures that will effectively inject the grout but, not cause damage to the manhole structure or the surrounding area.
   3. Grout typically, shall be injected through the lowest holes first, working the grout higher until the manhole is externally sealed with grout. Additional holes may be required to verify that the grout has encompassed the entire outside of the manhole.
   4. The injection holes shall be cleaned and patched as recommended by the manufacture.

D. TESTING AND ACCEPTANCE
   1. Visual inspection – all leakage into the manhole must be eliminated.
   2. Vacuum Testing, as required in the contract documents.

3.2 CEMENTITIOUS RESTORATION

A. GENERAL
   1. Before starting any patch work or liner application install a perforated device, catch bucket, or other straining device to prevent construction debris from entering down-stream pipes.
   2. Provide all materials, labor, equipment, etc. required to perform the work as recommended by the manufacturer and as required by the contract documents.
   3. Inspect each manhole to determine methods of stopping leaks and applying patch repairs.
   4. Promptly inform Owner of errors or discrepancies between the contract documents and the field conditions found, in order that changed conditions can be evaluated and revised directives issued in a timely manner.

5. Install all products in accordance with manufacturer's instructions regarding surface preparation, product application and curing.
6. Confirm that all material to be used, for the rehabilitation of the manhole are compatible with each other. Do not use any materials that have not been verified for compatibility.

B. SEALING ACTIVE LEAKS
   1. The work consists of hand applying a dry quick-setting cementitious mix designed to instantly stop running water or seepage in all types of concrete and masonry structures. The applicator shall apply material in accordance with manufacturer's recommendations in accordance with the following minimum specifications.
      a. The area to be repaired must be clean and free of all debris per the guidelines set forth elsewhere in these specifications.
      b. Once cleaned, prepare crack or hole by chipping out loose material to a minimum depth recommended.
      c. As recommended by the manufacturer, place a generous amount of the dry quick-setting cementitious material to the active leak, with a smooth fast motion, maintaining external pressure for 30 seconds, repeat until leak is stopped.
      d. Proper application should not require any special mixing of product or special curing requirements after application.
      e. Use of Oil-free Oakum Water Plugs.
         1. Saturate oakum with resin following approved submittals.
         2. Use additives as required.
         3. Place and cure following manufacturer's recommendations.

C. INVERT REPAIR
   1. The work consists of hand mixing and applying a rapid setting, high early strength, non-shrink patching material to fill all large voids and repair manhole channels prior to spray lining of the manhole. For invert repairs, flow must be temporarily restricted by inflatable or mechanical plugs prior to cleaning.
      a. The area to be repaired must be cleaned and free of all debris per the guidelines set forth in Section 3-C, Manhole Preparation.
      b. Mix water shall be clean potable water and require no additives or admixtures for use with cementitious patching materials.
      c. Cementitious material shall be mixed in a mortar tub or 5 gallon pail with water per manufacturer's specifications. Material should be mixed in small quantities, to avoid setting prior to placement in voids or channels.
      d. Once mixed to proper consistency, the materials shall be applied to the invert or void areas by hand or trowel. In invert applications, care should be taken to not apply excessive material in the channel, which could restrict flow. Once applied, materials should be smoothed either by hand or trowel in order to facilitate flow.
      e. Flows in channels shall be re-established when material has cured enough to withstand the flow as determined by the manufacturer.

D. APPLICATION OF CEMENTITIOUS MANHOLE LINER
   1. The work consists of troweling, spray applying and/or centrifugally spin-casting a cementitious based liner to the inside of the existing manhole. The necessary equipment and application methods to apply the cementitious based liner materials shall be only as recommended and approved by the material manufacturer.

2. Material shall be mixed with water in accordance with manufacturer's specifications. Once mixed to proper consistency, the materials shall be pumped via a rotor-stator style progressive cavity pump through a material plaster hose for delivery to the appropriate and / or selected application device. The equipment shall be as recommended by the manufacturer, matched for the material being applied.
3. If a chimney seal is required in conjunction with the lining technology, the Contractor should contact the chimney seal manufacturer to determine the proper preparation required for effectively installing the chimney seal after the coating has been applied and cured.

E. SPRAY APPLICATION OF THE CEMENTITIOUS MATERIAL.
1. All material shall be applied and finished, by the Contractor, using equipment specified by the manufacturer.
2. Material hose shall be coupled to a low-velocity spray application nozzle. Pumping of the material shall commence and the mortar shall be atomized by the introduction of air at the nozzle, creating a low-velocity spray pattern for material application.
3. Spraying shall be performed by starting at the manhole invert and progressing up the wall to the corbel and chimney areas.
4. Material shall be applied to a specified uniform minimum thickness as required by the manufacturer and as necessary for proper curing and application. Material shall be applied to the bench area in such a manner as to provide for proper drainage.
5. Material shall be troweled smooth to compact material into voids. A brush or broom finish may be applied when a top coating is desired.

F. SPIN CASTING APPLICATION OF THE CEMENTITIOUS MATERIAL
1. All material shall be applied and finished by the Contractor using equipment specified by the manufacturer.
2. Material hose shall be coupled to a high speed rotating applicator device. The rotating casting applicator shall then be positioned within the center of the manhole at either the top of the manhole chimney or the lowest point elevation corresponding to the junction of the manhole bench and walls.
3. The high speed rotating applicator shall then be initialized and pumping of the material shall commence. As the mortar begins to be centrifugally cast evenly around the interior of the manhole, the rotating applicator head shall be raised and / or lowered at a controlled retrieval speed conducive to providing a uniform material thickness on the manhole walls.
4. Controlled multiple passes are then made until the specified minimum finished thickness is attained. If the procedure is interrupted for any reason, simply stop the retrieval of the applicator head until flows are recommenced.
5. Material thickness may be verified at any point with a depth gauge and shall be no less than a uniform ½-inch. If additional material is required at any level, the rotating applicator head shall be placed at that level and application shall recommence until that area is thickened.
6. Material shall be applied only when manhole is in a saturated surface dry (SSD) state, with no visible water dripping or running over the manhole walls.
7. The low-velocity spray nozzle and the centrifugal spin casting head may be used in conjunction to facilitate uniform application of the mortar material to irregularities in the contour of the manhole walls and bench areas.

8. Troweling of materials shall begin immediately following the spray application. Initial troweling shall be in an upward motion, to compress the material into voids and solidify manhole wall. A brush or broom finish may be applied if top coating is desired.
9. Curing will take place once the manhole cover has been replaced. It is important that the manhole cover is replaced no more than 10-20 minutes after troweling is complete to avoid moisture loss in the material due to sunlight and winds.
10. Material shall not be applied during freezing weather conditions. Material shall not be placed when the ambient temperature is 37 degrees Fahrenheit and falling or when the temperature is anticipated to fall below 32 degrees Fahrenheit during 24 hours.

G. TESTING AND ACCEPTANCE
1. Visual inspection – verify no infiltration, cracks, or loose material.
2. Vacuum Testing, as required in the contract documents
3. Cementitious Material Physical Property Testing

3.3 POLYMER LINERS

A. GENERAL
1. Contractor shall comply with local, state and federal regulatory and other applicable agencies with regard to environment, health and safety during work.
2. New Portland cement concrete structures shall have cured a minimum of 28 days since manufacture prior to commencing coating installation or as recommended by the manufacturer.
3. Any active flows shall be dammed, plugged or diverted as required to ensure all liquids are maintained below or away from the surfaces to be coated.
4. Temperature of the surface to be coated should be maintained between 40 deg F and 120 deg F or as recommended manufacturer.
5. Specified surfaces should be shielded to avoid exposure of direct sunlight or other intense heat source. Where varying surface temperatures do exist, coating application shall be scheduled when the temperature is falling and not rising or as recommended by the manufacturer.
6. Prior to commencing surface preparation, Contractor shall inspect all surfaces specified to receive the coating and notify Owner, in writing, of any noticeable disparity in the site, structure or surfaces which may interfere with the work, use of materials or procedures as specified herein.

B. SURFACE PREPARATION
1. Oils, grease, incompatible existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts, or other contaminants which may affect the performance and adhesion of the coating to the substrate shall be entirely removed.
2. Concrete and/or mortar damaged by corrosion, chemical attack or other means of degradation shall be removed so that only sound substrate remains.
3. Choice of surface preparation method(s) should be based upon the condition of the structure and concrete or masonry surface, potential contaminants present, access to perform work, and required cleanliness and profile of the prepared surface to receive the specified polymer coating product, as recommended by the manufacturer.
4. Surface preparation methods or combination of methods that may be used include

high pressure water cleaning, high pressure water jetting, abrasive blasting, shot blasting, grinding, scarifying, detergent water cleaning, hot water blasting and others as described in NACE No. 6/SSPC SP-13. Whichever method(s) are used, they shall be performed in a manner that provides a uniform, sound clean neutralized surface with sufficient profile to promote an acceptable bond with the specified polymer coating.

5. Infiltration shall be stopped by using a material which is compatible with the repair products and is suitable for top-coating with the epoxy coating product. The manufacturer shall verify the product compatibility, in writing, to the Owner.
6. Manhole Chimney Joint and Casting: The area between the manhole and the manhole ring and the manhole casting shall be a termination point of the specified epoxy coating product.

C. APPLICATION OF REPAIR AND RESURFACING PRODUCTS
   1. Areas where reinforcing bars have been exposed shall be repaired in accordance with the manufacturer's recommendations.
   2. Areas where rebar has been exposed and is corroded shall be first prepared as required elsewhere in these specifications. The exposed rebar shall then be abrasive blasted and coated with the polymer coating product specified as recommended by the manufacturer.
   3. Repair products shall be used to fill voids, bugholes, and other surface defects which may affect the performance or adhesion of the epoxy coating product.
   4. Resurfacing products shall be used to repair, smooth or rebuild surfaces with rough profiles to provide a concrete or masonry substrate suitable for the polymer coating product to be applied. These products shall be installed to minimum thickness as recommended within the manufacturer's published guidelines. Should structural rebuild be necessary, these products shall be installed to a thickness as specified in the contract documents. Structural rebuild should be specified in advance of bid whenever feasible, and paid for at a separate unit price in the Proposal.
      a. Repair and resurfacing products shall be handled, mixed, installed and cured in accordance with manufacturer recommendations.
      b. All repaired or resurfaced surfaces shall be inspected for cleanliness and suitability to receive the coating product(s). Additional surface preparation may be required prior to coating application.
   5. If a chimney seal is required in conjunction with the lining technology, the Contractor should contact the chimney seal manufacturer to determine the proper preparation required for effectively installing the chimney seal after the coating has been applied and cured.

D. APPLICATION OF POLYMER COATING PRODUCT
   1. Application procedures shall conform to the recommendations of the epoxy coating product manufacturer, including environmental controls, product handling, mixing, application equipment and methods.
   2. Spray equipment shall be specifically designed to accurately ratio, apply the polymer coating product, shall be in proper working order and shall be as recommended by the product manufacturer.
   3. Contractors qualified in accordance with these specifications shall perform all aspects of polymer coating product installation.
   4. Prepared surfaces shall be coated by spray application of the coating product(s) described herein to a minimum as recommended by the manufacturer to meet the requirements of these contract documents.

5. NOTE: Coating thickness recommendations are available through the polymer coating product manufacturer based upon project assessment. Contact the manufacturer of the polymer coating for project specific recommendations.
6. Subsequent top coating or additional coats of the polymer coating product shall occur within the product's recoat time. Additional surface preparation procedures will be required if this recoat time is exceeded. The polymer manufacturer's re-coat time for the specific application, based on temperature and project conditions, shall be strictly followed by the applicator.
7. The polymer coating product shall mechanically bond with adjoining construction materials throughout the manhole structure to effectively seal and protect concrete or masonry substrates from infiltration and attack by corrosive elements. Procedures and materials necessary to effect this bond shall be as recommended by the polymer coating product manufacturer. No hollow spots will be accepted.
8. Contractor must submit manufacturers recommended method for terminating a coating or lining in a manhole
9. If required sewage flow shall be stopped, bypassed or diverted for application of the polymer coating product to the invert and interface with pipe materials.

E. TESTING AND ACCEPTANCE
1. Visual Inspection: Installed liner system shall be completely free of pinholes and hollow spots/voids and other defects that will reduce the life expectancy of the applied system.
2. Film thickness Measurements: (either wet or dry) Liner thickness shall be the minimum value as specified in the contract documents.
3. Holiday Detection Test (Spark Testing): to identify pinholes, thin material and any defects that will affect the life of the installed system.
4. Adhesion Testing: To verify that the system has consistently mechanically bonded to the host structure.
5. Dye Testing: For non-bonded systems to verify no leakage from an annular space
6. Vacuum Testing as specified in the contract documents.

3.4 MANHOLE CHIMNEY SEALS

A. MECHANICAL FRAME SEAL
1. The contact surfaces for the sleeve and/or extensions shall be reasonably clean and smooth, circular and free from excessive voids or defects. If the masonry surface is rough or irregular and will not provide an effective sealing surface, it shall be smoothed with a single component non-shrink quick set repair mortar designed for vertical and overhead use. Realign manhole frame and cover if offset is greater than Three (3) inches between the frame and top of the manhole structure.
2. After any surface preparation is completed and the rubber sleeve has been placed in the proper position, the lower band is positioned in the band recess and expanded as required to provide a water tight seal. If an extension or extensions are being used, place the extension in the proper position, insert the band into the lower band recess and expand as required to provide a watertight seal.
3. Extension flap shall be placed into or behind the expansion band recess to allow for the compression of both the extension flap and sleeve against the manhole surface by the expansion band. Continue by placing the upper band or bands in the recess, insuring the seal is properly placed on the manhole cone, chimney and frame and expand as required to provide an effective seal.

4. Installation procedures shall be in accordance with the manufacturer's recommended instructions.
5. TESTING AND ACCEPTANCE
    a. Visual Inspection
    b. Leakage test - Following the expansion of the lower band a quality assurance test shall be performed to insure effective sealing by pulling the upper section of the seal or extension inward to create a recess behind the seal where water can be poured. Pour the water behind the seal and observe the lower sealing area for any visible leaks. The sealing shall be considered effective if no water leaks from behind the seal at the lower sealing area.
6. Upon completion of the chimney repair requiring excavation, suitable base and sub-base material shall be compacted in place and pavement replaced matching existing material in accordance with Ingham County Road Commission requirements.

