RURAL MUNICIPALITY OF HANOVER

STANDARD CONSTRUCTION SPECIFICATIONS

Adopted by resolution of the Rural Municipality of Hanover Council
This day of January 24th, 2007

Revised January 24, 2014
Revised May 10, 2016
Revised July 14, 2016
Revised January 3, 2017

STANDARD CONSTRUCTION SPECIFICATIONS

GENERAL CONDITIONS

STANDARD PROVISIONS

DESIGN STANDARDS

SURFACE WORKS

UNDERGROUND WORKS

General Conditions

GENERAL CONDITIONS OF THE CONTRACT

TABLE OF CONTENTS

GC1 - GENERAL

GC1.1 DEFINITIONS

.1 Contract Documents: consists of the executed Agreement, General Conditions of the Contract, Supplementary Conditions, the executed Tender, Division 1 - General Requirements, specifications, drawings and such other documents as are listed in Article A-2 of the Agreement including all amendments thereto incorporated before their execution as agreed upon between the parties in writing.

.2 Owner, Engineering Manager, Contractor: persons, firms or corporations identified in the Agreement. Such parties are referred to throughout the Contract Documents as if singular in number and masculine in gender. The terms Owner or Engineering Manager include their authorized representatives as designated in writing to each of the other parties.

.3 Subcontractor: a person, firm or corporation, not contracting with or directly employed by the Owner, but contracting with or directly employed by the Contractor, performing at the Place of the Work, a part or parts of the Work, or supplying Products worked to a special design according to the Contract Documents, but does not include one who supplies Products not so worked. The term Subcontractor is referred to throughout the Contract Documents as if singular in number and masculine in gender.

.4 Other Contractor: a person, firm or corporation employed by or having a separate contract directly or indirectly with the Owner for work other than the Work.

.5 Project: means the total concept of which the Work may be the whole or a part.

.6 Work: means the totality of all Products, labour and services required by the Contract Documents.

.7 Place of the Work: the site or location of the Work, designated in the Contract Documents.

.8 Products: means all materials, machinery, equipment and fixtures forming or intended to form the completed Work or a part thereof but excludes machinery and equipment used for preparation, fabrication, conveying and erection of the Work and normally referred to as construction machinery and equipment.

.9 Day: shall mean a calendar day.

.10 Working Day: shall mean days other than Saturdays, Sundays and holidays which are observed by the construction industry in the area of the Place of the Work. If the Contract Time is based on a number of Working Days, in addition to the foregoing, a Working Day shall mean a day on which, in the opinion of the Engineering Manager, atmospheric and/or ground conditions are suitable for work on one or more of the main work items for at least seven (7) hours between either 7:00 a.m. local time or the Contractor's normal starting time, whichever is earlier, and 7:00 p.m. local time.

.11 Substantial Performance: shall mean when the Engineering Manager in his absolute discretion shall so certify; in so certifying the Engineering Manager shall be guided by any definition in applicable lien legislation or by the availability for use of the Work.

.12 Final Payment: shall mean all sums due the Contractor when terms and conditions of the Contract appear to be complete.

.13 Net Cost: shall mean the proven cost of Products; labour which includes actual worker's pay, Workers' Compensation Insurance, Canada Pension Plan; workers' premium for Unemployment Insurance, holiday pay and medical benefits; payments to a proportionate part of the wages of foreman; plant and tools; as applicable to the item being costed.

Equipment Rental for which published rates are used or for which rates are included in the Tender shall be excluded.

.14 Contract Price: shall mean the sum stated in the Agreement and as may be amended during the progress of the Work.

.15 Contract Time: identified as the time stated in Article A-1 of the Agreement, elapsing from the date of commencement of the Work until the date of completion of the Work, certified by the Engineering Manager.

GC1.2 DOCUMENTS

.1 The Contract Documents, except the Agreement, shall be signed or initialed in triplicate by the Owner and the Contractor; any contract documents which may be bound separately shall be signed or initialed for identification.

.2 The Contract Documents are complementary, and what is required by one shall be as binding as if required by all.

.3 The intention of the Contract Documents is to include all Products, labour, and services necessary to perform the Work in accordance with these documents, including all minor Products, labour and services not shown or specified, but which are reasonably necessary for performance and completion of the Work.

.4 Words which have well known technical or trade meanings are used in the Contract Documents in accordance with such recognized meanings.

.5 In the event of conflicts between Contract Documents the following shall apply:

(a) Documents of later date shall govern over earlier documents of the same classification.
(b) Figured dimensions shown on the Drawings shall govern even though they may differ from scaled dimensions.
(c) Drawings of larger scale shall govern over those of smaller scale.
(d) Specifications shall govern over Drawings.
(e) Sections of Division 1 - General Requirements shall govern over Specifications.
(f) The General Conditions of the Contract shall govern over Division 1 - General Requirements.
(g) Supplementary Conditions where included in the Contract Documents shall govern over the General Conditions of the Contract.
(h) The Agreement shall govern over all documents.

GC2 - OWNER

GC2.1 CLEAR PROPERTY TITLE

.1 The Owner shall indemnify and hold harmless the Contractor from and against all claims, demands, losses, costs, damages, actions, suits or proceedings arising out of the Contractor's performance of the Contract which are attributable to lack of or a defect in title to the Place of the Work.

. 2 Necessary access or easements to the Place of the Work will be arranged by the Owner. The Contractor shall have use of this access for purposes incidental to the Contract. Any such use shall not interfere with operations of the Owner, any Other Contractor or persons employed by the Owner, or with the rights of any other persons.

.3 The Contractor may wish to arrange for special easements or special use of adjoining or neighbouring public or private properties for purpose of expediting the Work. The Contractor shall hold the Owner and the Engineering Manager harmless from any claims arising from use thereof.

GC2.2 OWNER'S RIGHT TO STOP WORK OR TERMINATE THE CONTRACT

.1 If the Engineering Manager at any time is of the opinion that the Contractor:

- is neglecting to prosecute the Work properly or in accordance with the approved Schedule; or
- is failing or has failed to perform any provision of the Contract; or
- refuses or fails to supply sufficient skilled workers, provide proper workmanship, supply· sufficient or proper
- Products, construction machinery or equipment; or
- persistently disregards laws *or* ordinances or the Engineering Manager's instructions; or
- otherwise violates to a substantial degree the provisions of the Contract

and so certifies in writing to the Owner and the Contractor, the Owner may give the Contractor notice in writing requiring him to correct such failure or default within five (5) working days.

.2 If the Contractor fails to correct the failure or default within the lime specified in such notice, the Owner may, without prejudice to any other right or remedy he may have, terminate forthwith the Contractor's right to perform the Work or any part thereof or terminate the Contract forthwith.

.3 If the failure or default is such that, in the opinion of the Engineering Manager, it cannot be corrected within the time specified in the notice, the Contractor shall be deemed to have complied with the notice if he:

- commences the correction of the failure or default within the time specified and
- furnishes the Engineering Manager with a schedule for such correction acceptable to the Engineering Manager within the time specified and
- completes such correction within the time or times set forth in such schedule.

.4 It the Contractor should be adjudged bankrupt, *or* makes a general assignment for the benefit of creditors, *or* if a receiver is appointed on account of his insolvency, the Owner may, without prejudice to any other right or remedy he may have, by giving the Contractor written notice, terminate forthwith the Contractor's fight to perform the Work, or may terminate the Contract forthwith.

.5 If the Owner terminates the Contract or the Contractor's right to perform the Work, the Owner is entitled:

(a) to take possession of the Place of the Work and Products thereon and utilize the construction machinery and equipment, the whole subject to the rights of third parties, and to finish the Work by whatever method the Owner may deem expedient but without undue delay or expense.
(b) to withhold any further payment to the Contractor until the Work is completed.

(c) Upon completion of the Work charge the Contractor the difference in cost to the Owner, as certified by the Engineering Manager, between the cost of finishing the Work and the amount which would have been due to the Contractor under the Contract if all of the Work had been performed by the Contractor and also the additional costs of the Engineering Manager for his additional services caused by such termination. In addition, the Owner shall retain a reasonable allowance as determined by the Engineering Manager to cover the costs of any corrections required by GC10.2 - Warranty.

(d) on expiry of the warranty period or periods, charge the Contractor the amount by which the cost of corrections under GC10.2 Warranty exceeds the allowance provided for such corrections, as described in (c) above, or if the cost of such corrections is less than the allowance, pay the Contractor the difference.

GC2.3 OWNERS RIGHT OF ENTRY

1. The Owner shall have the right to enter, occupy, and use the Work, in whole or in part at any time before completion of the Contract, if such entry, occupation and use does not prevent or interfere with the performance of the Work.

2. Such entry, occupation and use shall neither be considered as acceptance of the Work by the Owner nor shall it relieve the Contractor of responsibility to complete the Work.

GC3 - CONTRACTOR

GC3.1 CONTRACTOR'S RESPONSIBILITIES AND CONTROL OF THE WORK

.1 The Contractor shall have complete control of the Work. He shall effectively direct and supervise the Work to ensure conformance with the Contract Documents. He shall be solely responsible for all the construction means, methods, techniques, sequences, and procedures and for coordinating all parts of the Work.

.2 The Contractor shall have the sale responsibility for the design, erection, operation, maintenance and removal of temporary structures and other temporary facilities and the design and execution of construction methods required in their use. The Contractor shall engage and pay for registered professional engineering personnel skilled in the appropriate discipline to perform these functions where required by law or by the Contract Documents and in all cases where such temporary facilities and their method of construction are of such a nature that professional engineering skill is required to produce safe and satisfactory results.

GC3.2 SUPERINTENDENCE

.1 The Contractor shall employ a competent superintendent who shall be in attendance at the Place of the Work at all times while work is being performed.

.2 The superintendent shall represent the Contractor at the Place of the Work and directions given to him shall be held to have been given to the Contractor. Important directions will be confirmed to the Contractor in writing by the Engineering Manager.

.3 The superintendent shall be satisfactory to the Engineering Manager and shall not be changed by the Contractor except for good reason and only then after consultation with and agreement by the Engineering Manager.

.4 The Engineering Manager shall have the authority to order the removal from the Work, of any Superintendent, Supervisor, Foreman or other employee on the Work should the Engineering Manager consider such person detrimental to the progress or quality of the Work. Any person so removed shall not be re-employed on the Work by the Contractor or by a Subcontractor.

GC3.3 CONTRACTOR·S RIGHT TO TERMINATE THE CONTRACT

.1 If the Owner should be adjudged bankrupt, or makes a general assignment for the benefit of creditors or if a receiver is appointed on account of his insolvency, the Contractor may, without prejudice to any other right or remedy he may have, by giving the Owner written notice, terminate the Contract.

.2 If the Work should be stopped or otherwise delayed for a period of thirty days or more under an order of any court, or other public authority, provided such order was not issued as the result of any act or fault of the Contractor or of anyone directly or indirectly employed by him, the Contractor may, without prejudice to any other right or remedy he may have, by giving the owner written notice, terminate the Contract.

.3 The Contractor may notify the Owner in writing, with a copy to the Engineering Manager, that the Owner is in default of his contractual obligations if the Owner fails to pay to the Contractor within twenty five (25) days of the date of the Engineer's Certificate any amount certified by the Engineer, subject always to the Owner's rights under law or this Contract to make deductions. Such written notice shall advise the Owner that if such default is not corrected within five (5) working days from the Owner's receipt of the written notice, the Contractor may, without prejudice to any other right or remedy he may have, terminate the Contract.

F o

.4 If the Contractor terminates the Contract under the conditions set out above, he shall be entitled to be paid for all work performed up to the date of the Owner's receipt of such notice. The Engineering Manager shall in his absolute discretion, certify the value of such work to the said date. If the Contractor terminates the Contract under the provisions of GC 3.3.1 or GC 3.3.3, the Contractor shall also be entitled to two and one half (2-½%) per cent of the difference between such value and the Contract Price if such value is less than fifty (50%) per cent of the Contract Price and to five (5%) per cent of the difference between such value and the Contract Price if such value is fifty (50%) per cent or more of the Contract Price in lieu of all other claims for damages.

GC3.4 REJECTED WORK

.1 Defective work whether the result of poor workmanship, use of defective Products or damage through carelessness or other act or omission of the Contractor, and whether incorporated in the Work or not, which has been rejected by the Engineering Manager as failing to conform to the Contract Documents shall be removed promptly from the Work and replaced or re-executed by the Contractor in accordance with the Contract Documents at the Contractor's expense.

. 2 Other work destroyed or damaged by such removals, replacements or re-execution shall be made good promptly at the Contractor's expense.

.3 The Owner reserves the right to correct defective or rejected work and deduct the cost of the same from the Contract Price.

.4 If in the opinion of the Engineering Manager it is not expedient to correct defective work or work not done in accordance with the Contract Documents, the Owner may deduct from the Contract Price the difference in value between the Work as done and that required by the Contract, the amount of which shall be determined and certified by the Engineer.

GC3.5 USE OF PREMISES

.1 The Contractor shall confine his equipment and plant, storage of materials and his operations to limits indicated by Laws, Ordinances, Permits, the Contract Documents or by specific direction of the Engineering Manager and shall not unreasonably encumber the Place of the Work.

. 2 The Contractor shall not load or permit to be loaded on any part of the Work, a weight or load or force that will endanger its safety or exceed the design loads.

. 3 The Contractor shall not interfere in any way with the work or scheduling of any Other Contractor or employee of the Owner. In order to avoid or minimize such interference, the Engineering Manager may in his absolute discretion establish schedules or methods and shall notify the Contractor accordingly. The Contractor shall without receiving any additional payment comply with the schedules or methods established by the Engineering Manager.

GC4 - OWNER AND CONTRACTOR

GC4.1 DAMAGES AND MUTUAL RESPONSIBILITY

.1 If either party to this Contract should suffer damage in any manner because of any wrongful act or neglect of the other party or anyone employed by or through him, then he shall be reimbursed by the other party for such damage. The party reimbursing the other party shall be subrogated to the rights of the other party in respect of such wrongful act or neglect if it be that of a third party.

.2 Claims under this- Article shall be made in writing to the party liable within ten (10) working days after the first observance of such damage and may be settled by agreement or in the manner set out in the Contract Documents for the settlement of disputes.

.3 If the Contractor has caused damage to any Other Contractor on the Project, the Contractor shall indemnify and hold harmless the Owner from and against any and all claims, costs, suits or proceedings arising therefrom.

.4 It the Contractor becomes liable to pay or satisfy any final order, judgment or award against the Owner, then the Contractor, upon undertaking to indemnify the Owner against any and all liability for costs, shall have the right to appeal in the name of the Owner such final order or judgment to any and all courts of competent jurisdiction.

GC4.2 ASSIGNMENT

.1 Neither party to the Contract shall assign the Contract or any portion thereof without the written consent of the other.

GC5 – ENGINEERING MANAGER

GC5.1 ENGINEERING MANAGER'S DECISIONS

.1 The Engineering Manager shall decide on questions arising under the Contract Documents and interpret the requirements therein. Such decisions shall be given in writing. The Engineering Manager shall use his powers under the Contract to enforce its faithful performance by both parties hereto.

.2 The Contractor shall notify the Engineering Manager in writing within five (5) working days should he hold that a decision by the Engineering Manager is in error or at variance with the Contract Documents.

.3 If the question of error or variance is not resolved within five (5) working days, and the Engineering Manager decides that the work in dispute shall be carried out, the Contractor shall act according to the Engineering Manager's written decision.

.4 Should the Engineering Manager's employment be terminated, the Owner shall appoint an Engineering Manager whose status under the Contract shall be that of the former Engineering Manager.

.5 Nothing contained in the Contract Documents shall create any contractual relationship between the Engineering Manager and the Contractor.

.6 The Engineering Manager will not, except by written notice to the Contractor, stop or delay any part of the Work pending instructions or proposed changes in the Work.

GC5.2 INSPECTION OF THE WORK

.1 The Owner and the Engineering Manager and their authorized representatives shall have access to the Work at any time for inspection wherever it is in preparation or progress. The Contractor shall cooperate to provide reasonable facilities for such' access. If such inspection shows that any Product or workmanship is not in accordance with the Contract Documents, such Product or workmanship shall be rejected.

.2 If special tests, inspections or approvals are required by the Contract Documents, the Engineering Manager's instructions or the law of the Place of the Work, the Contractor shall give the Engineering Manager and the affected authority adequate notice requesting inspection. Inspection by the Engineering Manager will be made promptly. The Contractor shall arrange inspections by other authorities and shall notify the Engineering Manager of the date and time. The Contractor shall furnish promptly to the Engineering Manager two (2) copies of all certificates and inspection reports relating to the Work.

.3 If, without the approval of the Engineering Manager or the affected authority, the Contractor covers or permits to be covered any of the Work that is subject to inspection or before any special tests and approvals are completed, the Contractor shall uncover the Work, have the inspections satisfactorily completed and make good the Work at his own expense.

.4 Examination of any Questioned work may be ordered by the Engineering Manager. If such work be found in accordance with the Contract Documents, the Owner shall pay the cost of examination and replacement. If such work be found not in accordance with the Contract Documents, the Contractor shall pay the cost of examination and replacement.

GC5.3 OWNERSHIP OF DOCUMENTS AND MODELS

.1 All Contract Documents and copies thereof furnished by the Engineering Manager are and shall remain his property and are not to be used on other work.

.2 Such documents are not to be copied or revised in any manner without the written authorization of the Engineering Manager.

.3 Models, samples, mock-up panels or units, furnished by the Engineering Manager, Contractor or the Owner are the property of the Owner.

GC6 - OTHER PARTIES

GC6.1 SUBCONTRACTORS

.1 The Contractor agrees to preserve and protect the rights of the Owner under the Contract with respect to any Work to be performed by Subcontractors.

GC6.2 OTHER CONTRACTORS

.1 The Owner reserves the right to let separate contracts in connection with the Project and to coordinate insurance coverages.

.2 The Engineering Manager will coordinate the work of Other Contractors as it affects the Work of this Contract.

.3 The Contractor shall coordinate his work with that of Other Contractors and connect or interface as described in the Contract Documents.

.4 The Contractor shall report to the Engineering Manager in writing, any apparent deficiencies in Other Contractors' work which would affect the Work of this Contract immediately they come to his attention. Failure to so report shall invalidate any claims by the Contractor against the Owner by reason of the deficiencies of Other Contractors' work except as to those of which the Contractor could not have been reasonably aware.

.5 The Owner will take all reasonable precautions to avoid labour or other disputes on the Project arising from the work of Other Contractors but shall not be in any way liable for delays or costs occasioned by such disputes, beyond the provisions of GC7.3 Delays.

GC7 - CONTRACT TIME

GC7.1 CONTRACT TIME

.1 The Contract Time shall be adjusted only by written instruction of the Engineering Manager to the Owner and the Contractor and only as described in GC7.3 - Delays or GC8 - Changes and Instructions.

.2 If the Contractor fails to complete the Work within the time required by the Contract Documents, the Owner, in addition to any other rights and remedies he may have, shall be entitled to deduct from any payments due to the Contractor the additional costs to the Owner of the engineering services incurred as a result of the Contractor's failure to complete on time.

.3 No bonus will be allowed by the Owner for completion of the Work in less time than specified in the Agreement.

.4 If the Contract Time is based on Working Days, the Engineering Manager shall prepare a statement at the end of each day, beginning on the date stated in the Agreement for the commencement of the Work, showing the number of hours charged to each main work item and signifying whether or not said hours constitute a Working Day. If the Contractor agrees, he shall sign the statement.

.5 If the Contractor does not agree with the Engineering Manager's statement, he shall within three (3) days present in writing his reasons for disagreement. Failing receipt of such communication, the Engineering Manager's statement shall be considered binding.

.6 If the Engineering Manager and the Contractor fail to agree on any such statement, the disagreement shall be settled in the manner set out in the Contract Documents for the settlement of disputes.

GC7.2 SCHEDULE

.1 The Contractor shall, immediately after the award of the Contract, prepare and submit for the Engineering Manager's review, a Schedule of activities of the Work to show dates of commencement and completion or number of working days for completion of various phases or parts of the Work, in relation to the Contract Time stated in the Agreement. The Schedule shall provide sufficient detail to the satisfaction of the Engineering Manager. After acceptance, the Schedule shall not be changed without the consent of the Engineering Manager.

.2 The Owner reserves the right to withhold payment from the Contractor if such Schedule is not submitted prior to or with the first application for payment, or a revised Schedule is not submitted prior to the next sub· sequent application for payment after an extension of time has been granted.

.3 The Contractor shall comply with the Schedule. The Contractor shall bear all costs necessary to meet the Schedule. If the progress of the Work falls behind the most recent schedule or is delayed for any reason other than one for which extra time is provided for in GC7.3 Delays, the Contractor shall immediately engage such additional labour and equipment, and work such additional hours as the Engineering Manager may direct, to bring the Work back on schedule, at the Contractor's expense.

.4 If at any time the Contractor has been granted additional time under the provisions of GC7.3 - Delays or GC8 - Changes and Instructions, he shall forthwith submit a revised schedule for the Engineering Manager's review, and in sufficient detail to the satisfaction of the Engineering Manager.

.5 More detailed requirements for this Schedule may be described in Division 1 - General Requirements.

GC7.3 DELAYS

.1 If in the opinion of the Engineering Manager the Contractor is delayed in the performance of the Work by any act or neglect of the Owner, or the Engineering Manager or any employee of either of them, the Contract Time shall be extended by an amount to be determined by the Engineering Manager.

.2 If in the opinion of the Engineering Manager the Contractor is delayed in the performance of the Work by a Stop Work Order issued by any court, or other public authority, or the Engineering Manager and providing that such order was not issued as a result of any act or fault of the Contractor or of anyone employed by him directly or indirectly, then the Contract Time shall be extended by an amount to be determined by the Engineering Manager.

.3 If in the opinion of the Engineering Manager, the Contractor is delayed in the performance of the Work by labour disputes, strikes, lock-outs (including lock-outs decreed or recommended for its members by a recognized Contractors' Association, of which the Contractor or a Subcontractor is a member), fire, unusual delay by common carriers or unavoidable casualties or, without limit to any of the foregoing, by any cause beyond the Contractor's control, then the Contract Time shall be extended by an amount to be determined by the Engineering Manager.

.4 No extension of the Contract Time shall be considered for delay unless written notice or claim is given to the Engineering Manager within fourteen (14) days of its commencement.

.5 Extension of the Contract Time shall not be a ground for any increase in the Contract Price.

GC8 - CHANGES AND INSTRUCTIONS

GC8.1 CHANGES IN THE WORK

.1 The Owner but only through the Engineering Manager, without invalidating the Contract, may make changes by altering, adding to, or deducting from the Work, with the Contract Price and the Contract Time being adjusted accordingly.

. 2 No change shall be made without a written instruction from the Engineering Manager and no claim for an addition or deduction to the Contract Price shall be valid unless so ordered and at the same time valued or agreed to be valued as provided in GC8.2 - Valuation and Certification of Changes in the Work.

GC8.2 VALUATION AND CERTIFICATION OF CHANGES IN THE WORK

.1 If the Engineering Manager is of the opinion that a change in the Work justifies a change in the Contract Price, the method of determining such change shall be established by the Engineering Manager in one or combination of the following methods:

(a) by the Contractor's estimate and acceptance by the Owner of a lump sum
(b) by unit prices set out in the Contract or subsequently agreed upon by the Owner and the Contractor
(c) by Contractor's net cost and a fixed or percentage fee as provided in the Contract Documents.

Equipment rental shall be at locally accepted rates or, in the absence of such rates, at the current provincial government approved rates. For equipment which has to be brought to the Place of the Work for the purpose, transportation costs will be negotiated. A piece of equipment shall mean a unit complete including operator, fuel, grease and maintenance and such costs as are normal to an operating unit. Rental shall be paid for actual hours of work only.

.2 When a change in the Work is proposed or required, the Contractor shall present to the Engineering Manager his claim for any change in the Contract Price and/or change in Contract Time. If the Engineering Manager approves such claim, he will after approval by the Owner, issue a written order to the Contractor to proceed with the change. The value of work performed in the change shall be included for payment with the next and subsequent regular certificates for payment. In the event that the Owner decides not to proceed with a proposed change, the Engineering Manager will notify the Contractor in writing.

.3 In the case of changes in the Work to be paid for under methods (b) and (c) of GC8.2.1, the form of presentation of costs and methods of measurement shall be determined by the Engineering Manager and Contractor before proceeding with the change. The Contractor shall keep accurate records of quantities or costs and present an account of the cost of the change in the Work, together with vouchers where applicable.

.4 If the method of valuation or measurement of a change, modification of the Contract Price or change in Contract Time cannot be promptly agreed upon, and the change must proceed without delay, the Engineering Manager shall order the change and shall determine the method, modification or change to be employed or allowed.

.5 In the case of dispute in the value of a change authorized in the Work and pending final determination of such value, the Engineering Manager shall determine the value of work performed and include that amount with the regular certificates for payment.

GC8.3 ADDITIONAL INSTRUCTIONS

.1 During the progress of the Work the Engineering Manager will furnish to the Contractor such additional instructions as may in the opinion of the Engineering Manager, be necessary to supplement or clarify the Contract Documents. All such instructions will be consistent with the intent of the Contract Documents.

.2 Additional instructions may include changes to the Work which affect neither the Contract Price nor the Contract Time.

.3 Additional instructions may be in the form of drawings, samples, models, oral or written instructions.

GC9 - PAYM ENT/CERTIFICATES

GC9.1 APPLICATION FOR PAYMENT

.1 Application for payment on account as provided for in Article A·4 of the Agreement shall be made monthly as the Work progresses and shall be for the monthly period ending on the date or the application. A specific date for the commencement of each monthly period may be given in the Supplementary Conditions.

.2 The Engineering Manager may require a breakdown of any Lump Sum prices contained in the executed Tender.

.3 When making application for payment, the Contractor shall submit a statement based on the actual quantities performed on the Work at the Contract Unit Prices and Lump Sums up to the last day of the agreed monthly period, made out in such form and supported by such evidence to its correctness as the Engineering Manager may require.

.4 The statement shall identify the items of Work, quantities performed, Contract Unit Prices, Lump Sums, the total of money paid to date, all lien holdback sums and the net amount applied for. Measurement for payment shall be in accordance with the relevant provisions of the Specifications.

.5 The Application shall be received by the Engineering Manager within five (5) days following the end of the agreed monthly period.

.6 Applications for release of holdback monies following the Substantial Performance of the Work and the application for final payment shall be made at the time and in a manner set forth in GC9.2 - Certificates and Payments.

GC9.2 CERTIFICATES AND PAYMENTS

.1 The Engineering Manager shall within seven (7) days of receipt of an application for payment from the Contractor submitted in accordance with GC9.1 - Application for Payment, issue a certificate for payment in the amount applied for or such other amount as he shall determine to be properly due. If the Engineering Manager amends the application, he will promptly notify the Contractor in writing giving his reasons for the amendment.

.2 The Owner shall, on or before the last day of the next monthly period, make payment to the Contractor on account, in accordance with the provisions of Article A-4 of the Agreement. The actual amount paid is subject to the Owner's rights under law or this Contract to make deductions.

.3 The Engineering Manager will, within ten (10) days of receipt of an application from the Contractor for a certificate of Substantial Performance, make an inspection and assessment of the Work to verify the validity of the application. The Engineering Manager will within seven (7) days of his inspection notify the Contractor of his approval or disapproval of the application. When the Engineering Manager finds the Work to be substantially performed, he will issue such a certificate to the Owner and the Contractor. The date of this certificate shall be the date of Substantial Performance of the Work. No Certificate for Final Payment shall be issued by the Engineering Manager until final measurements of all unit price quantities incorporated in or made necessary by the Work have been made by the Engineering Manager and have been approved by the Contractor.

.4 Notwithstanding any other provisions of this Contract:

(a) If on account of climatic or other conditions reasonably beyond the control of the Contractor there are items of work that cannot be completed, the payment for work which has been substantially performed as certified by the Engineering Manager shall not be withheld or delayed by the Owner on account thereof.

(b) Where legislation permits and where, upon application from a Subcontractor, the Engineering Manager has certified that a subcontract has been completed prior to the Substantial Performance of the Work, the Owner will pay the Contractor the holdback retained for such subcontract following the expiration of the statutory period stipulated in the Lien Legislation applicable to the Place of the Work, providing no lien derived under that subcontract is preserved by anything done under the appropriate Lien Legislation, and the Subcontractor has submitted to the Owner a sworn statement that all accounts for labour, subcontractors, Products, construction machinery and equipment and any other indebtedness which may have been incurred by the Subcontractor in the performance of the subcontract and for which the Owner might in any way be held responsible have been paid in full except holdback monies properly retained.

(c) Notwithstanding the provisions of Article (b) above and the wording of such certificates, the Contractor shall ensure that such work is protected pending the Substantial Performance of the Work and be, responsible for the correction of any defects in it regardless of whether or not they were apparent when such certificates were issued.

.5 Following the issuance of the Certificate of Substantial Performance the Engineering Manager will issue a certificate for payment of Lien holdback monies. The Owner shall pay the holdback monies authorized by this certificate on the next working day following the expiration of the statutory period stipulated in the Lien Legislation applicable to the Place of the Work; providing no lien claims have been registered which are still outstanding and the Contractor has submitted to the Owner a sworn statement that all accounts for labour, subcontracts. Products, construction machinery and equipment and any other indebtedness which may have been incurred by the Contractor in the Substantial Performance of the Work and for which the Owner might in any way be held responsible have been paid in full except holdback monies properly retained.

.6 The Engineering Manager will within ten (to) days of receipt of an application from the Contractor for final payment, make an inspection and assessment of the work to verify the validity of the application. The Engineering Manager will within seven (7) days of his inspection notify the Contractor of his approval or disapproval of the application. When the Engineering Manager finds the Work to be completed to his satisfaction, he will issue a certificate for final payment for the remaining monies due to the Contractor under the Contract less any holdback monies which are still required to be retained. The Owner shall make payment to the Contactor in the amount of such certificate, and on the next working day following the expiration of the statutory period stipulated in the Lien Legislation applicable to the Place of the Work make final payment providing no lien claims been registered which are still outstanding.

.7 No certificates nor any payments made thereunder, nor any partial or entire use or occupancy of the Work by the Owner shall constitute an acceptance of any work or Products not in accordance with the Contract Documents.

.8 The Certificate of Substantial Performance given by the Engineering Manager shall be conclusive evidence between the Owner and the Contractor with respect to the start of the Warranty Period as described in GC10.2 - Warranty.

GC10 - PERFORMANCE ASSURANCE

GC10.1 BONDS

.1 The Owner shall have the right to require the Contractor to provide and maintain in good standing until the fulfillment of the Contract, bonds covering the faithful performance of the Contract and labour and materials payment thereunder, including the requirements of the Warranty provided for in GC10.2 - Warranty, and the payment of all obligations arising under the Contract.

.2 All such bonds shall be issued by a duly incorporated surety company approved by the Owner and authorized to transact a business of suretyship in the Province or Territory of the Place of the Work. The forms of such bonds shall be acceptable to the Owner.

.3 If the Tender Documents require the successful bidder to provide bonds, the Contractor shall pay for same.

.4 It the Owner requests bonds of the Contractor and such bonds were not demanded in the Tender, the Owner shall reimburse the Contractor on receipt of a receipted premium demand and the executed bond itself.

.5 The Contractor shall produce all required or requested bonds prior to commencing any work of this Contract.

GC10.2 WARRANTY

.1 The Contractor shall promptly correct at his own expense any defects in the Work due to faulty Products or workmanship appearing within a period of one (1) year from the date of Substantial Performance of the Work, or for such extended period as may be specifically stated in the specifications. A like Warranty shall apply to any repaired or replaced Product or workmanship effective as of date of repair or replacement and remain in effect for one (1) year thereafter.

.2 To ensure the Owner has benefit of any and all Product or system warranties offered by manufacturers or others, the Contractor shall ensure that all Warranties are assignable and are assigned to the Owner in the Owner's name. Such assignment shall not relieve the Contractor of his obligations under this Article GC10.2 - Warranty.

.3 The Contractor shall correct at his own expense, all damage resulting from any defects or corrections to any defects required under conditions of Article 10.2.1.

.4 The Owner may in an emergency or if the Contractor neglects to correct defects for any reason, do the work or direct someone else on his behalf to do the work, and charge the Contractor accordingly.

.5 No certificate of the Engineering Manager nor payment thereunder shall relieve the Contractor from his responsibility herein.

.6 The Owner or the Engineering Manager will give the Contractor written notice of all observed defects promptly.

.7 The Engineering Manager will, one month prior to termination of the Warranty Period, notify the Owner and the Contractor by written notice that an inspection of the Work is required and will in such notice fix a date for such inspection which shall be within the next ten (10) days. The inspection will be carried out by the Engineering Manager who may be accompanied by the Owner and the Contractor. The Engineering Manager will record defects requiring repair or correction and will instruct the Contractor in writing to remedy such defects within fifteen (15) days. It the Contractor refuses or neglects for any reason to correct such defects, the Owner may correct them or direct someone else on his behalf to correct them and charge the Contractor for all the costs of such correction.

GC11 - INDEMNIFICATION AND INSURANCES

GC11.1 INDEMNIFICATION

.1 The Contractor shall indemnify and hold harmless the Owner and the Engineering Manager, their agents and employees from and against all claims, demands, losses, costs, damages, actions, suits, or proceedings arising out of or attributable to the Contractor's performance of the Contract. Without limiting the generality of the foregoing. such indemnity shall extend to claims for liens filed under the appropriate Lien Legislation after the time available to the Contractor for tiling liens.