B. POLYMER CHIMNEY SEAL
1. All loose and protruding mortar and brick that would interfere with the polymer chimney seal's performance shall be removed. Any lips for gravel pan supports shall be cut off flush with the manhole casting. All loose material or excessive voids shall be repaired using patching cement, as recommended by the manufacturer. The Contractor shall obtain from the polymer chimney seal manufacture, in writing, the material compatibility and the recommended time required for the patching cement to properly cure prior to installing the polymer chimney seal.
2. Preparation of the chimney surface and casting may include using high pressure water, sandblasting, wire brushing, or other methods as described by the manufacturer, to ensure a clean surface. Active leaks (infiltration) shall be sealed by a method as recommended by the polymer chimney seal manufacturer prior to installing the chimney seal. After water or sandblasting, pressure wash the entire area remove any loose sand that may have been deposited. The substrate surface must be free of sand, loose debris, latencies, dust, oil, grease or chemical contamination. A blower may be required to completely dry the substrate surface or as recommended by manufacturer.
3. The polymer chimney seal shall require the proper mixing of several components, is recommended by the manufacture. If a primer is required, ensure that all surfaces are clean and dry before applying. After proper curing of the primer, the polymer chimney seal may be applied evenly by brush over the entire chimney area, including the frame joint area and the area above the manhole cone including all extensions to the chimney area.
4. Installation procedures shall be in accordance with the manufacturer's recommended instructions.
5. TESTING AND ACCEPTANCE
    a. Visual Inspection - Final liner system shall be completely free of pinholes or voids
    b. Holiday Detection Test
    c. Adhesion Testing
6. Upon completion of the chimney repair requiring excavation, suitable base and sub-base material shall be compacted in place and pavement replaced matching existing material in accordance with Ingham County Road Commission requirements.

3.5 REPLACE FRAME AND COVER

A. The manhole frame and cover shall be manufactured and installed to the dimensions shown on the contract documents in Appendix B.

B. Measurement shall be by each manhole frame and cover removed and replaced.

C. Payment shall be at the unit price each Bid in the Proposal.
   1. Payment includes removal of existing frame and cover, replacing frame and cover, and disposal of old frame and cover as required.

3.6 MANHOLE ADJUSTMENT MATERIALS

A. ADJUSTMENT MATERIAL INSTALLATION
   1. The contractor shall furnish all materials, equipment, tools and labor required for the adjustment of rings and covers to grade.
   2. The ring and cover to be adjusted shall be located and clearly marked.
   3. The existing road or ground surface shall be cut all around the ring & cover, either by triangular, square or round cut (being careful to not create stress fracture points in the corners by over-cutting) to an adequate depth that will allow the desired adjustments to be accomplished. If the cut is not deep enough, the increase in depth may be accomplished with the use of various digging investments.
   4. All of the road or ground inside of the cut shall be removed to allow safe working conditions during the adjustment and restoration to the proper height or level.
   5. The ring shall be positioned, either by suspension or by placement on the correct amount of adjustment rings, If the positioning is accomplished by suspension, the required retainer shall be installed properly.
   7. Once the ring is properly positioned and secured, the open area shall be filled with a suitable base and sub-base material then properly compacted in place and pavement replaced matching existing material in accordance with Ingham County Road Commission requirements.
   6. If the area has been filled (in whole or in part) with poured concrete and/or asphalt, it shall be adequately protected by control devices for a period of time that will allow the fill to properly cure before allowing traffic to resume.

3.7 MANHOLE STEPS

A. Manhole steps shall be driven into pre-cast or drilled holes. Steps shall be installed no more than 16 inches apart vertically on the interior of the manhole wall at a point 4” below the base flange of the manhole casting.

B. Measurement shall be for each manhole step provided

C. Payment shall be at the price per each Bid in the Proposal.
   1. Payment includes the removal and replacement of manhole steps per each Bid in the Proposal.

3.8 QUALITY ASSURANCE AND TESTING

A. GENERAL
   1. The Contractor shall test the installed SYSTEM's as specified by these contract documents. 10% of the installed SYSTEM's shall be tested using a testing procedure as further delineated below. If more than 5% of the tested SYSTEM's fail the test than an additional 10% of the manholes are selected for further testing. This process continues until the SYSTEM's tested meet the requirements of these contract documents, to the satisfaction of the Owner.

B. CHAIN OF CUSTODY
   1. The Contractor shall perform all testing in the presence of the Owner's representative. The Owner's representative shall receive test samples from the Contractor and transmit samples to a third party testing laboratory. The Owner's representative will maintain the chain of custody of all samples that are transmitted and tested to verify SYSTEM compliance with these contract documents.

C. TEST REQUIREMENTS
   1. Visual Inspection
      a. All manholes shall be visually inspected. Any leakage into the manhole in areas where SYSTEM's were installed by the Contractor shall be identified.
      b. The Contractor shall provide samples for testing to the Owner from the actual installed SYSTEM. Samples shall be provided, at a minimum from one location per every ten (10) SYSTEM's installed.

   2. Cementitious Material Property Testing
      a. Where specified one 2 X 2 inch sample cube shall be taken for every 50 bags of material used. Samples shall be sprayed from nozzle, identified in the presence of the Owner's representative and sent, by the Owner's representative, to an independent test laboratory for compression strength testing as described in ASTM C-109.

   3. Vacuum Testing
      a. Where specified if the entire manhole including invert and pipe penetrations is rehabilitated to as new condition then a Vacuum Test may be performed according ASTM F1244. Where specified no less than 10% of the sealed Manholes shall be vacuum tested. If vacuum test fails then the contractor shall spray entire manhole with a soap solution and retest to determine where air is entering the manhole. Inspector shall determine if failure was due to improper rehabilitation or poor pipe condition or improperly seated plugs. If inspector determines that the failure is due to improper rehabilitation then the Contractor shall repair manhole according to manufacturer recommendations and retest until a successful vacuum test is achieved. If inspector determines that the failure was due to poor condition of the pipes, or annular space between the pipe and its liner, or the inability to seat the plugs properly and that there are no visible defects in the applied product then it will be determined that the manhole has passed.

   4. Film thickness Measurements
      a. Where applicable and specified during application a wet film thickness gauge,

meeting ASTM D4414 - Standard Practice for Measurement of Wet Film Thickness of Organic Coatings by Notched Gages, shall be used. Measurements shall be taken, in the presence of the Owner's representative, documented and attested to by Contractor for submission to Owner.

5. Holiday Detection Test
   a. Where specified Holiday Detection shall be performed for all coating systems installed in corrosive environments.
   b. After the epoxy coating product have set in accordance with manufacturer instructions, all surfaces shall be inspected for holidays with high-voltage holiday detection equipment. Reference NACE RPO 188-99 for performing holiday detection.
   c. All detected holidays shall be marked and repaired by abrading the coating surface with grit disk paper or other hand tooling method. After abrading and cleaning, additional coating can be hand applied to the repair area.
   d. All touch-up/repair procedures shall follow the coating manufacturer's recommendations.
   e. Documentation on areas tested, results and repairs made shall be provided to the Owner, in writing, by Contractor.

6. Adhesion Testing
   a. Where specified a minimum of 10% of the manholes coated shall be tested For adhesion/bond of the coating to the substrate. Testing shall be conducted in accordance with ASTM D4541, ASTM D7234, or NACE SP018. Owner's representative shall select the manholes to be tested.
   b. A minimum of three (3) - 50 mm dollies shall be affixed to the coated surface at the cone area, mid section and at the bottom of the structure or in areas suspect from non-destructive evaluation and testing The adhesive used to attach the dollies to the coating shall be rapid setting with tensile strengths in excess of the coating product and permitted to cure in accordance with manufacturer recommendations. The coating and dollies shall be adequately prepared to receive the adhesive.
   c. Failure of the dolly adhesive shall be deemed a non-test and require retesting. Prior to performing the pull test, the coating shall be scored to the substrate by mechanical means without disturbing the dolly or bond within the test area.
   d. Two of the three adhesion pulls shall exceed 300 psi or concrete failure with more than 50% of the subsurface adhered to the coating.
   e. Should a structure fail to achieve two successful pulls as described above, additional testing shall be performed at the discretion of the Owner. Any areas detected to have inadequate bond strength shall be evaluated by the Owner.
   f. Further bond tests may be performed in that area to determine the extent of potentially deficient bonded area and repairs shall be made by Contractor.

7. All testing shall conform to these contract specifications and the submitted PWS.

MERIDIAN TOWNSHIP TECHNICAL SPECIFICATIONS
DIVISION 7

PAY ITEMS, METHOD OF MEASUREMENT & BASIS OF PAYMENT

INDEX

7.01 SCOPE

7.02 SPECIFIC PAY ITEMS

1-19 GENERAL
1. Traffic Control
2. Road Repair
3. Extra Sand Backfill
4. Extra Stone Bedding
5. Road or R.R. Crossing
6. Wood Pile Sets
7. Wells & Well Points
8. Special Structures
9. Pavement Removal
10. Misc. Items

20-29 SANITARY
20. Sewer Mains
21. Manholes
22. Sewer Services

30-39 WATER
30. Ductile Iron Pipe
31. Water Main Fittings
32. Valves and Boxes
33. Fire Hydrants
34. Live Tap
35. Water Services

40-49 PAVEMENT
40. Concrete Sidewalk
41. Sidewalk Ramps
42. Bituminous Construction
43. Embankment
44. Aggregate Base or Surface Course
45. Curb and Gutter
46. Subgrade Preparation

50-59 LANDSCAPE
50. Retaining Wall
51. Fence
52. Ditching
53. Erosion Control
54. Site Restoration
55. Drainage Pipe

7.03 TRENCH PAY ITEMS (SCHEMATIC)

7.04 RAMP PAY ITEMS (SCHEMATIC)

7.01 SCOPE

It is intended that payment for all work done under the Contract Documents including the furnishing of all labor, equipment and materials and the performing of all operations in connection with the construction of the project, will be made under the following pay items. Other work for which there is not a specific pay item will be considered included in the Contract Unit Price for the various specified pay items and no additional compensation will be allowed.

The Owner reserves the right to alter the plans, extend or shorten the improvement and increase or decrease the quantities of work to be performed to accord with such changes, including the deduction or cancellation of any one or more of the Pay Items. Such changes shall not be considered as a waiver of any conditions of the Contract nor to invalidate any of the provisions thereof. A supplemental agreement between the Contractor and the Owner will be required when such changes involve a net increase or decrease in the total amount of the original contract of more than 25 percent. For a net increase or decrease of less than 25 percent, the Contractor will accept payment according to contract prices for such items of work as appear in the original contract.

The work will be done in compliance with the Contract Documents and paid for under the Pay Items or Contract Items herein listed. The Contractor shall take no advantage of any apparent error or omission in the plans or specifications, and the Engineer shall be permitted to make such corrections and interpretations as may be deemed necessary for the fulfillment of the intent of the Contract.

7.02 SPECIFIC PAY ITEMS

1-19 GENERAL

1. Traffic Control
   A. Description: The Contract Unit Price on this item includes labor, equipment, and material necessary to complete traffic control for this project in accordance with the Michigan Manual of Uniform Traffic Control Devices and, as applicable, Michigan Department of Transportation (MDOT) or Ingham County Road Department (ICRD) requirements.

   B. Method of Measurement & Basis of Payment: This item will be paid for at the Contract Unit Price on the following basis: after first use of traffic control measures, 25% will be paid; once 50% of the original contract price is completed, 50% will be paid; once 75% of the original contract price is completed, 75% will be paid; once the contract work is complete, 100% will be paid.

2. Road Repair
   A. Description: The Contract Unit Price on this item includes restoration of all public roads to at least their conditions as existed prior to the start of construction. Specific examples are furnishing and placing of subbase, gravel or asphalt base and gravel, asphalt or concrete surface plus all other miscellaneous work associated with the complete restoration of all public roads including shoulders. All work shall be done in accordance with the plans and specifications.

   B. Method of Measurement & Basis of Payment: This item will be paid for at the Contract Unit Price when all public roads have been restored to their original condition.

7.02 SPECIFIC PAY ITEMS

1-19 GENERAL (Cont'd.)

3. Extra Sand Backfill [Ref. Sec. 1.02 (E)]

A. Description: When the Engineer deems the native backfill material above the pipe to be unsuitable (such as rocks, peat or landfill outside the right of way and clay within the right of way) the Engineer may order extra sand backfill. It includes the excavation and disposal of the unsuitable material. Fill material shall be Class II granular material and placed at the direction of and to the satisfaction of the Engineer.

Sand used under paved driveways, for pavement subbase at road crossings, or for pipe bedding and initial backfill is considered incidental to sewers or water main and will not be paid for under this item.

B. Method of Measurement & Basis of Payment: This item will be paid for at the Contract Unit Price for the total volume actually furnished and placed. Volume will be determined compacted-in-place (CIP) by measurements obtained at the site unless otherwise stated.

4. Extra Stone Bedding [Ref. Sec. 1.02 (F)]

A. Description: The Contract Unit Price on this item includes the furnishing and placing of crushed stone bedding material to replace unsuitable subgrade material under the pipe. This work shall be done at the direction of, and to the satisfaction of, the Engineer.

Stone used for dewatering purposes or to stabilize water sand is considered incidental to sewers or water main and will not be paid for under this item.

B. Method of Measurement & Basis of Payment: This item will be paid for at the Contract Unit Price for the total volume actually furnished and placed. Volume will be determined in place by measurements obtained at the site unless otherwise stated.

5. Road and Railroad Crossing

A. Description: The Contract Unit Price on this item includes all extra work over and above that described under Sewers, Site Restoration, and Road Repair herein. Specific work includes furnishing and installing the steel casing pipe (by methods other than open cut), placing crushed stone around the carrier pipe, sealing the casing ends plus all miscellaneous related work.

B. Method of Measurement & Basis of Payment: This item will be paid for the Contract Unit Price after the work is completed. The lineal footage of pipe installed inside the casing will be paid for under the pay item sewer or water main in addition to this item.

6. Wood Pile Sets

A. Description: The Contract Unit Price on this item includes the furnishing and placing of wood pile sets to support the structures and/or pipeline as shown on the plans, including all timber bracing, hardware, trimming of piles to final grade, and all miscellaneous related work as required.

B. Method of Measurement & Basis of Payment: This item will be paid for at the Contract Unit Price per pile set for the actual number placed and incorporated into the finished work.

7.02 SPECIFIC PAY ITEMS

1-19 GENERAL (Cont'd.)

7. Wells & Well Points [Ref. Sec. 1.02 (C.3)]
   A. Description: The Contract Unit Price on this item includes the furnishing, installation, operation and removal of all materials and equipment to lower the groundwater level adjacent to the construction area to expedite the excavation for and installation of the work.

   B. Method of Measurement & Basis of Payment: This item will be paid for at the Contract Unit Price per lineal foot of excavation actually dewatered or as lump sum. Measurement will be along the centerline of the pipeline.

8. Special Structure
   A. Description: The Contract Unit Price on this item includes the furnishing and installation of labor and materials to complete the structure as shown on the plans, including excavation, backfilling, access openings and covers, floor drains and associated piping, pre-cast concrete sections, poured-in-place concrete, waterproofing, vent piping, removal of surplus excavated material and restoration of surface to within three inches of finished grade.

   B. Method of Measurement & Basis of Payment: This item will be paid for at the Contract Unit Price for each special structure as actually installed.

9. Pavement Removal
   A. Description: The Contract Unit Price on this item includes all labor, equipment, and material necessary to remove and dispose of existing concrete or asphalt as marked in the field by the Engineer and as described herein. The Contractor shall SAWCUT the existing pavement to the full depth to ensure clean and proper removal. Any additional sawcutting, removal, and replacement necessitated by damage caused by the Contractor shall be incidental.

   B. Method of Measurement & Basis of Payment: This item will be paid for at the Contract Unit Price as measured in the field.

10. Miscellaneous Items
   A. Description: This item includes the complete labor, equipment, and materials for constructing and/or placing in service a bid item not found elsewhere in this division.

   B. Method of Measurement & Basis of Payment: This item will be paid for at the Contract Unit Price.

20-29 SANITARY

20. Sewer Mains
   A. Description: The Contract Unit Price on this item includes clearing the work site of all trees, brush, structures and other objects which interfere with the placement of the sewer under construction, all excavation, the furnishing and placing of sewer pipe complete including wyes or tees, bedding material, backfilling, removal of surplus excavated material, testing, concrete work, protection and replacement or repair of existing utilities, and restoration of the surface to within three inches of original grade or to bottom of pavement base course. All work shall be done in accordance with the plans and specifications.

7.02 SPECIFIC PAY ITEMS

20-29 SANITARY

20. Sewer Mains (Cont'd.)

B. Method of Measurement & Basis of Payment: The length of sewers to be paid for at the Contract Unit Price will be determined by measurement along the centerline of the various diameters, classes and depths of pipe as actually furnished and installed. Diameters, classes and depths shall be as shown on the proposal. Measurements shall be from center to center of adjacent manholes with no deduction for manhole diameter. Depth shall be determined by measuring the distance from sewer invert to existing grade at each manhole plus at a point midway between manholes; the average of the three measurements shall be the average depth of the sewer.

21. Manholes

A. Description: The Contract Unit Price on this item includes all excavation, the furnishing and placing of precast sections and cast iron frame and cover, concrete work, drop pipes, connection of existing and new pipes, backfilling, removal of surplus excavated material, and restoration of surface to within three inches of original grade. All work shall be in accordance with the plans and specifications.

B. Method of Measurement & Basis of Payment: This item will be paid for at the Contract Unit Price per manhole for the various depths as actually installed. The depth shall be determined by measuring the distance from sewer invert to top of casting.

22. Sewer Services

A. Description: The Contract Unit Price on this item includes all the work and materials (excepting wyes and tees but including necessary bends) as described in sewer main above.

B. Method of Measurement & Basis of Payment: The length of sewers to be paid for at the Contract Unit Price will be determined by measurement along the centerline of the pipe including risers as actually furnished and installed. Measurement shall be from end of tee or wye to end of service.

30-39 WATER

30. Ductile Iron Water Mains

A. Description: The Contract Unit Price on this item includes clearing the work site of all trees, brush, structures and other objects which interfere with the placement of the water main under construction, all excavation, the furnishing and placing of water main testing, concrete work, disinfecting, backfilling and the removal of surplus excavated material, protection and replacement or repair of existing utilities, and restoration of the surface to within three inches of original grade or to bottom of pavement base course. All work shall be done in accordance with the plans and/or specifications.

B. Method of Measurement & Basis of Payment: The length of water mains will be paid for on a lineal foot basis for pipe measured along the centerline of the various diameters and classes of pipe actually furnished and installed. There will be no deductions for fitting lengths. Unit price includes all labor and materials and related work described above.

7.02 SPECIFIC PAY ITEMS

30-39 WATER (Cont'd.)

31. Water Main Fittings

A. Description: The contract unit price includes the furnishing and installation of the fittings delineated in the proposal.

B. Method of Measurement & Basis of Payment: Fittings will be paid for at the Contract Unit Price for each piece, complete with restraints, thrust block, and required appurtenances.

32. Water Valves and Boxes

A. Description: The Contract Unit Price on this item includes the furnishing and installation of valves and valve boxes. All work shall be done in accordance with the Plans and/or Specifications and result in an operating valve.

B. Method of Measurement & Basis of Payment: This work will be paid for at the Contract Unit Price per valve specified by size of valve on the proposal, which price includes all labor, materials, and related work as described above.

33. Fire Hydrants

A. Description: The Contract Unit Price on this item will consist of furnishing and installing fire hydrants. It shall also include the furnishing and installation of the tee, auxiliary valve, valve box, connecting piping, thrust block, drainage pit, and miscellaneous appurtenances. All work shall be done in accordance with the plans and/or specifications and result in an operating hydrant.

B. Method of Measurement & Basis of Payment: Fire hydrants will be paid for at the Contract Unit Price per complete Fire Hydrant assembly, which payment includes the furnishing and placing of all materials, the labor, and all related work necessary to complete the work as described above.

34. Live Tap

A. Description: The Contract Unit Price on this item will consist of furnishing and installing tapping sleeves and valves on existing mains without loss of pressure in the existing main. It shall also include the installation of a valve box and a thrust block. All work shall be done in accordance with the plans and/or specifications.

B. Method of Measurement & Basis of Payment: This work will be paid for at the Contract Unit Price per live tap as specified on the proposal, which price includes all labor, materials, and related work as described above.

35. Water Services

A. Description: The Contract Unit Price on this item includes the furnishing and installation of corporation stops, curb stops, curb boxes and service pipe in accordance with the plans and or specifications. Work includes all excavation, backfill, furnishing and replacement of sand backfill, tapping of main, and removal of surplus excavated material. Long side service leads includes crossing of roads. Short side service leads are those which do not cross roads.

B. Method of Measurement & Basis of Payment: This item will be paid for at the Contract Unit Price for each service lead completely installed.

7.02 SPECIFIC PAY ITEMS (Cont'd.)

40-49 PAVEMENT

40. Concrete Sidewalk

A. Description: The Contract Unit Price on this item includes furnishing all labor, equipment, and materials required in connection with forming, placing, and curing of the concrete sidewalk to the lines and grade shown on the plans or as directed. All work shall be done in accordance with the plans and specifications.

B. Method of Measurement: Concrete sidewalk will be measured and paid for in square feet, determined by multiplying the actual length as measured along the centerline of the surface of the pathway, by the actual width. The area of fillets and odd shaped sidewalk will be computed separately. Deductions will be made for structures, crossroads, sidewalk ramps, and other discontinuities in the sidewalk. Sidewalk ramps and other appurtenances included in the contract as pay items will be paid for separately.

41. Sidewalk Ramps

A. Description: Sidewalk Ramps consist of several different pay items, the combination of which include all labor, equipment, and material necessary to construct an ADA compliant curb ramp, in accordance with MDOT Special Detail R-28. The ramp pay items are depicted below in 7.04 RAMP PAY ITEMS. All work shall be done in accordance with the plans and specifications.

B. Method of Measurement & Basis of Payment: The ramp components will be measured and paid for at each Contract Unit Price.

42. Bituminous Construction

A. Description: The Contract Unit Price on this item includes all labor, equipment, and material necessary for the construction of a bituminous surface, on a prepared foundation, at the specified application rate. If the bituminous mixture is not specified, the type used shall meet the approval of the Engineer. Construction methods shall conform to the latest edition of the MDOT Standard Specifications for Construction (SSC). All work shall be done in accordance with the plans and specifications.

B. Method of Measurement & Basis of Payment: This item will be paid for at the Contract Unit Price as verified at the site through load tickets from the supplier or by field measurements.

43. Embankment

A. Description: The Contract Unit Price on this item includes all labor, equipment, and materials required in connection with delivery and placement of granular embankment material. Embankment includes areas requiring fill as called for on the plans and the 3" of base for concrete sidewalk. All work shall be done in accordance with the plans and specifications. Granular material as noted shall mean Class II material per the MDOT 2020 SSC, Section 902.

B. Method of Measurement & Basis of Payment: Embankment material shall be as measured in the vehicle transporting the material to the site. Load tickets from the supplier are required to verify the delivered amount.

7.02 SPECIFIC PAY ITEMS

40-49 PAVEMENT (Cont'd.)

44. Aggregate Base or Surface Course

A. Description: The Contract Unit Price for this item includes all labor, equipment, and materials required in connection with the delivery and placement of the material. This work includes the required shaping, grading, and compacting of the material for the foundation of the asphalt ramps and driveway approaches.

The material shall be 21AA or 22A aggregate per the MDOT 2020 SSC, Section 902, unless otherwise specified. All work shall be done in accordance with the plans and specifications.

B. Method of Measurement & Basis of Payment: Aggregate Surface Course shall be as measured in the vehicle transporting the material to the site. Load tickets from the supplier are required to verify the delivered amount.

45. Curb and Gutter

A. Description: The Contract Unit Price on this item includes furnishing all labor, equipment, and materials required for forming, placing, and curing of the concrete curb and gutter to the line and grade as shown on the plans, including excavation, backfill, reinforcing steel, removal of existing curb and gutter, and all joints and joint materials. All work shall be done in accordance with the plans and specifications.

B. Method of Measurement & Basis of Payment: The length of curb and gutter to be paid for at the Contract Unit Price will be determined by measurement along the face of the curb as actually installed, with no deductions in length for catch basins, inlet castings or gutters through concrete driveway openings.

46. Subgrade Preparation

A. Description: The work of subgrade preparation includes furnishing all labor, equipment, and material necessary for clearing and grubbing, including all tree and bush removal, tree trimming, topsoil stripping, grading to shape the earth to develop the typical cross section shown on the plans, and any additional excavation required to construct the pavement to the grade shown on the plans.

B. Method of Measurement & Basis of Payment: This item will be paid on a basis of lineal feet of pathway for work completed according to the specifications.

50-59 LANDSCAPE

50. Retaining Wall

A. Description: The Contract Unit Price for this item includes all labor, equipment, and materials required in connection with the construction of a retaining wall, as shown on the plans. All work shall be done in accordance with the plans and specifications.

B. Method of Measurement & Basis of Payment: Retaining walls will be measured by the square foot of the exposed face, above the pathway/sidewalk.

7.02 SPECIFIC PAY ITEMS

50-59 LANDSCAPE (Cont'd.)

51. Fence

A. Description: The Contract Unit Price for this item includes all labor, equipment, and materials required in connection with the construction of a fence, as shown on the plans. All work shall be done in accordance with the plans and specifications.

B. Method of Measurement & Basis of Payment: The fence will be measured along the centerline of the fence, from centerline to centerline of the end posts.

52. Ditching

A. Description: The Contract Unit Price on this item includes all excavation, and grading to develop the cross sections such that upon completion of site restoration the final grade shall be within plus or minus 0.1 foot of the required lines and grade. This item will also include clearing the work site of all trees, brush, structures and other objects which interfere with the performance of the work. All work shall be done in accordance with the plans and specifications. Final restoration will be paid for separately.

B. Method of Measurement & Basis of Payment: This item will be paid for at the Contract Unit Price when the required cross section has been obtained. Measurement will be made along the centerline of the ditch. Payment for any final trimming of the subgrade required prior to site restoration is included in this pay item.

53. Erosion Control

A. Description: The Contract Unit Price on these items includes all labor, equipment, and material necessary to install and maintain the specified erosion control device(s).

B. Method of Measurement & Basis of Payment: This item will be paid for at the Contract Unit Price for each erosion control item used.

54. Site Restoration

A. Description: The Contract Unit Price on this item includes restoration of the ground surface to at least its preconstruction state. Specific examples are final grading of the top three inches of ground surface, furnishing and installation of seed and mulch, driveway and parking area repair, culvert replacement, sidewalk repair, replacement of signs, mailboxes, and fences, plus all other miscellaneous work associated with the complete restoration of the project site. The slope between new sidewalks and a lawn shall not exceed 1:3. All work shall be done in accordance with the plans and specifications.

B. Method of Measurement & Basis of Payment: This item will be paid for at the Contract Unit Price when the complete project site has been restored to its original condition.