.2 Nothing in the Contract Documents or any approval, expressed or implied, of the Engineering Manager or the Owner shall· relieve the Contractor of any liability for latent defects or inherent vice which may be imposed by law.

GC11.2 INSURANCES

.1 The Contractor shall maintain Comprehensive liability and Property Insurance applicable to the Work and all parties thereto for the full term of the Contract including the Warranty period (s), unless specified otherwise.

.2 The Contractor shall provide proof of all insurance to the Owner prior to commencing the Work.

.3 A specific listing of required insurances may be described in Supplementary Conditions.

GC11.3 PROTECTION OF WORK AND PROPERTY

.1 The Contractor shall protect all property adjacent to the Place of the Work from damage as the result of his operations under the Contract.

.2 The Contractor shall protect the Work and the Owner's property from damage and shall be responsible for any damage which may arise as the result or his operations under the Contract.

GC12 - WORKERS' COMPENSATION

.1 Prior to commencing Work, prior to receiving payment for Substantial Performance of the Work and the final payment, and at any time during the term of Contract, when requested by the Engineering Manager, the Contractor shall provide evidence that the Contractor and all Subcontractors have complied with all requirements of the Province or Territory of the Place of the Work with respect to Workers' Compensation, including payments due thereunder.

STANDARD PROVISIONS

TABLE OF CONTENTS OF STANDARD PROVISIONS

STANDARD PROVISIONS

1. ENGINEERING MANAGER AND INSPECTOR

The term "Engineering Manager" shall be used to denote any Manager or Engineer acting on the Rural Municipality of Hanover's behalf. The term "Inspector" shall denote any person delegated by the Engineering Manager to inspect the construction of the work.

In case of any dispute arising between the Contractor and any Inspector as to materials furnished or the manner of performing the work, the Inspector shall have the authority to reject materials or suspend the work until the question at issue can be referred to and decided by the Engineering Manager.

The Inspectors shall perform such other duties as are assigned to them by the Engineering Manager. They shall not be authorized to revoke, alter, enlarge, relax or release any requirements of the work nor to issue instructions contrary to the plans and specifications. Inspectors shall in no case act as foremen or perform other duties for the Contractor. No instructions of the Inspector to the Contractor shall release the Contractor from fulfilling the Contract.

2. WORKING DAYS

2.1 Definition of Working Day

Any day, other than a Saturday, Sunday or a Statutory or Civic Holiday, on which, in the opinion of the Engineering Manager, atmospheric and/or site conditions are such that the Contractor is able to work at least seven (7) hours during the period between 7:00 a.m. local time or the time the Contractor's operations normally commence, whichever is the earlier, and 7:00 p.m. local time, shall be defined as a working day.

2.2 Variations of Standard Working Days

The hereinbefore mentioned definition of a working day is meant to apply when only one major type of work is involved in a Contract. Where two or more major types of work are involved in a Contract a working day may be based, at one time on one type of work while at another time a working day may be based on another type of work. When more than one type of major work is involved, the quantity of equipment that must be able to work in order to meet the requirements of a working day may vary considerably from that specified in the preceding paragraph.

Notwithstanding the provisions hereinbefore set forth relating to the charging of working days, in the event that incidental work which, in the opinion of the Engineering Manager, should have been or could have been carried out by the Contractor in conjunction with or immediately following work of a major type, being behind schedule, the Municipality hereby reserves the right to charge working days on the incidental work until such time as it is up to schedule.

When the major type of work involves restoration of the site to the condition it was prior to a rainfall working days shall not be charged.

2.3 Record of Working Days

The Engineering Manager will furnish the Contractor with a daily record for each major type of work showing various information concerning the equipment, the time it worked, could have worked and working days charged. This report is to be signed each day by an authorized representative of the Contractor.

The Contractor will be allowed seventy-two (72) hours in which to file a written protest with the Engineering Manager on the project that the said daily statement is, in his opinion, incorrect. Otherwise the said daily statement shall be deemed to have been agreed to by the Contractor. Any such protest submitted by the Contractor will be dealt with promptly and the Contractor advised at an early date as to the Engineering Manager's decision.

2.4 Restoration of Boulevard or Grassed Areas

Where underground or surface work is being carried out in boulevard or grassed areas, restoration of the boulevard or grassed area shall be completed within 20 working days of the completion of underground or surface work in each work area.

3. LIQUIDATED DAMAGES

In the event that all the work specified under this Contract is not completed within the number of working days or by the project completion date as set forth in the Contract, the Contractor shall pay to the Municipality the sum stipulated as Liquidated Damages for each and every working day, as hereinbefore defined, that completion of the work exceeds the number of working days or the project completion date set forth in the Contract. The Municipality may, but is not obligated to increase the number of working days or extend the project completion date.

4. BUILDERS' LIENS ACT HOLDBACK

In conformance with the General Conditions, and with the Builders' Liens Act where it applies, and where monthly progress payments are made, a holdback of 7-1/2% will be retained until 40 days after a Notice of Substantial Performance has been issued and served in accordance with the Act. All holdbacks under the Act will pay such interest as is required by statute from the date of the initial retention until the date of release. Outstanding work completed after the date of substantial performance up to the date of completion as certified on the Final Certificate will also be subject to the statutory holdback and interest provisions of the Act. Builders' Liens holdbacks will be retained for 40 days after the completion date.

Further to Clause 9.2.3 of the General Conditions and upon application by the Contractor and upon being satisfied that the Contract has been substantially performed, the Engineering Manager shall, within seven (7) days after he receives the application or after the contract has, in his opinion, been substantially performed, whichever is the later, give or cause to be given a Certificate of Substantial Performance of the Contract.

The date of the Certificate shall be the date of Substantial Performance of the Work. No Certificate for Final Payment shall be issued by the Engineering Manager until final measurements of all unit price quantities incorporated in or made necessary by the Work have been made by the Engineering Manager and have been approved by the Contractor.

If, in the opinion of the Engineering Manager, the work has not been substantially performed, and the application by the Contractor is not valid, he shall notify the Contractor of his disapproval, within seven (7) days of his inspection.

Further to Clause 9.2.4 (b) of the General Conditions, requirements for release of the holdback, the Contractor shall also provide the following before the holdback monies will be released:

(i) A letter of clearance or certificate from the Workers' Compensation Board verifying that all assessments due by the Contractor have been fully paid as of the date of Substantial Performance;

(ii) A letter from the Contractor's Surety (if any) approving the release of holdback;

5. SUBSTANTIAL PERFORMANCE OF SUBCONTRACTS

The Contractor shall comply with his obligations under the Builders' Lien Act as regards subcontractors who have substantially performed their contracts. The Contractor shall also notify all subcontractors of the issuance of the Notice of Substantial Performance with regard to the prime contract.

6. COMPLETION OF WORK AND COMMENCEMENT OF GUARANTEE PERIOD

6.1 Completion Inspections

On completion of construction and required testing, the Contractor shall arrange, attend and assist in the inspection of the Work with the Engineering Manager. Any unsatisfactorily completed portions of the Work shall be corrected at the earliest possible instance.

6.2 Project Completion Date

The date that the Works are certified by the Engineering Manager, as acceptably completed shall be, for the purposes of the Final Certificate and the maintenance guarantee, the project completion date.

7. EXISTING SERVICES AND UTILITIES

No responsibility will be assumed by the Municipality or the Engineering Manager for correctness or completeness of the Drawings with respect to the existing utilities, pipes or other objects either underground or on the surface, and neither the Municipality nor the Engineering Manager shall be liable for errors, omissions or inadequacies therein. It shall be the responsibility of the Contractor to verify the location of all such utilities, pipes and other objects and, if encountered, to adequately protect them during construction period, and if disturbed or damaged by the Contractor, to have them replaced or rest in their original position after construction has been completed at the Contractor's cost.

The Engineering Manager will arrange for the relocation of existing utilities, poles, traffic signals, signs and lamp posts which interfere with the proposed construction. The Municipality will be responsible for the cost of this relocation. The Contractor shall make the necessary arrangements for and pay the cost of all relocations required for his convenience.

8. CONTRACTOR TO NOTIFY UTILITIES AND OTHER AUTHORITIES

Whenever the work requires that a public street or lane be cut for underground works, the Contractor shall, before entering on the work, make application to each utility or authority.

Notice must also be filed with the Engineering Manager at the time of notification.

The Contractor shall maintain accurate records of these notifications. The Engineering Manager shall have access to these records.

Where any watermains feeding fire hydrants are to be placed temporarily out of service or where any streets are to be temporarily closed, the Contractor shall give written notice of these closures and their probable duration to the Engineering Manager. The Engineering Manager shall notify the Police Department and Fire Department of these closures. The Engineering Manager shall notify the Police Department and Fire Department as soon as the watermain is restored to service and/or the street is reopened.

9. HYDRO AND M.T.S. POLES

When underground works occur within two metres of a Hydro or M.T.S. pole, the Contractor shall make arrangements with the authority concerned regarding temporary support and/or relocation of the poles at the Contractor's expense. Under the above condition, the Contractor shall use (a) mechanically tamped clay and/or granular material

for trench backfill, (b) tunnel a minimum of 1.5 metres on each side of the pole and install the pipe in tunnel construction, or (c) as otherwise specified by the utility concerned.

10. OPERATING VALVES ON WATERMAINS

Upon receipt of adequate notice, Municipal work forces shall turn existing watermains off and on as required for the Contractor. At no time shall the Contractor operate the valves on the existing watermain system or new valves tied into the existing system.

11. SHUTDOWN OF EXISTING WATER SERVICES

The Contractor shall notify the Municipality and any premises to be affected by the shutdown of any existing waterlines well in advance of shutdown. In the event of water being shut off for a planned period of more than six (6) hours, the Contractor must make arrangements at his own expense to supply any residences or businesses affected with a temporary pressurized water supply. For all shutdowns of existing watermains, the Contractor shall provide a temporary water supply by means of water tanker. If and when the Municipality is required to supply any residences or businesses with a temporary water supply during any hour of the day because of the neglect or deficiency of the Contractor, the Contractor will be charged with the total cost of the work.

The foregoing, however, is at the Municipality's discretion and may insist upon greater levels of service dependent on circumstances and the nature of establishments affected by the shutdown.

12. GAS MAINS

Should gas pipes be found by sounding or on exposure to be at such depths as to interfere with the proposed work, the Engineering Manager may order the grade and/or alignment of proposed underground work altered to clear the existing gas pipes. No extra payment for extra excavation will be paid. Similarly, should less excavation result, no reduction in the Contract price shall be made.

Alternatively, the Engineering Manager may order the existing gas main or gas service relaid. In this case, these pipes will be relocated by the Gas Company prior to or at the same time as the installation of the new pavement, sewer or watermain. The cost of relocating these gas pipes, including disconnecting, removing, relaying and reconnecting the new pipe will not be borne by the Contractor.

13. EXISTING CULVERTS

It is the Contractor's responsibility to replace any culverts damaged by the Contractor in

the course of the work to the satisfaction of the Engineering Manager.

14. SURFACE RESTORATION

Unless otherwise specified, the Contractor shall be responsible for restoring all surfaces to conditions equal to or better than the original condition.

Arrangements shall be made by the Contractor with the Authority concerned regarding restoration of surfaces.

It shall be the Contractor's responsibility to maintain all surfaces including pavement, boulevards, curbs, sidewalks, culverts, etc. until permanent repairs have been made.

All ditches shall be graded and restored upon completion of the installation. Ditch grades shall be as determined by the Engineering Manager or by the Authority having jurisdiction over the roadway. The Contractor will also be responsible to maintain the drainage of the existing ditches during the construction period and the one year maintenance period.

Surface restoration and clean-up shall be done block by block immediately behind the installation crews.

15. CO-OPERATION WITH OTHERS

The Contractor's attention is directed to the fact that other Contractors, personnel of other utilities and the staff of the Municipality may be working on or adjoining the site.

The activities of these agencies may coincide with the Contractor's execution of the work, and it will be the Contractor's responsibility to co-operate to the fullest extent with personnel working in the areas, and such co-operation is an obligation of the Contractor under the terms of the Contract. The Municipality will endeavour to inform the Contractor of any known works that may influence the execution of the Contract.

16. ACTS, STATUTES, BY-LAWS AND REGULATIONS

The Contractor shall comply with all Federal and Provincial Statutes, Orders, Regulations and By-laws. The Contractor shall co-operate with the Municipality in promptly furnishing all information that may be required by regulations. The Contractor shall be responsible to ensure that his personnel are familiar with and shall obey such regulations.

The Contractor shall observe and comply with the requirements of the Workplace Safety and Health Act and all addenda thereto under the Workplace Safety and Health Act of the Province of Manitoba, for the safety of the men to be employed on the project.

17. PROTECTION OF SURVEY BARS

The Contractor shall not disturb, deface, alter, destroy or remove any survey post, monument or bar and if the same shall occur, then, and in every such case, the Engineering Manager shall have such post, monument or bar replaced at the expense of the Contractor. The Contractor shall pay all costs and expenses incurred in connection therewith.

All known survey posts, monuments or bars are indicated on the drawings. If the Contractor is in doubt about the location of the bars in the field, he will contact the Engineering Manager before doing any work in the area. Other survey posts, monuments or bars may exist and the Contractor shall exercise care at intersections and other places where such survey posts, monuments or bars may exist.

Where a survey bar lies in the line of the proposed work and must be disturbed, the Contractor shall provide the Engineering Manager with 72 hours notice to have the survey bar referenced and relocated. The survey bar shall be referenced and replaced at no cost to the Contractor.

18. ENCROACHMENT ON PRIVATE PROPERTIES

Particular care shall be taken to assure no damage is done to trees and plants, including grass, located on private property, and provision is to be made to maintain full drainage during construction. The Contractor shall take such measures as are necessary to ensure safe and convenient pedestrian and vehicle ingress and egress to private properties and around work sites in the public right-of-way.

19. TRAFFIC CONTROL AND MAINTENANCE OF ACCESS

It will be the responsibility of the Contractor under the Contract to maintain traffic during the entire period of the Contract and to ensure that maximum protection is afforded to the road user and that the Contractor’s operations in no way interfere with the safe operation of traffic.

Where deemed necessary by the Engineering Manager, a temporary access roadway shall be provided by the Contractor for any residence or building that does not have an alternate means of vehicular access. The access roadway shall also be maintained, removed and the site thoroughly cleaned up on completion by the Contractor.

The Contractor shall supply, erect and maintain all applicable traffic control devices in accordance with the provisions contained in the latest edition of “Manual of Temporary Traffic Control” Specification MH 4000.

The Contractor shall provide and maintain flagmen in accordance with the Manual.

Improper signing will be sufficient reason for the Engineering Manager to immediately shut down the entire job.

20. DUST NUISANCE

The Contractor shall take such steps as may be required to prevent dust nuisance resulting from his operations whether within the right-of-way or elsewhere or by public traffic where it shall be the Contractor's responsibility to maintain a roadway throughout the work. Upon direction by the Engineering Manager, corrective measures will be taken by and paid for by the Contractor. Where the work requires the sawing of asphalt or the sawing or grinding of concrete, blades and grinders of the wet type shall be used together with sufficient water to prevent the incidence of dust wherever dust would affect traffic or wherever dust would be a nuisance to the residents of the area where the work is being carried out.

21. NOISE ELIMINATION

The Contractor shall reduce noise to as great an extent as possible at all times. Air compressing plants shall be equipped with silencers and the exhausts of all gasoline motors or other power equipment shall be provided with mufflers.

22. WATER USED BY CONTRACTOR

Water for use by the Contractor, shall be obtained from the Municipality at the prevailing rates. The Contractor shall arrange with the Engineering Manager as to the hydrants available for his use. The required permit for hydrant use shall be obtained from the Municipal Office. All water used shall be metered and protected against contamination by the use of approved backflow prevention devices. Other sources of water may be used only after special written permission has been received from the Engineering Manager.

23. WATER AND SEWER SERVICE INSTALLATION LICENSES

All Contractors carrying out water and sewer installations shall be licensed to Municipal Standards.

24. PRIVATE APPROACHES LICENSE

All Contractors carrying out construction of private approaches shall be licensed to Municipal Standards.

25. MUNICIPALITY'S RIGHT TO DO WORK

If the Contractor should neglect to prosecute the work properly or fail to perform any provision of this Contract, one (1) day after receiving written notice from the Municipality, the Municipality may, without prejudice to any other remedy it may have, make good such deficiencies and may deduct the cost thereof from the payment then or thereafter due to the Contractor.

26. CONTRACTOR'S LIABILITY INSURANCE

The Contractor shall secure and maintain such insurance or pay such assessments as will protect himself, his sub-contractors and the Municipality from claims for bodily injuries, death or property damage which may arise from operations under this Contract, whether such operations be by himself or anyone employed by them directly or indirectly. The following insurance policies or protection are required:

(a) Statutory Workers Compensation

(b) Contractor's Public Liability or Property Damage

(Bodily Injury: each person - each accident	$1,000,000/person $l0,000,000/accident
Property Damage: each accident - aggregate)	$1,000,000/accident $10,000,000 aggregate

(c) Automobile Public Liability and Property Damage, owned and non-owned vehicles

(Bodily Injury: each person - each accident;	$1,000,000/person $10,000,000/accident
Property Damage: each accident - aggregate)	$1,000,000/accident $10,000,000 aggregate

All policies shall be for amounts as specified above or, if no amounts are so specified, shall be in such amounts as the Engineering Manager requires. Contractor shall also provide copies of other insurance policies (i.e. All Risks) including the limits of liability which would apply to the project for review by the Engineering Manager.

Certificates of such insurance shall be filed with the Engineering Manager and shall be subject to the Engineering Manager's approval as to the adequacy of protection. The Municipality shall be named jointly with the Contractor on the certificates of insurance. Such insurance policies shall be maintained until the Engineering Manager certifies that the work is complete. If the Contractor has to return to the site of the work for the purpose of repairing defects in material or workmanship, he shall again be required to secure and maintain insurance policies in such amounts as the Engineering Manager may require.

If the Contractor fails to maintain in force the required insurance, the Municipality after giving reasonable notice, may do so itself and deduct the amount paid as premiums from money due the Contractor, or recover it as a debt due from the Contractor.

27. DAMAGE CLAIMS

The Contractor shall defend, indemnify and save harmless the Municipality, its officers, agents, servants, and employees against and from all suits, losses, demands, payments, actions, recoveries, judgments and costs of every kind and description and from all damages to which the Municipality or any of its officers, agents, servants, and employees may be subjected by reason of injury to the person or property of others resulting from the performance of the Contract, or through any improper or defective machinery, equipment, implements, or appliances used by the Contractor on the Contract, or through any act or omission on the part of the Contractor or his agents, employees or servants, and he shall defend, indemnify and save harmless to the Municipality, its officers, agents, servants and employees from all suits and actions of any kind or character whatsoever which may be brought or instituted by any sub-contractor, material supplier or labourer who has performed work or furnished materials in or about the work or by, or on account of, any claims or amount recovered for an infringement of patent, trademark or copyright.

DESIGN STANDARDS

TABLE OF CONTENTS

SECTION A
WATERMAINS AND APPURTENANCES

A.1 SIZE

All new watermains shall be at least 150 mm in diameter. On cul-de-sacs less than 90 m in length, where it is practical to provide adequate fire protection from the street intersection and/or from 150 mm watermains and also adequate water supply pressures; watermain sizes may be reduced.

A.2 DEPTH

All new watermains shall be laid to a minimum depth to crown of 2.7 m below the finished street centreline grade.

A.3 PIPE CLASS

All piping for waterworks purposes shall be capable of withstanding a minimum operating pressure of 1 MPa.

A.4 DESIGN PRESSURE

Local systems must be capable of supplying maximum hourly rate or a maximum daily rate plus fire demand, whichever is the greatest. Pressure shall not full below 207 kPa in street laterals during the demand of maximum hour or 138 kPa at the hydrant during the demand of maximum day plus fire demand loading.

A.5 DESIGN GUIDE

Waterworks system design will be to the full consideration of the requirements of the "Water Supply for Public Fire Protection" manual by the Fire Underwriters Survey, unless specifically specified herein.

A.6 VALVE DISTRIBUTION

Distribution valves shall be spaced so as to provide adequate shutdown capabilities, i.e., the ability to isolate a block. Minimum spacings shall be based on, but are not limited to, the following criteria:

* maximum spacing 150 m apart,
* it is desirable that there be a maximum of 20 services between valves

* minimum 4 valves per four way intersection,
* minimum 3 valves for all other intersections,
* all bays and cul-de-sacs or their equivalent must be isolated.

Valves shall be located in line with street right-of-way lines, or on property line projections.

A.7 ALIGNMENTS

All watermains and appurtenances shall be located as specified within the Standard Details. Any and all deviations from these standards shall be subject to special review by the Municipality.

A.8 BEDDING

Bedding shall be a minimum TYPE B as specified by the WPCF Manual of Practice No. 9 (1969) and shall consist of a sand envelope around pipe for full width of trench extending a minimum of 100 mm below to 200 mm above all mains.

A.9 HYDRANTS

Connection to Watermain

All hydrants shall have a minimum 150 mm diameter valved connection to the watermain. Valve and piping shall be the same quality as line piping and fittings.

Hydrant Spacing

Linear spacing of hydrants along streets shall not be greater than 120 m. The maximum spacing of hydrants shall be such that a circle of protection is not more than a 76 radius.

Height Above Grade

Hydrants shall be installed so that the distance from the bottom of the hydrant flange to the finished ground line is from 50 mm to 150 mm, above finished grade.

SECTION B
WASTEWATER AND LAND DRAINAGE SEWER AND APPURTENANCES

B.1 SIZE

Wastewater Gravity Sewer

Wastewater sewers shall be of such size that they shall be capable of handling the peak hour flow based upon the Harmon peaking factor, plus allowable infiltration and extraneous flows, and shall in no case be less than 200 mm in diameter.

Wastewater Low Pressure Sewer

Wastewater sewers shall be of such size that they shall be capable of handling the peak hour flow based upon the Harmon peaking factor, plus allowable infiltration and extraneous flows, and shall in no case be less than 75 mm in diameter.

Interim Land Drainage Standards

Land drainage shall be designed to accommodate the runoff from a rainfall having a return frequency of one in two (2) years unless otherwise authorized by the Municipality. Land drainage sewers shall be a minimum of 250 mm diameter (for cleaning purposes).

B.2 DEPTH

Wastewater Sewer

The minimum invert depth of a wastewater sewer system shall be 2.6 m below finished ground level.

Land Drainage System

The minimum invert depth of a land drainage sewer system shall, where practicable, be 1.5 m below ground level.

B.3 SLOPES

All wastewater sewers shall be designed with the slope to give minimum velocities when flowing full of 0.6 m per second. All land drainage sewers shall be designed for a minimum velocity when flowing full of 1 m per second.

B.4 MANHOLES AND/OR CATCHBASINS

Location and Spacing

Manholes for sewers shall be installed at the junction of sewers (except at catchbasin connections) at changes of alignment or grade (except in curved sewers) at the upper end of each line and at all street intersections, with a maximum desirable spacing between any two manholes of 110 m, and in no case more than 120 m. In cases of sewers 1375 mm and larger, the manhole spacings may be varied upon approval.

Size (Diameter)

For all manholes and catchbasins, the minimum barrel diameter shall be 900 mm. The minimum bottom section diameter for manholes shall be 1200 mm.

Size (Height)

For all catchbasins installed within 1 metre of any roadway or pavement, the minimum bottom section height shall be 1800 mm, regardless of pipe inverts.

B.5 ALIGNMENTS

All sewers and appurtenances shall be located as specified within the Standard Details. Any and all deviations from these standards shall be subject to special review by the Municipality.

SECTION C
SERVICE CONNECTIONS (WATER AND SEWER)

C.l WATER SERVICE LINES

Size

Service lines shall be a minimum of 19 mm in diameter. Services shall be sized according to the latest revision of the Manitoba Building Code. Sizing shall suit the hydraulic conditions and shall be subject to approval by the Manager of Municipal Engineering.

Minimum service lines shall be as follows:

- Properties zones UR ..... 19-25 mm
- Properties zones C, M .....50 mm
- Other ..... as determined by individual requirements

Depth

A water service, either in the street or in private property, shall be placed at least 2.6 m below the surface of the ground, but shall not be deeper than 3.0 m in the ground unless a greater depth is approved.

Curb Stop

An approved water curb stop and approved box shall be provided at or near the street line for control of water to the premises served. The water service pipe on the property shall be connected to the curb stop and where the Water Works Utility installs the street portion, the owner shall provide extra service pipe not less than 0.3 m in length at the street line to facilitate this connection. Adaptors necessary to connect different types or sizes of property pipe to the Water Works Utility curb stop shall be provided by the owner.

C.2 SEWER SERVICE LINES

Size

Service lines shall be a minimum of 100 mm in diameter for gravity services and 38mm for low pressure services and shall be sized according to the latest edition of the Manitoba Building Code.

Quality

Materials, joints, and workmanship shall equal those specified for main sewers.

Slope

The minimum slope for a 100 mm sewer service shall be one percent (1%).

Depth

Sewer connections shall have not less than 1.8 m of cover at the building line nor less than 2.1 m of cover at the street line. Ideally, sewer service depth to invert at the property line shall be a minimum of 2.75 m from design finished grade.

Location

Sewer service shall be located such that when facing the lot to be serviced from the street right-of-way, the sewer service will be to the left-hand side of the water service stop box.

Sewer and water services shall be located within the middle third of the frontage of the lot that is being serviced.

SECTION D
TRANSPORTATION

The purpose of this section is to ensure design and construction are consistent with current practice and trends.

The following is not intended to contain an exhaustive summary of parameters required to design a street or street network, but to specify key parameters and reference to standard design aids. Designers are referenced to the Roads and Transportation Association of Canada publication entitled "Geometric Design Standards for Canadian Roads" (RTAC Manual) and "Guidelines for Urban Major Street Design", a recommended practice of the Institute of Transportation Engineers.

D.1 STREET CLASSIFICATION

The roadway classification system used in the Rural Municipality of Hanover separates roadways and streets on the basis of differences in traffic service and land service provided, as well as on the basis of required geometric design features. Classifications are as categorized below:

1. Rural Roadways and Streets

Rural arterials carry significant traffic flows between major traffic generators such as towns, residential, commercial, and industrial subdivisions, etc. Rural roadways collect and distribute traffic between major thoroughfares, other arterials, and collector roadways and streets.

Right-of-Way Width:	30.183 metres
Standard Cross-section:	Drawing No. S-16
Traffic Lanes:	2
Traffic Volumes:	Up to 10,000 vehicles per day
Access Conditions:	

Direct access to adjacent properties is not is normally limited. Rural roadways may also intersect with major thoroughfares, other arterials, and collector streets.

2. Local Urban Residential Streets and Roadways

Local residential streets provide direct access to abutting properties. A local urban street is not intended to carry large volumes of traffic. It primarily serves traffic with an origin or destination along its length and is not intended to carry traffic between neighbourhoods or between two streets of a higher classification.

Right-of-Way Width:	20.117 metres
Standard Cross-section:	Drawing No. S-13
Traffic Volumes:	Up to 1,000 vehicles per day

Access Conditions:

Direct access is allowed to all fronting properties not served with back lanes. Local residential streets may intersect with other local residential streets and collector streets but should not intersect with arterial streets or major thoroughfares.

Traffic Features:

Intersections involving only local residential streets are stop sign controlled. Intersections of local streets with streets in other classification categories are also stop sign controlled except where signal controls are warranted. Parking is restricted to one side. Trucks are generally not permitted on local streets in residential areas except for local service or deliveries. Pedestrian traffic is unrestricted.

D.2 STREET DESIGN

Standard Cross-Sections

Refer to the standard details for cross-sections of underground and above ground services.

Alignment, Standard Intersections, Turnarounds

The Primary objective in the design of any street system is to provide a safe, efficient, and aesthetically pleasing access and circulation system for both pedestrians and motorists.

Design shall conform to minimum requirements as set within the publications aforementioned, or otherwise approved by the Rural Municipality of Hanover.

D.3 RECOMMENDED PRACTISE FOR SUBDIVISION STREET DESIGN

1. Local street systems should be designed to minimize through traffic movement, by creating discontinuities in the local street system, and by channelizing or controlling median crossings along peripheral arterial routes.

2. The local street system should be designed for a relatively low uniform volume of traffic.

3. Local streets should be designed to discourage excessive speeds, through the use of curvilinear alignments and discontinuities in the street systems.

4. Pedestrian-vehicle conflict points should be minimized. This can be achieved through proper design of the street system, land use arrangements, and pedestrian routes.

5. Intersections on curves are undesirable and should be eliminated wherever possible.

6. Offset intersections are acceptable on local streets and residential collector streets if the offset is 75 m or greater between centerlines.

7. Intersection angles of less than 75° are unacceptable.

8. The maximum number of dwelling units in a cul-de-sac shall be limited to 16. Lots shall be zoned for “UR” Residential use only.

9. All streets which are to become part of a transit bus route in newly developed residential areas should be developed to residential collector standards as a minimum.

10. Walkways should be provided to facilitate pedestrian movement to and from proposed transit routes, commercial areas, institutional areas, parks, etc.

11. Direct access to arterial streets from private holdings should be restricted to those holdings which contain or are zoned to permit development expected to generate significant volumes of traffic (ie. shopping centres, major sports facilities, etc.).

12. Sidewalks are to be provided on both sides of streets classified as arterials or collectors.

13. Sidewalks are to be provided on one or both sides of streets classified as local if any one of the following warrants is met.

(i) Land uses adjacent to the street are expected to generate high pedestrian and vehicular volumes; e.g. schools, commercial areas, multiple family dwellings, recreational areas, etc.

(ii) There is a potential accident or safety problem(s) related to pedestrians.

(iii) There is a need for sidewalk(s) to provide sidewalk continuity, safe routes to schools, commercial areas, transit routes, etc.

14. Minimum desirable gutter gradients to be 0.4%.

15. Minimum pavement cross full to be 2.0%.

16. An alternative Local Residential road pavement width of 7.5 m from back-of-curb to back-of-curb may be approved for proposed low-traffic volume, local residential cul-de-sacs and crescents less than 300 m in length.

SECTION E
BOULEVARD AND LOT GRADING

E.1 RESIDENTIAL LOTS

All roof downspouts shall be located in a manner such that they provide effective positive drainage away from the building. They shall discharge through a suitable elbow fitting into a splash pad in order to carry run-off across any settled backfill adjacent to the foundation.

Any driveway on a lot shall have a minimum grade of 2% and a maximum grade of 6% and shall be constructed in a manner such that it will not inhibit storm water run-off away from the building.

Minimum lot grades shall be as follows:

(i) Where a property drains onto an alley - 2% front and rear - building to be perched 150 mm for 3.0 m around its perimeter.

(ii) Where a property drains onto a rear drainage swale - 2% front, 3% rear - building to be perched 150 mm for 3.0 m around its perimeter.

(iii) Where a property is to be drained to the front street - 2% from rear to front - building to be perched 250 mm for 3.0 m around its perimeter.

E.2 COMMERCIAL, INDUSTRIAL AND MULTIPLE RESIDENTIAL FAMILY SITES

Any driveway on a lot shall have a minimum grade of 2% and a maximum grade of 6% and shall be constructed in a manner such that it will not inhibit storm water run-off away from the building.

Roof and surface drainage from these lots shall be controlled in a manner satisfactory to the Municipality in order that maximum rate of run-off into the Municipality's storm system shall be not greater than if these lots had been developed as residential properties, (i.e. the average residential lot has an imperviousness of 35%). All Rational Formula calculations are to be based on a 2 year storm event, with "t" (time) = 15 minutes and "I" (intensity) = 2.63 in./hr.

SECTION F
CONSTRUCTION DRAWINGS

The following represent minimum criteria for the production of construction drawings relative to all municipal services that ultimately full under the jurisdiction of the Rural Municipality of Hanover.

The following is specified in metric. Imperial use for Drawings requires prior approval from the Municipality.

General Drawing Requirements

Chainages on drawings should proceed from left to right and from bottom to top corresponding to west to east and south to north. When more than one plan is required, the most westerly sheet should be first, and subsequent sheets continue in an easterly direction. Similarly, sheet progression should be from south to north. All drawings require approval from the Municipality. The drawing format should be reviewed and approved prior to drawing production.

Requirements For Roadway Construction Drawings

Roadway construction drawings should be clear and precise. The amount of information required varies greatly with the complexity of the project. In general, information required on roadway construction drawings must fulfill the following requirements:

Right-of-Way

Roadway construction drawings must identify and fully describe the right-of-way limits for the project on the plan view as follows:

- basic information including street right-of-way widths, block dimensions, street angles at intersections, right-of-way deflection angles, survey bars, curve data for the right-of-way (including length of curve, deflection angle, sub tangent and radius) and comer cuts.

- if the construction project has utilized a coordinate system, the limits of the right-of-way and all legal survey bars and geodetic survey control monuments must be tied into that system

Horizontal Alignment

“Horizontal Alignment” is information which could in any way be used to describe the pavement alignment. The required information is as follows:

- centreline or baseline chainage must be tied to all intersecting street right-of-way, legal survey bars, beginning and ends of curves, spirals, tapers, tangents, cut-offs, radii, etc.

- complete cross-section dimensions (i.e. width of pavement on each side of the centreline, the total width or widths of pavement, boulevards, medians, sidewalks, rights-of-way, etc.) to be placed on the plan view of each street or at each change in the cross-section. The back of curb or outside limit of pavement should be used for dimensioning purpose.

- all information necessary for field layout of the pavement within the right -of-way such as curve and spiral data, amount of taper, coordinate information, azimuths, chainage ties, etc. should be tabulated on each drawing, or referenced to a special curve information sheet.