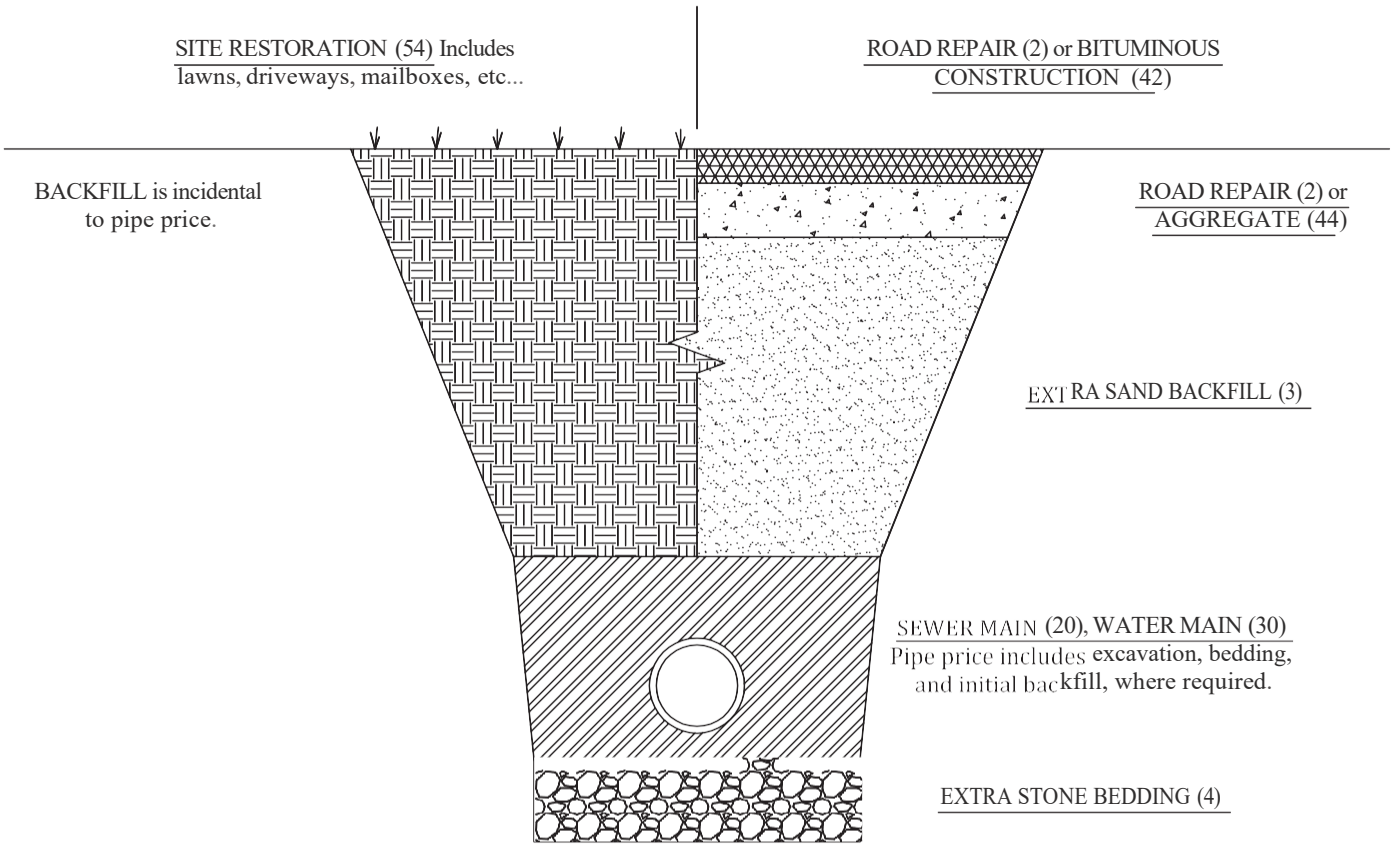
55. Drainage Pipe

A. Description: The Contract Unit Price on these items includes all labor, equipment, and material necessary to install drainage pipe of the type and size specified, as shown on the plans.

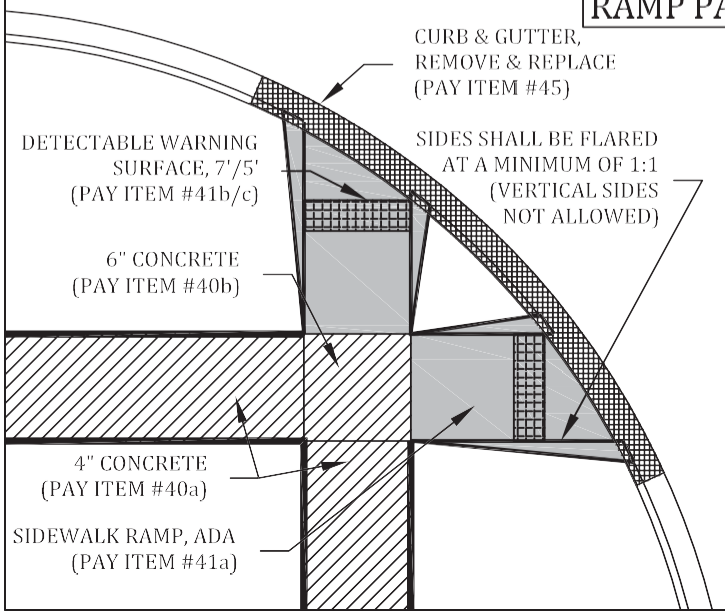
B. Method of Measurement & Basis of Payment: This item will be paid for at the Contract Unit Price for the length installed, as measured along the ground surface.

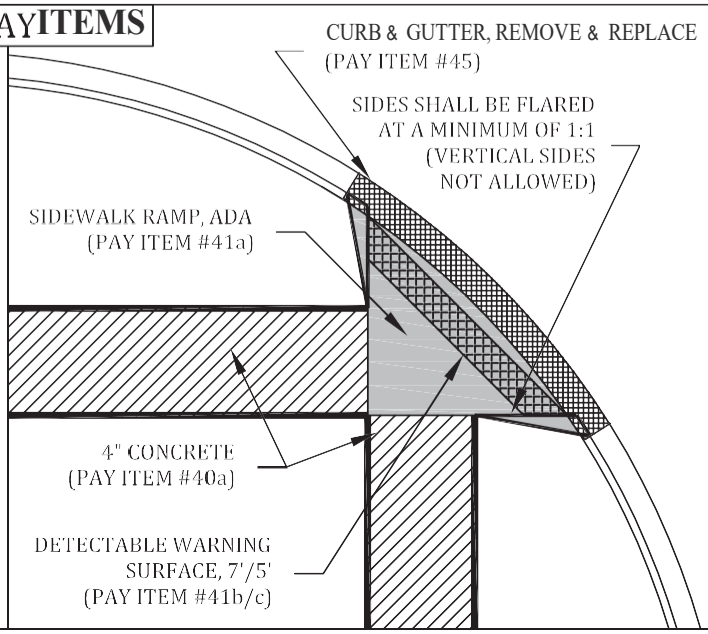
PAY ITEM SCHEMATICS

TRENCH PAY ITEMS



RAMP PAY ITEMS





SANITARY SEWER REHABILITATION 2026

SPECIAL PROVISIONS

These Special Provisions *are in addition to the provisions in the General Specifications and supersede the other specifications in the event of a conflict.*

GENERAL

CCTV FOR BIDDING – The sewer CCTV inspection reports and videos are available upon request. Manhole inspection reports are also available. Please contact the Department of Public Works, Engineering Division by phone at (517) 853-4440, or by email at DPW@meridian.mi.us.

ROAD RIGHTS-OF-WAY – All work in the road right-of-way is done under permit and approval of the Ingham County Road Department (ICRD). The Contractor shall secure the necessary right-of-way permit from the ICRD.

RAILWAY RIGHTS-OF-WAY – All work in the railway right-of-way will be coordinated with the railway authorities, CSX and CN. The Owner will secure the necessary right-of-way permits.

WARRANTY – All materials and workmanship shall be warranted to be free from defects for one year after completion of installation. The Owner shall hold retainage in an amount equal to 10% of the final contract cost, until performance warranty inspections have been completed satisfactorily, in accordance with the respective technical specification, as determined by Engineer. The Owner's inspector shall be present during all warranty inspections. Warranty inspections shall begin 10 months after all work has been completed. All cost for the warranty inspections, and any resulting repairs shall be the responsibility of the Contractor.

NOTE:

- *The pay items detailed in this contract are intended to provide for the complete scope of work as depicted on the plans. Any and all work not covered under a specific pay item, but necessary to complete the project, is considered incidental.*

1. **TRAFFIC CONTROL** – The Contract Unit Price for this pay item includes all labor, equipment, and materials necessary to provide and maintain traffic control in accordance with the Michigan Manual of Uniform Traffic Devices, the relevant MDOT Traffic Control Typicals, and all ICRD permit requirements. This pay item also includes all necessary flag control, detour signing, work zone signing, and traffic control devices. Access to all residential and commercial driveways shall be maintained throughout the duration of the project.

10. **MOBILIZATION** – The Contract Unit Price for this pay item includes all labor, equipment, and materials necessary for the Contractor to mobilize in accordance with the MDOT 2020 SSC, Section 110. Payment for this item will be made according to said Section 110.

INTERCEPTOR REHAB
PAY ITEMS

20a-e. **SEWER, CIPP, _____ INCH** – The Contract Unit Prices for these pay items include all labor, equipment, and material necessary to install a full CIPP liner of the specified size in accordance with the Technical Specification in this contract, "Cured-In-Place Pipe – Mainline Lining". Payment will be made according to the footage measured between manholes along the ground surface at the Contract Unit Price on the following basis: after successful completion of the CIPP & grouting work, 90% of this item will be paid; after the successful completion of the warranty inspection, the remaining 10% of this item will be paid.
The CIPP rehabilitation broadly includes the following:

- All cleaning and preparation of existing sewer;
- Video inspection and recordings of the pre- and post-lined pipes;
- Bypass Pumping (paid for separately);
- Collection and disposal of debris removed from sewers.
- Removal of roots and mineral deposits from sewers, as needed.
- **Grouting or use of Pre-Liners for infiltration**,
- Design and engineering of the CIPP liner;
- Insertion and curing of the CIPP liner;
- Testing;
- Lateral locating and reinstatement;
- Site Restoration (paid for separately);
- All necessary labor, materials and equipment;
- All necessary and specified safety equipment, procedures and traffic control;
- Project supervision; and
- Any other items incidental, but necessary, to the installation of the CIPP liner.

20f. **SEWER, SECTIONAL CIPPR, 8 INCH** – The Contract Unit Price for this pay item includes all labor, equipment, and material necessary to install a sectional CIPP liner of the specified size, or longer, in accordance with the Technical Specification in this contract, "Cured-In-Place Pipe – Mainline Lining". Payment will be made at the Contract Unit Price per each installation accepted by the Owner.

20g-p. **SEWER, JOINT AIR TESTING and JOINT GROUTING, _____ INCH** – The Contract Unit Prices for these pay items include all labor, equipment, and material (except Grout, paid separately) necessary to grout all joints and circumferential defects along a mainline in accordance with the Technical Specification in this contract, "Pipeline Chemical Grouting and Testing". Payment will be made according to the number of joints and defects sealed per diameter of pipe at the Contract Unit Price on the following basis: after successful completion of the grouting work, 90% of this item will be paid;

after the successful completion of the warranty inspection, the remaining 10% of this item will be paid.
Grouting rehabilitation broadly includes the following:

- All cleaning and preparation of existing sewer;
- Video inspection and recordings of the pre- and post-grouted pipes;
- Bypass Pumping (paid for separately);
- Collection and disposal of debris removed from sewers.
- Removal of roots and mineral deposits from sewers, as needed.
- Grouting of non-joint infiltration.
- Design and engineering of the grouting mixture;
- Injection and curing of the grouting mixture;
- Air Testing, before and after grouting;
- Lateral locating and connection grouting;
- Site Restoration (paid for separately);
- All necessary labor, materials and equipment (grout volume paid separately);
- All necessary and specified safety equipment, procedures and traffic control;
- Inspector training and demonstration of grouting procedure and equipment;
- Project supervision; and
- Any other items incidental, but necessary, to the application of grout.

20q. **SEWER, MATERIAL, GROUT** – The Contract Unit Price for the quantity of this Item will be the number of gallons of grout used for sealing Mainline Joints, Lateral Tap Connections and Laterals Connected to Manholes (including void space grout -- except for Lateral Tap Connection packers where an undersized sock is used in a lateral (e.g., 4" sock in a 6" lateral), in which case the void space volume will be subtracted from the volume of grout measured for payment). The unit price for this Item will be full compensation for providing all labor, materials, equipment, tools, and incidentals not included in other Items required for all aspects of grouting.

22a,b. **SEWER, LATERAL CONNECTION, AIR TESTING and GROUTING** – The Contract Unit Prices for these pay items include all labor, equipment, and material (except Grout, paid separately) necessary to air test and grout all lateral connections along a mainline in accordance with the Technical Specification in this contract, "Pipeline Chemical Grouting and Testing". Lateral connections on grouted mains will be air tested before grouting. Lateral connections on mains with CIPP liners installed will be grouted. Payment will be made per each tested and grouted connection at the Contract Unit Price on the following basis: after successful completion of the grouting work, 90% of this item will be paid; after the successful completion of the warranty inspection, the remaining 10% of this item will be paid.

MANHOLE REHAB

PAY ITEMS

21a. **MANHOLE, GROUTING, FULLY SEALED** – The Contract Unit Price for this pay item includes all labor, materials and equipment required by the Contractor to furnish a leak proof manhole to the Owner, in accordance with the Technical Specification in this contract "Manhole Rehabilitation". Manhole is to be cleaned before rehabilitation as described in Section 3C "Manhole Preparation" using a pressure washer. It includes the sealing of all barrel joints, pipe connections and sources of infiltration. Payment will be made for each structure rehabilitated at the Contract Unit Price on the following basis: after successful completion of the grouting work, 90% of this item will be paid; after the successful completion of the warranty inspection, the remaining 10% of this item will be paid. **The material cost of Grout is included in this pay item.**

21b. **MANHOLE, LINER, CEMENTITIOUS** – The Contract Unit Price for this pay item includes all labor, equipment, and material necessary to rehabilitate the specified manholes with a corrosive resistant,

cementitious liner in accordance with the Technical Specification in this contract, "Manhole Rehabilitation". Manhole is to be cleaned before rehabilitation as described in Section 3C "Manhole Preparation" using a pressure washer. Payment will be made per each vertical foot of manhole depth at the Contract Unit Price on the following basis: after successful completion of the lining work, 90% of this item will be paid; after the successful completion of the warranty inspection, the remaining 10% of this item will be paid.
Cementitious lining broadly includes the following:

i. Cleaning of MH.
ii. Removal of roots and mineral deposits from MH.
iii. Removal and disposal of debris removed from MH.
iv. Bypass pumping of MH, as needed (paid for separately).
v. Grouting of all joints and pipe connections for infiltration, if needed.
vi. Line bench, walls, cone section and chimney in accordance with the specification.
vii. Inspection and testing of work to insure compliance.

21c. **MANHOLE, GROUT PIPE CONNECTION** – The Contract Unit Price for this pay item includes all labor, materials and equipment required by the Contractor to seal the pipe connections present within a specified manhole, in accordance with the Technical Specification in this contract "Manhole Rehabilitation". Payment will be made for each manhole with connections sealed against infiltration and accepted by the Owner at the Contract Unit Price. 50% or at least 2 of the total number of Grouted Pipe Connections will be warranty inspected (instead of 10%) for this item.

21d,e. **MANHOLE, REBUILD CHIMNEY, _____** – The Contract Unit Price for this pay item includes all labor, equipment, and material necessary to remove and replace a manhole chimney in accordance with the MDOT 2020 SSC, Section 403 and Appendix B. Minimum pavement removal limits shall be as follows: for concrete, to the nearest construction joint; for asphalt, a rectangle extending seven (7) feet from the center of the casting. All sawcutting and pavement replacement are included in pay item 21d. Replacement pavements shall be in accordance with MDOT requirements. Payment will be made per each chimney replaced and accepted by the Owner.

23a. **BYPASS PUMPING, RESIDENTIAL** – The Contract Unit Prices for these pay items include all labor, equipment, and material necessary to bypass pump sewage around the work area, as necessary. The bypass pumps and bypass lines shall be sufficiently sized for peak flow conditions. The Contractor shall have adequate standby equipment available and ready for immediate operation and use including an extra pump and generator. The maximum effluent level in the influent sewer cannot exceed the crown of the influent sewer. Generators used to provide the electrical service shall be housed in sound attenuating enclosures with critical-area-type silencers. An automatic call box is required for all overnight bypass pumping. Additionally, a backup generator must be provided. The backup generator must be installed and ready for immediate use, including all cabling, disconnect panels, and switch gear. The Contractor shall submit a detailed bypass procedure for review and approval by the Township prior to construction. The following flows reflect measured and calculated upstream flows and capacities:

Towar Gardens Area, Typical Flow – 146 GPM
Towar Gardens Area, Recorded Peak Flow – 1053 GPM

Haslett Road Area, Typical Flow – 281 GPM
Haslett Road Area, Recorded Peak Flow – 1742 GPM

Carlton Street Area & Interurban, Typical Flow – 165 GPM
Carlton Street Area & Interurban, Recorded Peak Flow – 860 GPM

White Owl Way Area, Typical Flow – 213 GPM
White Owl Way Area, Recorded Peak Flow – 554 GPM

Maintaining traffic around the bypass pumping setup is critical. Submit a detailed plan for the bypass setup to Meridian Township and the ICRD. Maintain all vehicular and pedestrian traffic for the duration of the project. Use pump-through ramps, designed for the purpose, at all vehicle route crossings, including roads and driveways. Cross each road or driveway in a single span with the ramps. Install and maintain warning lights at the corners of all such ramps to alert vehicles during nighttime use. Additionally, place asphalt wedges on the ramp approaches, as directed, to mitigate the disruption caused by the ramps. This is especially important for any primary road crossings. Lastly, install advance-warning signs for each ramp indicating a 'bump' (MMUTCD – W8-1).

BYPASS PUMPING, _____ will be paid for at the Contract Unit Price on the following basis: upon successful startup of each bypass system, 50% of **Bypass Pumping** will be paid; after successful return of the respective gravity mains to normal service, 100% of **Bypass Pumping** will be paid.

23b. **BYPASS PUMPING, RAILWAY, SHORT -** Bypass Pumping for the sections of sewer crossing railroads will require more than the typical leapfrogging method. These bypass routes will utilize nearby drain culverts to cross underneath railroads and will require off-road work in marshy terrain. Contractor is to Coordinate with the railway authorities while performing this work. The applicable conditions and requirements of Item 23a are included in this item.

These crossings are shown on Sheet 9, 10 and 11 of the Plan Set. These three (3) crossings are expected to use less than 550 feet of bypass piping.

23c. **BYPASS PUMPING, RAILWAY, LONG -** The applicable conditions and requirements of Item 23a are included in this item.

There is no drain culvert available for the railway crossing located on Hulett Rd. A suggested bypass route is shown on Sheet 12 of the Plan Set. This bypass route is expected to use more than 550 feet of bypass piping. This item may be converted to an additional Item 23b if an easement is procured from one of the properties surrounding Manhole 28-122, shown on sheet 12 of the Plan Set.

54. **SITE RESTORATION** – The Contract Unit Prices for these pay items include all labor, equipment, and material necessary to restore disturbed grass areas in accordance with the MDOT 2020 SSC, Section 816, and as described herein. Restore the disturbed areas to grade with three (3) inches of screened topsoil. For slopes less than 1:4, hydroseeding may be utilized with fertilizer, loose mulch, and a spray-applied tackifier. For slopes greater than 1:4, mulch blankets must be used.

Figure 6B-1. Component Parts of a Temporary Traffic Control Zone

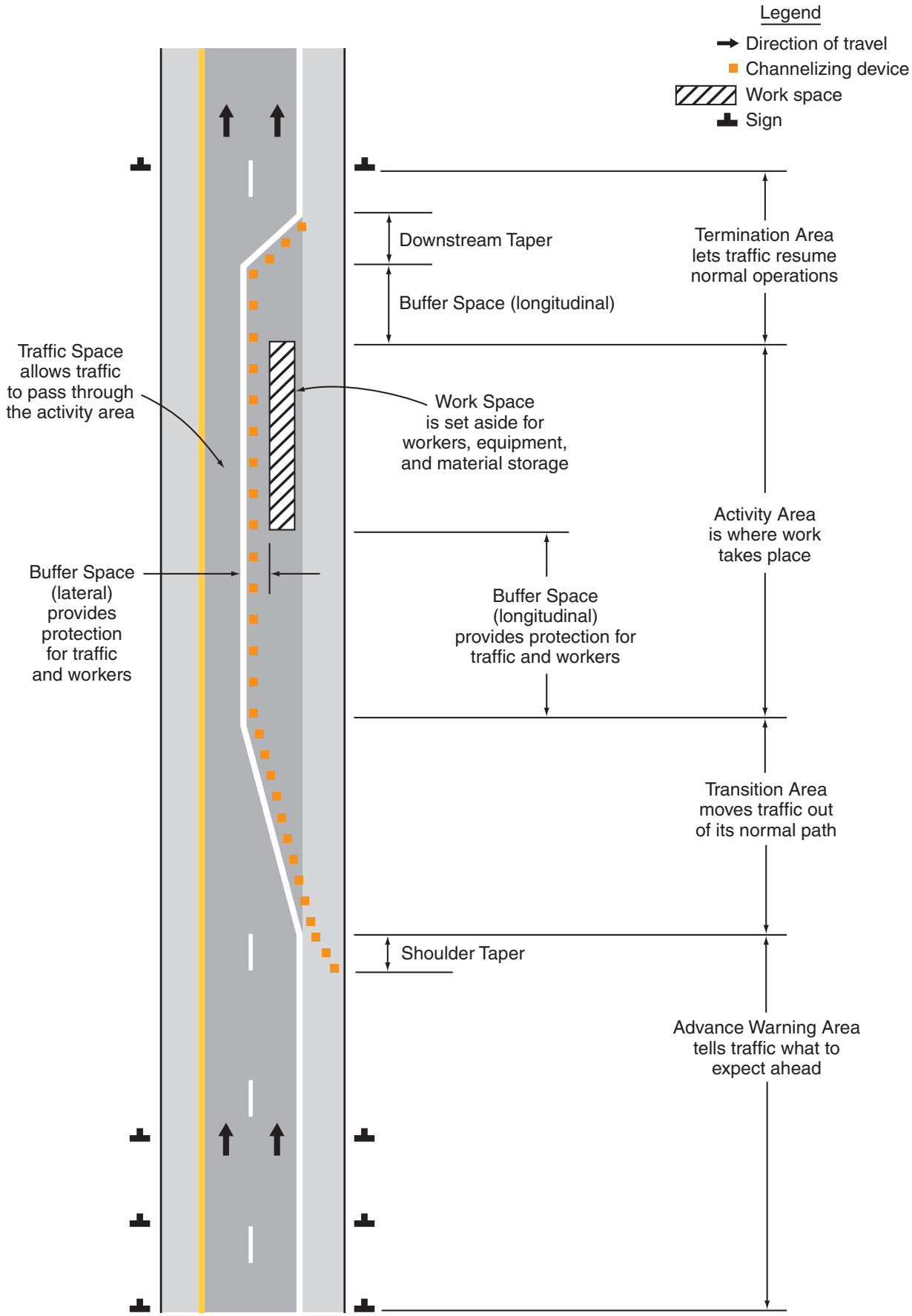


Table 6B-1. Recommended Advance Warning Sign Minimum Spacing

Road Type	Distance between Signs**		
	A	B	C
Urban (low speed)*	100 feet	100 feet	100 feet
Urban (high speed)*	350 feet	350 feet	350 feet
Rural	500 feet	500 feet	500 feet
Expressway / Freeway	1,000 feet	1,500 feet	2,640 feet

* Speed category to be determined by the highway agency or owner of site roadways open to public travel.

** The column headings A, B, and C are the dimensions shown in Figures 6P-1 through 6P-54 The A dimension is the distance from the transition or point of restriction to the first sign. The B dimension is the distance between the first and second signs. The C dimension is the distance between the second and third signs. (The "first sign" is the sign in a three-sign series that is closest to the TTC zone. The "third sign" is the sign that is furthest upstream from the TTC zone.)

Section 6B.06 Activity Area

Support:

01 The activity area is the section of the highway where the work activity takes place. It is comprised of the work space, the traffic space, and the buffer space.

02 The work space is that portion of the highway closed to road users and set aside for workers, equipment, and material, and a shadow vehicle if one is used upstream. Work spaces are usually delineated for road users by channelizing devices or, to exclude vehicles and pedestrians, by temporary barriers.

Option:

03 The work space may be stationary or may move as work progresses.

Guidance:

04 *Since there might be several work spaces (some even separated by several miles) within the project limits, each work space should be adequately signed to inform road users and reduce confusion.*

Support:

05 The traffic space is the portion of the highway in which road users are routed through the activity area.

06 The buffer space is a lateral and/or longitudinal area that separates road user flow from the work space or an unsafe area, and might provide some recovery space for an errant vehicle.

Guidance:

07 *Neither work activity nor storage of equipment, vehicles, or material should occur within a buffer space.*

Option:

08 Buffer spaces may be positioned either longitudinally or laterally with respect to the direction of road user flow. The activity area may contain one or more lateral or longitudinal buffer spaces.

09 A longitudinal buffer space may be placed in advance of a work space.

10 The longitudinal buffer space may also be used to separate opposing road user flows that use portions of the same traffic lane, as shown in Figure 6B-2.

11 If a longitudinal buffer space is used, the values shown in Table 6B-2 may be used to determine the length of the longitudinal buffer space.

Support:

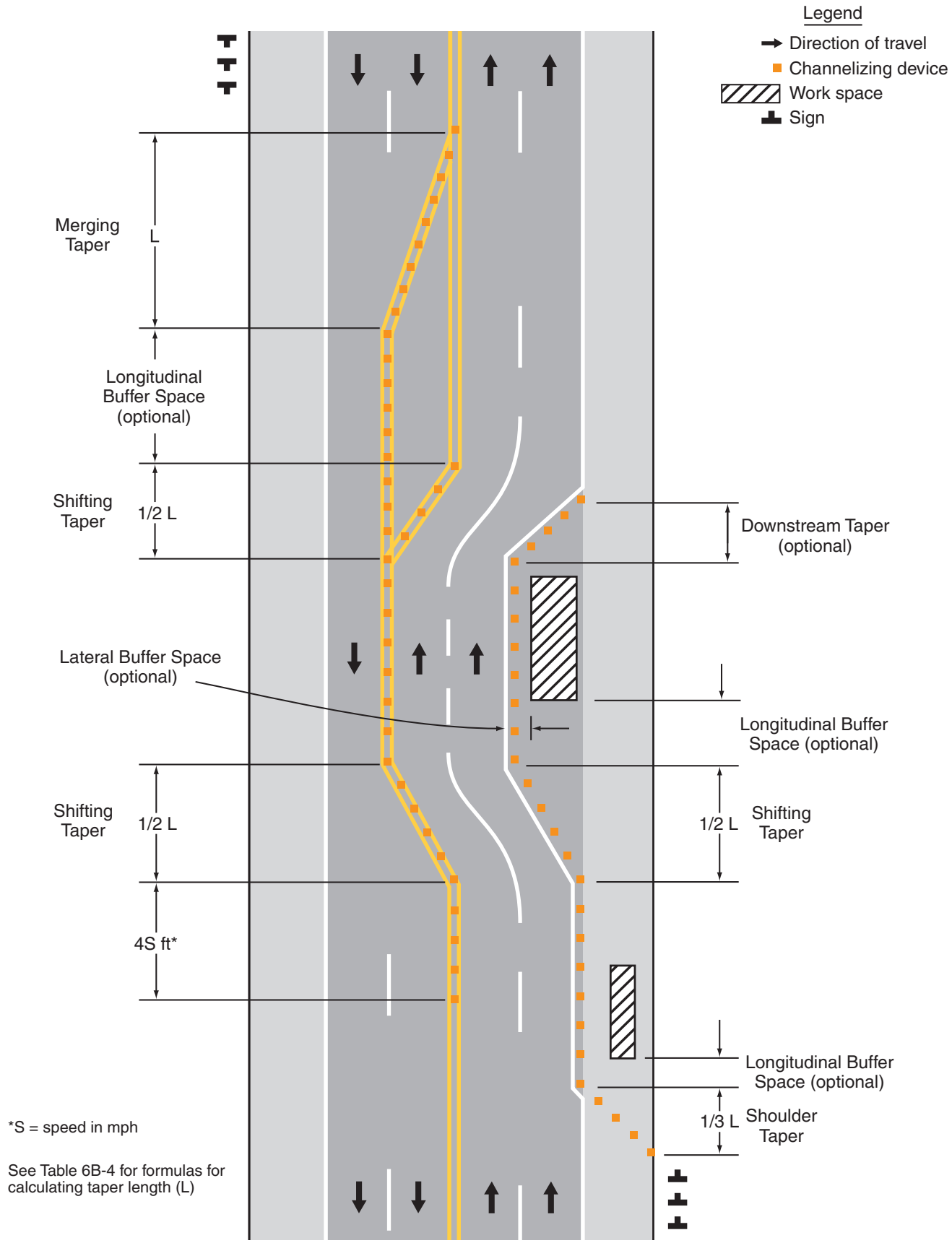
12 Typically, the buffer space is formed as a traffic island and defined by channelizing devices.

13 When a shadow vehicle, arrow board, or changeable message sign is placed in a closed lane in advance of a work space, only the area upstream of the vehicle, arrow board, or changeable message sign constitutes the buffer space.

Option:

14 The lateral buffer space may be used to separate the traffic space from the work space, as shown in Figures 6B-1 and 6B-2, or such areas as excavations or pavement-edge drop-offs. A lateral buffer space also may be used between two travel lanes, especially those carrying opposing flows.

Figure 6B-2. Types of Tapers and Buffer Spaces



Guidance:

15 *The width of a lateral buffer space should be determined by engineering judgment.*

Option:

16 When work occurs on a high-volume, highly-congested facility, a vehicle storage or staging space may be provided for incident response and emergency vehicles (for example, tow trucks and fire apparatus) so that these vehicles can respond quickly to road user incidents.