- all street and lane turnout radii and median nose radii marking the beginning and ends of curves and points of compound curve must be identified.

Vertical Alignment (Pavement Elevations and Profiles)

This category includes all information necessary for setting the grade of the proposed roadway and its relationship to existing features. Pavement elevations and profiles are usually combined in a plan-profile arrangement, although in some cases, profiles may have to be on separate sheets, because of large differences in elevations. The guidelines for presentation of information under this category are as follows:

- in the case of asphalt overlays, pavement reconstruction, pavement widening and miscellaneous improvements, the horizontal scale must be 1:200 or 1:250 and the vertical scale 1:10. New pavements must be drawn using a horizontal scale of 1:200 or 1:250 with a vertical scale of 1:20, however, a scale of 1:500 may be used for drawings with a right-of-way of 30 m or more where it would become too cumbersome at a large scale. In the event that a scale of 1:500 is used, a scale of 1:200 or 1:250 must still be used for details such as intersections.

- the profile stationing should be aligned vertically with the plan stationing if possible.

- on vertical curves, chainages should be provided at the Beginning of Vertical Curve, the Point of Vertical Intersection, the End of Vertical Curve and all calculated elevation points.

- in general, the profile control for pavement will be the drainage gutter.

- all elevations must be referenced to geodetic benchmarks.

- relevant benchmarks should be shown on each sheet.

- Locations and elevations of all existing controlling features such as curbs, public and

private sidewalks, door sills, driveways, garage floors, etc. must be clearly indicated.

- generally, proposed pavement grades should be illustrated at:

    - grade changes
    - drainage points
    - 10 m intervals on vertical curves
    - 5 m intervals on superelevation transitions
    - intersections as required to adequately describe the surface.

- indication of curb elevations is unnecessary unless required by variations from the standard cross-section.

- metric elevations shall be shown to three decimal places. Although it is not expected that grades will be set to 1 mm accuracy they can be set to 5 mm accuracy requiring three decimal places.

Requirements for Pavement Resurfacing Drawings

The importance of having complete information on existing controlling features is stressed. The elevations and locations of adjacent features are extremely important in assessing the proposed design as well as facilitating the constant checking which must be done by field layout personnel.

For roadway resurfacing drawings, the required information is as follows:

- in the case of pavement resurfacing drawings, existing elevations are to be shown at 15 m intervals longitudinally and at longitudinal joints or traffic lane divisions transversely. Proposed elevations are shown at drainage locations and profile break points longitudinally and at longitudinal joints, or lane divisions transversely. Sufficient existing elevations should be provided along intersecting roadways to determine the direction of drainage.

- indicate the percent of gradient on profiles showing proposed grades.

- indicate direction of drainage along gutters, around comer radii, etc.

- include geometric data, if specifically requested.

Paving and Grading

Information included under this topic includes description and limits of pavement and curb types, earth grading design, surface drainage, and pavement joints. Recommended guidelines are as follows:

- indicate specific limits for various existing surface or pavement types.

- define all existing pavements which abut or intersect the proposed pavement.

- earth grading may be depicted by the contour method, or the slope line methods, although the contour method is preferred.

- show all ditches and indicate the direction of flow.

Cross-Sections

Typical and special cross-sections are required to clearly define the relationship of the proposed pavement, curbs, base course shoulder ditches, sidewalks, medians, etc., to one another and to the existing right-of-way and surface. Generally roadway cross-sections should be drawn at a horizontal scale of 1:100 and a vertical scale of 1:50. Some details may require greater distortion but N.T.S. cross-sections should be avoided.

- indicate percentage of crossfall

- indicate percentage of superelevation.

Standard and Special Details

Standard details are included in the Municipality's "Standard Construction Specifications" manual. Special details are, of course, as required by the project and at the discretion of the designing agency. They may or may not be grouped depending on the magnitude of the project.

Drainage and Utilities

In illustrating drainage facilities, the following procedure should be followed:
- provide chainage and offset (or coordinates) for all manholes, catch basins, curb inlets, catch pits, etc. Also provide top and invert elevations.
- for drainage connections indicate pipe size, type, length, invert elevation, and grade.
- indicate scale ratio.

Requirements for "As Constructed" Drawings

Finally, it must be kept in mind from the outset, that the construction drawing will become a valuable permanent record. It is extremely important that the designing agency maintain

an accurate record of any changes to the design occurring in the field, and that these changes are accurately and completely recorded on the construction drawing.

When a project is completed, the originals of the contract drawings must be revised and forwarded to the Municipal Office. Copies of any manufacturer's drawings for equipment that was installed as part of the contract are also to be forwarded. These drawings then become part of the permanent records.

In order that drawings maintain uniformity in the presentation of "as constructed" information and that the drawings are forwarded within a reasonable period of time, the following procedures are to be followed:

- All geometric details are to be corrected to final measurement.

- All "as constructed" drawings must be supplied in their original form on one A1 size quality paper drawing set and stamped " as constructed" by a registered Engineer along with one complete AutoCad file and one complete electronic pdf file.

- All alignment details should be retained on the "as constructed" drawings to facilitate possible redrafting.

- All "as constructed" drawings are to be clearly identified as such with a date and signature.

- "As constructed" drawings must be complete and delivered to the requesting agency within three months of the completion of the project.

- All service connections are to be shown in their entirety and in their as-constructed location on the plan.

- Measurements for service connection locations are to be recorded on the standard charts in the format described below.

- All service locations (corporation and stop, junction and property line location) are to be shown as longitudinal measurements along the respective mains.

- All measurements are to be tied into at least two references.

References shall be:

(a) Valves and hydrants for water services.
(b) Manholes for sewer services.
(c) Survey Monuments for long measurements
(d) Property lines of the lot being serviced for short measurements

- Property line and stop cock location of services shall be shown as the perpendicular distance from the respective mains.

- Sewer connection inverts at property line shall be shown.

- All service measurements are to be shown in conventional terminology, and not as chainages from stations.

- Where the situation requires (such as cul-de-sacs), measurements may be taken from a straight-line projection of the respective mains. Where the situation requires additional information, or a modified format to provide clarity, the record information shall be provided as directed by the Municipality.

A complete material list shall be shown and will include the following:

- Manufacturer's name
- Manufacturer's identification and number of the product
- Type of material
- Valve turns.

EXAMPLES OF STANDARD CHART FOR SERVICE CONNECTION LOCATIONS

SEWER SERVICE DATA					WATER SERVICE DATA		
LOT DESCRIPTION	LOCATION OF TEE ON MAIN	SERVICE SIZE / TYPE	LOCATION AT $\mathcal{L}$	INVERT AT $\mathcal{L}$	LOCATION OF CURB STOP BOX	LOCATION OF CORP. ON MAIN	SERVICE SIZE / TYPE
	LONG SHORT				LONG SHORT		
	LONG SHORT				LONG SHORT		
	L S				L S		
	L S				L S		
	L S				L S		
	L S				L S		
	L S				L S		
	L S				L S		

SURFACE WORKS
TABLE OF CONTENTS

STANDARD DETAILS

S1 - Paraplegic Sidewalk Ramp

S2 - Paraplegic Sidewalk Ramp

S3 - Paraplegic Sidewalk Ramp Sections

S4 - Paraplegic Sidewalk Ramp

S5 - Standard Curb and Gutter Sections with Asphaltic Pavements

S6 - 75mm Lip Curb

S7 - Portland Cement Concrete Sidewalk

S8 - Interlocking Paving Stone Detail for Sidewalks and Private Approaches on Granular Base or Lean Concrete Base

S9 - Private Approach for Streets with Ditch Drainage

S10 - Private Unpaved Approach for Streets with Ditch Drainage

S11 - Typical Approach Opening Detail (Residential)

S12 - Concrete Carry Through Gutter Section

S13 - Standard Locations for Utility Structures Local Residential Street

S14 - Standard Locations for Utility Structures Industrial or Residential Collector

S15 - Standard Locations for Utility Structures Minor Arterial and Industrial Collector

S16 - Rural Municipal Road

S17 - Concrete Drain Channel

SPECIFICATION FOR SUB-GRADE, SUB-BASE AND BASE COURSE CONSTRUCTION

1. GENERAL CONDITIONS

All standards in this edition, attached hereto, shall apply to and be a part of this Specification.

2. DEFINITIONS

(a) Sub-grade - the natural in-situ material.
(b) Sub-base - where required, that layer of material provided between the sub-grade and the base course.
(c) Base course - that layer of material immediately underlying the pavement.

3. DESCRIPTION

This Specification shall cover all phases of sub-grade, sub-base and base course preparation for pavements, slabs, curb and gutter sections, sidewalks and other related works.

The work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, equipment, tools, supplies and all other things necessary for and incidental to the satisfactory performance and completion of all work as hereinafter specified.

4. MATERIALS

4.1 General

The Contractor shall be responsible for the supply, safe storage and handling of all materials set forth in this Specification.

4.2 Handling and Storage of Materials

All materials shall be handled and stored in a careful and responsible workmanlike manner, to the satisfaction of the Engineering Manager.

4.3 Testing and Approval

All materials supplied under this Specification shall be subject to inspection and testing by the Engineering Manager or by the Testing Laboratory designated by the Engineering Manager. There shall be no charge to the Municipality for any materials taken by the Engineering Manager for testing purposes.

All materials shall be approved by the Engineering Manager at least ten (10) days before any construction is undertaken. If, in the opinion of the Engineering Manager, such materials, in whole or in part, do not conform to the Specification detailed herein or are found to be defective in manufacture or have become damaged in transit, storage or handling operations, then such material shall be rejected by the Engineering Manager and replaced by the Contractor at his own expense.

4.4 Sub-Base Materials

Sub- Base material shall consist of sound, hard, crushed rock or crushed gravel and shall be free from organic or soft material that would disintegrate through decay or weathering. The Sub-Base material to be supplied by the Contractor shall be well graded throughout and shall conform to the following grading requirements:

Cdn. Metric Sieve Size	Percent of Total Dry Weight Passing Each Sieve
37500	100%
25000	85% - 100%
5000	25% - 80%
425	15% - 40%
75	8% - 18%

Note: Minimum Crushed Content = 15 percent
Maximum Shale Content = 20 percent
Maximum L.A. = 40 percent

4.5 Base Course Material

Base course material shall consist of sound, hard, crushed rock or crushed gravel and shall be free from organic or soft material which would disintegrate through decay or weathering. The base course material to be supplied by the Contractor shall be well-graded

throughout and shall conform to the following grading requirements.

Cdn. Metric Sieve Size	Percent of Total Dry Weight Passing Each Sieve
25000	100%
20000	80% - 100%
5000	40% - 70%
2500	25% - 55%
315	15% - 30%
80	5% - 15%

The material passing the 315 sieve shall have a liquid limit not greater than 25 and a plasticity index not greater than six (6).

Where base course is being placed under an asphaltic concrete pavement, the aggregate retained on a No. 5000 sieve shall contain not less than thirty-five (35%) crushed aggregate as determined by actual particle count. Crushed aggregate shall be considered as that aggregate having at least one fractured face.

4.7 Lime or Portland Cement

Either lime or Type 10 normal Portland cement may be used for drying the sub-grade. Lime shall meet CSA A82.43 and Portland cement CAN3-A5-M77. Neither shall be used without receiving prior written approval from the Engineering Manager.

5. EQUIPMENT

All equipment shall be of a type approved by the Engineering Manager and shall be kept in good working order.

6. CONSTRUCTION METHODS

6.1 Excavation

Excavation shall be understood to mean the required excavation of in- situ material, the stockpiling of suitable site sub-base material and topsoil, and the hauling and disposal of all unsuitable site material such as frost heaving clays, silts, rock, rubble, rubbish, and any surplus suitable site sub-base material, unless otherwise specified herein. Disposal of material shall comply with the requirements of Section 6.3 of this Specification.

Where indicated, the Contractor shall strip and stockpile topsoil from the site in a manner which will prevent contamination of topsoil with underlying soil materials. The topsoil stripped shall be stockpiled at locations on site for later use.

The limits of excavation shall be taken as a vertical plane 600 mm beyond the limits of the proposed pavement, unless otherwise specified.

The Contractor shall initially only proceed with the common excavation. Common excavation shall be understood to mean that part of the excavation down to a depth such that after compaction the sub-grade will be at the elevation of the bottom sub-base for an asphaltic concrete pavement.

During the course of common excavation, the Contractor will be advised by the Engineering Manager as to which areas have an unsuitable sub-grade. In the areas of unsuitable sub-grade, whether in a homogeneous mass or in isolated pockets, the excavation shall be extended either to the lower limit of the unsuitable material or to a depth of 900 mm below the elevation of the bottom of the asphaltic concrete pavement, whichever is the lesser.

Areas over-excavated by the Contractor shall be backfilled and compacted in accordance with this Specification by the Contractor at his own expense, using sub-base material specified by the Engineering Manager.

6.2 Removal of Existing Pavement

Removal of existing pavement shall be understood to mean the required demolition, loading and disposal of the existing pavement, including curbs and overlay, designated for removal within limits of the Contract. Disposal of material shall comply with the requirements of Section 6.3 of this Specification.

6.3 Disposal of Material

Disposal of material shall be understood to mean the hauling of a material from the site and the unloading and grading of the material in a manner satisfactory to the Engineering Manager at a disposal site.

Any material dropped or spilled on any streets during the hauling operations shall be promptly cleaned up by and at the expense of the Contractor, to the satisfaction of the Engineering Manager.

6.4 Preparation of Sub-grade, Sub-base and Base Course

The bottom of the excavation shall be inspected and approved by the Engineering Manager before the Contractor may begin compaction of the sub-grade. The full width of the bottom of the sub-grade shall be thoroughly mixed and compacted to a minimum of ninety-five percent (95%) of Standard Proctor Density.

Unless otherwise specified, the sub-base material shall be supplied, placed and compacted in layers not exceeding 150 mm in compacted thickness to a minimum of one hundred percent (100%) of Standard Proctor Density, for the full width of the excavation, and each layer shall be trimmed level and inspected, tested and approved by the Engineering Manager before the succeeding layer may be applied.

In sub-base construction, the Contractor shall use up the suitable site sub-base material before placing any other type of sub-base material, unless otherwise authorized by the Engineering Manager in writing.

Suitable sub-grade material, suitable site sub-base material and clay borrow sub-base material shall be compacted at the - optimum moisture content or at a moisture content up to two percent (2%) above the optimum moisture content.

Any layer that has been rejected by the Engineering Manager, shall be either recompacted or removed and replaced by and at the expense of the Contractor to the satisfaction of the Engineering Manager.

Any material that has been placed over a compacted layer which has not been inspected, tested and approved by the Engineering Manager shall be removed by and at the expense of the Contractor.

The compacted sub-grade or final compacted layer of sub-base shall be trimmed to the elevation of the bottom of base course.

The compaction requirement specified herein shall extend to a minimum depth of 150 mm below the surface being compacted. If necessary, water sprinkling shall be carried out in such a manner as to provide a uniform soil wetting distribution over the area to be compacted.

When excess water has been applied, either by sprinkling operations or by precipitation, to cause local or continuous pondage, soil compaction shall not be permitted until sufficient soil drying has occurred, creating a condition lending itself favourably to compacting operations. The Contractor shall, as much as is practical, exercise the necessary precautions to protect compacted areas against excess wetting from any natural or artificial sources of water application.

Should excess moisture from continuous or heavy rainfall threaten to unduly delay the completion of the Contract, the Contractor may apply in writing to the Engineering Manager requesting permission to use lime or Portland cement to dry out the clay sub-grade or sub-base at specific location(s), with the provision that the placing of the lime or Portland cement shall be done in such a manner as may be approved by the Engineering Manager and that the cost of placing the lime or Portland cement will be borne entirely by the Contractor.

The base course shall be thoroughly compacted to a minimum of one hundred percent (100%) of Standard Proctor Density. The compacted base course shall be trimmed to the finished base course elevation as specified. The finished base course shall be maintained in a smooth compacted condition until the pavement is placed.

When concrete pavement is to be placed using forms, the compacted base course immediately beneath the forms shall be trimmed true to grade in order to provide firm support for the forms. When concrete pavement is to be placed using extrusion type paving equipment, the compacted surface that will support the equipment shall be trimmed and maintained true to grade.

The Engineering Manager shall inspect and approve the finished base course before any reinforcing steel, Portland cement concrete, or asphaltic concrete is placed on the base course.

6.5 Fill Section

A fill section may be required whenever the existing ground surface is below the bottom of base course. Excavation shall be carried out to the limits of excavation specified by the Engineering Manager, in accordance with Clause 6.1 of this Specification. Preparation of the sub-grade and sub-base shall be carried out as described in this Specification, except that the sub-base material shall be built up with stable side slopes.

6.6 Grading of Boulevard

After completion of paving operations, the Contractor shall remove all debris, stones and concrete rubble from the boulevards and medians before commencing grading.

The boulevards and medians shall then be graded to receive sod, unless otherwise specified.

Grading of boulevards and medians to receive sod shall be understood to mean the required backfilling or excavation so that the boulevards and medians, after compacting, are at a uniform depth of 100 mm below finished boulevard grade.

The material used as backfill shall be free of concrete or asphalt rubble and all stones larger than 25 mm in diameter.

Compaction of the graded boulevard shall be understood to mean that compaction required to eliminate voids in the backfill, as approved by the Engineering Manager.

7. QUALITY CONTROL

7.1 Inspection

All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Engineering Manager including all operations from the selection and production of materials through to final acceptance of the specified work. The Contractor shall be wholly responsible for the control of all operations incidental thereto notwithstanding any inspection or approval that may have been previously given. The Engineering Manager reserves the right to reject any materials or works that are not in accordance with the requirements of this Specification.

7.2 Access

The Engineering Manager shall be afforded full access for the inspection and control testing of construction materials, both at the site of work and at any plant or borrow pit used for the supply of the materials, to determine whether the material is being supplied in accordance with this Specification.

7.3 Materials

All materials supplied under this Specification shall be subject to testing and approval by the Engineering Manager in accordance with Section 4 of this Specification.

7.4 Quality of Sub-grade, Sub-base and Base Course Layers

The Standard Proctor Density for the sub-grade, sub-base and base course materials shall be determined at the optimum moisture content in accordance with ASTM Standard D698. The field density of each sub-grade, sub-base and base course layer shall be a percentage of the applicable Proctor Density.

Quality control tests will be used to determine the acceptability of each sub-grade, sub-base and base course layer, as placed and compacted by the Contractor, before the succeeding layer may be applied.

The field density of the compacted layers shall be verified by Field Density Tests in accordance with ASTM Standard D1556, Test for Density of Soil in Place by the Sand-Cone Method, or ASTM Standard D2922, Test for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

The frequency and number of tests to be made shall be as determined by the Engineering Manager.

Holes made by the removal of samples from the layers shall be promptly filled by the Contractor with appropriate material and thoroughly compacted so as to conform in every way with the adjoining compacted material.

7.5 Corrective Action

The Contractor shall, at his own expense, correct such work or replace such materials found to be defective under this Specification in an approved manner to the satisfaction of the Engineering Manager.

SUPPLY AND INSTALLATION OF GEOTEXTILE FABRICS

1. DESCRIPTION

1.1 General

This specification covers the supply and installation of Geotextile Fabrics relating to Surface Works construction.

1.2 Referenced Standard Construction Specifications

1.2.1 SPECIFICTION MH 2000 – Sub-Grade, Sub-Base and Base Course Construction

1.2.2 Approved Products for Surface Works

2. MATERIALS

2.1 Material Identification

Geotextile fabric is to be labelled in accordance with ASTM D4873, and must clearly show the manufacture's product style number and unique roll number.

2.2 Storage and Handling

2.2.1 Protect geotextile fabric at all times from contamination of dirt, dust and any other deleterious materials.

2.2.2 Protective coating is to remain on geotextile fabric until installation.

2.2.3 Store and handle in accordance with manufacture's and/or supplier's recommendations.

2.2.4 Protect geotextile fabric from exposure to ultraviolet light during storage.

2.3 Mill Certificate and MARV Data

Provide Mill Certificate and MARV (Minimum Average Roll Value) Data upon request by the Engineering Manager.

2.4 Separation / Reinforcement Fabric

2.4.1 Separation/reinforcement fabric will be woven fabric and meet or exceed the following requirement:

TABLE CW 3130.1 – Separation/Reinforcement Fabric Requirements

Physical Property	Requirements	Test Method
Grab Tensile Strength	1400 N – minimum	ASTM D4632
Puncture Strength	530 N – minimum	ASTM D4833
Trapezoid Tear	500 N – minimum	ASTM D4533
Apparent Opening Size	0.430 mm – minimum	ASTM D4751
Permittivity	0.05 sec^{-1} – minimum	ASTM D4491
U.V. Resistance	70% per 500hrs – minimum	ASTM D4355
Mullen Burst	3500 kPa – minimum	ASTM D3786

2.4.2 All physical property requirements are MARV (Minimum Average Roll Values) determined in accordance with ASTM 4759.

3. CONSTRUCTION METHODS

3.1 Separation / Reinforcement Geotextile Fabric

3.1.1 Commence installation of geotextile fabric after material has been approved by the Engineering Manager and the preparation of the sub-grade has been completed in accordance with MH 2000.

3.1.2 Install geotextile fabric to the complete limits of the roadway sub-grade including intersections and turning lanes or as directed by the Engineering Manager.

3.1.3 Unroll geotextile fabric as smooth as possible of the prepared sub-grade in the direction of the construction traffic.

3.1.4 Install geo textile fabric in the longest continuous practical length, free from tension, stress, folds, wrinkles and creases.

3.1.5 Install geotextile fabric in accordance with this specification and procedures recommended by the manufacture.

3.1.6 Overlap joints a minimum of 600 millimeters.

3.1.7 Install pins and/or place piles of sub-base material as required to hold geotextile fabric in place.

3.1.8 Cut or fold geotextile fabric to conform to curves

3.1.9 Construction vehicles shall not be permitted directly on the geotextile fabric.

3.1.10 Remove or replace geotextile fabric improperly install or damaged as directed by the Engineering Manager.

4. MEASURMENT AND PAYMENT

4.1 Separation / Reinforcement Geotextile Fabric

4.1.1 Supply and installation of separation / reinforcement geotextile fabric will be measure on an area basis and paid for at the Contract Unit Price per square meter for "Separation / Reinforcement Geotextile Fabric". The area to be paid for will be the total number of square meters separation / reinforcement geotextile fabric, supplied and install in accordance with this specification, accepted and measured by the Engineering Manager.

4.1.2 Only material placed within the designated sub-grade limits will be included in the payment for "Separation / Reinforcement Geotextile Fabric".

4.1.3 No measurement or payment will be made for geotextile fabric removed and replaced due to improper installation or damaged materials.

SPECIFICATION FOR GRAVEL SURFACING

1. GENERAL CONDITIONS

All standards in this edition, attached hereto, shall apply to and be a part of this Specification.

2. DESCRIPTION

This Specification shall cover the preparation of the roadway as required, and the placing of crushed gravel as specified by the Engineering Manager.

The work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, equipment, tools, supplies and all other things necessary for and incidental to the satisfactory performance and completion of all work as hereinafter specified.

3. MATERIALS

3.1 General

The Contractor shall be responsible for the supply, safe storage and handling of all materials set forth- in this Specification.

3.2 Handling and Storage of Materials

All materials shall be handled and stored in a careful and responsible manner, to the satisfaction of the Engineering Manager.

3.3 Testing and Approval

Granular material supplied under this Specification shall be subject to inspection and testing by the Engineering Manager or by the Testing Laboratory designated by the Engineering Manager. There shall be no charge to the Municipality for any materials taken by the Engineering Manager for testing purposes.

Granular material shall be approved by the Engineering Manager at least ten (10) days before any construction is undertaken. If, in the opinion of the Engineering Manager, such material, in whole or in part, does not conform to the Specification as detailed herein, then such material shall be rejected by the Engineering Manager and replaced by the Contractor at his own expense.

3.4 Granular Surfacing Material

Granular surfacing material shall consist of sound, hard, crushed rock or crushed gravel and shall be free from organic or soft material that would disintegrate through decay or weathering. The granular material to be supplied by the Contractor shall be well-graded throughout and shall conform to the following grading requirements.

Cdn. Metric Sieve Size	Percent of Total Dry Weight Passing Each Sieve
25000	100%
20000	80% -100%
5000	40% - 70%
2500	25% - 55%
315	15% - 30%
80	5% - 15%

Aggregate retained on a No. 5000 sieve shall contain not less than thirty-five (35%) crushed aggregate as determined by actual particle count. Crushed aggregate shall be considered as that aggregate having at least one fractured face. The material passing the 315 sieve shall have a liquid limit not greater than 25 and a plasticity index of not greater than 6.

4. EQUIPMENT

All equipment shall be of a type approved by the Engineering Manager and shall be kept in good working order.

5. CONSTRUCTION METHODS

5.1 Preparation of Existing Roadway

The existing roadway shall be shaped to the proper grade and cross- section as specified. The existing roadway material shall be thoroughly compacted to a minimum of 95% of Standard Proctor Density. Where excavation or fill material is required, this work shall be carried out in accordance with Specification MH 2000.

5.2 Placing of Granular Surfacing Material

No granular surfacing material shall be placed until preparation of the existing roadway has been completed and approved by the Engineering Manager. The amount of granular surfacing material to be placed shall be as specified by the Engineering Manager.

The material shall be spread uniformly over sections of the roadway, which have been approved by the Engineering Manager. The material shall be thoroughly compacted to a minimum of 95% of Standard Proctor Density.

All material delivered to the site shall be promptly spread, and no granular material shall remain unspread on the roadbed overnight.

6. QUALITY CONTROL

6.1 Inspection

All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Engineering Manager including all operations from the selection and production of materials through to final acceptance of the specified work. The Contractor shall be wholly responsible for the control of all operations incidental thereto notwithstanding any inspection or approval that may have been previously given. The Engineering Manager reserves the right to reject any materials or works that are not in accordance with the requirements of this Specification.

6.2 Access

The Engineering Manager shall be afforded full access for the inspection and control testing of materials, both at the site of work and at any gravel stockpile used for the supply of the materials, to determine whether the material is being supplied in accordance with this Specification

6.3 Materials

All materials supplied under this Specification shall be subject to testing and approval by the Engineering Manager in accordance with Section 3 of this Specification.

6.4 Quality of Existing Roadway and Gravel Surface

The Standard Proctor Density for the existing roadway and the gravel surface shall be determined at the optimum moisture content in accordance with ASTM Standard D698. The field density of the existing roadway and the gravel surface shall be a percentage of the Standard Proctor Density.

Quality control tests will be used to determine the acceptability of the existing roadway and the gravel surface layers, as placed and compacted by the Contractor, before the succeeding layer may be applied.

The field density of the compacted layers shall be verified by Field Density Tests in accordance with ASTM Standard D1556, Test for Density of Soil in Place by the Sand-Cone Method, or ASTM Standard D2922, Test for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

The frequency and number of tests to be made shall be as determined by the Engineering Manager.
Holes made by the removal of samples from the layers shall be promptly filled by the Contractor with appropriate material and thoroughly compacted so as to conform in every way with the adjoining compacted material.

6.5 Corrective Action

The Contractor shall, at his own expense, correct such work or replace such materials found to be defective under this Specification in an approved manner to the satisfaction of the Engineering Manager.

SPECIFICATION FOR EARTHWORK AND GRADING FOR RURAL TYPE CONSTRUCTION

1. GENERAL CONDITIONS

All standards in this edition, attached hereto, shall apply to and be a part of this Specification.

2. DESCRIPTION

This Specification shall cover all phases of removal and/or placement of all materials necessary for the construction and preparation of embankments, slopes, drainage works, and approaches.

The work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, equipment, tools, supplies and all other things necessary for and incidental to the satisfactory performance and completion of all work as hereinafter specified.

3. MATERIALS

3.1 General

The Contractor shall be responsible for the supply, safe storage and handling of all materials set forth in this Specification.

3.2 Handling and Storage of Materials

All materials shall be handled and stored in a careful and responsible manner, to the satisfaction of the Engineering Manager.

3.3 Testing and Approval

All materials supplied under this Specification shall be subject to inspection and testing by the Engineering Manager or by the Testing Laboratory designated by the Engineering Manager. There shall be no charge to the Municipality for any materials taken by the Engineering Manager for testing purposes.

All materials shall be approved by the Engineering Manager before any construction is undertaken. If, in the opinion of the Engineering Manager, such material, in whole or in part, does not conform to the Specification as detailed herein, then such material shall be rejected by the Engineering Manager and replaced by the Contractor at his own expense.

3.4 Fill Material

Fill material for embankment construction shall obtained from site excavation, from borrow sites as specified or shall be imported material, of a type approved by the Engineering Manager.

Approved clay material shall consist of low to medium plastic clays or of mixtures of sand and clay, uniform in texture and suitable for compaction.

4. EQUIPMENT

All equipment shall be of a size and type as required to complete the work in reasonable time as approved by the Engineering Manager, and shall be kept in good working order.

5. CONSTRUCTION METHODS

5.1 Clearing and Grubbing

No earthwork or grading shall commence until clearing and grubbing operations have been completed, and have been approved by the Engineering Manager.

5.2 Excavation

Excavation shall consist of topsoil excavation, common excavation and borrow excavation, which shall be understood to mean the following:

(a) Topsoil excavation - the excavation of surface soil, organic growth, or other material designated by the Engineering Manager as overburden, the stockpiling of topsoil for re-use on site, and the satisfactory disposal of unsuitable material such as brush, grass, weeds and all other organic growth and any surplus topsoil, unless otherwise specified.

(b) Common excavation - the excavation of all material encountered within the limits of grading following topsoil excavation, the stockpiling of suitable site material, and the satisfactory disposal of unsuitable site material such as frost heaving clays, silts, rock, rubble, rubbish and any surplus suitable site material, unless otherwise specified.

(c) Borrow excavation - the excavation and placing of excavated material, obtained from designated borrow locations. The widening of roadway cuts and ditches will not be considered as borrow.

The excavation procedure shall be subject to the approval of the Engineering Manager. Excavation shall continue in as nearly a continuous manner as possible. Excavation at multiple locations at the same time shall be subject to the approval of the Engineering Manager.

The Contractor shall conduct his excavation procedure in such a manner as to enable the Engineering Manager to inspect the separation of materials and determine which materials are to be disposed of and which materials are to be used.

The Contractor shall excavate as required to reach sub-grade levels for pavement and landscaping, and rough grade levels for areas to be graded only.

During the course of common excavation, the Contractor will be advised by the Engineering Manager as to which areas have an unsuitable sub-grade. In the areas of unsuitable sub-grade, whether in a homogeneous mass or in isolated pockets, the excavation shall extend to the lower limit of the unsuitable material or to a minimum depth of one metre below the elevation of the bottom of base course. Additional excavation of unsuitable material may be required as specified by the Engineering Manager.

In areas of excavation of unsuitable material, the side of the excavation may be sloped into the excavation provided that the sides remain at least 150 mm outside of the limits of the proposed pavement at the bottom of the excavation. The longitudinal slope shall not be steeper than 1:1.

5.3 Removal of Existing Pavement

Removal of existing pavement shall conform with the requirements of Specification MH 2000.

5.4 Disposal of Material

Disposal of material shall be understood to mean the hauling of a material from the site and the unloading and grading of the material in a manner satisfactory to the Engineering Manager at a disposal site.

Any material dropped or spilled on any- streets during the hauling operation shall be promptly cleaned up by and at the expense of the Contractor, to the satisfaction of the Engineering Manager.

5.5 Preparation of Existing Ground Surface

Before any embankment is placed on original ground having a smooth firm surface, the existing ground shall be scarified or ploughed so as to permit bonding with the new material. Where the existing ground surface is sloped sufficiently to affect the bond between the old and new materials, the original ground on which the embankment is to be placed shall be ploughed deeply or stepped before embankment construction is commenced, as directed by the Engineering Manager.

When embankment is being placed on an existing roadbed, the side slopes of the existing roadbed shall be denuded of vegetation and scarified or ploughed, as directed by the Engineering Manager, to ensure adequate bonding between the new embankment and the existing material.

Following the excavation and disposal of unsuitable material and the preparation of the side slopes, as described above, the surface of the existing roadbed shall be scarified to a depth of 150 mm, and compacted to the proper density, at the optimum moisture content.

Where existing roadbeds are being widened and existing embankments extended, the existing slopes shall be denuded of all vegetation and either stepped or ploughed so as to form a medium of contact with the new embankment. Vertical cuts for the full depths of embankment shall not be permitted.

5.6 Embankment

Embankment construction shall be understood to mean the placing of suitable earth fill to obtain the required lines, grades and cross-sections shown on the Drawings.

Materials shall be deposited and spread in uniform layers of specified thickness, for the full width of the embankment. Each layer shall be shaped to line and cross-section and thoroughly compacted before the succeeding layer is placed.

Where embankment is being placed on side fill or sloping sections, the lower portion shall be constructed as above, until a full width surface of the specified cross-section is obtained. The embankment shall be completed thereafter with full width layers.

5.7 Compaction

All material placed in embankments shall be spread and bladed smooth in successive layers not exceeding 150 mm in compacted thickness to the full width of the cross-section, unless otherwise directed by the Engineering Manager.

Each layer, including the existing sub-grade, shall be compacted to a minimum of 95% of Standard Proctor Density. The material shall be compacted at the optimum moisture content, or up to two percent (2%) higher than optimum, as directed by the Engineering Manager.

Where the grade line is in cut, the sub-grade shall be excavated to a minimum depth of 500 mm below the sub-grade line, or as directed by the Engineering Manager. The sub-grade shall then be reconstructed in layers as specified and compacted to 95% of Standard Proctor Density.