Table 6B-2. Stopping Sight Distance as a Function of Speed

Speed*	Distance
20 mph	115 feet
25 mph	155 feet
30 mph	200 feet
35 mph	250 feet
40 mph	305 feet
45 mph	360 feet
50 mph	425 feet
55 mph	495 feet
60 mph	570 feet
65 mph	645 feet
70 mph	730 feet
75 mph	820 feet

* Posted speed, off-peak 85th-percentile speed prior to work starting, or the anticipated operating speed

Section 6B.07 Termination Area

Support:

01 The termination area is the section of the highway where road users are returned to their normal driving path. The termination area extends from the downstream end of the work area to the last TTC device such as END ROAD WORK signs, if posted.

Option:

02 An END ROAD WORK sign, a Speed Limit sign, or other signs may be used to inform road users that they can resume normal operations.

03 A longitudinal buffer space may be used between the work space and the beginning of the downstream taper.

Section 6B.08 Tapers

Option:

01 Tapers may be used in both the transition and termination areas. Whenever tapers are to be used in close proximity to an interchange ramp, crossroads, curves, or other influencing factors, the length of the tapers may be adjusted.

Support:

02 Tapers are created by using a series of channelizing devices and/or pavement markings to move traffic out of or into the normal path. Types of tapers are shown in Figure 6B-2.

03 Longer tapers are not necessarily better than shorter tapers (particularly in urban areas with characteristics such as short block lengths or driveways) because extended tapers tend to encourage sluggish operation and to encourage drivers to delay lane changes unnecessarily. The test concerning adequate lengths of tapers involves observation of driver performance after TTC plans are put into effect.

Table 6B-3. Taper Length Criteria for Temporary Traffic Control Zones

Type of Taper	Taper Length
Merging Taper	at least L
Shifting Taper	at least 0.5 L
Shoulder Taper	at least 0.33 L
One-Lane, Two-Way Traffic Taper	50 feet minimum, 100 feet maximum
Downstream Taper	50 feet minimum, 100 feet maximum

Note: Use Table 6B-4 to calculate L

Table 6B-4. Formulas for Determining Taper Length

Speed (S)	Taper Length (L) in feet
40 mph or less	$L = \frac{WS^2}{60}$
45 mph or more	L = WS

Where: L = taper length in feet
W = width of offset in feet
S = posted speed limit, or off-peak 85th-percentile speed prior to work starting, or the anticipated operating speed in mph

Guidance:

04 *The appropriate taper length (L) should be determined using the criteria shown in Tables 6B-3 and 6B-4.*

Support:

05 A merging taper requires the longest distance because drivers are required to merge into common road space.

Table 6P-1. Index to Typical Applications (Sheet 2 of 2)

Typical Application Description	Typical Application Number
Work within the Traveled Way of a Freeway or Expressway (see Section 6N.13)	
Lane Shift on a Freeway	TA-36
Double Lane Closure on a Freeway	TA-37
Interior Lane Closure on a Freeway	TA-38
Median Crossover on a Freeway	TA-39
Median Crossover for an Entrance Ramp	TA-40
Median Crossover for an Exit Ramp	TA-41
Work in the Vicinity of an Exit Ramp	TA-42
Partial Exit Ramp Closure	TA-43
Work in the Vicinity of an Entrance Ramp	TA-44
Temporary Reversible Lane Using Movable Barriers	TA-45
Work in the Vicinity of a Grade Crossing (see Section 6N.17)	
Work in the Vicinity of a Grade Crossing	TA-46
Work in the Vicinity of Bicycle Lanes and Shared Use Paths (see Section 6N.04)	
Bicycle Lane Closure without a Detour	TA-47
Bicycle Lane Closure with an On-Road Detour	TA-48
Shared-Use Path Closure with a Diversion	TA-49
On-Road Detour for a Shared-Use Path	TA-50
Paved Shoulder Closure with a Bicycle Diversion onto a Temporary Path	TA-51
Work in the Traveled Way of Roundabouts	
Short-Term or Short-Duration Work in a Circular Intersection	TA-52
Flagging Operation on a Single-Lane Circular Intersection	TA-53
Inside Lane Closure on a Multi-Lane Circular Intersection	TA-54

Table 6P-2. Meaning of Symbols on Typical Application Diagrams

Arrow board

Arrow board support or trailer (shown facing down)

Changeable message sign or support trailer

Channelizing device

Crash cushion

Direction of temporary traffic detour

Direction of travel

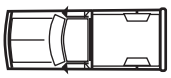
Flagger

High-level warning device (Flag tree)

Longitudinal channelizing device

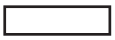
Luminaire

Pavement markings that should be removed for a long-term project


Shadow vehicle

Sign (shown facing left)

Surveyor


Temporary barrier

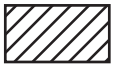
Temporary barrier with warning light

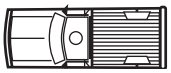
Traffic or pedestrian signal

Truck-mounted attenuator

Type 3 barricade

Warning light


Work space


Work vehicle

Notes for Figure 6P-1—Typical Application 1
Work Beyond the Shoulder

Guidance:

1. *If the work space is in the median of a divided highway, an advance warning sign should also be placed on the left-hand side of the directional roadway.*

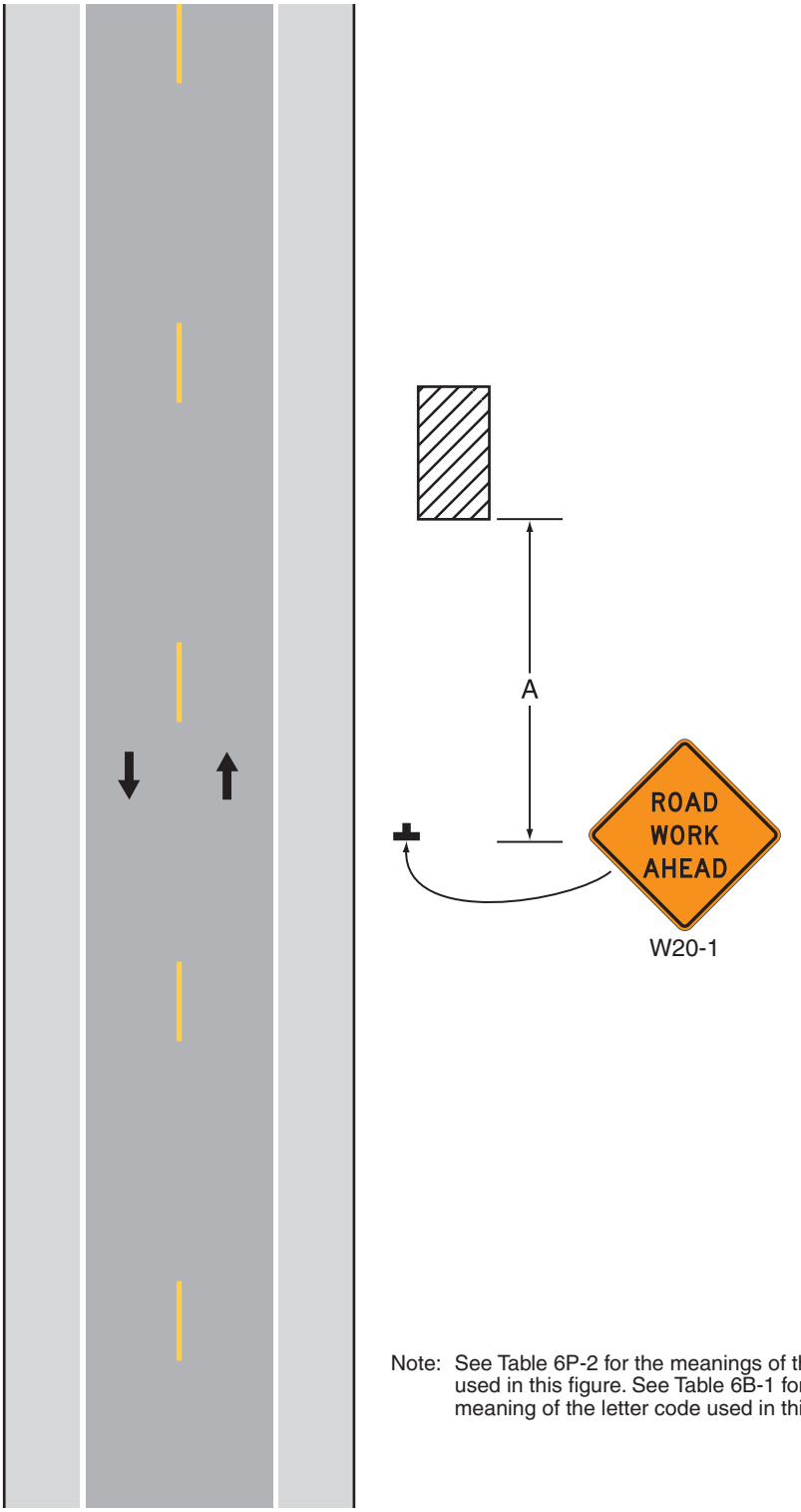
Option:

2. The ROAD WORK AHEAD sign may be replaced with other appropriate signs such as the SHOULDER WORK sign. The SHOULDER WORK sign may be used for work adjacent to the shoulder.
3. The ROAD WORK AHEAD sign may be omitted where the work space is behind a barrier, more than 24 inches behind the curb, or 15 feet or more from the edge of any roadway.
4. For short-term, short-duration or mobile operation, all signs and channelizing devices may be eliminated if a vehicle with activated high-intensity rotating, flashing, oscillating, or strobe lights is used.
5. Vehicle hazard warning signals may be used to supplement high-intensity rotating, flashing, oscillating, or strobe lights.

Standard:

6. **Vehicle hazard warning signals shall not be used instead of the vehicle's high-intensity rotating, flashing, oscillating, or strobe lights.**

Figure 6P-1. Work Beyond the Shoulder (TA-1)



Note: See Table 6P-2 for the meanings of the symbols used in this figure. See Table 6B-1 for the meaning of the letter code used in this figure.

Typical Application 1

Notes for Figure 6P-4—Typical Application 4
Short-Duration or Mobile Operation on a Shoulder

Guidance:

1. *In those situations where multiple work locations within a limited distance make it practicable to place stationary signs, the distance between the advance warning sign and the work should not exceed 5 miles.*
2. *In those situations where the distance between the advance signs and the work is 2 miles to 5 miles, a Supplemental Distance plaque should be used with the ROAD WORK AHEAD sign.*

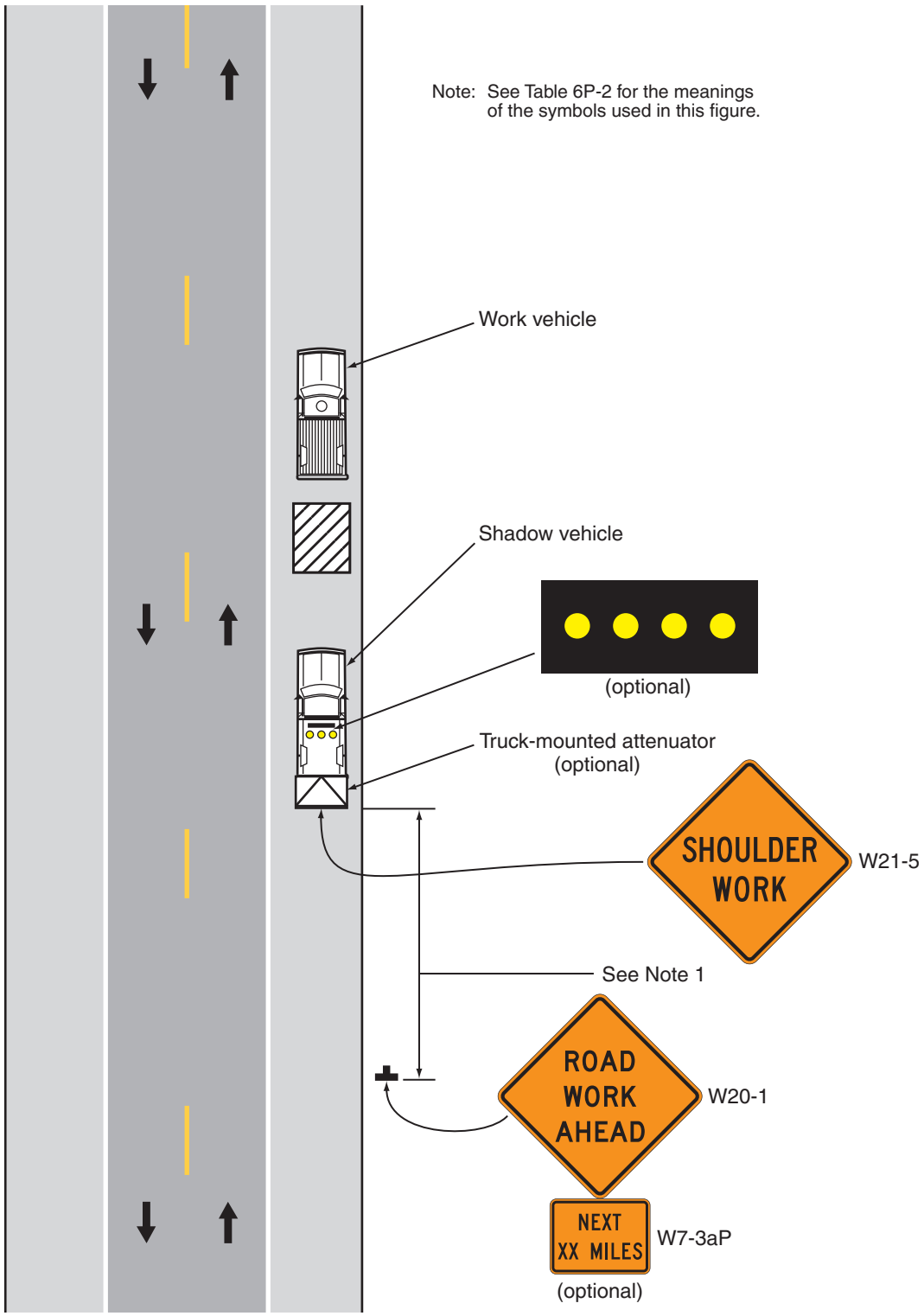
Option:

3. Additional positive protection devices may be used per Section 6M.02.
4. The ROAD WORK NEXT XX MILES sign may be used instead of the ROAD WORK AHEAD sign if the work locations occur over a distance of more than 2 miles.
5. Stationary warning signs may be omitted for short-duration or mobile operations if the work vehicle displays high-intensity rotating, flashing, oscillating, or strobe lights.
6. Vehicle hazard warning signals may be used to supplement high-intensity rotating, flashing, oscillating, or strobe lights.