Where the moisture content of the embankment material is too dry, the material shall be thoroughly disced and broken down, water added as required and the material thoroughly worked to mix the water throughout the material, prior to commencing compaction operations.

5.8 Finishing

The Contractor shall, as soon as practicable, bring the excavations and embankments to the correct widths, lines and grades as shown on the Drawings.

All surfaces shall be maintained to the specified grade and cross-section and to the specified density until the project or that portion of the project is accepted.

5.9 Boulevard Grading

Boulevard grading shall be done in accordance with Specification MH 2000.

6. QUALITY CONTROL

6.1 Inspection

All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Engineering Manager including all operations from the selection and production of materials through to final acceptance of the specified work. The Contractor shall be wholly responsible for the control of all operations incidental thereto notwithstanding any inspection or approval that may have been previously given. The Engineering Manager reserves the right to reject any materials or works that are not in accordance with the requirements of this Specification.

6.2 Access

The Engineering Manager shall be afforded full access for the inspection and control testing of materials, both at the site of work and at any gravel stockpile used for the supply of the materials, to determine whether the material is being supplied in accordance with this Specification.

6.3 Materials

All materials supplied under this Specification shall be subject to testing and approval by the Engineering Manager in accordance with Section 3 of this Specification.

6.4 Quality of Existing Roadway and Gravel Surface

The Standard Proctor Density for the sub-grade and the embankment materials shall be determined at the optimum moisture content in accordance with ASTM Standard D698. The field density of each layer shall be a percentage of the Standard Proctor Density, as specified in Section 5 of this Specification.

Quality control tests will be used to determine the acceptability of each layer, as placed and compacted by the Contractor, before the succeeding layer may be applied.

The field density of the compacted layers shall be verified by Field Density Tests in accordance with ASTM Standard D1556, Test for Density of Soil in Place by the Sand-Cone Method, or ASTM Standard D2922, Test for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

The frequency and number of tests be made shall be as determined by the Engineering Manager.

Holes made by the removal of samples from the layers shall be promptly filled by the Contractor with appropriate material and thoroughly compacted so as to conform in every way with the adjoining compacted material.

6.5 Corrective Action

The Contractor shall, at his own expense, correct such work or replace such materials found to be defective under this Specification in an approved manner to the satisfaction of the Engineering Manager.

SPECIFICATION FOR BOULEVARD SODDING

1. GENERAL CONDITIONS

All standards in this edition, attached hereto, shall apply to and be a part of this Specification.

2. DESCRIPTION

This Specification shall cover the supplying and placing of topsoil and sod in boulevard and median areas adjacent to the pavement.

The work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, equipment, tools, supplies and all other things necessary for and incidental to the satisfactory performance and completion of all work as hereinafter specified.

3. MATERIALS

3.1 General

The Contractor shall be responsible for the supply, safe storage and handling of all materials set forth in this Specification. All materials supplied under this Specification shall be subject to inspection and testing by the Engineering Manager. There shall be no charge to the Municipality for any materials taken by the Engineering Manager for testing purposes.

3.2 Top Soil

All soil required shall consist of a screened clay-textured or loam- textured dark top soil, a fertile friable material containing 25% by volume organic matter (peat, rotted manure or composted materials), 25% sand, and having a pH range of 6.0 - 7.5 and a salinity rating of less than 1.5 mohms/cm. It shall be free of any mixture of subsoil, clay lumps and free of stones and roots over 40 mm in diameter and other extraneous matter. It shall not contain couch grass or Canada Thistle rhizomes.

Topsoil may be either site topsoil or imported topsoil.

Topsoil, which has been stockpiled, shall be shredded or screened prior to being spread.

3.3 Sod

Mineral soil base sod shall consist of one of the following alternatives:

(a) Nursery sod grown from Canada No.1 Kentucky Blue Grass or a mixture of Kentucky Blue and creeping Red Fescue.

(b) Cultured sod produced from native grass sod improved by top seeding with Canada No.1 grade Kentucky Blue Grass after at least two (2) years of maintenance in the field.

The sod field should be inspected by the Contractor to ensure that there is a good stand of grass and that couch grass is not present in the sod. Sod sections with couch grass will not be accepted by the Engineering Manager.

All sod shall have a mineral soil base of 25 mm and shall be mowed to a height of 40 mm prior to delivery. Peat base sod will not be accepted by the Engineering Manager.

4. CONSTRUCTION METHODS

4.1 Grading of Boulevards

The grading of boulevard and median areas will be done and in accordance with Specification MH 2000.

4.2 Placing of Top Soil

The topsoil shall be placed on the graded boulevard subsoil, such that after grading and compacting, the topsoil will be at a level of 25 mm below the finished boulevard grade. The topsoil layer shall be a minimum of 75 mm in thickness.

4.3 Placing of Sod

The sod shall be laid evenly, and shall be closely packed together. Joints in adjacent rows shall be staggered. A row of sod, 300 mm in width, shall extend around the full perimeter of each boulevard or median area. The placing of sod shall proceed progressively from one end of each boulevard or median area to the other end. The sod shall be laid immediately upon delivery to the job site, or as soon as possible thereafter, and must not be allowed to dry out before and after laying. Dried out sod must be replaced with viable sod at the Contractor's expense.

On embankments, sod shall be laid lengthwise across the face of the slope. On slopes 1

vertical to 3 horizontal (18 degrees) or steeper, in every second row on the slope and at the foot of the slope, each piece of sod shall be pegged with two 175 mm wooden meat skewers driven in below lawn level. On slopes 1 vertical to 2 horizontal (26 degrees) or steeper, each piece of sod in every row shall be pegged as indicated above. Other methods of stabilizing the sod may be used if approved.

All sodded areas shall be thoroughly watered within twenty-four (24) hours after laying. After watering, the areas shall be rolled to form a uniform even surface, level with adjoining existing curbs, sidewalks or existing sod.

Sodding operations in each boulevard or median area shall be completed within a two-day (48-hour) period after the laying of the sod. This shall be deemed to include the application of top dressing, and the watering, rolling, patching and top seeding of the sod.

No sod shall be laid in frozen state, or when any other conditions unfavourable to the successful transplanting of sod exist.

4.4 Maintenance of Sodded Area

The Contractor shall be responsible for the maintenance of the sodded areas for a period of thirty (30) days after the completion of sodding operations. Any areas sodded after September 15th which do not show an even stand of live growth and/or adequate root development in that year shall have the maintenance period commence on May 15th of the following year or such date as mutually agreed upon by all parties, at which time all sod must show an even stand of live growth. Defective sod shall be replaced and the area so replaced shall be further maintained for a period of thirty (30) days. Maintenance shall be understood to include all necessary watering, mowing, cleaning, and upkeep of the sodded area, including replacement of damaged or vandalized areas and any required spring clean-up.

Water sodded areas in sufficient quantities and at required frequency to maintain sub-soil immediately under sod continuously moist for depth of 75 to 100 mm.

Cut grass first time to 40 mm when it reaches height of 60 mm. Remove clippings that will smother grassed areas.

Apply herbicide when broadleaf weeds start developing in competition with grass. When sod is top dressed and seeded, apply herbicide only after new grass is well established and resistant to herbicide. Apply herbicide in accordance with manufacturer's instruction when winds are less than 10 km/h, when air temperature is above 10°C.
.1 Use 2, 4-D amine herbicide for susceptible broadleaf weeds.

4.5 Site Clean-Up

All sidewalks, streets, approaches and driveways in the vicinity of the sodding operations shall be kept clean at all times by the Contractor.

All excess materials and debris shall be removed from the site immediately upon completion of the job.

4.6 Acceptance

Areas will be accepted by Engineering Manager provided that:

.1 Sodded areas are properly established.

.2 Turf is free of eroded, bare or dead spots and free of weeds.

.3 Sodded areas have been cut at least twice, the last cut being carried out within 24 h of acceptance.

Areas sodded in fall will be accepted in following spring one month after start of growing season provided acceptance conditions are fulfilled.

SPECIFICATION FOR BOULEVARD SEEDING

1. GENERAL CONDITIONS

All standards in this edition, attached hereto, shall apply to and be a part of this Specification.

2. DESCRIPTION

This Specification shall cover the supplying and placing of topsoil in boulevard and median areas adjacent to the pavement, and seeding these areas.

The work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, equipment, tools, supplies and all other things necessary for and incidental to the satisfactory performance and completion of all work as hereinafter specified.

3. MATERIALS

3.1 General

The Contractor shall be responsible for the supply, safe storage and handling of all materials set forth- in this Specification. All materials supplied under this Specification shall be subject to inspection and testing by the Engineering Manager. There shall be no charge to the Municipality for any materials taken by the Engineering Manager for testing purposes.

3.2 Top Soil

All soil required shall consist of a screened clay-textured or loam- textured dark top soil, a fertile friable material containing not more than 25% by volume organic matter (peat, rotted manure or composted materials), 25% sand, and having a pH range of 6.0 - 7.5 and a salinity rating of less than 1.5 mohms/cm. It shall be free of any mixture of subsoil, clay lumps and free of stones and roots over 40 mm in diameter and other extraneous matter. It shall not contain couch grass or Canada Thistle rhizomes.

Topsoil may be either site topsoil or imported topsoil.

Topsoil, which has been stockpiled, shall be shredded or screened prior to being spread.

3.3 Seed

Seed shall be Canada No.1 grade mixture of 50% Kentucky Blue Grass, 10% Perennial Rye and 40% Creeping Red Fescue.

3.4 Top Dressing

Top dressing shall consist of well-decomposed screened manure.

3.5 Hydro Mulch Grass Seeding

3.5.1 Mulch

The wood cellulose fiber product containing a bonding agent shall be combined and added, with water, to a 3600 litre tank of the hydraulic seeding equipment, that seeds approximately 465 m^2 per tank:

(a) 110 kg of "Conweb 2000" or equivalent (Rate of application shall be not less than 235 kg per 1000 m^2.)

(b) 10.5 kg of grass seed mixture (Rate of application shall be not less than 22.5 kg per 1000 m^2.)

(c) Qne of the following fertilizers per tank or equivalent:

7 kg of Ammonium Phosphate Sulphate 16-20-0 (14.5 kg per 1000 m^2)
7 kg of Lawn Green 20-10-5 (14.5 kg per 1000 m^2)
10 kg of Golf Green 12-4-8 (21.0 kg per 1000 m^2)
23 kg of Milogranite 6-3-1 (48.0 kg per 1000 m^2)

4. CONSTRUCTION METHODS

4.1 Grading of Boulevards

The grading of boulevard and median areas will be done in accordance with Specification MH 2000.

4.2 Placing of Top Soil

The topsoil shall be placed on the graded boulevard subsoil, such that after grading and compacting, the topsoil will be level with the finished boulevard grade as shown on the Plans, or as directed by the Engineering Manager. Areas to be seeded by hydro mulch grass seeding shall be fine graded by raking or by other acceptable means. The topsoil

layer shall be a minimum of 100 mm in thickness after compaction.

The Contractor shall prepare and use all available topsoil stockpiled on site before importing topsoil.

4.3 Seeding

Grass seed shall be sown at a rate of 25 kg per 100 mm^2.

The seed shall be raked in and top-dressed with 10 mm of top dressing. After top dressing all seeded areas shall be rolled to form a uniform even surface, level with adjoining curbs, sidewalks or sod.

Seeding operations in each boulevard or median area shall be completed within a two-day (48 hour) period after the sowing operation. This shall be deemed to include the application and placing of top dressing, and the rolling and watering.

No seeding shall be done in a frozen state, or when any other conditions unfavourable to the successful planting of seed exist.

4.4 Hydro Mulch Grass Seeding

The slurry mixture shall be mixed and sprayed on the prepared surface with hydraulic seeding equipment. The mixture shall be applied at a uniform thickness of not less than six millimetres (6 mm).

4.5 Maintenance of Seeded Area

The Contractor shall be responsible for the maintenance of the seeded areas for a period of thirty (30) days after the completion of seeding operations. Any areas seeded after September 15th, which do not show an even stand of live growth in that year, shall have the maintenance period commence on May 15th of the following year or such date as mutually agreed upon by all parties, at which time all seeded areas must show an even stand of live growth. Defective areas shall be reseeded and the area so reseeded shall be further maintained for a period of thirty (30) days. Maintenance shall be understood to include all necessary watering, mowing, cleaning, and upkeep of the seeded area, including replacement of damaged or vandalized areas and any required spring clean-up.

Apply water to ensure moisture penetration of 75 to 100 mm. Control sprinkling to prevent wash-outs.

Cut grass when it reaches height of 60 mm and cut to height of 40 to 50 mm. Remove Clippings that exceed 10 mm in depth.

Maintain grassed areas free of pests and disease.

Apply herbicide when it will not cause damage to new grass or other plants.

.1 Avoid use of dicambal and picloram solutions near trees and shrubs.
.2 Use only mecoprop on Bentgrass turf areas.

Fertilize seeded areas one month after seeding. Spread evenly and water in well. Postpone fertilizing until next spring if application falls within four-week period prior to expected end of growing season in locality.

4.6 Site Clean-Up

All sidewalks, streets, approaches and driveways in the vicinity of the seeding operations shall be kept clean at all times by the Contractor.

All excess materials and debris shall be removed from the site immediately upon completion of the job.

4.7 Acceptance

Seeded areas will be accepted at final inspection provided that:

.1 Seeded areas are properly established.
.2 Turf is free of bare and dead spots and without weeds.
.3 No surface soil is visible when grass has been cut to height of 40 mm.
.4 Seeded areas have been maintained for a period of at least thirty (30) days.
.5 Turf has received a minimum of two (2) complete cuttings.

Lawns seeded in fall will be accepted-in following spring one month after start of growing season provided acceptance conditions are fulfilled.

SPECIFICATION FOR THE PLANTING OF BOULEVARD TREES

1. GENERAL CONDITIONS

All standards in this edition, attached hereto, shall apply to and be a part of this Specification.

2. DESCRIPTION

This Specification shall cover the supplying and planting of trees in the boulevard and median areas within right-of-ways or on Municipal property.

The work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, equipment, tools, supplies and all other things necessary for and incidental to the satisfactory performance and completion of all work as hereinafter specified.

3. MATERIALS

3.1 General

The Contractor shall be responsible for the supply, safe storage and handling of all materials set forth- in this Specification. All materials supplied under this Specification shall be subject to inspection and testing by the Engineering Manager. There shall be no charge to the Municipality for any materials taken by the Engineering Manager for testing purposes.

3.2 Soil

All soil required for the planting of boulevard trees shall consist of black top soil, a fertile friable natural loam containing not less than 4% of organic matter of clay loams and not less than 2% for sandy loams, with an acidity value ranging from pH 6.0 to 7.5 and capable of sustaining vigorous plant growth. It shall be free of any mixture of subsoil, clay lumps and free of stones and roots over 50 mm in diameter and other extraneous matter. It shall not contain couch or crab grass rhizomes. Topsoil backfill shall be screened garden soil mixture of two parts black loam topsoil, one part milled peatmoss, and one part sharp sand.

3.3 Plant Material

All plant material must be Canadian Prairie nursery grown and meet the specifications set out in the latest Guide Specifications for Nursery Stock prepared by the Canadian Nursery Trades Association (C.N.T.A.) for size, height, spread, grading, quality and method of cultivation.

Nomenclature of specified plants shall conform to the International Code of Nomenclature for Cultivated Plants and the latest edition of Standardized Plant Names.

Plant Material: true to name and type, structurally sound, well branched; healthy and vigorous and free from disease, insect infestations, rodent damage, sun scald, frost cracks, and other abrasions to the bark and densely foliated with a healthy, well developed root system. Pruning wounds must show vigorous bark on all edges and all parts must show live and green cambium tissue when cut.

All material must conform to the sizes shown on the plant list, except that larger material may be used when approved by Public Works.

Plant material sizes must conform to the following standards:

(a) caliper - diameter of the trunk measured 300 mm above the normal grade around the plant.

(b) height - measured from the normal grade around the plant to the top of the main foliage mass.

(c) spread - diameter of the main foliage mass, at its widest point.

Following is a list of tree species and their minimum planting sizes, which may be accepted for boulevard plantings:

(a) Large size trees:		Height	Caliper
Fraxinus	Black Ash (Fall Gold)	3700-4600 mm	50mm
Fraxinus pennsylvanica sub.	Green Ash (Patmore)	3700-4600 mm	50mm
Tilia Americana	Basswood	3700-4600 mm	50mm
Fraxinus Mandshurica mancana	Mancana Ash	3700-4600 mm	50mm
(b) Small size trees:			
Malus	Thunderchild flowering Crab	1800-2400 mm	25mm
Prunus virginiana melanocarpa	Shubert Chokecherry	1800-2400 mm	25mm
Syringa amurensis japonica	Japanese Tree Lilac	1800-2400 mm	25mm
Tilia flauescens	Dropmore Linden	1800-2400 mm	25mm

3.4 Other Materials

Planting accessories: galvanized or painted steel U or T bars sized as detailed, 11 gauge galvanized guy wire and new rubber hose tree protectors.

4. CONSTRUCTION METHODS

4.1 Approval Procedure

4.1.1 Plan Approval

Prior to tree planting, the Contractor shall submit to the Public Works Foreman a street plan, clearly indicating the following details:

- location of curbs and boulevards
- location of public sidewalk
- location of private approaches
- location of underground structures
- location of above ground structures
- proposed location of boulevard trees
- proposed species of boulevard trees
- proposed planting size of boulevard trees.

After plan approval has been received, the Contractor shall mark or stake the tree locations on the boulevard and request an on-site inspection by the Public Works Foreman.

4.1.2 Approval of Tree Locations

The Public Works Foreman or his representative will inspect the staked tree locations upon 24 hours notice and notify the Contractor of any revisions that may be required, or will approve the proposed tree locations as staked. After the approval has been received, the Contractor shall proceed with the planting project in accordance with the approved plans and specifications. (standard specifications attached)

4.1.3 Planting Inspection

The Contractor shall notify the Public Works Foreman when the planting project is completed. The Parks Foreman or his representative will conduct an inspection of the planted trees upon 48 hours notice and notify the Contractor of any deficiencies that may require correction. Upon satisfactory completion of the planting project, the Parks Foreman will approve the tree planting in writing.

4.1.4 Final Inspection

Prior to expiration of the one-year maintenance and guarantee period, the Public Works Foreman or his representative will inspect the trees and notify the Contractor of any replacements required or other deficiencies that may require correction. Upon satisfactory completion, the Parks Foreman will issue a certificate of acceptance that will release the Contractor of

further responsibilities for the boulevard trees.

4.2 Tree Locations

All boulevard trees shall be planted in a straight line to be located at a distance of 3.50 m from the property line, unless otherwise specified by the Municipality's Public Works Department.

All boulevard trees shall be planted at equal intervals, which may vary depending on their ultimate size, in accordance with the following schedule:

Large size trees	13-16 m apart
Small size trees	7-10 m apart

Boulevard trees shall not be planted any closer to above ground structures as indicated in the following schedule:

Min. distance from street intersections	6 m
Min. distance from light standards	4.5 m
Min. distance from private approaches	3 m
Min. distance from hydrants	3 m
Min. distance from hydro poles	3 m
Min. distance from manhole	3 m

4.3 Time of Planting

(a) The planting of boulevard trees shall not commence until all underground structures have been installed and the boulevard is graded and sodded or seeded.

(b) Boulevard trees shall not be planted when the ground is in frozen condition or during periods of extreme heat.

(c) Boulevard trees shall only be planted during the spring or fall planting season, unless container stock or balled and burlapped stock is used.

4.4 Handling of Trees

All trees shall be well protected against damage and drying out from the time of digging until planted on the site.

All roots shall be cleanly cut; split roots are not acceptable.

All trees which cannot be planted immediately upon arrival on the site, shall be well protected to prevent drying out and shall be kept moist until commencement of planting.

4.5 Preparation of Planting Areas

4.5.1 Layout and Staking

All areas and locations provided for planting shall be staked according to layout shown on the drawing. Excavation shall not proceed until the layout has been inspected and approved by the Park Foreman.

4.5.2 Tree Pits

Tree pits shall be excavated in circular shape with vertical sides to a depth and width amounting to twice the diameter of the root system. The minimum diameter shall be 600 mm. The excavated tree pits shall be refilled with topsoil (as described in 3.2.).

4.5.3 General

All surplus clay shall be removed from the construction site at time of planting. All planting areas shall be leveled, raked and edged to give a neat appearance.

4.6 Planting of Trees

4.6.1 Care of Root System

Each balled specimen shall be handled with sufficient care, so that the root balls shall not be broken. Burlap shall be folded back only at the top and sides. Broken balls or balls consisting of loose soil will not be accepted and shall be replaced. Broken roots of deciduous stock shall be pruned back prior to planting.

4.6.2 Planting Procedures

After inserting the tree and filling the plant hole with topsoil, water shall be poured in until the pit is thoroughly soaked. Filling of the-hole shall then be completed and the filled-in soil shall be packed firmly around roots, leaving a concave surface for convenient watering. Immediately after filling, the trees shall be watered at frequent intervals.

Planting shall be done during periods suitable to weather conditions and locally accepted practice. All nursery stock shall be set plumb in the centre of the pits and at levels shown on the planting details after settlement has taken place. (See Standard Details S21, S22 and S23.)

4.6.3 Pruning

All trees shall be pruned immediately after planting. The amount of pruning shall be

limited to the minimum necessary to remove dead or injured branches and to compensate for the loss of roots as a result of transplanting operations. Pruning shall be done in such a manner as to preserve the natural character of the plants. Leaders shall not be removed. Only clean, sharp tools shall be used. All cuts shall be clean and flush, leaving no stubs. Cuts, bruises or scars on the bark shall be traced back to living tissue and removed. The affected areas shall be shaped so as not to retain water and all cuts of not more than twenty-five (25) mm in diameter shall be painted with an approved tree paint.

4.6.4 Staking of Trees

All trees shall be staked in accordance with specifications as indicated in Standard Details S21, S22 and S23.

5. MAINTENANCE

5.1 Maintenance Period

The Contractor shall be responsible for regular maintenance of the trees and planting areas for a period of one year from recognized completion date.

5.2 Clean-up

All planting areas shall be kept clean and free of refuse, debris, excess soil, etc., resulting from the planting or maintenance of boulevard trees.

5.3 Cultivating

All planting areas shall be cultivated to a depth of seventy-five (75) mm and neatly edged biweekly. All weed growth shall be removed immediately.

5.4 Watering

All trees shall be watered biweekly or as frequently as necessary to keep ground continually in a moist condition from the top surface to a three hundred (300) mm depth. Trees shall be watered individually and a saucer-shaped circle shall be maintained around each plant for convenient watering.

Recommended application rates for trees are as follows:

Tree Caliper	Litres of Water
Up to 75 mm (3")	170 litres (35 gallons)
76 - 100 (3 - 4")	230 litres (50 gallons)
101 - 125 (4 - 5")	270 litres (60 gallons)
126 - 200 (5 - 6")	360 litres (70 gallons)
151 - 200 (6 - 7")	460 litres (100 gallons)

5.5 Pruning

All dead or broken branches shall be removed and cuts or wounds over twenty-five (25) mm in diameter shall be treated with approved tree paint.

6. TRANSPLANTING EXISTING TREES

6.1 Size of root ball: 12 times the tree caliper measure at 300 mm above grade, and deep enough to enclose 75% of the existing root system.

6.2 Double burlap and drum lace rootball before moving.

6.3 Size of new planting pit is to be in accordance with 4.5.2 and 300 mm deeper than the depth of the rootball.

6.4 Plant, guy or stake and prune as outlined in 4.6.2, 4.6.3 and 4.6.4.

7. DAMAGE TO PROPERTY

The Contractor shall take every precaution not to damage, injure or mark any existing structures or landscaping on the street allowance or adjacent properties. Should any damage be incurred by the Contractor, his employees or equipment, it shall be restored or replaced at the Contractor's expense and to the satisfaction of the Engineering Manager and/or property owner.

SPECIFICATION FOR INSTALLATION OF CULVERTS

1. GENERAL CONDITIONS

All standards in this edition, attached hereto, shall apply to and be a part of this Specification.

2. DESCRIPTION

This Specification shall cover the installation of culverts. The installation of extensions to existing culverts shall be considered and classed as new installations.

The work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, equipment, tools, supplies and all other things necessary for and incidental to the satisfactory performance and completion of all work as hereinafter specified.

3. MATERIALS

3.1 General

The Contractor shall be responsible for the supply, safe storage and handling of all materials set forth in this Specification. All materials supplied under this Specification shall be subject to inspection and testing by the Engineering Manager.

3.2 Testing and Approval

All materials supplied under this Specification shall be subject to inspection and testing by the Engineering Manager or by the Testing Laboratory designated by the Engineering Manager. There shall be no charge to the Municipality for any materials taken by the Engineering Manager for testing purposes. All materials shall be approved by the Engineering Manager before any construction is undertaken.

If, in the opinion of the Engineering Manager, such material, in whole or in part, does not conform to the Specification detailed herein or is found to be defective in manufacture or has become damaged in transit, storage or handling operations, then such material shall be rejected by the Engineering Manager and replaced by the Contractor at his own expense.

3.3 Pipe Culverts, Fittings and Accessories

All pipe culverts, fittings and other accessories or appurtenances shall conform to the requirements of this Specification and the requirements of the CSA Spec. CAN3-G401 for

Corrugated Steel Pipe (CSP) or one of ASTM Specifications C-14, C-76 or C-655 for Precast Concrete Pipe (PCP) or other approved equals.

3.4 Bedding and Backfill

Bedding and backfill material shall conform with sand backfill and Class 2 backfill in accordance with Specification MH 1000, "Excavation and Backfill".

Where used, clay backfill material shall be of a type approved by the Engineering Manager.

4. EQUIPMENT

All equipment shall be of a type approved by the Engineering Manager and shall be kept in good working order.

5. CONSTRUCTION METHODS

5.1 Excavation, Bedding and Backfill

Excavation, bedding and backfill shall be completed in accordance with Specification MH 1000, unless otherwise directed by the Engineering Manager.

Where indicated, an impervious compacted clay bedding shall be provided for a minimum length of one (1) metre or two (2) times the diameter of the pipe, whichever is the greater, at both ends of the culvert to achieve a seal against seepage.

5.2 Pipe Installation

5.2.1 Corrugated Steel Pipe and Pipe Arches (CSP)

Corrugated steel pipe shall be laid on the prepared base with the separate sections securely jointed together by means of tightly drawn coupling bands. Corrugated steel pipe of the round or elongated type and pipe arch culvert constructed from individual plates shall have the outside laps of circumferential joints in each pipe section on the upstream end and longitudinal lap seams at the sides of the pipe.

Corrugated steel pipe and pipe arches shall be laid to the established line and grade. The culvert shall be installed with a two percent (2%) camber at its center.

5.2.2 Precast Concrete Pipe (PCP)

Precast concrete pipe installation shall be in accordance with Specification MH 1400.

5.3 Connections to Existing Culverts

5.3.1 Corrugated Steel Pipe and Pipe Arches (CSP)

Where the Drawings indicate connection to an existing CSP culvert, the Contractor shall carefully expose the end of the existing culvert.

Where the existing culvert has a sloped end or damaged end, sufficient length of sloped or damaged culvert shall be removed to provide a straight end in acceptable condition. The cut end of the culvert shall be coated with a galvanized compound approved by the Engineering Manager.

New CSP culvert shall then be connected in accordance with Clause 9.2.1 of this Specification.

5.3.2 Precast Concrete Pipe (PCP)

Connection of PCP culvert to existing PCP culvert shall be in accordance with Specification MH 1400.

6. QUALITY CONTROL

6.1 Inspection

All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Engineering Manager including all operations from the selection and production of the materials through to final acceptance of the specified work. The Contractor shall be wholly responsible for the control of all operations incidental thereto not withstanding any inspection or approval that may be previously given. The Engineering Manager reserves the right to reject any materials or works that are not in accordance with the requirements of this Specification

6.2 Access

The Engineering Manager shall be afforded full access for the inspection and control testing of constituent materials both at the site of work and at any plant used for the production of the materials, to determine whether the material is being supplied in accordance with this Specification.

6.3 Materials

All materials supplied under this Specification shall be subject to testing and approval by the Engineering Manager in accordance with Section 3 of this Specification.

6.4 Line and Grade

Pipe culvert shall be installed to the line and grade set by the Engineering Manager. Vertical variance from grade shall not exceed 25 mm. and horizontal variance from line shall not exceed 100 mm. Sharp bends will not be permitted.

SPECIFICATION FOR ASPHALTIC CONCRETE PAVEMENT WORKS

1. GENERAL CONDITIONS

All standards in this edition, attached hereto, shall apply to and be a part of this Specification.

2. DESCRIPTION

This Specification shall cover the preparation of hot-mixed, hot- laid, asphaltic concrete paving mix for, and placing operations relating to, the construction of asphaltic concrete base courses, pavements, overlays, full-depth patching, and other related pavement works. The work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, equipment, tools, supplies and all other things necessary for and incidental to the" satisfactory performance and completion of all work as hereinafter specified.

3. MATERIALS

3.1 General

The Contractor shall be responsible for the supply, safe storage and handling of all materials set forth in this Specification.

3.2 Handling and Storage of Materials

All materials shall be handled and stored in a careful and responsible manner, to the satisfaction of the Engineering Manager.

3.3 Testing and Approval

All materials supplied under this Specification shall be subject to inspection and testing by the Engineering Manager or by the Testing Laboratory designated by the Engineering Manager. There shall be no charge to the Municipality for any materials taken by the Engineering Manager for testing purposes.

All materials shall be approved by the Engineering Manager before any construction is undertaken. If: in the opinion of the Engineering Manager, such materials, in whole or in part, do not conform to the Specification detailed herein or are found to be defective in manufacture or have become damaged in transit, storage or handling operations, then such material shall be rejected by the Engineering Manager and replaced by the Contractor at his own expense.

3.4 Asphaltic Concrete Constituent Materials

3.4.1 Aggregates

The Contractor shall furnish in writing to the Engineering Manager the location of the sources where aggregate will be obtained in order that same may be inspected and tentatively approved by the Engineering Manager. Changes in the source will not be permitted without notification in writing to and the express approval of the Engineering Manager.

(a) Fine Aggregate

Fine aggregate shall consist of sand having clean, hard, strong, durable, uncoated grains free from injurious amounts of dust, soft or flaking particles, shale, alkali, organic matter, loam or other deleterious substances.

(b) Coarse Aggregate

Coarse aggregate shall consist of natural gravel, crushed stone or other approved materials of similar characteristics having clean, hard, strong, durable, uncoated grains free from injurious amounts of soft, friable, thin, elongated or laminated pieces, alkali, organic or other deleterious matter.

Crushed stone shall consist of angular, cubical fragments of aggregate of uniform quality throughout. It shall be produced from rock formations or from boulders and stones and shall be from sources of approved nature and origin. Coarse aggregate will not be accepted from rock formations or from boulders and stones containing intrusions or stratifications of an undesirable nature or from sources showing signs of disintegration from the elements or other causes.

Coarse aggregate shall conform to the following additional requirements:

(i) Soundness - Coarse aggregate when subjected to five (5) cycles of the soundness test shall have a weighted loss of not more than twelve percent (12%) when sodium sulphate is used or not more than eighteen percent (18%) when magnesium sulphate is used, or have in the opinion of the Engineering Manager a satisfactory soundness record. The method of testing shall be in accordance with ASTM Standard C88, Test for Soundness of Aggregates by Use of Sodium Sulphate or Magnesium Sulphate.

(ii) Abrasion - Coarse aggregate when subjected to the abrasion test shall have a loss of not more than thirty-five percent (35%). The method of testing shall be in accordance with ASTM Standard C131, Test for Resistance to Abrasion of Small Size Coarse Aggregate by Use of the Los Angeles Machine.

(iii) Absorption - The absorption characteristics of coarse aggregate shall be determined in accordance with ASTM Standard C 127 Method of Test for Specific Gravity and Absorption of Coarse Aggregate.

(iv) Crushed Aggregate - Aggregate retained on a No. 5000 sieve shall contain not less than fifty percent (50%) crushed aggregate as determined by actual particle count. Crushed aggregate shall be considered as that aggregate having at least one fractured face.

5.4.2 Asphalt Cement

The asphalt cement shall be prepared by the refining of crude petroleum by suitable methods.
The asphalt cement shall be homogeneous, free from water, shall not foam when heated to 175°C, and shall conform to the following requirements:

Penetration at 25°C 100 g 5 sec., 0.1 mm	150 to 200
Ductility at 15°C 5 cm/minute, cm	100.0 minimum
Flash Point (Cleveland Open Cup, deg C.	218.0 minimum
Volatility at 163°C 50 g 5 hrs, percent loss by weight	1.0 maximum
Penetration of residue, percent of original sample	70.0 minimum
Solubility in Trichloroethylene, percent	99.5 minimum
Kinematic Viscosity at 135°C, centistokes	200.0 minimum

Methods of sampling and testing shall be in accordance with the requirements of ASTM Standard D946, Standard Specification for Asphalt Cement for Use in Pavement Construction, and ASTM Standard D2170, Standard Method to Test for Kinematic Viscosity of Asphalts.

5.4.3 Mineral Filler

Mineral filler, when required, shall consist of finely divided mineral matter such as rock dust, slag dust, hydrated lime, hydraulic cement, fly ash, loess or other suitable mineral matter, and shall conform to the requirements of ASTM Standard D242, Standard Specification for Mineral Filler for Bituminous Paving Mixtures.

5.5 Incidental Materials

5.5.1 Prime Coat

Prime coat shall consist of either an emulsified or cutback asphalt. Selection shall be based upon existing field conditions and shall be subject to the approval of the Engineering Manager. Method of application shall conform to the manufacturer's recommendations.

5.5.2 Tack Coat

Tack coat shall consist of either an emulsified or cutback asphalt. Selection shall be based upon existing field conditions and shall be subject to the approval of the Engineering Manager. Method of application shall conform to the manufacturer's recommendations.

6. DESIGN REQUIREMENTS FOR ASPHALTIC CONCRETE PAVING MIX

6.1 Mix Design Statement

For each type of asphaltic paving mix to be used, the Contractor shall provide the Engineering Manager with a Mix Design Statement certifying the constituent materials and mix proportions that will be used in the asphaltic concrete paving mix. The Contractor shall also supply reasonable evidence to the Engineering Manager that the mix proportions selected will produce asphaltic concrete conforming to the requirements specified in this Specification.

The Mix Design Statement must be submitted to the Engineering Manager at least one (1) week prior to the delivery of any asphaltic concrete paving mix to the job site. Once approved by the Engineering Manager, all asphaltic concrete paving mix shall be supplied in accordance with this Statement, which shall be called the Job Mix Formula.

No changes in Job Mix Formula will be permitted without following the above procedures.

6.2 Aggregate Gradation Requirements

For each type of paving mixture, the mineral constituents shall be combined in such proportions so as to fall within the Gradation Limits shown in Table MH 2600.1, unless the Contractor can conclusively show to the Engineering Manager that he can only meet the physical requirements by deviating from these gradation limits.

6.3 Allowable Deviation from Job Mix Formula

6.3.1 Aggregate Condition

The aggregate gradation of the asphaltic concrete supplied by the Contractor shall not deviate from that of the Job Mix Formula by more than the Allowable Deviations shown hereafter.

TABLE MH 2600.1

COMBINED AGGREGATE GRADATION LIMITS

Cdn. Metric Sieve Size	**Percent of Total Dry Weight Passing Each Sieve**		
	Type I (Surface Course)	Type II (Surface Course)	Type III (Base Course)
40,000			100%
25,000			90% to 100%
16,000	100%		65% to 85%
10,000	70% to 85%	100%	56% to 80%
5,000	45% to 70%	90% to 95%	29% to 59%
2,000	25% to 55%	74% to 80%	19% to 45%
1,250	20% to 40%	55% to 64%	12% to 31%
630	15% to 30%	35% to 46%	5% to 17%
315	5% to 20%	22% to 30%	4% to 13%
80	3% to 6%	8% to 11 %	3% to 6%

TABLE MH 2600.2

PHYSICAL REQUIREMENTS

	Type I (Surface Course)	**Type II (Surface Course)**	**Type III (Base Course)**
Asphalt Cement, % total sample weight	5.0% to 6.0%	5.0% to 7.0%	4.0% to 5.5%
Voids in Mineral Aggregate (VMA) *	14.5% minimum	16.0% minimum	12.0% minimum
Air Voids	2.5% to 5.0%	2.5% to 5.0%	2.5% to 5.0%
Marshall Stability, N at 60°C	5000 minimum	4000 minimum	5000 minimum
Flow Index, units of 250 um	6.0 to 16.0	6.0 to 16.0	6.0 to 16.0

* Above % VMA is for 3.5% Air Voids
Reduce % VMA by amount of Air Voids set less than 3.5%
Increase % VMA by amount of Air Voids more than 3.5%

MAXIMUM ALLOWBALE DEVIATION FROM JOB MIX FORMULA	
Cdn. Metric Sieve Size	Percent of Total Dry Weight Passing Each Sieve
10,000	+/- 4%
5,000	+/- 4%
2,500	+/- 4%
1,250	+/- 4%
630	+/- 4%
315	+/- 4%
80	+/- 2%

6.3.2 Asphalt Cement Content

The asphalt cement content of the asphaltic concrete supplied by the Contractor shall not deviate from that of the Job Mix Formula by more than ±0.4%, provided that the asphalt cement content requirements are maintained in accordance with Table MH 2600.2 of this Specification.

6.4 Physical Requirements

For each type of paving mixture, the asphaltic concrete paving mix shall conform to the physical requirements shown in Table MH 2600.2.

6.5 Method of Testing

The aggregate gradation and physical properties of asphaltic concrete paving mix shall be determined in accordance with the requirements of this Specification.

7. SUPPLY OF ASPHALTIC CONCRETE PAVING MIX

7.1 Mixing Plant

The asphaltic concrete paving mix shall be supplied from an approved mixing plant. The mixing plant shall conform to the requirements of ASTM Standard D995, Specifications

for requirements for Mixing Plants for Hot-Mixed, Hot-Laid, Bituminous Paving Mixtures.

7.2 Mixing Plant Operations

7.2.1 Aggregate Storage

The different sizes of aggregate used shall be kept separate and adequate provision shall be made to keep them from becoming mixed or otherwise contaminated.

7.2.2 Preparation of Asphalt Cement

The asphalt cement shall be heated at the paving plant to a temperature of 135°C to 160°C before mixing with the aggregates. The temperature of the asphalt cement and aggregates immediately prior to mixing shall be approximately that of the completed batch. In no case shall the temperature of the asphalt and aggregates differ by more than 15°C when placed in the pug mill. The penetration of the asphalt cement shall be maintained within the limits of penetration specified.

7.2.3 Preparation of Mineral Aggregate

The coarse and fine aggregate shall be fed by feeders to the cold elevators in their proper proportions and at a rate to permit correct and uniform temperature control of the heating and drying operation. The aggregates shall be dried and delivered to the mixer at a temperature between 135°C and 160°C. The temperature between these limits shall be regulated according to the penetration grade of the asphalt, temperature of the atmosphere and workability of the mixture, but shall be as low as possible consistent with proper mixing and laying. Immediately after heating, the aggregates shall be screened into bins with separation on such coarse sieves as the number of bins permits. All aggregates in the bins that contain sufficient moisture to cause foaming in the mixture shall be removed and replaced in their respective stockpiles.

7.2.4 Preparation of Asphaltic Concrete Paving Mix

Each size of hot "aggregate and the asphalt cement shall be measured separately and accurately to the proportions in which they are to be mixed. When the mixture is prepared in a twin pug mixer, the volume of mineral aggregate and asphalt cement shall not be so great as to extend above the tips of the mixer blades when these blades are in a vertical position. For batch mixing, the aggregates shall be mixed dry for a period of not less than 15 seconds, after which the asphalt cement shall be added and the mixing continued for a period of at least 30 seconds or longer if necessary to produce a uniform homogeneous mixture in which all particles of the mineral aggregate are thoroughly and uniformly coated. For continuous mixing, the total mixing time shall be not less than 45 seconds when calculated by the formula in Section 4.4 of ASTM Standard D995 or longer if

necessary to produce a homogeneous mixture.

7.2.5 Mixing Plant Inspection

The Engineering Manager shall have access at any time to all parts of the mixing plant in order to ensure the manufacture of the mixture in strict accordance with this Specification.

7.3 Transportation of Asphaltic Concrete Paving Mix

The mixture shall be transported from the mixing plant to the work in tight vehicles with metal bottoms previously cleaned of all foreign materials. The Contractor shall ensure that the vehicles are suitably insulated, as required. Each vehicle shall be equipped with a tarpaulin or other suitable covering material of sufficient size to overhang the truck box on three sides when the vehicle is fully loaded. Such tarpaulins shall be on the truck at all times and shall be used to cover the mixture completely as directed by the Engineering Manager. The inside surface of all vehicles used for hauling mixture may be lightly lubricated with fine oil, paraffin oil, lime water or soap solution just before loading, but an excess of lubricant will not be permitted. No loads of mixture shall be dispatched from the plant after sunset or during hours of darkness unless loads can be placed and compacted in accordance with this Specification and suitable artificial illumination is provided, all of which shall be subject to approval of the Engineering Manager. In no case shall temperatures be increased above 165°C at the plant to offset long distance hauling.

8. EQUIPMENT

All equipment shall be of a type approved by the Engineering Manager. The equipment shall be in good working condition and shall be so maintained for the duration of the Contract.

9. CONSTRUCTION METHODS

9.1 Base Preparation

9.1.1 Preparation of Base for Asphaltic Concrete Pavement

The placing of the asphaltic concrete paving mixture shall not commence until the construction of the sub-grade, sub-base and base course has been completed in accordance with the requirements of Specification MH 2000, and the installation of pavement and boulevard structures and appurtenances have been completed to the satisfaction of the Engineering Manager.

9.1.2 Preparation of Existing Pavement for Asphaltic Concrete Overlay

A layer of the existing asphaltic concrete surface course shall be removed to such depth as is specified. This work will be done in accordance with Specification MH 2700.

If the surface remaining after the removal of the specified layer of asphaltic concrete surface course is asphaltic concrete, the Contractor shall proceed to fill any remaining holes and depressions with asphaltic concrete paving mixture and compact said areas with a steel wheel roller. The asphaltic concrete surface upon which the asphaltic concrete overlay is to be placed shall be as true to grade and cross-section as possible, as approved by the Engineering Manager. At the locations designated by the Engineering Manager, the Contractor shall make adjustment to existing structures and appurtenances, reconstruct sections of curb, seal all cracks and do other repair works as required.

9.2 Placing Asphaltic Concrete Paving Mixture

The surface upon which new asphaltic concrete paving mix is to be placed shall be approved by the Engineering Manager before the paving operations for that course may begin.

The first course shall be laid upon a surface which is dry, clean and free from standing water, and only when weather conditions are suitable.

In the case of placing new asphaltic concrete pavement, the base course shall have been previously prepared with one uniform application of Prime Coat prior to the delivery of the asphaltic concrete paving mixture.

In the case of asphaltic concrete overlay, the existing pavement surface shall have been previously prepared with one uniform application of Tack Coat prior to the delivery of the asphaltic concrete paving mixture. The Tack Coat shall be applied in small quantities only sufficient to wet the pavement surface on which the overlay is to be placed.

The type and amount of Prime Coat/Tack Coat applied, and the method of application, shall be as recommended by the manufacturer and shall be subject to the approval of the Engineering Manager.

No paving course shall be started until any frost or moisture from previous inclement weather has evaporated to leave a dry surface. The surface course shall be laid only under such conditions that the Engineering Manager determines to be conducive to obtaining the specified results.

The mixture shall be delivered to the job and placed at a temperature optimum for proper compaction, taking into consideration the weather conditions, the temperature of the surface on which the mixture is to be placed, and the thickness of the lift. In no case shall the mixture be placed at a temperature of less than I25°C nor greater than I55°C.

Unless otherwise permitted by the Engineering Manager, the mixture shall be spread by means of a mechanical self-powered paver capable of spreading the mixture true to the line, grade and crown required.

Pavers shall be equipped with hoppers and distributing screws of the reversing type to place the mixture evenly in front of adjustable screeds. The mixture shall be dumped in the centre of the hoppers and care exercised to avoid overloading and slopping over of the mixture upon the base. When laying the mixture, pavers shall operate so as to provide as continuous an operation as possible at a speed of between three (3) metres and six (6) metres per minute as may be decided by the Engineering Manager. They shall be equipped with a quick and efficient steering device and shall have forward and reverse traveling speeds of not less than 30 metres per minute.

Pavers shall employ automatic grade control devices to meet grades. Alternately, and where permitted by the Engineering Manager, the Contractor will control grade by placing chalk lines between grades set in the field by the Engineering Manager for the purpose of establishing and maintaining grade control.

Unless operating on fixed side forms, pavers shall employ mechanical devices such as equalizing runners, straight-edge runners, evener arms or other compensating devices to adjust the grade and confine the edges of the mixture to true lines without the use of stationary side forms. They shall be capable of spreading the mixture, without segregation, in thicknesses of not more than 75 mm to a maximum width of not less than 3.90 metres and with adjustment to spread the mixture in strips of less than 3.90 metres in width, in steps of 300 mm or less, to a minimum width of 1.8 metres. They shall be equipped with blending or joint leveling devices for smoothing and adjusting all longitudinal joints between strips or courses of the same thickness. Pavers shall be equipped with screeds. Pavers shall employ automatic grade control devices to meet grades. Alternately, and where permitted by the Engineering Manager, the Contractor will control grade by placing chalk lines between grades set in the field by the Engineering Manager for the purpose of establishing and maintaining grade control.

The term screed includes any strike-off device operated by cutting, crowding or other practical action which is effective on the mixtures at workable temperature without tearing, shoving or gouging and which produces a finished surface of the evenness and texture specified. The screed shall be adjustable as to level and crown.

The placing of mixtures shall be as continuous as possible, and the roller shall pass over the unprotected end of the fresh-laid mat only when the laying of this course is to be discontinued for such length of time as to permit the mixture to become chilled.

9.3 Base and Surface Course Construction by Use of Mechanical Pavers

Immediately after any course is screeded and before roller compaction is started, the surface shall be checked, any inequalities adjusted, all fat sandy accumulation from the screed removed, and all fat spots in the course removed and replaced with satisfactory material. Irregularities in alignment and grade along the outside edge shall also be corrected by the addition or removal of mixture before the edge is rolled.

The Contractor shall provide a competent person who is capable of performing the work incidental to the correction of all pavement irregularities. Special attention shall be given by this person to the straight-edging of each course immediately following the initial rolling.

Where it is impractical, in the opinion of the Engineering Manager, to spread and finish the surface mixtures by machine methods, the Contractor may use approved spreading equipment or acceptable hand methods as directed.

9.4 Hand Spreading Asphaltic Concrete Paving Mixture

Upon arrival, the mixture shall be dumped outside of the area on which it is to be spread. Immediately thereafter, it shall be distributed into place by means of hot shovels and spread with hot lutes or with the back of hot rakes in a loose layer of uniform density and correct depth. Loads shall not be dumped any faster than they can be properly handled. The rakers will not be permitted to stand in the hot mixture while raking it except where necessary to correct errors in the first raking. The raking must be carefully and skillfully done in such a manner that after the first passage of the roller over the raked mixture a minimum amount of back patching will be required.

9.5 Joints

Joints shall be constructed in a careful and workmanlike manner by experienced and competent personnel. Joints shall be smooth, well bonded and tightly sealed. Joints shall conform smoothly and accurately to adjacent pavement surfaces such that when tested with a 300 mm straight edge placed across the joint the distance between the straight edge and the surface of the pavement shall not exceed 5 mm at any point.

Longitudinal joints shall be made true to line and parallel to the pavement edge wherever practicable. On straight sections, the joint line shall not deviate from a straight line by more than 75 mm at any point. On curved or tapered sections, the joint shall be shaped so as to be as smooth as possible. Jagged, stepped or wandering edges shall be· reshaped to a smooth line, to the satisfaction of the Engineering Manager, before the adjacent mat is laid.

9.5.1 Location of Joints

The location of joints shall be subject to the approval of the Engineering Manager, and in addition, shall conform to the following requirements:

(a) Longitudinal Joints

Longitudinal joints shall not be located within 150 mm of a longitudinal joint in any underlying pavement structure.

(b) Transverse Joints

Transverse joints shall not be located within two meters (2 m) of any transverse joints in the same paving course nor within one metre (1 m) of a transverse joint in any underlying pavement structure.

Note: Longitudinal cold joints are to be avoided wherever possible. To facilitate this:

(i) transverse joints shall be established with sufficient frequency to allow the full width of the paving course to be placed in a single shift.

(ii) no paving lane shall progress more than 500 m beyond the end of an adjacent paving lane in the same course without the prior approval of the Engineering Manager.

9.5.2 Preparation of Joints

(a) Hot Joints

Hot joints shall be considered to be those longitudinal joints between successive mats in which the previously laid mat retains sufficient heat to facilitate good bonding and sealing of the joint. The edge of the previously laid mat shall be inspected prior to laying the new mat. Any areas not conforming to line and grade or having a rounded-off comer shall be cut out to the full depth of the mat and replaced with fresh material and compacted before the new mat is laid.

(b) Cold Joints

Cold joints shall be considered to be those longitudinal and transverse joints where the existing pavement mat is at or near ambient temperatures and shall include joints against pavement mats laid on previous days and joints against existing pavement structures. Transverse joints shall be cut back to a straight line for the full depth and width of the mat. The transverse joint shall be cut back to a location

such that the pavement immediately before the joint, where checked with a three metres (3 m) straight edge, exhibits no tapering or rounding down. Longitudinal edges of existing mats shall be inspected before laying the new mat. Any areas not conforming to line and grade shall be cut out and replaced with fresh material and compacted before the new mat is laid. Any areas with a rounded off top comer shall be cut back to the full depth of the mat to form a vertical face with a square top comer.

Joints against existing asphaltic concrete pavements shall be prepared by saw cutting, cold planing, heater planing or other method(s) approved by the Engineering Manager, such that the face of the existing pavement is vertical with a square top comer.

All contact surfaces of cold joints shall be painted with a thin uniform coating of hot asphalt cement or asphalt cement dissolved in naptha before the new asphaltic concrete is placed against them.

9.5.3 Construction of Joints

Fresh asphaltic concrete shall not be placed against the existing mat until the joint preparation has been completed.

The fresh mat shall be laid to an elevation such that, when compacted, it will conform accurately to the grade of the existing pavement. Wherever practicable, this shall be done using mechanical pavers equipped with suitable automatic joint matching controls. Immediately after placing and before initial rolling, the joint shall be checked and "set-up" by experienced and competent personnel so that an absolute minimum of back patching is required after rolling.

Joints shall always be rolled before the remainder of the mat. Wherever practicable, the joint shall be rolled with the roller traveling parallel to the joint and with a minimum of seventy-five percent (75%) of the width of the main roller(s) supported on the existing mat. After the first pass of the roller, the joint shall be checked and corrected, if necessary, before any additional rolling is done.

9.6 Full-depth Patching of Existing Pavement

9.6.1 Pavement Removal

Where only a portion of pavement is being replaced, the Contractor shall saw-cut the pavement surface along the perimeter of the area designated for removal. The pavement shall be saw-cut full-depth. When the pavement exceeds 200 mm in thickness, a 200 mm saw-cut will be considered full-depth.

Where the perimeter of a patch is within 600 mm of a joint or the pavement edge, the area to be patched shall be extended to the edge of the pavement slab.

The Contractor shall remove the existing deteriorated pavement within the patch area by carefully breaking down and removing deteriorated pavement, or, for full-depth cuts only, by lifting out the deteriorated pavement in one piece.

Removal of deteriorated pavement shall be done in such a manner that the adjacent pavement is not damaged. The edge of the adjacent pavement shall be a vertical face. Where the edge of adjacent pavement is spalled at the surface or undercut below the surface by the removal operation, the Contractor shall re-saw the adjacent pavement beyond the limit of the spalled or undercut pavement area and remove the damaged pavement. This additional patching shall be carried out at the expense of the Contractor.

When concrete curb forms part of the pavement designated for removal, the curb shall be removed prior to the saw-cutting of the designated patch area.

Disposal of material shall comply with the requirements of Section 9.6.4.

9.6.2 Base Preparation

Where existing base is adequate, it shall be mechanically compacted to the satisfaction of the Engineering Manager. The cost of compaction shall be incidental to the cost of the patching.

Excavation of existing in-situ material and/or sub-grade, sub-base and base course construction, if authorized by the Engineering Manager, shall be done separately in accordance with Specifications MH 1000 and MH 2000.

9.6.3 Placing Full-depth Patches

Forms shall be used on all exposed edges of the patch, placed in accordance with the requirements of Specifications MH 2600 and MH 2800.

Placing, consolidation, finishing and curing shall comply with the requirements of Specifications MH 2600 and MH 2800, with the following exceptions:

Each patch shall be placed in one continuous operation.

All patches finished flush with adjacent pavement shall be straight- edged. The surface of the patch shall be checked with a 3 metre long metal straight edge. The straight edge shall be in contact with the existing pavement. Any depressions or high spots exceeding 5 mm shall be immediately corrected.

Where required, new curb shall be constructed such that it will be consistent with adjacent existing curb, either separate or integral. This work related to curb renewal shall be done in accordance with Specification MH 2800.

9.6.4 Disposal of Material

Disposal of material shall be understood to mean the hauling of a material from the site and the unloading and grading of the material in a manner satisfactory to the Engineering Manager at a disposal site indicated in the Special Provisions.

If a disposal site is not indicated in the Special Provisions, the Contractor shall locate a disposal site approved by the Engineering Manager.

Material dropped, spilled or tracked on any street during the hauling operations shall be promptly cleaned up by and at the expense of the Contractor, to the satisfaction of the Engineering Manager.

9.7 Compaction of Asphaltic Concrete Paving Mixture

Compaction of the mixture shall be obtained by the methods specified hereinafter.

A rolling pattern shall be established by the Contractor and approved by the Engineering Manager. Any deviation from the rolling pattern must be approved by the Engineering Manager.

9.7.1 Static Rolling

A minimum of two approved rollers will be required on every contract. When the output of the mixing plant exceeds 70 tonnes per hour, an extra roller will be required for each additional 35 tonnes of mix produced per hour.

The speed of the roller shall not exceed five (5) kilometres per hour and shall at all times be slow enough to avoid displacement of the hot mixture. Any displacements occurring as a result of reversing the direction of the roller or from any other cause shall at once be corrected. Rolling shall proceed continuously until all roller marks are eliminated and no further compression is possible. To prevent adhesion of the mixture to the roller, the wheels shall be kept properly moistened by use of water, limewater, or approved detergent. An excess of moisture will not be permitted.

The rollers shall be in good condition capable of reversing without backlash and capable of developing a minimum pressure on the mainroll(s) of 40 kilograms to one centimetre (1 cm) width of tread. They shall be operated by competent and experienced rollermen and must be kept in continuous operation as nearly as practicable in such a manner that all parts of the pavement shall receive substantially equal compaction.

Compaction of the paving mixture shall consist of three (3) separate rolling operations as follows:

(a) Breakdown Rolling

Breakdown rolling with a tandem steel wheel roller weighing between seven (7) and nine (9) tonnes shall commence as soon as possible after the mixture has been spread without causing undue checking and displacement of the mixture. Delays in rolling freshly spread mixture will not be tolerated. Rolling shall start longitudinally at the sides and proceed toward the center of the pavement overlapping on successive trips by at least 150 mm. Breakdown rolling shall consist of at least two complete coverages by the roller.

(b) The intermediate rolling shall be performed with a self- propelled pneumatic-tired roller having a minimum wheel load of 1100 kilograms and minimum tire pressure of 450 kPa. Intermediate rolling shall begin while the mix is still of a temperature that will result in the maximum density from this operation.

(c) Final Rolling

For final rolling, a tandem steel wheel roller weighing not less than nine (9) tonnes shall be used. It shall be done while the paving mixture is still warm enough for the removal of roller marks. Where the width permits, the pavement shall be subjected to diagonal rolling in two directions, the second diagonal rolling crossing the lines of the first. Final rolling shall be carried on until there is no further evidence of consolidation.

9.7.2 Vibratory Rolling

Vibratory rollers shall be of a type designed for asphalt finish rolling. They shall provide for the adjustment of both amplitude and frequency of vibration, and shall be equipped with an automatic device that positively prevents the drum from vibrating unless the roller is moving.

The optimum combination of amplitude, vibration frequency and roller speed shall be determined by the Contractor and approved by the Engineering Manager except that the maximum rolling speed in m/min. shall not exceed the vibration frequency per minute divided by 40.

$$\text{Maximum rolling speed (m/min.)} = \frac{\text{vibration frequency (VPM)}}{40}$$

Where vibratory rollers are used, the rolling pattern shall in all cases include at least one complete coverage in the static mode as the final rolling pass.

9.7.3 Compaction of Areas Inaccessible to Rollers

Along curbs, manholes and similar structures and all places not accessible to the roller, thorough compaction must be secured by means of hot tampers and at all contacts of this character the joints between these structures and the mixture must be effectively sealed.

9.8 Requirements after Final Rolling

After final rolling, the surface of each course shall be smooth and true to the established crown and grade. Any low or defective spots shall immediately be remedied by cutting out the course at such spots and replacing it with fresh, hot mixture that shall be immediately compacted to conform with the surrounding area and shall be thoroughly bonded to it. The surface of the finished pavement shall be free from depressions exceeding five millimetre (5 mm) as measured with a three (3) metre straight edge.

After final rolling, the completed course shall at no point have a density less than ninety-eight percent (98.0%) of the 75 blow Marshall density of the paving mixture.

9.9 Opening to Traffic

In no case shall traffic or construction equipment be allowed on the asphaltic concrete pavement until completion of quality control testing by the Engineering Manager and until the completed pavement has cooled to atmospheric 'temperature or to such other temperature, as may be approved by the Engineering Manager, that will ensure no deformation of the pavement surface under traffic loading.

The Engineering Manager's decision as to when the pavement will be opened to traffic shall be final.

10. QUALITY CONTROL

10.1 Inspection

All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Engineering Manager including all operations from the selection and production of the materials through to final acceptance of the specified work. The Contractor shall be wholly responsible for the control of all operations incidental thereto not withstanding any inspection or approval that may be previously given. The Engineering Manager reserves the right to reject any materials or works that are not in accordance with the requirements of this Specification.

10.2 Access

The Engineering Manager shall be afforded full access for the inspection and control testing of asphaltic concrete paving mixture and constituent materials, both at the site of work and at any plant used for the production of asphaltic concrete paving mixture, to determine whether the mixture is being supplied in accordance with this Specification.

10.3 Materials

All materials supplied under this Specification shall be subject to testing and approval by the Engineering Manager in accordance with Section 3 of this Specification.

10.4 Quality of Asphaltic Concrete Paving Mixture

Quality control tests will be used to determine the acceptability of the asphaltic concrete paving mixture supplied by the Contractor. The latest revisions of the test methods at the time of testing shall be used.

The Engineering Manager shall obtain samples of asphaltic concrete paving mixture and of the constituent materials required for quality control tests. The Contractor shall make no charge for these materials.

The frequency and number of quality control tests shall be as determined by the Engineering Manager.
An outline of some of the quality control tests that will be used to check the physical properties of the mixture, and to check the properties, gradations and proportions of the constituent materials are as follows:

Samples of mineral aggregates shall be taken in accordance with ASTM Standard D75, Standard Methods of Sampling Aggregates.

Samples of asphaltic concrete paving mixtures shall be taken in accordance with ASTM Standard D979, Standard Methods of Sampling Bituminous Paving Mixtures.

The determination of the particle size distribution of aggregates shall be made in accordance with ASTM Standard C136, Standard Method of Test for Sieve or Screen Analysis of Fine and Coarse Aggregates.

The specific gravity of aggregates shall be determined in accordance with ASTM Standard C127, Standard Method of Test for Specific Gravity and Absorption of Coarse Aggregate, and ASTM Standard C128, Standard Method of Test for Specific Gravity and Absorption of Fine Aggregate.

The determination of the percent of asphalt cement in asphaltic concrete paving mixtures and pavement specimens shall be made in accordance with ASTM D2172, Standard Methods of Test of Quantitative Extraction of Bitumen from Bituminous Paving Mixtures.

The percent air voids, the percent voids in the mineral aggregate, the Marshall density, Marshall stability and flow index shall be determined in accordance with the Standard Marshall Procedure (75 Blows) and in accordance with ASTM Standard D1559, Standard Method of Test for Resistance to Plastic Flow of Bituminous Mixtures using Marshall Apparatus.

10.5 Quality of Asphaltic Concrete Pavement

Quality control tests will be used to determine the acceptability of the compacted asphaltic concrete pavement, as placed and compacted by the Contractor. The latest revisions of the test methods at the time of testing shall be used.

Pavement specimen will be taken from each compacted pavement course by the Engineering Manager and the holes made by the removal of said specimens shall be carefully filled with the approved asphaltic concrete paving mixture and thoroughly compacted so as to conform in every way with the adjoining undisturbed pavement by the Contractor.

The frequency and number of quality control tests shall be as determined by the Engineering Manager.
An outline of some of the quality control tests that will be used to check the compaction of the completed asphaltic concrete pavement is as follows:

In-place density determinations shall be made in accordance with ASTM Standard D2950, Standard Method of Test for Density of Bituminous Concrete in Place by Nuclear Method. Density determinations on pavement specimens shall be made in accordance with ASTM Standard D2726, Standard Method of Test for Bulk Specific Gravity of Compacted Bituminous Mixtures using Saturated Surface-Dry Specimens.

10.6 Corrective Action

The Contractor shall, at his own expense, correct such work or replace such materials found to be defective under this Specification in an approved manner to the satisfaction of the Engineering Manager.

SPECIFICATION FOR PLANING OF PAVEMENT

1. GENERAL CONDITIONS

All standards in this edition, attached hereto, shall apply to and be a part of this Specification.

2. DESCRIPTION

This Specification shall cover the planing of Asphaltic concrete and Portland Cement concrete pavements.

The work to be done by the Contractor under this Specification shall include the supply of all materials, and the furnishing of all superintendence, overhead, labour, equipment, tools, supplies and all other things necessary for and incidental to the satisfactory performance and completion of all work as hereinafter specified.

3. EQUIPMENT

All equipment shall be of a type approved by the Engineering Manager. The equipment shall be in good working condition and shall be so maintained for the duration of the Contract.

Cold planing machines shall be self-propelled and have a means of milling to plane the surface to a determined grade.

Milling or cold planing equipment shall consist of a cutting drum with replaceable bits or teeth.

Where the entire roadway is being planed, the cold planing/milling machine used shall be capable of a minimum 2.1m wide cut with one pass, and shall be able to control both longitudinal grade and pavement crossfall slope automatically. Smaller capacity machines may be utilized for fine trimming around comers and appurtenances.

4. CONSTRUCTION METHODS

Sufficient passes or cuts shall be made so that all irregularities or high spots are eliminated and that the entire surface area has been leveled to the desired longitudinal grade and pavement crossfall.

When the pavement is being planed for the purpose of resurfacing, the finished edge of the planed section shall be constructed with a minimum 40 mm cut to eliminate the need to feather the edge of the new asphalt surface.

All asphalt cuttings shall be disposed of by the Contractor at a site located by the Municipality. Any material dropped on any streets during the disposal operations shall be promptly cleaned up.

SPECIFICATION FOR PORTLAND CEMENT CONCRETE PAVEMENT WORKS

1. GENERAL CONDITIONS

All standards in this edition, attached hereto, shall apply to and be a part of this Specification.

2. DESCRIPTION

This Specification shall cover the preparation of Portland Cement Concrete for, and all concreting operations relating to, the construction of Portland Cement Concrete pavements, sidewalks, curbs, gutters, private approaches, bullnoses, median slabs and other related pavement works. This Specification is applicable to both reinforced and non-reinforced concrete construction, but not prestressed concrete.

The work to be done by the Contractor under this Specification shall include the supply of all materials, and the furnishing of all superintendence, overhead, labour, equipment, tools, supplies and all other things necessary for and incidental to the satisfactory performance and completion of all work as hereinafter specified.

3. MATERIALS

3.1 General

The Contractor shall be responsible for the supply, safe storage and handling of all materials Set forth in this Specification.

3.2 Handling and Storage of Materials

All materials shall be handled and stored in a careful and workmanlike manner, to the satisfaction of the Engineering Manager. Storage of materials shall be in accordance with the requirements of CAN3-A23.1-M77, Section 9, Storage of Materials, except as otherwise specified herein.

3.3 Testing and Approval

All materials supplied under this Specification shall be subject to inspection and testing by the Engineering Manager or by the Testing Laboratory designated by the Engineering Manager. There shall be no charge to the Municipality for any materials taken by the Engineering Manager for testing purposes.

All materials shall conform to CAN3-A23.1-M77.

All materials shall be approved by the Engineering Manager at least ten (10) days before any construction is undertaken. If, in the opinion of the Engineering Manager, such materials, in whole or in part, do not conform to the Specification detailed herein or are found to be defective in manufacture or have become damaged in transit, storage or handling operations, then such materials shall be rejected by the Engineering Manager and replaced by the Contractor at his own expense.

3.4 Portland Cement Concrete Constituent Materials

3.4.1 Aggregates

The Contractor shall furnish in writing to the Engineering Manager the location of the sources where aggregate will be obtained in order that same may be inspected and tentatively approved by the Engineering Manager. Changes in the source will not be permitted without notification in writing to
and the express approval of the Engineering Manager.

(a) Fine Aggregate

Fine aggregate shall conform to the requirements ofCAN3-A23.1, Section 5, Aggregates.

(b) Coarse Aggregate

Coarse aggregate shall conform to the requirements ofCAN3-A23.1, Section 5, Aggregates.

The grading of coarse aggregates shall conform to the requirements of Group 1 Aggregate, CAN3-A23.1.

3.4.2 Cement

All cement used shall be Type 10 Normal Portland Cement conforming to the requirements of CAN3-A5, Portland Cements.

Cement shall be kept in weathertight storage that will protect it from moisture and contamination, and in such a manner as to permit inspection, sampling and identification, where required, of each lot.

Check tests of cement which has been previously approved by the Engineering Manager, will be made from time to time by the Engineering Manager and any cement which fails to comply with the requirements ofCAN3-AS will be rejected, notwithstanding any certificate of acceptance that may have been previously given. Cement which has been rejected for any reason must be removed immediately by the Contractor, at his expense.

Fly ash shall not be used in any concrete mixture. The use of I-P cement is not permitted.

3.4.3 Water

Water used for mixing concrete shall be clean and free from injurious amounts of oil, acid, alkali, organic matter or other deleterious substances. It shall be equal to potable water in physical and chemical properties.

3.4.4 Admixtures

No admixture, other than Air-Entraining Agent and Type WN Water Reducing Agent, shall be used without the written authorization of the Engineering Manager.