Standard:

7. **Vehicle hazard warning signals shall not be used instead of the vehicle's high-intensity rotating, flashing, oscillating, or strobe lights.**
8. **If an arrow board is used for an operation on the shoulder, the caution mode shall be used.**
9. **Vehicle-mounted signs shall be mounted in a manner such that they are not obscured by equipment or supplies. Sign legends on vehicle-mounted signs shall be covered or turned from view when work is not in progress.**

Figure 6P-4. Short-Duration or Mobile Operation on a Shoulder (TA-4)



Typical Application 4

Notes for Figure 6P-6—Typical Application 6
Shoulder Work with Minor Encroachment

Guidance:

1. *All lanes should be a minimum of 10 feet in width as measured to the near face of the channelizing devices.*
2. *The treatment shown should be used on a minor road having low speeds. For higher-speed traffic conditions, a lane closure should be used.*

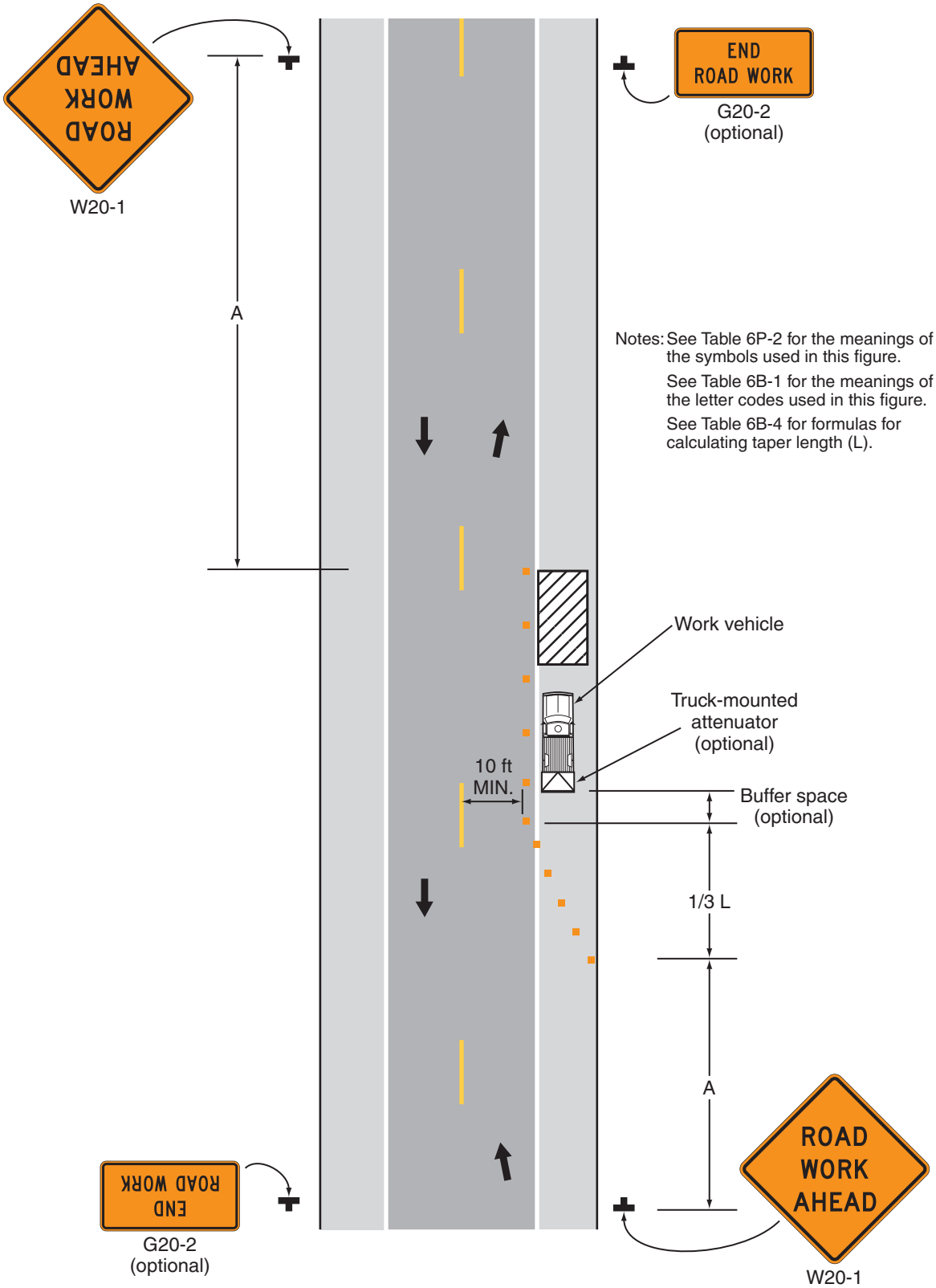
Option:

3. Additional positive protection devices may be used per Section 6M.02.
4. For short-term use on low-volume, low-speed roadways with vehicular traffic that does not include longer and wider heavy commercial vehicles, a minimum lane width of 9 feet may be used.
5. Where the opposite shoulder is suitable for carrying vehicular traffic and of adequate width, lanes may be shifted by use of closely-spaced channelizing devices, provided that the minimum lane width of 10 feet is maintained.
6. Additional advance warning may be appropriate, such as a ROAD NARROWS sign.
7. Temporary traffic barriers may be used along the work space.
8. The shadow vehicle may be omitted if a taper and channelizing devices are used.
9. A truck-mounted attenuator may be used on the shadow vehicle.
10. For short-duration work, the taper and channelizing devices may be omitted if a shadow vehicle with activated high-intensity rotating, flashing, oscillating, or strobe lights is used.
11. Vehicle hazard warning signals may be used to supplement high-intensity rotating, flashing, oscillating, or strobe lights.

Standard:

12. **Vehicle-mounted signs shall be mounted in a manner such that they are not obscured by equipment or supplies. Sign legends on vehicle-mounted signs shall be covered or turned from view when work is not in progress.**
13. **Shadow and work vehicles shall display high-intensity rotating, flashing, oscillating, or strobe lights.**
14. **Vehicle hazard warning signals shall not be used instead of the vehicle's high-intensity rotating, flashing, oscillating, or strobe lights.**

Figure 6P-6. Shoulder Work with Minor Encroachment (TA-6)



Typical Application 6

Notes for Figure 6P-18—Typical Application 18
Lane Closure on a Minor Street

Standard:

1. This TTC shall be used only for low-speed facilities having low traffic volumes.

Option:

2. Where the work space is short, where road users can see the roadway beyond, and where volume is low, vehicular traffic may be self-regulating.

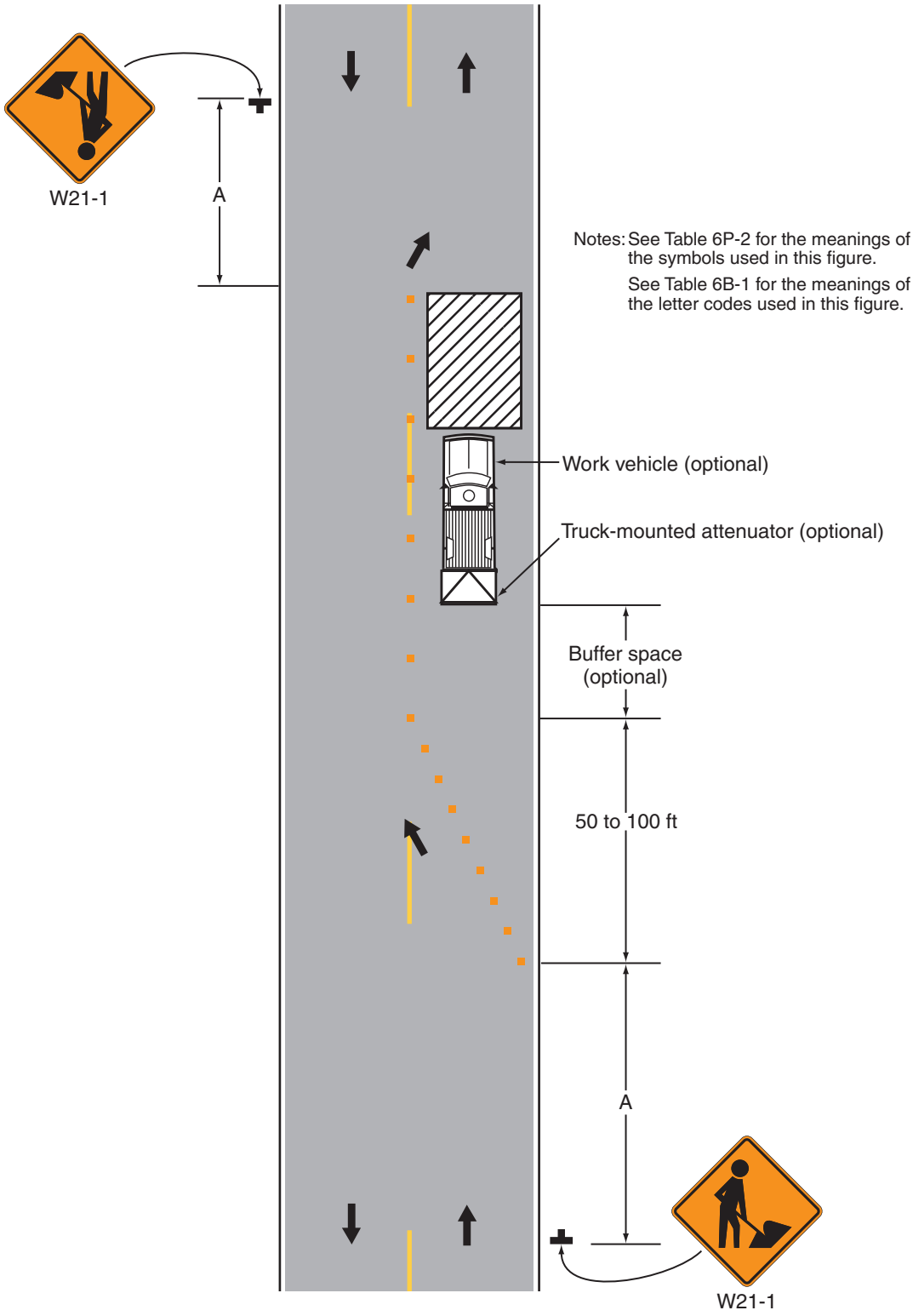
Standard:

3. Where vehicular traffic cannot effectively self-regulate, one or two flaggers shall be used as illustrated in Figure 6P-10.

Option:

4. Flashing warning lights and/or flags may be used to call attention to the advance warning signs.
5. A truck-mounted attenuator may be used on the work vehicle and the shadow vehicle.
6. Positive protection devices may be used per Section 6M.02.

Figure 6P-18. Lane Closure on a Minor Street (TA-18)

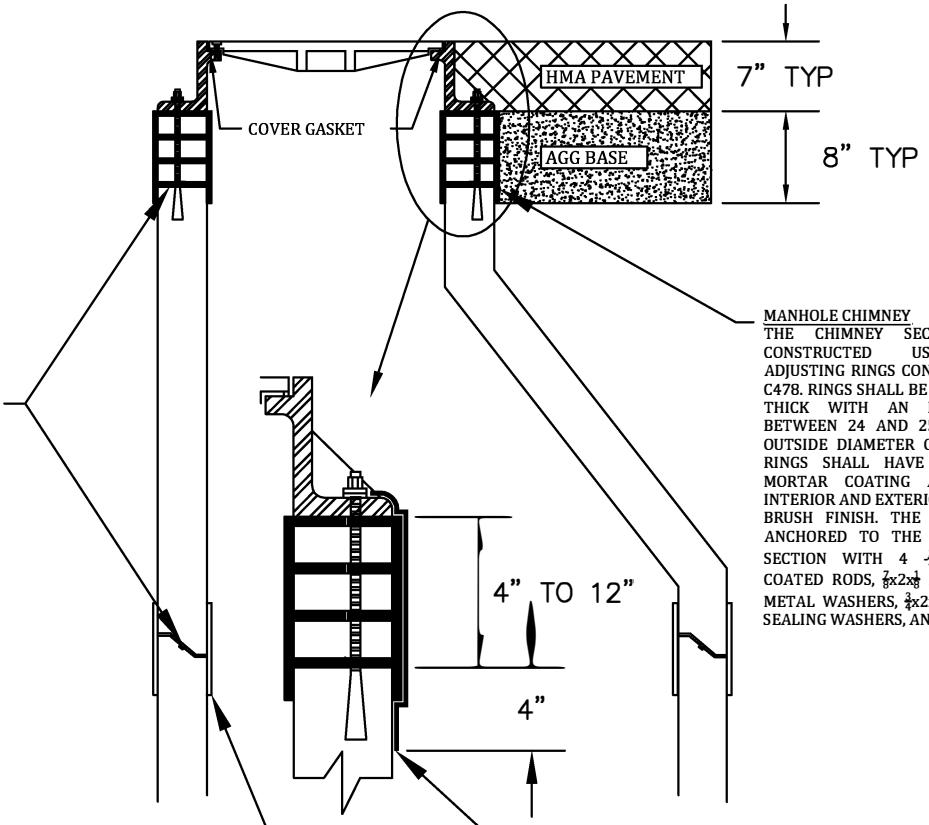


Typical Application 18

MANHOLE CASTING DETAIL

COVER AND FRAME: OFF-ROAD
FRAME SHALL BE EAST JORDAN IRON WORKS 1045ZPT. COVER SHALL BE A SOLID BOLT-DOWN LID WITH WATERTIGHT RUBBER GASKET ASSEMBLY BEARING THE WORD "SANITARY" AND SHALL BE EQUIPPED WITH (4) STAINLESS STEEL CAP SCREWS.

COVER AND FRAME: IN-ROAD
FRAME SHALL BE EAST JORDAN IRON WORKS 1045W. COVER SHALL BE A SOLID EJIW 1040 WITH WATERTIGHT RUBBER GASKET ASSEMBLY AND BEARING THE WORDS "SANITARY", "MERIDIAN TOWNSHIP", AND THE TOWNSHIP TREE LOGO.