(a) Air-Entraining Agent

The Air-Entraining Agent shall conform to ASTM C260 (latest version) Standard Specification for Air Entraining Admixtures for Concrete.

(b) Water-Reducing Agent

The Water-Reducing Agent shall be Type A and shall conform to ASTM C494 (latest version) Standard Specification for Chemical Admixtures for Concrete.

3.5 Incidental Materials

3.5.1 Joint Sealer

The joint sealer shall be a hot-poured elastic type and shall meet or exceed ASTM D-1190 or AASHTO M-173 and shall be Crafco RS 211, unless otherwise approved.

3.5.2 Fibre Joint Filler

Fibre joint filler shall be rot-proof and of the preformed, non- extruding, resilient type made with a bituminous fibre and shall conform to the requirements of ASTM Standard D1751, Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction.

3.5.3 Reinforcing Steel

Reinforcing steel shall be deemed to include all reinforcing bars, tie bars, dowel bars and bar mat reinforcement, including all bar accessories.

All reinforcing steel shall be supplied according to the type and dimensions specified.

All reinforcing steel shall conform to the requirements of CSA Standard G30.12-M, Billet-Steel Bars for Concrete Reinforcement. If, in the opinion of the Engineering Manager, any reinforcing steel provided for the concrete works that exhibits flaws in manufacture or fabrication, such material shall be immediately removed from the site and replaced with acceptable reinforcing steel.

(a) Bar Mat Reinforcement shall be Grade 300 bars with all bar intersections welded by an electric resistance spot welder. Welding shall be done in such a manner that the minimum requirements for tensile strength and Yield point of the reinforcing steel shall be met when a specimen is tested across points of weld.

Longitudinal bars shall be plain bars. Transverse bars may be plain bars or deformed bars.

Bar mats with defective spot welds or with spot welds that have been broken while in transit, or during handling or placing operations, shall be replaced or repaired to the satisfaction of the Engineering Manager prior to installation.

(b) Deformed Reinforcing Bars shall be Grade 300 deformed bars.

(c) Tie Bars shall be Grade 300 epoxy coated deformed bars.

(d) Dowel Bars shall be Grade 300 epoxy coated plain bars.

(e) Bar Accessories shall be of a type approved by the Engineering Manager.

All reinforcing steel shall be straight and free from paint, oil, mill scale and injurious defects. Rust, surface seams, or surface irregularities will not be cause for rejection provided that the minimum dimensions, cross-sectional area and tensile properties of a hand wire-brushed specimen are not less than the requirements of CSA Standards G30.12M.

3.5.4 Epoxy-Coating

For all new construction, or where specified in the Special Provisions, tie bars, dowels and stirrups for separate curbs shall be shop-coated with epoxy conforming to the requirements of ASTM Standard D3963. All bar ends shall be free of burs and distortions. All visible defects in the epoxy-coating shall be field-coated with epoxy touch up paint.

3.5.5 Liquid Membrane-Forming Curing Compound

Curing compound shall be either Type I-D, clear or translucent with fugitive dye, or Type

2, white-pigmented, liquid membrane- forming curing compound conforming to the requirements of ASTM Standard C309.

3.5.6 Polyethylene Film

Polyethylene film shall be clear or white opaque and conform to the requirements of ASTM Standard C 171.

3.5.7 Bonding Agent

Epoxy resin shall be of a type conforming to the requirements of ASTM Standard C881. Type 1, Grade 3 epoxy shall be used for bonding tie bars and dowels into hardened concrete.

Bonding agents for bonding tie bars and dowels into holes in hardened concrete other than epoxy resin may be permitted provided that they develop a minimum pullout resistance of 50 kN within 48 hours after installation.

3.5.8 Form Coating

Form coating shall be of a type approved by the Engineering Manager.

3.5.9 Miscellaneous Materials

Miscellaneous materials shall be of the type specified on the Drawings or approved by the Engineering Manager.

4. DESIGN REQUIREMENTS

4.1 Mix Design Statement

For each type of concrete to be used, the Contractor shall provide the Engineering Manager with a Mix Design Statement certifying the constituent materials and mix proportions that will be used in the Portland Cement Concrete. The Contractor shall also supply evidence to the Engineering Manager that the mix proportions selected will produce concrete of the specified strength, workability and yield.

A water-reducing agent as approved by the Engineering Manager and not exceeding the manufacturer's recommended quantity may be used. Where additional water-reducing agent is required, written approval shall be obtained from the Engineering Manager.

This Mix Design Statement shall be submitted to the Engineering Manager at least one (1) week prior to the delivery of any concrete to the job site. Once approved by the Engineering Manager, all concrete shall be supplied in accordance with this Statement,

which shall be called the Job Mix Formula.

Fly ash will not be accepted in any mix design.

No changes in Job Mix Formula will be permitted without following the above procedure.

4.2 Concrete Strength and Workability

Proportioning of fine aggregate, coarse aggregate, cement, water, air-entraining agent and water-reducing admixture shall be such as to Yield concrete having the strength and workability, as follows:

(a) Concrete for all related Concrete Works

(i)	Minimum Specified Compressive Strength @ 28 days: 30 MPa	
(ii)	Minimum Cement Content:	320 kg/m^3
(iii)	Maximum Water/Cement Ratio:	0.49
(iv)	Maximum Slump:	100 mm
(v)	Aggregate Size:	20 mm Nominal
(vi)	Air Content:	6.0% to 8.0%

4.3 Concrete for Early Opening of Pavements

It shall be the responsibility of the Contractor to modify the mix design, as required, in order to ensure that the minimum compressive strength of the concrete pavement is 20 MPa and is achieved within the early opening requirements of the Contract.

The mix design statement for this concrete shall be submitted to the Engineering Manager in accordance with this Specification. Only Type 10 Portland Cement is approved for use in concrete required for early opening of pavement.

5. SUPPLY OF MATERIALS

5.1 Concrete Supply

Unless otherwise specified, the use of a ready-mixed concrete plant only will be permitted. Concrete shall be proportioned, mixed and delivered in accordance with the requirements of CAN3-A23.1, Section 18, Production of Concrete, except that the transporting of ready-mixed concrete in non-agitating equipment is not permitted without the written permission of the Engineering Manager.

The discharge of ready-mixed concrete from the transit mixer shall be completed within 1 hour after the introduction of the mixing water to the cement and aggregates, unless an extension of time is authorized by the Engineering Manager.

All delivery tickets shall indicate the time of batching.

The Contractor shall maintain all equipment used for handling and transporting the concrete in a clean condition and proper working order.

6. EQUIPMENT

All equipment shall be of a type approved by the Engineering Manager. The equipment shall be in good working order, kept free from hardened concrete or foreign materials, and shall be cleaned at frequent intervals.

7. CONSTRUCTION METHODS

7.1 Sub-grade, Sub-base and Base Course Construction

No concrete work shall commence until the construction of sub-grade, sub-base and base course has been completed and has been approved by the Engineering Manager.

7.2 Forms

Forms for concrete shall be constructed of steel or wood and shall be sufficiently rigid to prevent lateral or vertical distortion from the loading environment to which the forms will be subjected. All forms shall be set to the design grades, lines and radii as specified by the Engineering Manager. Forms shall be adequately anchored and firmly set over bearing areas to prevent displacements during concrete placement. All formwork in place shall be subject to inspection and correction of grade and alignment prior to, and at any time during, concrete placement.

The surfaces of all formwork to come in contact with the concrete shall be thoroughly cleaned and treated with form coating before concrete placement. The form coating shall be applied by brush or spray so as to give the forms an even coating without excess or drip, and shall not be allowed to get on any reinforcing steel. The form coating shall not cause a softening or permanent staining of the concrete surface and, further, it shall not impede the proper functioning of the curing compound.

Forms shall not be removed for a period of at least twenty-four (24) hours after the concrete placement has been completed. Removal of forms shall be done in a careful and

workmanlike manner in order to avoid damage to, or spalling of, the concrete.

7.3 Placing Reinforcing Steel

7.3.1 Reinforced Concrete Pavement

All reinforcing steel shall be positioned as shown on the Drawings and shall be held in place by positive and satisfactory means so that the correct position of the reinforcing steel will be maintained after the concrete has been placed, vibrated and finished. If reinforcing steel is displaced during concrete placing operations, concrete placement shall cease and shall not resume until the displaced reinforcing steel has been reset to its true design position.

Field lap joints shall be securely wired or clipped. Splices, other than those shown on the Drawings or approved by the Engineering Manager, will not be permitted. Splices shall have a length sufficient to develop the full strength in bond of the bar and shall be well distributed and only located in areas of low tensile stress. Reinforcing steel shall be securely fastened at all laps, intersections and splices.

Longitudinal steel bars, which cross transverse joints, shall be aligned parallel to the centreline and surface of the slab with a maximum allowable tolerance of +/- 6 mm from the transverse joint to the end of the bar.

Once all reinforcing steel is in position, it shall be inspected and approved by the Engineering Manager before any concrete is placed. Otherwise the concrete will be rejected by the Engineering Manager and shall be removed by the Contractor at his own expense.

7.3.2 Plain Concrete Pavement

Tie bars shall be positioned as shown on the Drawings and shall be held in place by positive and satisfactory means so that the correct position of the tie bars will be maintained after the concrete has been placed, vibrated and finished. If tie bars are displaced during concrete placing operations, concrete placement shall cease and shall not resume until the displaced tie bars have been reset.

7.3.3 Plain-Dowelled Concrete Pavement

Dowels shall be located at all transverse contraction joints by means of an approved dowel assembly positioned as shown on the drawings. The methods for fastening the dowel assembly to the base shall be subject to the approval of the Engineering Manager. The dowels shall be aligned parallel to the centreline and surface of the slab with a maximum allowable tolerance of +/- 12 mm. The dowel assemblies shall be fabricated sufficiently rigid so the dowels are held in alignment within the specified tolerance, both horizontally and vertically, until the concrete placing and setting cycle is complete.

For dowel assemblies with side members and ties, the dowels shall be securely fastened at alternate ends to the side members to prevent any movement of the dowels.

All dowels shall be thoroughly coated at the site with a thin uniform coating ofMC-250 cutback asphalt or approved equal bond breaker for the length of the dowel. The bond breaker coating shall be smooth and free of voids.

The position of the dowel assembly shall be clearly marked by the Contractor on the forms or by stakes so that the location of the transverse joint can be accurately located for joint construction.

Tie bars shall be positioned as shown on the Drawings. They shall be place at mid-depth of the pavement and parallel to the pavement surface and the transverse joints. The use of 90° bent tie bars will not be allowed.

If dowels or tie bars are displaced during concrete placing operations, concrete placement shall cease and shall not resume until the displaced dowels or tie bars have been reset to the true design position.

Once dowels and tie bars are in position, they shall be inspected and approved by the Engineering Manager before any concrete is placed. Otherwise the concrete will be rejected by the Engineering Manager and shall be removed by the Contractor at his own expense.

7.3.4 Tying Into Existing Pavement

Where a new slab is to be tied into an existing slab along a longitudinal joint, the Contractor shall install tie bars into the existing slab. Holes shall be drilled in the existing pavement, 16 mm in diameter by a minimum of 230 mm deep. Particular care shall be exercised to ensure that no damage to the pavement results from such drilling operation. Any damage shall be repaired at the Contractor's expense to the satisfaction of the Engineering Manager.

Holes shall be thoroughly cleaned prior to installation of epoxy. Epoxy, as approved by the Engineering Manager, shall be mixed in accordance with manufacturer's instructions.

Using a method approved by the Engineering Manager, the hole shall be thoroughly coated with epoxy.

After the hole has been cleaned and lined with epoxy, a No.15 tie bar shall be driven into the hole.

Where a new slab is to be tied into an existing slab along a transverse joint, the Contractor shall install dowels into the existing slab. Holes shall be drilled in the existing pavement, 20 mm in diameter by a minimum of380 mm deep. Particular care shall be exercised to ensure that no damage to the pavement results from such drilling operation. Any damage

shall be repaired at the Contractor's expense to the satisfaction of the Engineering Manager.

The hole shall then be cleaned and a 20 mm dowel shall be driven into the hole.

Dowels shall be installed parallel to one another and to the longitudinal direction of the pavement. A maximum tolerance of 10 mm in the vertical and horizontal position is permitted.

Once all reinforcing steel is in position, it shall be inspected and approved by the Engineering Manager before any concrete is placed. Otherwise the concrete will be rejected by the Engineering Manager and shall be removed by the Contractor at his own expense.

7.4 Joints

Contraction, longitudinal and construction joints shall be constructed as directed by the Engineering Manager. The joints shall be vertical and shall not deviate more than 15 mm from the horizontal alignment specified. All joints in pavement slabs shall be continuous through the curbs.

Expansion joints shall be constructed only where new concrete is being placed up against existing non-pavement structures, or where directed by the Engineering Manager. A 15 mm thick fibre joint filler shall be installed in expansion joints. The fibre joint fill shall extend from the base of the concrete slab up to the concrete surface, but no higher.

Where concrete is to be placed against an existing pavement structure, the joint shall be constructed as directed by the Engineering Manager.

Contraction joints shall be saw-cut as soon as the concrete is sufficiently hard so that it will not be ravelled or damaged by the blade. The time at which all such saw-cutting is to be undertaken shall be determined by the Contractor. The Contractor shall be wholly responsible for all concrete defects arising from this operation and shall further correct or replace all such defective concrete as may be required in the opinion of the Engineering Manager. The costs of all corrective measures shall be borne entirely by the Contractor and rejected concrete shall be removed by and at the expense of the Contractor clear of the site of the work.

Immediately after the sawing of each joint, the joint and the concrete surface shall be cleaned of all residue left by the sawing operation. When the joint is wet cut, the cleaning shall be done by water jet having sufficient volume and pressure to remove the residue. When the joint is dry cut, the cleaning shall be done by air jet having sufficient volume and pressure to remove the residue. Alternative methods of cleaning joints must be approved by the Engineering Manager.

Longitudinal joints shall be saw-cut. When the longitudinal joint is saw-cut, the

Contractor shall ensure that any residue cleaned from the longitudinal joint does not go into the previously cleaned contraction joints. For lane-at-a-time paving only, the longitudinal joint may be constructed by initially depressing an approved tool into the plastic concrete or by installing a filler strip which shall remain in place until the concrete has attained it's initial set and shall then be saw-cut to the width and depth shown on the standard details.

Formed joints for sidewalks not greater than 1.5 metres in width may be constructed by depressing an approved tool into the plastic concrete or by installing an approved parting strip to be left in place.

When the concrete has begun to cure sufficiently to prevent flow together, joints shall be installed on the curb and gutter, not more than 5 metres (5 m) apart, and the penetration shall be between 20% and 25% of the thickness of the concrete section being jointed.

7.5 Concrete Placement

No concrete shall be placed until the Engineering Manager has examined and approved the layout of the forms, reinforcing steel dowels, tie bars and joints, and the condition and grade of the compacted base course.

The placing of concrete on a base course which is too wet or too dry, or which is frozen, will not be permitted. The prepared grade shall be sufficiently moist to prevent absorption of water from the freshly placed concrete, but must be free from mire or water pondage. The temperature of the fresh concrete shall not be less than 10.0°C nor greater than 30.0°, as measured at time of placing.

Concrete shall be deposited in the forms as nearly as practicable to its final position in a rapid and continuous operation in such a manner as to require as little rehandling as possible and to avoid segregation and separation of the materials.

The sequence of concrete placement shall be arranged so that no concrete that has partially hardened will be subjected to injurious Vibration or shock.

The vertical height of free fall of concrete shall not exceed 1.5 m. For falls greater than 1.5 m, or if segregation occurs, chutes or spouts designed to prevent segregation of the concrete shall be used. They shall be moved about as required by the Engineering Manager.

Concrete shall be placed while fresh and before it has taken its initial set. Retempering of partially hardened concrete with additional water will not be permitted.

The deposited concrete shall be spread by means of a mechanical spreader or by an approved hand method. The surface of the concrete shall then be struck off by mechanical means in a manner such that when the concrete is vibrated and screeded, the finished concrete will conform to the cross-section and elevation shown on the Drawings.

In areas unaccessible to mechanical equipment, after the concrete has been vibrated, the surface of the concrete shall be struck-off manually with appropriate tools and in an approved manner so that the concrete will conform to the cross-section and elevation specified by the Engineering Manager. Neat cement or mortar shall not be used to facilitate the finishing surfaces.

Only mechanical vibrators shall be used to consolidate the concrete. Spading, hand tamping, using puddling rods, or using other similar methods will not be permitted in place of vibration.

Vibration shall be applied at the point of deposit and in areas of freshly deposited concrete. Vibrators shall be inserted into and withdrawn out of the concrete slowly. Vibrations shall be of sufficient duration and intensity to thoroughly consolidate the concrete, but shall not be continued so as to cause segregation. Vibrators shall not be used for flowing the concrete or spreading it into place.

Concrete shall be worked thoroughly around any reinforcement, around embedded fixtures and into the angles and comers of the forms. During placement, concrete shall be sufficiently vibrated with suitable equipment to secure close bond with the reinforcement, to eliminate entrapped air voids, and to ensure a homogeneous structure and adequate consolidation. Particular care shall be given to placing and vibrating the concrete along the faces of the forms to ensure a dense, smooth surface devoid of imperfections.

Once the placing and vibrating of the concrete has been completed, the forms shall not be jarred, and any projected reinforcing steel shall not be disturbed, for a period of at least twenty-four (24) hours.

7.6 Concrete Finishing

Finishing shall be regulated in order that quality of the surface is not impaired by overworking and by bringing excessive fines and water to the surface. The use of steel trowels is not permitted.

Prior to final finishing, the surface grade of concrete slabs shall be checked to an accuracy of plus or minus 5 mm with a 3 metre long metal straight edge, unless otherwise specified in the Specifications for the Work. The straight edge shall be drawn across the pavement in a scarping motion to identify deviations for immediate correction. The straight edge shall be advanced one-half of its length for successive checks.

After floating, the surface grade of concrete slabs shall be checked with a three metre (3 m) long metal straight edge to an accuracy of plus or minus five millimetre (5 mm), unless otherwise specified by the Engineering Manager.

Following completion of floating operations, but prior to initial set of the concrete, the edges of all concrete slabs shall be carefully finished with an appropriate edging tool.

Upon completion of finishing operations, and when excessive moisture has evaporated, the plastic surface of the pavement shall be given a textured finish by means of broom finishing with a steel or fibre broom or a type approved by the Engineering Manager at right angles to the direction of traffic. Surface depressions introduced by the broom strands in the brooming operations shall not be more than three millimetre (3 mm) deep. Broom finishing will similarly be required for surfaces of private approaches, gutters, bullnose slabs, boulevard and median slabs, and other related slabs. Broom finishing will not be required when the concrete does not form the finished surface.

7.7 Concrete Curing

Immediately following concrete finishing, the surface of the concrete shall be treated with a liquid membrane-forming curing compound. The rate of application shall not be less than that recommended by the manufacturer: As soon as the side forms are stripped, the edges of all concrete slabs shall be sprayed. In the case of slip form paving, the edges shall be treated at the same time as the pavement surface.

Liquid membrane-forming curing compound shall not be used when the pavement is otherwise protected from cold weather by polyethylene film for a period of not less than five (5) days.

7.8 Joint Sealing

The joints shall be thoroughly cleaned of all dirt, loose mortar particles and other foreign material lodged in the joints.

After this cleaning and immediately before applying the joint sealer, the joint shall be wire brushed and blown out with an air jet having sufficient volume and pressure to remove dust and loose material remaining after the cleaning operation.

The joint shall then be filled with joint sealer to the depth shown on the Drawings using an approved mechanical pressure joint filling system. Overfilling of joints shall not be permitted.

Overfilled joints shall have excess material removed to the satisfaction of the Engineering Manager.

The joint must be surface dry at the time of filling, and the ambient temperature must be at least four degrees centigrade (4°C) and rising.

7.9 Climatic Conditions

The Contractor shall be responsible for taking all necessary measures to protect freshly laid concrete from climatic conditions including hot weather, wind, rain, sleet, snow and cold weather, to the satisfaction of the Engineering Manager.

Concrete shall be adequately protected from freezing for a minimum of five (5) days after completion of placing operations, or longer as required to ensure that the pavement opening requirements are met. A minimum requirement for protection shall be provided as follows when the air temperature as forecast by Environment Canada is:

O°C to -3°C The concrete shall be covered with polyethylene film.
Below -3°C Two sets of polyethylene film covering separated by 300 mm. of dry straw.

Concrete damaged as a result of inadequate protection against climatic conditions shall be removed and replaced by the Contractor at his own expense.

7.10 Opening to Traffic

In no case shall traffic or construction equipment be allowed on the pavement until the concrete has reached a minimum compressive strength of 20MPa, as determined by additional field cured cylinders.

Before the pavement may be opened to traffic and/or before the Contractor may commence boulevard-grading operations, the, pavement joints shall be filled with joint sealer in accordance with this Specification.

The Engineering Manager's decision as to when: the pavement will be opened to traffic or construction equipment shall be final.

8. QUALITY CONTROL

8.1 Inspection

All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Engineering Manager, including all operations from the selection and production of materials through to the final acceptance of the specified work. The Contractor shall be wholly responsible for the control of all operations incidental thereto notwithstanding any inspection or approval that may have been previously given. The Engineering Manager reserves the right to reject any materials or works that are not in accordance with the requirements of this Specification.

8.2 Access

The Engineering Manager shall be afforded full access for the inspection and control testing of concrete and constituent materials, both at the site of work and at any plant used for the production of concrete, to determine whether the concrete is being supplied in accordance with this Specification.

8.3 Materials

All materials supplied under this Specification shall be subject to testing and approval by the Engineering Manager in accordance with Section 3 of this Specification.

8.4 Concrete Quality

Quality control tests will be used to determine the acceptability of the concrete supplied by the Contractor.

The Engineering Manager shall obtain samples of concrete and of the constituent materials required for quality control tests. The Contractor shall make no charge for these materials.

The frequency and number of concrete quality control tests shall be in accordance with the requirements of CAN3-A23.1.

An outline of the quality control tests is as follows:

Slump tests shall be made in accordance with CAN3-A23.2-5C, Slump of Concrete. If the measured slump falls outside the limits specified in this Specification, a second test shall be made. In the event of a second failure, the Engineering Manager reserves the right to refuse the use of the batch of concrete represented.

Air content determinations shall be made in accordance with CAN3- A23.2-4C, Air Content of Plastic Concrete by the Pressure Method. If the measured air content falls outside the specified limits, a second test shall be made at any time within the specified discharge time limit for the mix. In the event of a second failure, the Engineering Manager reserves the right to reject the batch of concrete represented.

Samples of concrete for all slump, air and strength tests shall be taken in accordance with CAN3-A23.2-1C, Sampling Plastic Concrete.

Test specimens shall be made and cured in accordance with CAN3- A23.2-3C, Making and Curing Concrete Compression and Flexure Test Specimens.

Compressive strength tests of laboratory cured cylinders at twenty- eight (28) days shall be

the basis for acceptance of all concrete supplied by the Contractor. For each twenty-eight (28) day strength test, the strength of two companion standard-cured test specimens shall be determined in accordance with CAN3-A23.2-9C, Compressive Strength of Cylindrical Concrete Specimens, and the test result shall be the average of the strengths of the two specimens.

Compressive strength tests on specimens cured under the same conditions as the concrete works shall be made to check the strength of the concrete so as to determine if the pavement may be opened to traffic; and also to check the adequacy of curing and/or cold weather protection. For each field-cured strength test, the strength of two field-cured test specimens shall be determined in accordance with CAN3-A23.2-9C, Compressive Strength of Cylindrical Concrete Specimens, and the test result shall be the average of the strengths of the two specimens.

8.5 Concrete Pavement Roughness

As a basis for acceptance, the surface of the finished concrete pavement shall be checked with a 3 metre long metal straight edge to an accuracy of plus or minus 5 mm. Areas of pavement that do not meet these tolerances shall be corrected to the satisfaction of the Engineering Manager.

8.6 Addition of Water and/or Air Entraining Admixture

After initial mixing, no water and/or air entraining admixture may be added except if, at the start of discharge the measured slump of the concrete or the measured air content of the concrete is less than that specified and no more than 60 minutes have elapsed from the time of batching to the start of discharge. Water added shall not exceed 12 litres per cubic metre as measured by an approved measuring device. Air entraining admixture shall be added as required to meet specified allowable air content ranges. The mixer drum shall be turned a minimum of 30 revolutions at mixing speed and the slump and air content shall be retested.

8.7 Correction Action

Acceptance criteria for compressive strengths of laboratory cured cylinders shall conform with CAN3-A23.1 The Contractor shall, at his own expense, correct such work or replace such materials found to be defective under this Specification in an approved manner to the satisfaction of the Engineering Manager.

SPECIFICATION FOR PORTLAND CEMENT CONCRETE SIDEWALK

1. GENERAL CONDITIONS

The General Conditions, Standard Provisions and Special Provisions attached hereto shall apply to and be a part of this Specification.

2. DESCRIPTION

This Specification shall cover the operations relating to the construction of Portland Cement concrete sidewalks.

The work to be done by the Contractor under this Specification shall include the supply of all materials, and the furnishing of all superintendence, overhead, labour, equipment, tools, supplies and all other things necessary for and incidental to the satisfactory performance and completion of all work as hereinafter specified.

3. MATERIALS

3.1 General

The Contractor shall be responsible for the supply, safe storage and handling of all materials set forth in this Specification.

3.2 Handling and Storage of Materials

All materials shall be handled in a careful and workmanlike manner, to the satisfaction of the Engineering Manager.

3.3 Testing and Approval

All materials supplied under this Specification shall subject to inspection and testing by the Engineering Manager or by the Testing Laboratory designated by the Engineering Manager. There shall be no charge to the Municipality for any materials taken by the Engineering Manager for testing purposes.

All materials shall be approved by the Engineering Manager before any construction is undertaken. It: in the opinion of the Engineering Manager, such materials, in whole or in part, do not conform to the Specification detailed herein or are found to be defective in manufacture or have become damaged in transit, storage or handling operations, then such

material shall be rejected by the Engineering Manager and replaced by the Contractor at his own expense.

3.4 Portland Cement Concrete Constituent Materials

Portland cement concrete constituent materials shall conform to the requirements of Specification MH 2800.

3.5 Incidental Materials

Incidental materials shall conform to the requirements of Section 3.5 of Specification MH 2800.

4. SUPPLY OF MATERIALS

4.1 Concrete Supply

Unless otherwise specified in the Special Provisions of the Contract, the use of a ready-mixed concrete plant only will be permitted. Concrete shall be proportioned, mixed and delivered in accordance with the requirements of CAN3-A23.1, Section 18, Production of Concrete, except that the transporting of ready-mixed concrete in non-agitating equipment is not permitted without the written permission of the Engineering Manager.

The discharge of ready-mixed concrete from the transit mixer shall be completed within 1 hour after the introduction of the mixing water to the cement and aggregates, unless an extension of time is authorized by the Engineering Manager.

All delivery tickets shall indicate the time of batching.

The Contractor shall maintain all equipment used for handling and transporting the concrete in a clean condition and proper working order.

5. EQUIPMENT

All equipment shall be of a type approved by the Engineering Manager. The equipment shall be in good working order, kept free from hardened concrete or foreign materials, and shall be cleaned at frequent intervals.

6. CONSTRUCTION METHODS

6.1 Sub-Grade Construction

No concrete work shall commence until the excavation has been completed in accordance with Specification MH 2000 and the Drawings, and has been approved by the Engineering Manager.

Sub-grade compaction shall be completed in accordance with Specification MH 2000.

Where required as a leveling course, a minimum thickness of 150 mm of approved material shall be supplied and placed in accordance with Specification MH 2000.

6.2 Forms

Forms for concrete shall conform with Section 7.2 of Specification MH 2800.

6.3 Joints

Sidewalk joints shall be constructed, where required, in accordance with the details shown on the Drawings or as directed by the Engineering Manager. The joints shall be vertical and shall not deviate more than 15 mm from the horizontal alignment shown on the Drawings.

Expansion joints shall be constructed only where new concrete is being placed up against existing non-pavement structures or where directed by the Engineering Manager. A 15 mm thick fibre joint filler shall be installed in expansion joints. The fibre joint filler shall extend from the base of the concrete slab up to the concrete surface, but no higher.

Joints shall be saw-cut by approved methods to the dimensions shown on the Drawings as soon as the concrete is sufficiently hard so that it will not be raveled or damaged. The time at which all such saw-cutting is to be undertaken shall be determined by the Contractor. The Contractor shall be wholly responsible for all concrete defects rising from this operation and shall further correct or replace all such defective concrete as may be required in the opinion of the Engineering Manager. The costs of all corrective measures shall be borne entirely by the Contractor and rejected concrete shall be removed by and at the expense of the Contractor clear of the site of the work.

During saw-cutting operations, the Contractor shall take necessary measures to protect adjacent properties and structures from the saw-cut residue.

Formed joints for sidewalks not greater than 1.5 metres in width may be constructed by depressing an approved tool into the plastic concrete or by installing an approved parting strip to be left in place.

6.4 Concrete Placement

Concrete shall be placed in accordance with Section 7.5 of Specification MH 2800.

6.5 Concrete Finishing

Concrete finishing shall be carried out in accordance with Section 7.6 of Specification MH 2800.

6.6 Concrete Curing

Concrete curing shall be carried out in accordance with Section 7.7 of Specification MH 2800.

6.7 Weather Conditions

The Contractor shall be responsible for taking all necessary measures to protect freshly laid concrete from adverse weather conditions, including hot weather, wind, rain, sleet, snow and cold weather, to the satisfaction of the Engineering Manager.

Concrete shall be adequately protected from freezing for a minimum of five (5) days after completion of placing operations, or longer as required to ensure that the pavement opening requirements are met. A minimum requirement for protection shall be provided as follows when the air temperature as forecast by Environment Canada is:

O°C to -3°C	The concrete shall be covered by polyethylene film.
Below -3°C	Two sheets of polyethylene film covering separated by 300 mm of dry straw.

Concrete damaged as a result of inadequate protection against weather conditions shall be removed and replaced by the Contractor at his own expense.

7. QUALITY CONTROL

All workmanship and all materials furnished and supplied under this Specification shall conform to Specification MH 2800.

SPECIFICATION FOR RENEWAL OF EXISTING CURBS

1. GENERAL CONDITIONS

The General Conditions, Standard Provisions and Special Provisions attached hereto shall apply to and be a part of this Specification.

2. DESCRIPTION

This Specification shall cover all operations relating to renewal of curb, curb and gutter, and other works relating to the renewal of designated sections of existing curb.

The work to be done by the Contractor under this Specification shall include the supply of all materials, and the furnishing of all superintendence, overhead, labour, equipment, tools, supplies and all other things necessary for and incidental to the satisfactory performance and completion of all work as hereinafter specified.

3. MATERIALS

3.1 General

The Contractor shall be responsible for the supply, safe storage and handling of all materials set forth in this Specification.

3.2 Handling and Storage of Materials

All materials shall be handled in a careful and workmanlike manner, to the satisfaction of the Engineering Manager.

3.3 Testing and Approval

All materials supplied under this Specification shall subject to inspection and testing by the Engineering Manager or by the Testing Laboratory designated by the Engineering Manager. There shall be no charge to the Municipality for any materials taken by the Engineering Manager for testing purposes.

All materials shall be approved by the Engineering Manager before any construction is undertaken. If, in the opinion of the Engineering Manager, such materials, in whole or in part, do not conform to the Specification detailed herein or are found to be defective in manufacture or have become damaged in transit, storage or handling operations, then such material shall be rejected by the Engineering Manager and replaced by the Contractor at his own expense.

3.4 Bonding Agent

Epoxy resin shall be of a type listed in the approved products list conforming to the requirements of ASTM Standard C881. Type 1, Grade 3 epoxy shall be used for bonding tie bars and dowels into hardened concrete.

Bonding agents for bonding tie bars and dowels into holes in hardened concrete other than epoxy resin may be permitted provided that they develop a minimum pullout resistance of 50 kN within 48 hours after installation. Alternative bonding agents are listed in the approved products list.

3.5 Concrete Materials

All concrete materials shall conform with the requirements of Specification MH 2800.

3.6 Miscellaneous Materials

Miscellaneous materials shall be of the type specified on the Drawings or approved by the Engineering Manager.

4. CONSTRUCTION METHODS

4.1 Portland Cement Concrete Curb Renewal

The Contractor shall reconstruct sections of Portland cement concrete curb at the locations designated on the Drawings and at any other locations designated by the Engineering Manager.

Renewal of a designated section of concrete curb shall be understood to mean all works and materials required in the removal, loading, disposal, construction and restoration in the vicinity of a new section of Portland cement concrete curb in accordance with the requirements of Specification MH 2800 and the Drawings.

The Contractor shall saw-cut the curb at each end of the length designated for renewal, carefully break down the concrete curb to the top of the existing pavement slab and remove all loose concrete.

Care shall be taken to ensure that the reinforcing steel in the existing curb is not damaged and that the saw-cut edges are not chipped or broken. Disposal of material shall comply with the requirements of Section 4.2 of this Specification.

For Portland cement concrete pavements with an existing asphaltic concrete overlay, the existing overlay may be removed from immediately in front of the curb to permit the

construction of the new curb. After the curb reconstruction is completed, new asphaltic concrete paving mix is to be placed back in front of the new curb in accordance with the requirements of Specification MH 2600.

Where a curb and gutter section is being removed, the Contractor shall saw-cut the curb and gutter at each end of the length designated for renewal and carefully break down the existing concrete in the curb and gutter section. Where possible, existing tie bars and reinforcing steel encountered during removal operations shall not be damaged.

The Contractor shall excavate immediately back of curb only that material necessary to permit construction of the new curb.

Where approved by the Engineering Manager, the Contractor shall utilize the existing stirrups or dowels where possible in replacing the curb, in accordance with the requirements of Specification MH 2800 and the Drawings.

When there is no reinforcing steel in the existing curb or when the existing reinforcing steel is damaged, in poor condition or missing, the Contractor shall supply new reinforcing steel in conformance with the Drawings.

Installation of deformed bars into existing and new pavements shall be in accordance with Clause 7.3 of Specification MH 2800 and shall be considered incidental to the cost of the curb renewal.

Existing reinforcing steel that is acceptable to the Engineering Manager shall be cleaned of all loose concrete and surface rust prior to the placing of the new concrete. Immediately prior to the placing of new concrete, the exposed ends of the existing concrete curb and the existing concrete pavement shall be thoroughly cleaned. Joints shall be saw-cut or hand formed in the reconstructed section of curb at the locations of the pavement joints in accordance with the requirements of Specification MH 2800.

After the curb reconstruction is completed, the excavated boulevard or median area back of curb shall be backfilled, compacted and graded to finished boulevard grade in accordance with the requirements of Specification MH 2000.

4.2 Disposal of Material

Disposal of material shall be understood to mean the hauling of a material from the site and the unloading and grading of the material in a manner satisfactory to the Engineering Manager at a disposal site indicated in the Special Provisions.

If a disposal site is not indicated in the Special Provisions, the Contractor shall locate a disposal site approved by the Engineering Manager.

Material dropped or spilled on any street during the hauling operations shall be promptly cleaned up by and at the expense of the Contractor, to the satisfaction of the Engineering Manager.

4.3 Maintenance of Traffic

The renewal of curb sections must proceed in such a manner as to conform with the requirements for maintenance of traffic as set out in the General Conditions or as directed by the Engineering Manager.

5. QUALITY CONTROL

5.1 Inspection

All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Engineering Manager including all operations from the selection and production of materials through to final acceptance of the specified work. The Contractor shall be wholly responsible for the control of all operations incidental thereto notwithstanding any inspection or approval that may have been previously given. The Engineering Manager reserves the right to reject any materials or works that are not in accordance with the requirements of this Specification.

5.2 Corrective Action

The Contractor shall, at his own expense, correct such work or replace such materials found to be defective under this Specification in an approved manner to the satisfaction of the Engineering Manager.

SPECIFICATION FOR GROUTED RIPRAP

1. GENERAL CONDITIONS

The General Conditions, Standard Provisions and Special Provisions attached hereto shall apply to and be a part of this Specification.

2. DESCRIPTION

This Specification shall cover all operations relating to the supply and placement of grouted riprap and other works relating to the placing of grouted riprap.

The work to be done by the Contractor under this Specification shall include the supply of all materials, and the furnishing of all superintendence, overhead, labour, equipment, tools, supplies and all other things necessary for and incidental to the satisfactory performance and completion of all work as hereinafter specified.

3. MATERIALS

3.1 General

The Contractor shall be responsible for the supply, safe storage and handling of all materials set forth in this Specification.

3.2 Handling and Storage of Materials

All materials shall be handled in a careful and workmanlike manner, to the satisfaction of the Engineering Manager.

3.3 Testing and Approval

All materials supplied under this Specification shall subject to inspection and testing by the Engineering Manager or by the Testing Laboratory designated by the Engineering Manager. There shall be no charge to the Municipality for any materials taken by the Engineering Manager for testing purposes.

All materials shall be approved by the Engineering Manager before any construction is undertaken. If, in the opinion of the Engineering Manager, such materials, in whole or in part, do not conform to the Specification detailed herein or are found to be defective in manufacture or have become damaged in transit, storage or handling operations, then such material shall be rejected by the Engineering Manager and replaced by the Contractor at his own expense.

3.4 Rock

Rock for riprap shall consist of hard, dense, durable rock. The rock shall be fieldstone, boulders or quarry rock, resistant to the air and water and suitable in all other respect for the purpose intended. The stones shall range in size from 100 mm to 300 mm in diameter, with at least 75 percent ranging from 100 mm to 200 mm in diameter. The rock for riprap shall be approved by the Engineering Manager prior to placing.

3.5 Concrete Grout

All concrete grout shall be 30 MPa compressive strength at 28 days and shall conform with the requirements of Specification MH 2800.

3.6 Miscellaneous Materials

Miscellaneous materials shall be of the type specified on the Drawings or approved by the Engineering Manager.

4. CONSTRUCTION METHODS

4.1 Preparation of Existing Ground

The bed for riprap shall be trimmed to the lines as shown on the Drawings or as staked in the field by the Engineering Manager, prior to placing any riprap. No riprap shall be placed until the bed has been inspected and approved by the Engineering Manager.

4.2 Grouted Stone Riprap

The outside perimeter of the riprap shall be constructed using a vertical formed edge equal to the depth of the grout layer.

Any and all tie bars and/or reinforcing steel shall be placed as shown on the drawings and/or as directed by the Engineering Manager.

The concrete grout shall be placed on the approved bed as shown on the drawings and shall be a minimum of 300 mm in thickness. The grout surface shall be stricken and rough floated with wooden tools to present an even, closed surface. Rocks shall then be placed and worked into the grout so that 75% of the rock's diameter is embedded into the grout. Rocks shall be positioned in the grout so that a spacing of between 150 mm and 250 mm exists between rocks. The area around each rock shall be finished with a brush or other tool in order to eliminate any voids or pockets in the surface finish. No rocks shall be placed within 300 mm of the outside edge of the riprap area.

After initial set of the grout, the portion of the rocks projecting above the grout layer shall be thoroughly cleaned of grout by sandblasting, to the satisfaction of the Engineering Manager. Following sandblasting, all loose material shall be removed from the site.

5. QUALITY CONTROL

5.1 Inspection

All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Engineering Manager including all operations from the selection and production of materials through to final acceptance of the specified work. The Contractor shall be wholly responsible for the control of all operations incidental thereto notwithstanding any inspection or approval that may have been previously given. The Engineering Manager reserves the right to reject any materials or works that are not in accordance with the requirements of this Specification.

5.2 Corrective Action

The Contractor shall, at his own expense, correct such work or replace such materials found to be defective under this Specification in an approved manner to the satisfaction of the Engineering Manager.

SPECIFICATION FOR RANDOM STONE RIPRAP

1. GENERAL CONDITIONS

The General Conditions, Standard Provisions and Special Provisions attached hereto shall apply to and be a part of this Specification.

2. DESCRIPTION

This Specification shall cover all operations relating to the supply and placement of random stone riprap and other works relating to the placing of random stone riprap.

The work to be done by the Contractor under this Specification shall include the supply of all materials, and the furnishing of all superintendence, overhead, labour, equipment, tools, supplies and all other things necessary for and incidental to the satisfactory performance and completion of all work as hereinafter specified.

3. MATERIALS

3.1 General

The Contractor shall be responsible for the supply, safe storage and handling of all materials set forth in this Specification.

3.2 Handling and Storage of Materials

All materials shall be handled in a careful and workmanlike manner, to the satisfaction of the Engineering Manager.

3.3 Testing and Approval

All materials supplied under this Specification shall subject to inspection and testing by the Engineering Manager or by the Testing Laboratory designated by the Engineering Manager. There shall be no charge to the Municipality for any materials taken by the Engineering Manager for testing purposes.

All materials shall be approved by the Engineering Manager before any construction is undertaken. If, in the opinion of the Engineering Manager, such materials, in whole or in part, do not conform to the Specification detailed herein or are found to be defective in manufacture or have become damaged in transit, storage or handling operations, then such material shall be rejected by the Engineering Manager and replaced by the Contractor at his own expense.

3.4 Rock

Rock for riprap shall consist of hard, dense, durable rock. The rock shall be fieldstone, boulders or quarry rock, resistant to the air and water and suitable in all other respect for the purpose intended. The stones shall range in size from 100 mm to 300 mm in diameter, with at least 75 percent ranging from 100 mm to 200 mm in diameter. The rock for riprap shall be approved by the Engineering Manager prior to placing.

3.5 Filter Fabric

Filter fabric shall be a heavyweight non-woven polyester geotextile. Approved products are Armtec 350, Mirafi 1120 N, or Nilex NW120.

3.6 Miscellaneous Materials

Miscellaneous materials shall be of the type specified on the Drawings or approved by the Engineering Manager.

4. CONSTRUCTION METHODS

4.1 Preparation of Existing Ground

The bed for riprap shall be trimmed to the lines as shown on the Drawings or as staked in the field by the Engineering Manager, prior to placing of the filter fabric or riprap. No fabric or riprap shall be placed until the bed has been inspected and approved by the Engineering Manager.

4.2 Filter Fabric

Filter fabric shall be installed directly on the prepared slopes. The limits shall be the limits of the riprap material as shown on the Drawings, and as directed by the Engineering Manager. The filter fabric shall be rolled loosely over the slope so it will conform to the contours of the terrain.

Adjacent strips of the fabric shall be overlapped by a minimum of 600 mm. Care must be taken to avoid puncturing or tearing the material. Any damaged filter fabric shall be replaced by the Contractor at his own expense.

4.3 Random Stone Riprap

Riprap shall be dumped or rolled into place in such a manner that the larger stones are uniformly distributed and smaller rocks serve to fill the space between the larger rocks. Sufficient handwork shall be done to procure a neat and uniform surface with the thickness as shown on the Drawings.

The Contractor shall be responsible for removal, off-site, of all surplus excavated material.

5. QUALITY CONTROL

5.1 Inspection

All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Engineering Manager including all operations from the selection and production of materials through to final acceptance of the specified work. The Contractor shall be wholly responsible for the control of all operations incidental thereto notwithstanding any inspection or approval that may have been previously given. The Engineering Manager reserves the right to reject any materials or works that are not in accordance with the requirements of this Specification.

5.2 Corrective Action

The Contractor shall, at his own expense, correct such work or replace such materials found to be defective under this Specification in an approved manner to the satisfaction of the Engineering Manager.

SPECIFICATION FOR INSTALLATION OF INTERLOCKING PAVING STONES

1. GENERAL CONDITIONS

All standards in this edition, attached hereto, shall apply to and be a part of this Specification.

2. DESCRIPTION

This Specification shall cover the preparation of sub-grade and the supply and installation of interlocking paving stones, sand and crushed gravel on sidewalks and residential approaches.

The work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies and all things necessary for and incidental to the' satisfactory performance and completion of all work as hereinafter specified.

3. MATERIAL

3.1 General

The Contractor shall be responsible for the supply, safe storage and handling of all materials set forth in this Specification. All materials supplied under this Specification shall be subject to inspection and testing by the Engineering Manager. There shall be no charge to the Municipality for any materials taken by the Engineering Manager for inspection purposes.

3.2 Materials

3.2.1 Interlocking Paving Stones

Paving stones shall be as manufactured by Barkman Concrete, type, colour and pattern as indicated by the Engineering Manager. Paving stones shall conform with the requirements of CAN3A231.2, Precast Concrete Pavers.

3.2.2 Crushed Limestone

The crushed limestone shall be well graded and shall have a maximum aggregate size of 20mm.

3.2.3 Lean Concrete Mix

Lean Concrete Mix shall be supplied as specified in Specification MH 2800, and shall have the following properties:

Aggregate size .....20 mm nominal
Slump .....25 - 75 nun
Compressive Strength @ 28 days .....5 - 10 MPa
Air Content .....5 - 8%
Cement Content ..... 150 kg/m^3

3.2.4 Bedding Sand

Bedding sand shall be fine aggregate as specified in Specification MH 2800, with the exception that the sand shall have a minimum of 30% of the particles larger than three millimetres (3 mm).

3.2.5 Filler Sand

Filler sand shall have a maximum aggregate size of2.5 mm.

4. CONSTRUCTION METHODS

4.1 Excavation

The excavation, including removal of existing sidewalk, shall not extend beyond the specified limits of excavation. The limits of excavation shall be taken as a vertical plane 150 mm beyond the limits of the proposed paving stone sidewalk, unless otherwise specified.

For paving stone sidewalks and residential approaches, the sub-grade shall be excavated to the minimum depths shown on the - Standard Details, unless otherwise directed by the Engineering Manager.

4.2 Preparation of Sub-grade, Sub-base and Sand-base

4.2.1 Crushed Limestone Sub-base

The construction of sub-grade and crushed limestone sub-base shall be completed in accordance with Specification MH 2000 and the Drawings.

A layer of compacted crushed limestone shall be placed as shown in the appropriate detail on the compacted sub-grade. On top of this, a 25 mm layer of sand shall be placed.

The bedding sand layer shall be spread and leveled so that the paving stones when installed are 10 mm higher than the finished grade. No more sand shall be spread than can be covered in one day by paving stones. The bedding sand layer shall not be compacted prior to laying the paving stones.

Supply and placing of bedding sand shall be incidental to the installation of the paving stones.

No paving stones shall be placed until construction of the underlying layers has been approved by the Engineering Manager.

4.2.2 Lean Concrete Base

The construction of sub-grade shall be completed in accordance with Specification MH 2800 and the Drawings.

The construction of a lean concrete base shall follow the enclosure of all utilities (i.e. water valves, parking meter bases, street light pole bases, etc.) with a square concrete collar, to be a minimum of 225 mm in thickness. The cost of supplying and installing concrete collars shall be incidental to the installation of the lean concrete base.

The lean concrete base shall be placed to a minimum thickness of 150 mm. The surface shall be smooth, true to line, grade, and cross-section.

On top *of* the lean concrete base a 15 mm layer of sand shall be placed.

The bedding sand layer shall be spread and levelled so that the paving stones when installed are 5 mm higher than the finished grade. No more sand shall be spread than can be covered in one day by paving stones. The bedding sand layer shall not be compacted prior to laying the paving stones.

The cost of supplying and placing bedding sand shall be incidental to the installation of the paving stones.

No paving stones, shall be placed until construction of the underlying layers has been approved by the Engineering Manager.

4.3 Installation of Paving Stones

Where the edge support is required, precast concrete curbs shall be installed at locations determined by the Engineering Manager. Supply and installation of precast concrete curbs shall be incidental to the installation of the paving stones.

The paving stones shall be installed such that spaces between joints do not exceed three

millimetres (3 mm). Spaces between paving stones shall be uniform and consistent while maintaining straight and true patterns.

Work shall commence with edge stones along the longest straight section of curb or property line and work towards the opposite edge. Edge stones shall be used around any structure within the sidewalk limits and along the limits of the sidewalk.

If cutting of paving stones is required, the sawn or sheared edges shall be true, even and undamaged. Coloured mortar shall be used to fill small voids between blocks and curbs or other structures.

Paving stones shall be compacted into the sand layer using approved vibratory compactors until they are at the proper grade, uniformly level and free of any movement. Filler sand shall then be swept into the joints until full.

Supply and placing of filler sand shall be incidental to installation of the paving stones.

4.4 Regrading Existing Interlocking Paving Stone Installations

As directed by the Engineering Manager, the Contractor shall regrade existing interlocking paving stone installations.

The Contractor shall careful1y remove and clean existing paving stones from areas determined by the Engineering Manager. The crushed limestone sub-base and bedding sand layer shall be prepared in accordance with Clause 4.2 of this Specification.

The Contractor shall re-install existing paving stones to elevations determined by the Engineering Manager in accordance with Clause 4.3 of this Specification. Supply and replacement of damaged paving stones shall be incidental to the cost of regrading the existing paving stones. Replacement paving stones shall be of similar color and dimensions as the existing paving stones, and shall tie into adjoining interlocking paving stones without cutting of replaced interlocking paving stones.

5. QUALITY CONTROL

5.1 Inspection

All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Engineering Manager, including all operations from the selection and production of materials through to the final acceptance of the specified work. The Contractor shall be wholly responsible for the control of all operations incidental thereto notwithstanding any inspection or approval that may have been previously given.

The Engineering Manager reserves the right to reject any materials or works that are not in accordance with the requirements of this Specification.

5.2 Corrective Action

The Contractor shall, at his own expense, correct such work or replace such materials found to be defective under this Specification in an approved manner to the satisfaction of the Engineering Manager.

SPECIFICATION FOR ADJUSTMENT OR ABANDONMENT OF EXISTING PAVEMENT AND BOULEVARD STRUCTURES AND APPURTENANCES

1. GENERAL CONDITIONS

All standards in this edition, attached hereto, shall apply to and be a part of this Specification.

2. DESCRIPTION

This Specification shall cover the adjustment of existing pavement and boulevard structures and appurtenances to grade within the full limits of the Works.

The work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies and all things necessary for and incidental to the/satisfactory performance and completion of all work as hereinafter specified.

3. MATERIALS

3.1 General

The Contractor shall be responsible for the supply, safe storage and handling of all materials set forth in this Specification. All materials supplied under this Specification shall be subject to inspection and approval by the Engineering Manager.

3.2 Precast Concrete Ring Sections

Precast concrete ring sections shall be fabricated from sulfate-resistant Type 50 Portland cement and shall conform to ASTM Standard C76 Class II.

3.3 Cast Iron Lifter Ring Inserts

Cast iron lifter ring inserts shall conform with the requirements of this manual.

3.4 Concrete Connection Pipe

Precast concrete connection pipe, fittings, gaskets and other accessories shall be supplied in accordance with this manual.

3.5 Catchbasin/Manhole Frames and Covers

All catchbasin/manhole frames and covers shall conform to this manual.

3.6 Concrete for Underground Works

Concrete to be used for the underground works specified herein shall be supplied in accordance with this manual.

3.6.1 Watermain Valve Box Extension (Hinged Cover)

Valve box extensions with hinged cover shall conform with the requirements of this manual.

3.7 Concrete Brick

Concrete brick shall be of sound, compact texture with true, even faces and rectangular edges. The dried brick shall have a Modulus of Rupture of at least 2400 kPa and a crushing strength of at least 20 MPa.

3.8 Stabilized Fill

Stabilized fill shall be a blend of concrete aggregate, cement and water. A minimum of 30 kilograms of cement per cubic metre shall be used, unless otherwise specified by the Engineering Manager.

4. CONSTRUCTION METHODS

4.1 Responsibility of Contractor

The Contractor and Engineering Manager shall check all structures and appurtenances within the limits of the works for damage before commencing any construction activities. The Municipality shall assume responsibility for the cost of replacing any reported damaged materials, but the Contractor shall assume responsibility for disposing of the damaged items in accordance with this Specification.

Upon commencement of construction activities, it shall be the responsibility of the Contractor to ensure that no materials are damaged as a result of his construction activities. Materials found damaged, missing or lost after the commencement of construction activities, shall be repaired or replaced by the Contractor at his own expense to the satisfaction of the Engineering Manager.

4.2 Adjustment of Existing Catchbasins and Manholes

Existing catchbasins and manholes with the limits of the works shall be raised or lowered such that the top surfaces are flush with the new finished grade of the pavement, sidewalk or boulevard.

To raise a manhole or catch basin, the existing cast iron frame and cover shall be removed and the stack extended by up to 125 mm in height using concrete bricks laid in mortar. When the stack is to be extended 150 mm or more, or if the build-up of concrete bricks, including existing and new bricks and mortar, will have a total height of 150 mm or greater, then the existing brick shall be removed and added to the stack in accordance with this Specification, and the remaining adjustment made using concrete brick as specified herein.

For short extensions, to facilitate an asphaltic concrete overlay, the Engineering Manager may specify the installation of cast iron lifter ring insert(s) in which case, the adjustment of the existing catchbasin or manhole as specified herein will not be required.

After the stack has been extended to the correct height, the cast iron frame and cover shall be reinstalled to the new finished grade. If there is a flat top reducer on the catchbasin or manhole, the reducer shall be raised so as to be on top of any new concrete ring section.

To lower a manhole or catchbasin, the existing cast iron frame and cover shall be removed and the stack shortened by removing existing concrete bricks and/or removing precast concrete ring sections, as required in accordance with the requirements specified hereabove. All concrete ring sections so removed shall be hauled to the Municipality yard specified by the Engineering Manager and stockpiled therein, or to such other site as may be specified by the Engineering Manager.

All mortar droppings, concrete and other foreign material shall be cleaned out of the manhole or catchbasin as soon as practicable after the adjustment has been completed.

4.3 Installation of Precast Concrete Ring Sections

Precast concrete ring sections, complete with galvanized steps, shall be supplied by the Contractor and installed where directed by the Engineering Manager.

The installation of the ring section(s) shall be considered to include all works incidental to the installation of the required number of ring sections directly on top of the existing stack.

4.4 Installation of Cast Iron Lifter Ring Inserts

Cast iron lifter ring inserts of variable heights shall be supplied by the Contractor and installed where directed by the Engineering Manager.

The installation of the lifter ring insert(s) shall be considered to include all works incidental to the removal of the existing cover, the installation of the required number of lifter ring inserts into the cover opening, and the reinstallation of the cover on top of the lifter ring insert.

4.5 Abandonment of Existing Catch basins and Drainage Inlets

Existing catch basins and inlets to be abandoned shall be those designated by the Engineering Manager. The frame and cover of the designated catch basins and inlets shall be carefully removed from the concrete and stored for re-use on the project. If there is a surplus of existing frames on the project, the extra frames and covers shall be hauled to the Public Works yard specified by the Engineering Manager and stockpiled therein. All existing concrete riser rings and flat top reducers shall be salvaged by the Contractor and shall be hauled to the Public Works yard and stockpiled therein, or to such other site as may be specified by the Engineering Manager.

The existing catchbasin shall then be demolished to at least 1.2 m below the elevation of the new finished grade of the pavement or boulevard; the existing inlet box shall be carefully broken down and all demolished materials removed and disposed of by the Contractor. A concrete plug placed in each pipe opening, and the chamber backfilled with stabilized fill.

4.6 Adjustment of Existing Watermain Valve Boxes

Existing watermain valve boxes within the limits of the works shall be raised or lowered such that the top surface of the valve box is flush with the new finished grade of the pavement, sidewalk or boulevard. It shall include any required concrete removal and/or earth excavation necessary to complete the adjustment, and the replacement of said materials in a manner satisfactory to the Engineering Manager.

4.7 Installation of Watermain Valve Box Extendible Sections (Hinged Cover)

Cast iron watermain valve box extensions with hinged cover shall be supplied by the Contractor and installed to the specified design elevation.

Installation of the extendible sections shall be considered to include all works incidental to the removal of the existing hinged cover and the installation of the extension into the valve box to the design elevation.

4.8 Adjustment of Existing Curb Stop Boxes

Existing curb stop boxes with the limits of the works shall be raised or lowered such that the top surface of the box is flush with the new finished grade of the pavement, sidewalk or boulevard. This shall include any required concrete removal and/or earth excavation necessary to complete the adjustment, and the replacement of said materials in a manner

satisfactory to the Engineering Manager.

4.9 Adjustment of Existing Drainage Inlets

4.9.1 Adjustment of Existing Curb Inlets

Existing curb inlets shall be adjusted to the new grade by carefully removing the curb inlet frame from the existing curb, safely storing said frame, making the necessary grade adjustment to the top of the existing curb inlet box and reinstalling the curb inlet frame on top of the adjusted inlet box.

For curb inlets with inlet box, the adjustment shall be considered to include the supply and placing of reinforcing steel and concrete as required to cast the existing frame into the existing inlet box. For curb inlets with catchbasin the adjustment of the existing catchbasin shall be done in accordance with Section 4.2 of this Specification.

All mortar droppings, concrete and other foreign materials shall be cleaned out of the inlet box or catchbasin as soon as practicable after the adjustment has been completed.

4.10 Adjustment or Abandonment of Hydrants

Adjustments to hydrants shall be made in accordance with the requirements of "Specifications for Installation of Hydrants and Valves". Backfill to Class 4 unless otherwise specified.

4.10.1 Relocation of Hydrants

Hydrants shall be relocated to the locations specified by the Engineering Manager. The type of relocation and method of construction are defined below.

> Type A Relocation - Remove the hydrant and install piping and fittings. Install the hydrant in the location specified.
>
> Type B Relocation - Remove the hydrant, hydrant isolation valve, valve box and all piping up to the Tee on the watermain. Supply and install a plug into the Tee. Retain the plug in the Tee by the use of Type 316 stainless steel threaded rod or nuts and bolts. Wrap the entire Tee-Plug-Fastener system in two wrappings of 6-mil polyethylene film.
>
> Reinstall the hydrant, isolation valve and valve box at the location shown on the drawings. If the reinstallation requires the connection to an existing watermain, make the connection by the use of a tapping sleeve and valve.

4.10.2 Raising of Hydrants

Raise hydrants at the locations and to the grades as directed by the Engineering Manager. Hydrants shall be raised by removing the upper hydrant body and inserting the appropriate extension section complete with stem extension. The extension section shall incorporate a break away traffic flange to be located approximately 50 mm above the ground surface. Adjust the isolation valve valve box.

4.10.3 Lowering of Hydrants

Remove hydrants requiring lowering. Replace with new hydrants of the appropriate bury depth. Adjust the isolation valve valve box. Deliver hydrants, which have been removed, to the Public Works Yard.

4.10.4 Abandonment of Hydrants

Remove the hydrant, hydrant isolation valve, valve box and all piping and insert a plug. Deliver the hydrant, hydrant isolation valve, valve box and piping to the Public Works Yard.

4.11 Disposal of Material

Disposal of material shall be understood to mean the hauling of a material from the site and the unloading and grading of the material in a manner satisfactory to the Engineering Manager at a disposal site indicated.

Any material dropped or spilled on any streets during the hauling operations shall be promptly cleaned up by and at the expense of the· Contractor, to the satisfaction of the Engineering Manager.

5. QUALITY CONTROL

5.1 Inspection

All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Engineering Manager, including all operations from the selection and production of materials through to the final acceptance of the specified work. The Contractor shall be wholly responsible for the control of all operations incidental thereto notwithstanding any inspection or approval that may have been previously given. The Engineering Manager reserves the right to reject any materials or works that are not in accordance with the requirements of this Specification.

5.2 Corrective Action

The Contractor shall, at his own expense, correct such work or replace such materials found to be defective under this Specification in an approved manner to the satisfaction of the Engineering Manager.

MANUAL OF TEMPORARY TRAFFIC CONTROL IN WORK AREAS ON MUNICIPAL STREETS

1.0 INTRODUCTION

1.1 Purpose

It is the purpose of this Manual to ensure safe conditions for motorists, pedestrians, and workmen in areas on the Rural Municipality of Hanover's Street System where unusual and temporary conditions prevail for periods of time due to work being undertaken. This purpose can be achieved by faithful observance of adequate and uniform standards of traffic control, and methods of work-area enclosure. Such standards are set forth in this Manual.

1.2 Scope

The Manual includes the general principles and detailed methods of providing for the safe and convenient movement of vehicular and pedestrian traffic on all streets in the Rural Municipality of Hanover where normal operation are not possible due to work on that street. The responsibilities by any Department of the Rural Municipality, public utility of Construction Agency responsible for the work or undertaking the work are clearly defined herein.

The methods of traffic control and work area enclosure described in the Manual take full advantage of recent improvements in traffic control devices for these purposes. The devices conform with the general principles of the Manual on Uniform Traffic Control Devices for Canada and rely largely on the use of symbols in traffic signs. In many cases this now allows the presentation of information to motorists that was not previously possible with written message.

Typical traffic control and work area enclosure arrangement are illustrated in the Manual. The devices utilized and their placement were chosen to give adequate warning to the approaching motorist and to provide him with sufficient information to enable safe and convenient travel through the work area. Methods are also provided to ensure adequate provision for the requirements of pedestrians on Municipal streets.

Definite rules, methods and procedures are specifically set out in the Manual, and it is expected that they will be sufficient for most circumstances. It is recognized, however, that there will be occasions when they will prove either inadequate or inapplicable. For such situations, general guidelines have been set out to be used in coping with peculiar or unusual circumstances. In all cases, it shall be understood that the safety and convenience of highway users is to be a principal goal.

1.3 Interpretations

For purposes of this Manual, the following words and expressions shall have the meaning indicated below.

(1) "Agency" or "Construction Agency" shall mean the contractor or other person who is responsible for the undertaking of work on any section of the Rural Municipality of Hanover's street system.

(2) "Information and Warning Devices" shall mean all signs that convey warning or essential information to the highway user as specified in this Manual and shall include such devised as flashers, traffic cones, and any other device of a similar nature which is approved herein for use on the street for this purpose.

(3) "Regulatory Signs" shall mean those signs that inform highway users of certain law or regulations, the violation of which would constitute a misdemeanour.

1.4 Revisions

The Manual will be revised at any time that a clear need arises. Any suggestions for revision or improvement should be submitted in writing to the Municipal Engineering Manager of the Rural Municipality of Hanover.

2.0 AUTHORITY & RESPONSIBILITY

2.1 General Authority

The Highway Traffic Act of the Province of Manitoba assigns to the Rural Municipality of Hanover the authority to regulate traffic movement, as it deems necessary under the circumstances, on any public street in the Rural Municipality of Hanover upon which public or private works are taking place. Compliance with the contents of this Manual of Temporary Traffic Control in Work Areas on Municipality Streets (hereinafter referred to as the Manual) is a requirement of the Rural Municipality of Hanover's Standard Design and Construction Specifications. All measures of traffic control and work site enclosure shall be undertaken in conformance with the Manual.

2.2 Responsibilities and Procedures of Construction Agencies

The Construction Agency will be responsible for the placement and maintenance of warning, guidance and information signing for traffic control purposes, and for the placement of devices to ensure work site enclosure, in conformance with the provisions of this Manual. This responsibility will apply to all Agencies undertaking work on all streets in the Rural Municipality of Hanover. These responsibilities shall generally include the following:

(i) To secure the necessary permit(s).

(ii) To place and maintain the appropriate signs and barricades as specified in this Manual.

(iii) To provide for the safety and convenience of motorists and pedestrians.

(iv) To provide for the safety of the worker by ensuring the wearing of a CSA approved safety helmet and reflectorized vest when working on Municipal streets.

(v) To ensure that all traffic control devices are removed from the street whenever, and as soon as they are no longer appropriate.

(vi) To reimburse the Municipality for all costs incurred arising from placement of traffic control devices by the Municipality's forces at or adjacent to the work site, in connection with works undertaken by the Agency.

3. PLANNING AND LIAISON

3.1 Joint Planning

Prior to securing an Excavation , tear up, or remove any pavement, curbing or other road surface on a Municipal street, the Agency will undertake to contact the Manager of Municipal Engineering. This contact will include a full discussion of the scope and scheduling of the construction or repair work involved and will include joint planning of the necessary traffic control and work site enclosure methods. This allows for the preparation of traffic control devices both by the Agency and by the Municipality's Departments and can ensure that upon commencement of the work, the proper methods and procedures are undertaken at the outset. The joint planning procedure may include any or all of the following considerations.

(i) A detailed discussion of the intended work in order to review the influence of this work upon normal traffic operations on the streets or roadways. This review may indicate the need to reschedule the work to minimize the disruption and hazard to users of the street(s).

(ii) Not less than 24 hours advance notification of the time and date of commencement of work is to be given by the Agency to the Rural Municipality of Hanover's Fire Department, the RC.M.P. and the Manager of Municipal Engineering.

3.2 Emergency Work

In connection with an emergency situation on a street, the existence of which includes an element of public hazard, it shall be clearly understood that the agency responsible for the repair function has the authorization to enter upon the site immediately and commence elimination of the public hazard. However, this authorization bears the following conditions, which must also be carried out immediately. The conditions are the requirement to notify the authorities listed below:

(i) The Rural Municipality of Hanover. (204-326-4488)
(ii) The City of Steinbach Detachment of the Royal Canadian Mounted Police (204-326-1234)

3.3 Work Undertaken at Night, on Sundays, or on Public Holidays

Under certain circumstances it may prove necessary to undertake part or all of the work during night hours, on Sunday, or on a public holiday. Such requirement would normally occur only where the work would cause extreme disruption of vehicular or pedestrian traffic operations during normal working hours. Work may only be undertaken during night hours, Sundays, or public holidays if allowed by the City of Steinbach Detachment of the R.C.M.P.

4.0 FIELD PRACTICES

4.1 Introduction

This section prescribes the types of devices for traffic control and work site enclosure that are to be used on streets in the Rural Municipality of Hanover and the manner in which they must be used. Included are a number of drawings which illustrate typical arrangements of proper traffic control measures designed to cope with those circumstances most frequently encountered in work being undertaken on Municipal streets. It is to be understood that the Agency responsible for the work shall conform with the specifications in this section, and shall be allowed to depart therefrom only if the departure is clearly specified in the Permit. It is to be noted that the Public Works Department will undertake placement and removal of all regulatory traffic control signals and signs.

The traffic control signs and barricades and their prescribed usage provide information to the driver and pedestrian using the street under the abnormal conditions resulting from public or private works. The requirements set out herein give full consideration to the

characteristics of major traffic movements which occur on major streets, including the special requirements of motorists on streets and highways under night-time conditions and inclement weather.

4.2 Basic Requirements of the Highway User

The traffic control and work site enclosure methods prescribed herein are designed to meet the needs of the highway user in situations that result from construction and repair operation. To be adequate, information related to the following factors must be displayed by the Agency on all approaches to the work site:

(i) The fact that work is being undertaken on the highway ahead.

(ii) The intended traffic diversion.

(iii) Confirmation that the motorist is properly following the diversion. Traffic control and information signing along the diversion will be undertaken by the Public Works Department.

(i) End of construction area and/or diversion.

(v) Any other information required to safely guide the motorist through or around the work site.

(vi) The boundaries of the work site.