1" BUTYL GASKET IN FLEXIBLE ROPE FORM: SUCH AS `E-Z STIK, `BUTYL-LOK', OR APPROVED EQUAL

MANHOLE CHIMNEY
THE CHIMNEY SECTION SHALL BE CONSTRUCTED USING CONCRETE ADJUSTING RINGS CONFORMING TO ASTM C478. RINGS SHALL BE AT LEAST 2 INCHES THICK WITH AN INSIDE DIAMETER BETWEEN 24 AND 25 INCHES AND AN OUTSIDE DIAMETER OF 40 INCHES. THE RINGS SHALL HAVE A CEMENTITIOUS MORTAR COATING APPLIED TO THE INTERIOR AND EXTERIOR WITH A SMOOTH BRUSH FINISH. THE FRAME SHALL BE ANCHORED TO THE RINGS AND CONE SECTION WITH 4 $\frac{3}{4}$ INCH CADMIUM COATED RODS, $\frac{7}{8}$x2x$\frac{1}{8}$ INCH ZINC PLATED METAL WASHERS, $\frac{3}{4}$x2x$\frac{1}{8}$ INCH NEOPRENE SEALING WASHERS, AND NUTS.

EXTERNAL SEAL
THE SEAL SHALL BE A PRODUCT SUCH AS BOA TAPE™, INFI-SHIELD®, EZ WRAP, OR APPROVED EQUAL AND SHALL COVER ALL ADJUSTING RINGS, 2 INCHES OF THE CASTING, AND 4 INCHES OF THE CONE SECTION.

JOINT SEAL
FILL EXTERIOR & INTERIOR JOINTS WITH NON-SHRINK CEMENT MORTAR WITH A SMOOTH BRUSHED FINISH. ALL MANHOLE SECTIONS TO HAVE O-RINGS AT THE JOINTS. SEAL EXTERIOR OF JOINT WITH BOA TAPE™, INFI-SHIELD®, EZ WRAP, OR APPROVED EQUAL.

MAINLINE TREATMENT - CIPP INDEX - PRIORITY 1								
US MH	DS MH	Sheet #	Street Name	Diameter (in)	Type	Length (ft)	Joints	Laterals
11-55	11-1	9	Carlton St	8	VCP	305	61	0
28-209	28-32	11	Sower Blvd	18	VCP	295	59	0
28-32	28-31	11	White Owl Way (Offroad)	18	RCP	155	31	0
28-31	28-224	11	White Owl Way (Offroad)	18	RCP	340	68	0
28-224	28-30	11	White Owl Way (Offroad)	18	RCP	205	41	0
28-30	28-29	11	White Owl Way (Offroad)	18	RCP	140	28	0
28-29	28-28	11	White Owl Way (Offroad)	18	RCP	315	63	0
28-28	28-170	11	White Owl Way (Offroad)	18	RCP	270	54	0
28-170	28-27	11	Woodfield Rd	18	RCP	35	7	0
28-27	28-26	11	Woodfield Rd (Offroad)	18	RCP	315	63	0
28-26	28-25	11	Sugar Maple Lane (Offroad)	18	RCP	320	64	0
28-25	28-24	11	Sugar Maple Lane (Offroad)	18	RCP	160	32	0
10-43	15-2	10	Nemoke Trail (Offroad)	36	RCP	325	65	0
15-2	15-3	10	Nemoke Trail (Offroad)	36	RCP	110	22	0
28-109	28-108	12	Hulett Rd	8	VCP	170	34	0
Pvt	28-55	20	Okemos Rd	8	VCP	75	15	0

MAINLINE TREATMENT - CIPP INDEX - PRIORITY 2							
US MH	DS MH	Sheet #	Street Name	Diameter (in)	Type	Length (ft)	Laterals
9-27 _	9-26	6	Haslett Road	8	VCP	370	5
9-26 _	9-25	6	Haslett Road	8	VCP	345	5
9-25 _	9-24	6	Haslett Road	8	VCP	345	2
9-24 _	9-23	6	Haslett Road	8	VCP	350	6
9-23 _	9-22	6	Haslett Road	8	VCP	375	8
9-22 _	9-21	6	Haslett Road	8	VCP	325	4
9-21 _	9-20	6	Haslett Road	8	VCP	320	4
9-20 _	9-19	6	Haslett Road	8	VCP	335	7
9-19 _	9-18	6	Haslett Road	8	VCP	310	6
9-18 _	9-17	6	Haslett Road	8	VCP	315	6
9-17 _	9-6	6	Haslett Road	8	VCP	320	2
9-48 _	9-49	7	Lac du Mont Drive	10	RCP	265	5
5-21 _	5-22	5	Skyline Dr	8	VCP	340	9
5-22 _	5-23	5	Skyline Dr	8	VCP	350	4
5-23 _	5-24	5	Skyline Dr	8	VCP	215	4
5-24 _	5-25	5	Skyline Dr	8	VCP	185	4
5-59 _	5-152	3	Birch Row Dr	10	VCP	150	0
5-152 _	5-67	3	Birch Row Dr	10	VCP	95	0
5-67 _	6-180	3	Birch Row Dr	10	VCP	240	0
6-180 _	6-181	3	Birch Row Dr	10	VCP	90	0
6-181 _	6-29	3	Birch Row Dr	10	VCP	135	1
6-29 _	6-28	3	Birch Row Dr	10	VCP	255	0
6-28 _	6-30	3	Birch Row Dr	10	VCP	235	5
6-134 _	6-28	3	Birch Row Dr	8	VCP	355	1
6-34 _	6-35	3	Birch Row Dr	8	VCP	235	4
6-35 _	6-36	3	Birch Row Dr	8	VCP	210	5
5-30 _	5-34A	5	Margate Ln	10	VCP	205	2
5-34A _	5-34	5	Margate Ln	10	VCP	230	4
5-34 _	5-43	5	Margate Ln	10	VCP	225	2
6-158 _	6-190*	4	Biber St	12	VCP	290	4
5-49 _	5-48	5	Horizon Dr	8	VCP	345	8
11-37 _	11-42	9	Carlton St	10	VCP	225	5
11-42 _	11-43	9	Carlton St	10	VCP	180	4
11-43 _	11-44	9	Carlton St	10	VCP	120	1
11-44 _	11-45	9	Carlton St	10	VCP	265	0
11-45 _	11-1	9	Carlton St	10	VCP	65	0
26-95	26-96	13	Shoals Dr	8	VCP	130	1
26-160 _	26-159	13	Breakwater Dr	8	VCP	5	0
			Sectional CIPP	357 ft Downstream			
26-160 _	26-159	13	Breakwater Dr	8	VCP	5	0
			Sectional CIPP	384 ft Downstream			
6-116 _	6-117	4	Carino Ct	8	VCP	5	0
			Sectional CIPP	99ft Downstream			
5-57	5-58	5	Briarwick Dr	8	VCP	5	0
			Sectional CIPP	199 ft Downstream			

MAINLINE TREATMENT - GROUT INDEX								
US MH	DS MH	Sheet #	Street Name	Diameter (in)	Type	Length (ft)	Joints	Laterals
9-5 _	9-6	7	Okemos Road	10	VCP	310	62	1
9-8 _	9-7	7	Okemos Road	8	VCP	250	50	2
11-1 _	11-2	9	Carlton St	24	VCP	130	26	0
9-55 _	9-54	7	Haslett Road	10	VCP	355	71	5
10-51 _	10-52	8	Bois Ile Drive	8	VCP	305	61	7
10-64 _	10-14	8	Bayonne Avenue	21	RCP	180	36	4
10-69 _	10-68	8	Haslett Road	10	VCP	365	73	3
10-75 _	10-76	7	Sherbrook Way	8	VCP	215	43	3

MANHOLE TREATMENT INDEX 1						
MH #	**Sheet #**	**Street Name**	**Location**	**Depth (ft)**	**Joints** (estimate)	**Treatment Plan**
26-173	17	Alderwood Dr	Roadway	9.5	2	Cementitious Liner
26-29	17	Arbor Dr	Right of Way	8.5	2	Rebuild Chimney
10-18	10	Bayonne Ave. (Offroad)	Offroad	6.3	2	Cementitious Liner
10-19	10	Bayonne Ave. (Offroad)	Offroad	7.9	2	Cementitious Liner
10-90	8	Benson Drive	Right of Way	7.7	2	Cementitious Liner
10-91	8	Benson Drive	Parking Lot	10.3	3	Cementitious Liner
10-94	8	Benson Drive	Parking Lot	11.6	3	Grouting, Fully Sealed
10-94	8	Benson Drive	Parking Lot	11.6	3	Rebuild Chimney
10-96	8	Benson Drive	Offroad	5.1	1	Grouting, Fully Sealed
6-61	4	Biber St	Roadway, Shoulder	6.7	2	Cementitious Liner
6-28	3	Birch Row Dr	Roadway, CL	8	2	Grouting, Fully Sealed
6-29	3	Birch Row Dr	Roadway, RL	6.8	2	Cementitious Liner
27-37	11	Birch Wood Dr	Right of Way	6	1	Rebuild Chimney
10-49	7	Bois Ile Drive	Roadway	8.1	2	Grouting, Fully Sealed
10-52	7	Bois Ile Drive	Roadway	16.1	4	Cementitious Liner
6-118	4	Carino Ct	Right of Way	9.8	2	Grouting, Fully Sealed
26-152	16	Cornell St	Right of Way	21.5	5	Cementitious Liner
23-15	17	Cranwood Ct	Parking Lot	12.2	3	Rebuild Chimney
22-59	15	Danbury	Driveway	8.8	2	Rebuild Chimney
34-7	18	Dobie Rd	Offroad	9.2	2	Cementitious Liner
6-103	2	E Lake Lansing Rd	Offroad	8.3	2	Grouting, Fully Sealed
6-13	3	E Lake Lansing Rd	Curb	9.1	2	Grouting, Fully Sealed
26-25	17	Elmwood Dr	Right of Way	6.9	2	Rebuild Chimney
6-131	4	Endenhall Way	Right of Way	5.4	1	Cementitious Liner
6-133	4	Endenhall Way	Offroad, Backyard	6.5	2	Cementitious Liner
22-18	15	Grand River Ave	Right of Way	11	3	Cementitious Liner
22-39	18	Grand River Ave	Right of Way	7.8	2	Cementitious Liner
12-4	16	Green Rd	Roadway, Shoulder	9.2	2	Cementitious Liner
6-163	4	Hardy Ave	Offroad	12.8	3	Cementitious Liner
6-8	3	Hardy Ave	Roadway	8.7	2	Grouting, Fully Sealed
6-9	3	Hardy Ave	Roadway	10	2	Grouting, Fully Sealed
6-135	3	Hart St	Parking Lot	8.8	2	Cementitious Liner
6-30	3	Hart St	Roadway, RL	9.2	2	Cementitious Liner
6-5	3	Hart St	Roadway, Shoulder	8.1	2	Cementitious Liner
10-214	8	Haslett Rd	Parking Lot	5.5	1	Rebuild Chimney
9-27	6	Haslett Rd	Roadway, RL	8.4	2	Cementitious Liner

MANHOLE TREATMENT INDEX 2

MH #	Sheet #	Street Name	Location	Depth (ft)	Joints (estimate)	Treatment Plan
12-78	16	Haslett Road	Right of Way	15	4	Cementitious Liner
9-17	6	Haslett Road	Roadway, RL	11.4	3	Cementitious Liner
9-54	7	Haslett Road	Roadway, RL	15.3	4	Grouting, Fully Sealed
9-55	7	Haslett Road	Roadway, RL	12.3	3	Grouting, Fully Sealed
9-6	7	Haslett Road & Okemos	Intersection	12	3	Grouting, Fully Sealed
11-33	9	Hickory Island St	Roadway	5	1	Cementitious Liner
11-33	9	Hickory Island St	Roadway	5	1	Rebuild Chimney
28-112	12	Hulett Rd	Right of Way	10.6	3	Cementitious Liner
26-1	17	Ivywood Dr	Roadway	6.6	2	Cementitious Liner
10-123	8	Lake Court	Roadway	8.3	2	Grouting, Fully Sealed
10-186	8	Marsh Rd	Parking Lot	6	1	Cementitious Liner
10-223	19	Marsh Rd	Offroad	8.7	2	Cementitious Liner
22-158	14	Marsh Rd	Right of Way	9.1	2	Cementitious Liner
22-158	14	Marsh Rd	Right of Way	9.1	2	Rebuild Chimney
22-3	14	Marsh Rd	Sidewalk	11.5	3	Grout Pipe Connection
22-3	14	Marsh Rd	Sidewalk	11.5	3	Rebuild Chimney
15-48	14	Marsh St	Right of Way	10.8	3	Cementitious Liner
15-49	14	Marsh St	Sidewalk	10.7	3	Cementitious Liner
26-141	13	Mizzen Dr	Roadway, LL	5.3	1	Cementitious Liner
6-113	4	N Raindrop Rd	Offroad, Backyard	5.7	1	Cementitious Liner
6-114	4	N Raindrop Rd	Offroad, Backyard	6.8	2	Cementitious Liner
22-113	17	Oakwood Dr	Right of Way	7.1	2	Cementitious Liner
4-58	19	Okemos Rd	Right of Way	9.7	2	Cementitious Liner
9-122	19	Okemos Rd	Right of Way	4.8	1	Cementitious Liner
9-29	19	Okemos Road	Roadway, CL	10.5	3	Cementitious Liner
6-99	2	Pebblebrook Lane	Offroad, Fenced	11.3	3	Grouting, Fully Sealed
6-17	3	Pollard Ave	Roadway	9.8	2	Grouting, Fully Sealed
6-18	3	Pollard Ave	Roadway	10.6	3	Grout Pipe Connection
10-162	8	Potter	Roadway	10.8	3	Grouting, Fully Sealed
12-20	16	River Knoll Dr & Green Rd	Roadway	14.7	4	Grout Pipe Connection
6-170	4	Rothbury Ln	Parking Lot	8.5	2	Cementitious Liner
6-22	2	Rutherford Ave	Roadway, RL	7.7	2	Grouting, Fully Sealed
29-113	18	S Hagadorn	Offroad	11	3	Cementitious Liner
6-95	2	Taylor Dr	Offroad	8.2	2	Grout Pipe Connection
5-84	5	W Longview Dr	Roadway, LL	10.7	3	Cementitious Liner
22-52	15	Washington Height ave	Roadway	13.9	3	Rebuild Chimney
12-112	16	Green Rd	Sidewalk	7.3	2	Grouting, Fully Sealed
2-27	19	E Lake Dr	Roadway, Shoulder	8.7	2	Rebuild Chimney
3-52	18	Wilder St	Roadway, RL	8.1	2	Cementitious Liner