(vii) The name and emergency telephone number of the Agency undertaking the work. (This information will be prominently placed by the Agency at the work sites).

Speed Limits and Warning Sign Spacing

In suburban areas of the Municipality, higher vehicular speeds are permitted on major streets that require more advanced warning of construction sites than is the case where lower speed limits exist. This manual includes a series of sketches illustrating “typical situations” and with each sketch, a distance table is provide setting forth the dimensions which are to be used in the placement of signs and barricades on the approaches to a construction site. These tables set forth specific requirements in speed-ranges of 50 kilometres per hour, 60 kilometres per hour and 70 kilometres per hour and higher. In some instances, it may be necessary to utilize signs that are larger than the minimum sizes specified in Section 5.0.

Work Site Illumination

Where diversions or detours are undertaken on streets without street lighting or with low levels of street lighting, it will be necessary to utilize the device known as the delineator. This device delineates the edges of the usable roadway for motorists, under conditions of poor visibility. It is illustrated in the sketches included with the manual.

It may also be deemed necessary that the Agency arrange for the illumination of the work

site during hours of darkness. In all cases where there is no street lighting or there is a low level of street lighting and when large objects or items of equipment are left on the highway during hours of darkness, the Agency shall adequately illuminate in white light the object or equipment and the immediate surrounding area. The light sources shall be suitably shielded to overcome glare so that the motorists' vision is not impaired.

There shall be no light source placed by the Agencies within or adjacent to the work site which utilities a colour other than white or amber. White light shall be the only colour utilized for general illumination of the work site. All light sources used for delineation of the edge of the usable roadway or the boundaries of the work site shall be amber in colour.

Position of Barricades

The placement of barricades and portable flashers shall generally be in the manner indicated in the sketches of "Typical Situations", and the barricades and flashers will conform with the specifications set out in Section 5.3. The enclosure of the work site using barricades will be as complete as possible to ensure that motorists and pedestrians are adequately advised of the boundaries of the work site. When barricades are, removed to permit access to/egress from the work site for vehicles or equipment, the barricades shall be placed immediately after such access/egress has occurred.

Position of Construction Equipment

The location of equipment, material, construction vehicles, and personnel shelters within the work site shall not interfere with the visibility of motorists and pedestrians. The parking of vehicles shall not contravene any section of the Highway Traffic Act of the Province of Manitoba or of the Rural Municipality of Hanover Traffic By-Law.

Maintenance of Traffic Control Devices

It is the responsibility of the Agency to undertake regular maintenance of the warning and information signs and devices and barricades to ensure that they are clean, legible, and in their proper place at all times. The Agency 'shall also undertake to remove signs and devices from the work site as soon as circumstances permit in order to restore the highway to public us as soon as possible, having due regard for the safety of pedestrians and motorists and the specific requirements set out in this Manual.

Removal of Curb Parking

The Agency is to notify the Public Works Department when the prohibition of parking is required. The Public Works Department will install the necessary parking prohibition signs and is to be notified by the Agency upon completion of the work in order to restore parking where necessary. No other Department or Agency is authorized to prohibit parking.

Removal of Traffic Control Devices

In some cases the diversion or detour will be in operation only during certain hours of the day and the section of highway on which work is taking place will be restored to normal public use at other times. It is essential that all the devices which are not applicable times. It is essential that all the devices which are not applicable when the highway is restored to public use be either removed from the motorist's view or covered in such manner that they are not visible to motorists.

4.3 Typical Situations and Proper Measures

There are a number of factors that relate directly to the task of driving safely. Among these are such matters as traffic lane width, design of transition sections approaching an obstruction posting of relevant information and the spacing of signs.

Traffic Lanes and Required Clearance

A traffic lane on a major thoroughfare shall normally be 3.6 m wide, and in no case less than 3.0 m. Placement of large objects within 1.0 m of the edge of a traffic lane effectively reduces the width of lane. A motorist requires a clearance of approximately 1.5 m on each side of his vehicle to drive with a sense of safety at 50 kilometres per hour. Therefore, the placement of large objects within 1.0 m of either side of a traffic lane on a major thoroughfare should be avoided wherever possible. At higher speeds the distance should be increased proportionally, (e.g. 2.0 mat 90 kilometres per hour). In any case, the basic lane width specified above shall be completely clear of traffic control devices and equipment and the necessary lateral clearance shall be provided whenever possible.

Traffic Channelization

In the enclosed drawings of "typical situations" a line of traffic control devices is placed to channelize and guide traffic past all roadway constructions. This line will be tapered over the appropriate distance indicated in the associated distance table. This distance is sufficient to allow a motorist to move aside to pass the obstruction safely and conveniently at the highest associated sped shown in the distance table under normal traffic flow conditions.

In heavier traffic flow, a driver cannot observe in advance, through the vehicles preceding him, the details of the obstruction on the road ahead or its location on the road. The driver is therefore, unable to select the proper traffic lane in which to by-pass the obstruction. To overcome this problem, high-level warning devices (red or orange warning flags) are to be employed as indicated in the drawings of “typical situations”, one such installation in each of the traffic lanes that is obstructed.

Movement or Construction Equipment in Work Site

The movement of vehicles and equipment into and out of the work site shall be undertaken with the least possible interference to traffic movements on the street. Under conditions of heavy traffic flow, a flagperson will be required for this purpose.

4.4 Flagperson & Practices

On streets or highways where the work activity limits two-way traffic movement to a single traffic lane for short periods of time, it will generally be undesirable to undertake major diversion of detours. In such circumstances, flagperson operation will be established and conducted as set out below.

Where maximum speed limits are 70 kilometres per hour or greater, "FLAGPERSON AHEAD" signs shall be places 120 m in advance of all fIagperson stations and a flagperson shall stand approximately 60 m in advance of each end of the work site. He/She should be clearly visible to the motorists he/she is controlling for a distance of at least 150 m. Where maximum speed limits are 60 kilometres per hour or less, "FLAGPERSON AHEAD" signs shall be placed 90 m in advance of all flagperson stations and a flagperson shall stand approximately 30 m in advance of each end of the work site. He/She should be clearly visible to the motorists he/she is controlling for a distance of at least 75 m*. For this reason, he/she must wear the reflectorized orange vest and approved CSA safety helmet, and he/she must stand alone, never permitting a group of workmen to congregate around him/her. He/She should stand either on the edge of the shoulder or in the barricaded traffic lane and under no circumstances should he/she stand in the traffic lane which he/she is controlling. The following procedures shall be used:

(i) The flagperson must face traffic in signaling motorists to stop or proceed.

(ii) To stop traffic, the flagperson shall stand in a stationary position and extend the paddle or flag horizontally across the traffic lane. The signal shall be held still so the message may be read and understood from a maximum distance away. For greater emphasis, the free arm shall be raised with the palm towards approaching traffic.

(iii) When it is safe for traffic to proceed, the flagperson shall stand parallel to the traffic movement and, with paddle or flag lowered from the view of the driver, motion traffic ahead with his/her free arm. The paddle or flag is never to be used or waved to signal traffic to proceed.

*NOTE: Fluorescent equipment is only suitable during daylight conditions. For nighttime conditions, reflectorized vests, helmets, paddles and red flashlights must be used.

Additional information is contained in the "FLAGMAN'S MANUAL", published by the Manitoba Highways, Traffic Section.

5.0 EQUIPMENT FOR TRAFFIC CONTROL AND WORK ENCLOSURE

5.1 Introduction

Considerable progress has been made in recent years in a number of areas that relate directly to motorist and pedestrian safety in construction areas. Levels of street lighting have been increased on the majority of streets in the Rural Municipality of Hanover improving nighttime visibility in difficult driving conditions. Improved traffic control devices, including reflectorization, have ensured the communication of information to drivers under all weather conditions. The use of high-level warning flags, reflectorized barricades, and battery-operated flashers have contributed to a more clear-cut definition of on-street work areas. It is the intention of the Rural Municipality of Hanover in producing this Manual to take advantage of this progress in serving the needs of road users.

5.2 Warning and Information Signs

Many of the signs and standard practices of signing that apply to construction and maintenance activities are to be found in the Manual on Uniform Traffic Control Devices for Canada (Metric edition), which is available at the office of the Roads and Transportation Association of Canada, 1765 St.Laurent Boulevard, Ottawa, Ontario, K1G 3V4. All traffic control devices in the Canadian Manual, and other signs shown herein, are approved for use in the Province of Manitoba by the Highway Traffic Board. It is illegal to use signs not approved by the board. All warning and traffic control signs are to be fully reflectorized.

All sign placement on streets in the Rural Municipality of Hanover is to conform with the general terms expressed in Section A1.15 of the Canadian Manual. The basic goal is that of placement in the most advantageous position for motorist visibility. In general, signs are placed on the right hand side lithe roadway and/or in the median at a minimum height of 2.0 m measured from ground elevation at the base of the post to the bottom of the sign, except for signs on portable stands.

It is imperative that traffic signs be well maintained. They must be kept clean, and properly located.

The warning and traffic control signs are depicted in sketches included with this manual. Their permitted use is indicated in the sketches of “Typical Situations”, and as described in Section 4.

Traffic control devices used in Manitoba must conform as closely as possible', with the standard colours for Canadian signs. Colour specifications have been established by the Canadian Government Specifications Board (CGSB). All colour used on signs shall conform to these standards.

5.3 Work Area Enclosure and Other Devices

Work site enclosure devices are utilized to indicate the location and extent of a work area to motorists and pedestrians, to prohibit their entry into the work area which is generally unsuitable or unsafe for their passage, and to protect workmen within the area from the unanticipated and possible dangerous entry of vehicles and pedestrians. These devices include reflectorized metal barricades and portable flashers.

Other devices, such as traffic cones, high flags, and portable sign supports are used to assist in guiding and informing motorists when approaching and bypassing a work area. The designs and dimensions of these devices are to conform with the specifications set out in the sketches included with this manual. Their usage and placement is to conform with the general terms expressed in Section AI.IS of the Canadian Manual. It is imperative that work areas be well enclosed, and that all of the work area enclosure and other devices be properly located and well maintained. Their permitted use is indicated in the sketches of “Typical Situations”.

WARNING AND INFORMATION SIGNS

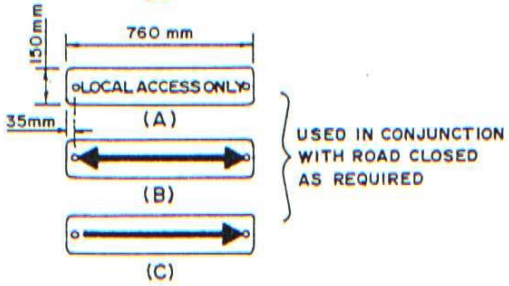
WD-A41T
CONSTRUCTION
AHEAD

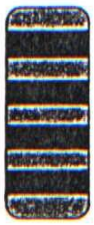
WD-46
SURVEY
CREW

WD-A45
FLAGMAN

WD-22
BUMP SIGN

C9

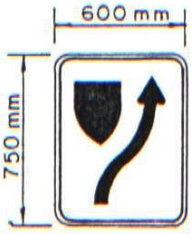




WDA-62
CONSTRUCTION
MARKER

WD-A9
CHEVRON

R8-25L
KEEP LEFT



R8-25
KEEP RIGHT

NOTE: DIAMOND SHAPED WARNING SIGNS SHALL BE 750 mm X 750 mm REFLECTORIZED ORANGE. TABS SHALL BE 300 mm X 600 mm REFLECTORIZED ORANGE.

WARNING AND INFORMATION SIGNS

WD-A33L

WD-A33LT
LANE DROPS
(LEFT)

WD-A23

WD-A23T
PAVEMENT NARROWS

WD-A33R

WD-A33RT
LANE DROPS
(RIGHT)

WD-A23R

WD-A23RT
PAVEMENT NARROWS
(RIGHT)

WD-A23L

WD-A23LT
PAVEMENT NARROWS
(LEFT)

WD-B3

WD-A43L
ROADSIDE DETOUR
(LEFT)

WD-A17
DOUBLE ARROW

WD-A43R
ROADSIDE DETOUR
(RIGHT)

WD-A41(A)

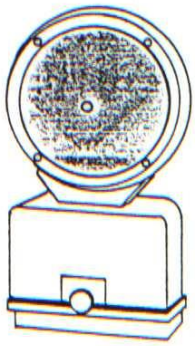
WD-A50

WD-A54

NOTE: DIAMOND SHAPED WARNING SIGNS SHALL BE 750mm X 750mm REFLECTORIZED ORANGE. TABS SHALL BE 300mm X 600mm REFLECTORIZED ORANGE.

WORK AREA ENCLOSURE AND OTHER DEVICES

PORTABLE FLASHER



(A) THE LENS SHALL BE NOT LESS THAN 175 mm IN DIAMETER.

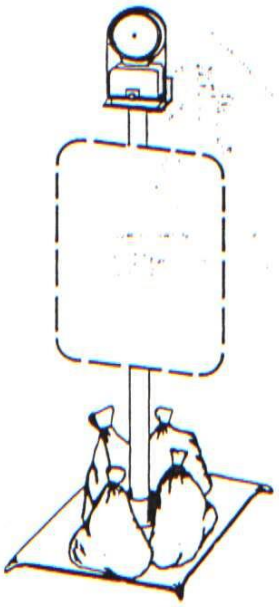
(B) THE FLASHER SHALL GIVE NOT LESS THAN 50 NOR MORE THAN 60 FLASHES PER MINUTE.

(C) THE LAMP SHALL BE ILLUMINATED NOT LESS THAN 40 NOR MORE THAN 60 PER CENT OF THE TIME WHEN OPERATING.

(D) THE FLASHER SHALL OPERATE AS DESCRIBED IN ITEMS (A) AND (B) ABOVE, DURING HOURS OF DARKNESS BUT NEED NOT OPERATE DURING DAYLIGHT HOURS.

(E) FLASHERS SHALL BE EMPLOYED FROM APRIL 1, TO NOV. 15, INCLUSIVE.

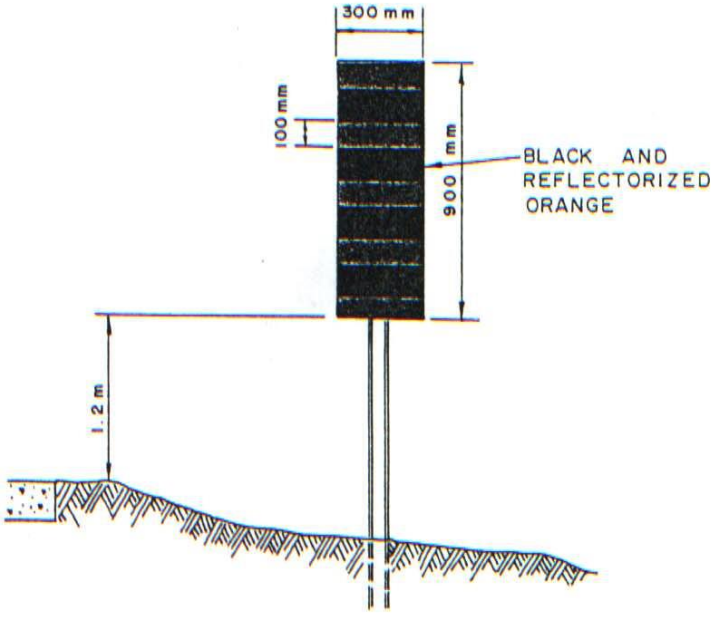
PORTABLE SIGN SUPPORT



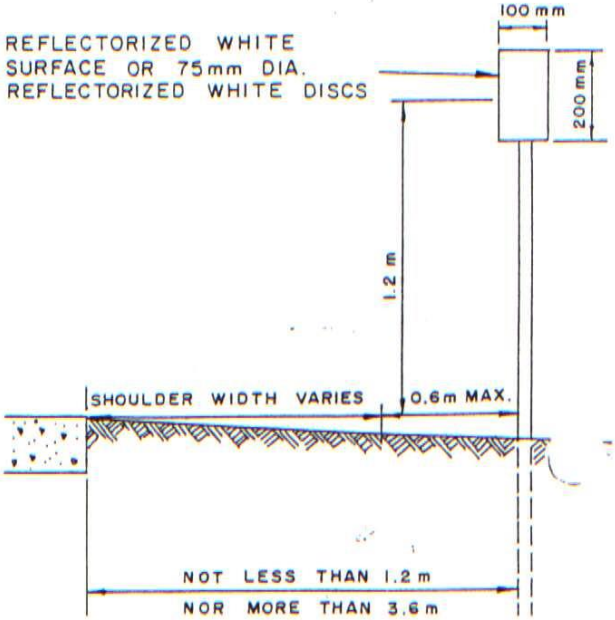
A) BOTTOM EDGE OF SIGN SHALL BE NOT LESS THAN 1.0 m ABOVE THE ROADWAY.

B) PORTABLES SHALL BE PROPERLY STABILIZED WITH SANDBAGS.

CONSTRUCTION MARKER

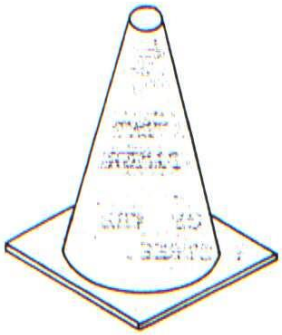


ROAD EDGE DELINEATORS



1988

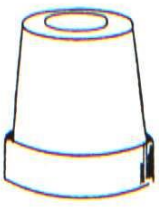
TRAFFIC CONES



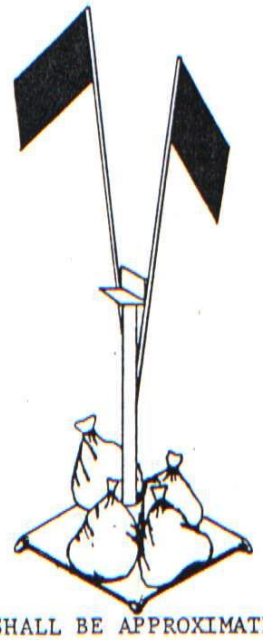
A) SHALL BE YELLOW OR ORANGE RUBBER OR PLASTIC AND REFLECTORIZED OVER 75% OF THE UPRIGHT OUTER SURFACE.

B) FOR SHORT TERM LANE CLOSURES, CONES SHALL BE NOT LESS THAN 700mm IN HEIGHT.

FLASHING AMBER BEACON FOR VEHICLES



HIGH LEVEL WARNING FLAG DEVICE



A) FLAGS SHALL BE APPROXIMATELY 3.0 m ABOVE THE ROADWAY.

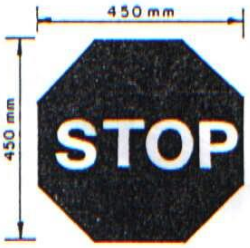
B) FLAGS SHALL BE APPROXIMATELY 400 mm SQUARE.

C) FLAGS SHALL BE RED OR ORANGE.

D) SHALL NOT BE FEWER THAN 2 FLAGS PER DEVICE.

E) PORTABLES SHALL BE PROPERLY STABILIZED WITH SANDBAGS.

FLAGPERSON'S PADDLE

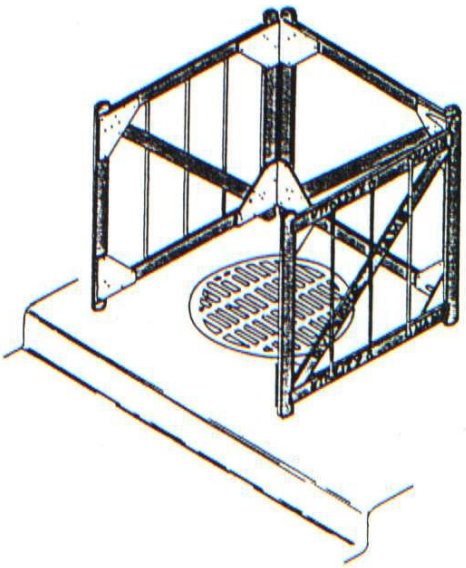


SIDE 1

SIDE 2

1988

SIDEWALK BARRICADE
(USED AROUND MANHOLES)



A) THE OVERALL HEIGHT OF THE BARRICADE SHALL BE APPROXIMATELY 900 CENTIMERES.

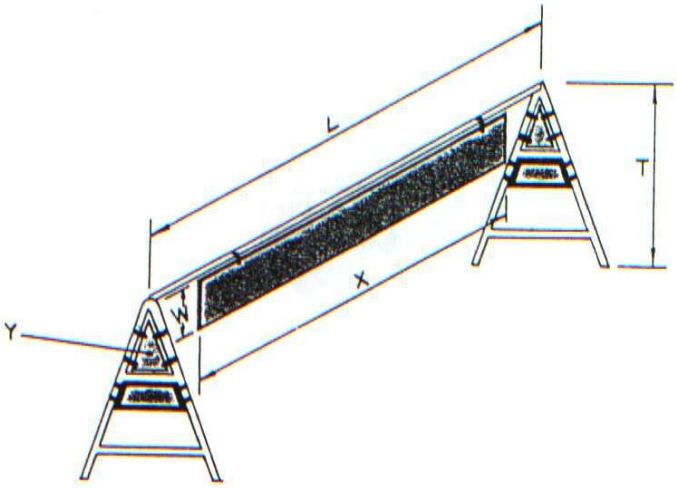
B) THE OVERALL WIDTH OF THE SET UP BARRICADE SHALL BE 900 CENTIMETRES.

C) OPEN SIDE OF SET UP BARRICADE SHALL FACE THE ROADWAY.

D) BARRICADE SHALL BE OF A WOOD MATERIAL INCLUDING CROSS BRACES, ORANGE IN COLOUR.

E) VERTICAL BARS SHALL BE OF A METAL TUBING MATERIAL TO TRANSMIT SOUND TO THE VISUALLY IMPAIRED USING A WHITE CANE. THE VERTICAL BARS SHALL BE FLATTENED AT BOTH ENDS.

REFLECTORIZED METAL BARRICADE



A) THE OVERALL LENGTH OF "L" SHALL BE APPROXIMATELY 250 CENTIMETRES.

B) THE OVERALL HEIGHT "T" OF THE BARRICADE SHALL BE APPROXIMATELY 100 CENTIMETRES.

C) "W" SHALL NOT BE LESS THAN 25 CENTIMETRES.

D) "X" SHALL NOT BE LESS THAN 80% OF "L".

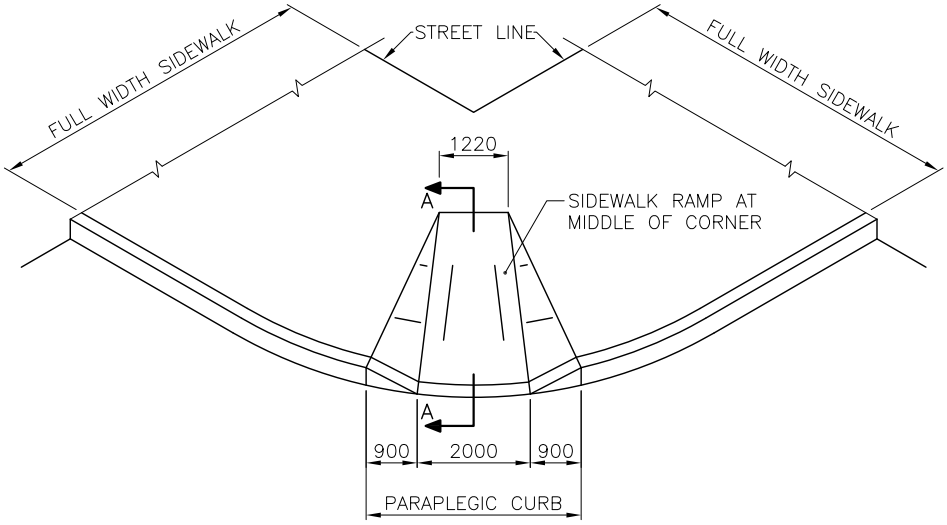
E) "Y" SHALL NOT BE LESS THAN 1,000 SQUARE CENTIMETRES.

F) BARRICADE SHALL BE OF METAL MATERIAL BOTH SIDES OF EACH END, AND BOTH SIDES OF THE PANEL ("W" x "X") SHALL BE REFLECTORIZED ORANGE IN COLOUR.

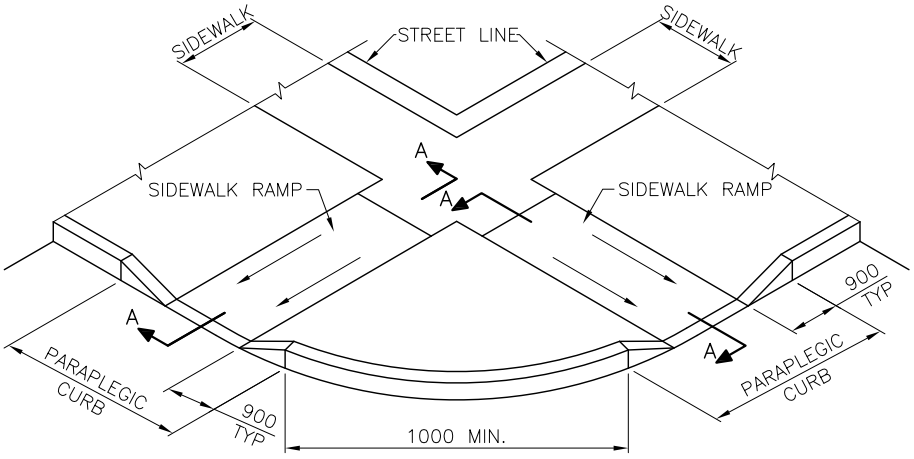
G) THE OWNERS NAME AND TELEPHONE NUMBER SHALL BE SHOWN ON BOTH SIDES OF THE PANEL ("W" x "X").

STANDARD

DETAILS



DOWNTOWN INTERSECTION



RESIDENTIAL INTERSECTION

NOTE: FOR SECTION A–A,
SEE S3

DIMENSIONS ARE IN MILLIMETERS

R.M. OF HANOVER

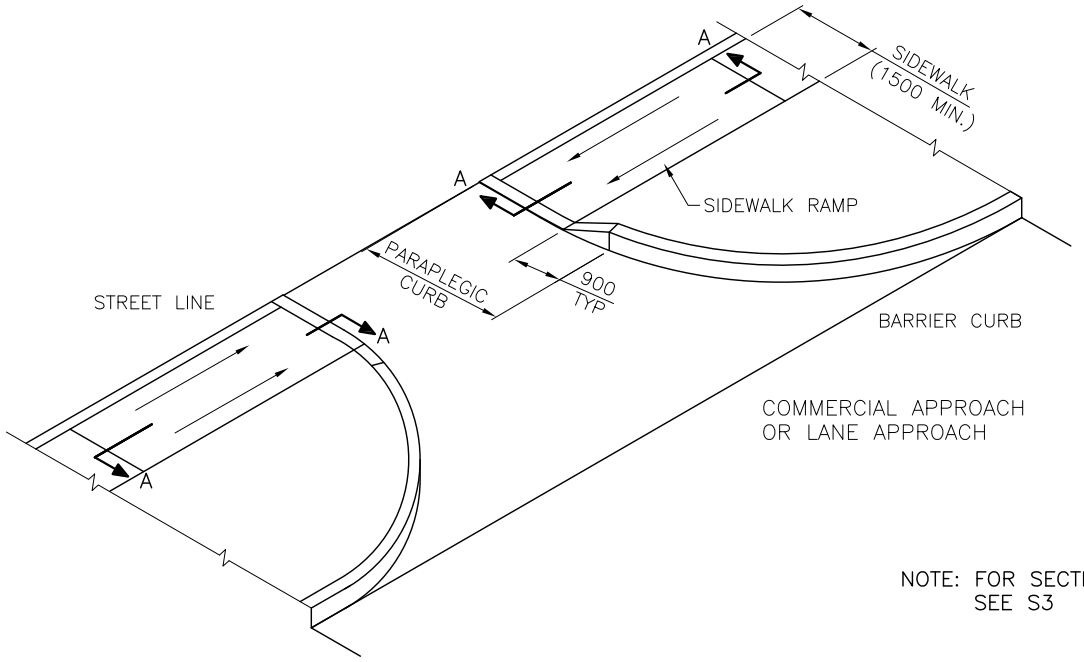
PARAPLEGIC SIDEWALK RAMP

DRAWN BY:	AE
DATE:	JAN 2014
SCALE:	NTS

DATE	REVISION	BY

DRAWING NO. S1

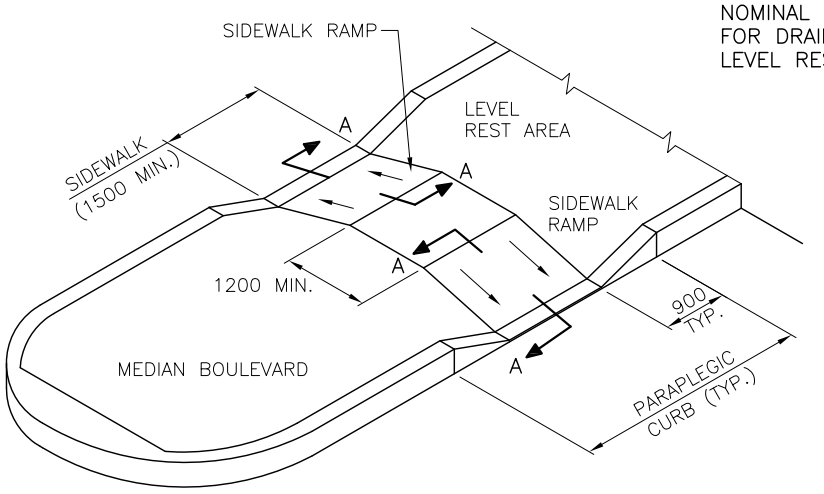
REV. NO.



NOTE: FOR SECTION A–A, SEE S3

COMMERCIAL OR LANE APPROACH WITH BARRIER CURB

NOTE: FOR NARROW MEDIANS, SIDEWALK TO BE DEPRESSED WHILE MAINTAINING A NOMINAL 2% LONGITUDINAL GRADIENT FOR DRAINAGE AND A 1200mm MIN. LEVEL REST AREA.



MEDIAN SIDEWALK CROSSING

DIMENSIONS ARE IN MILLIMETERS

R.M. OF HANOVER

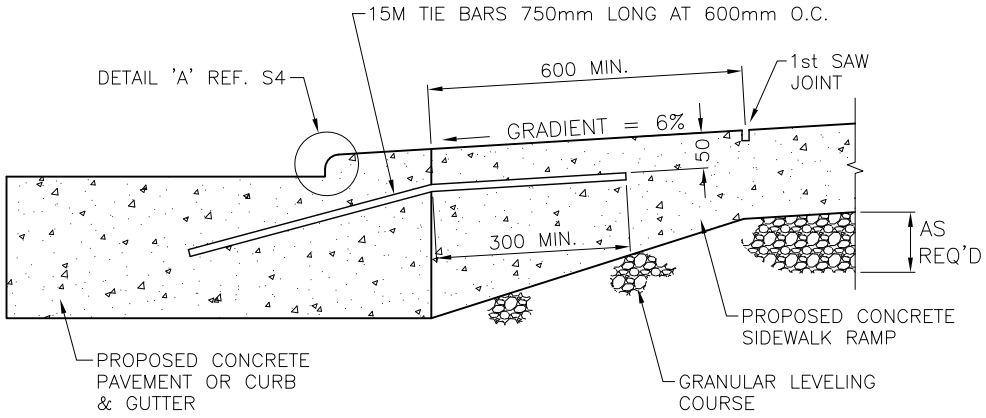
PARAPLEGIC SIDEWALK RAMP

DRAWN BY:	AE
DATE:	JAN 2014
SCALE:	NTS

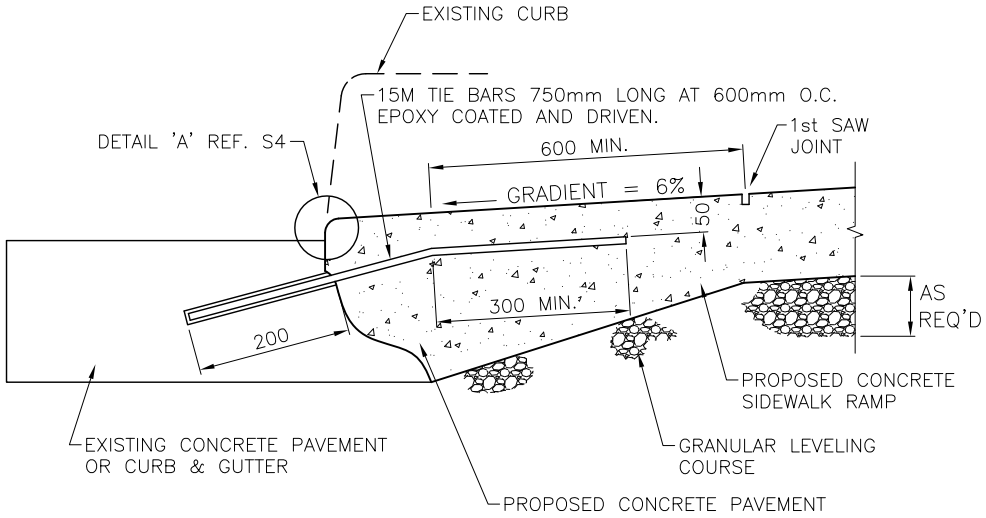
DATE	REVISION	BY

DRAWING NO. S2

REV. NO.



SECTION A–A (FOR NEW CONCRETE PAVEMENT OR CURB & GUTTER)



SECTION A–A (FOR EXISTING CONCRETE PAVEMENT OR CURB & GUTTER)

DIMENSIONS ARE IN MILLIMETERS

R.M. OF HANOVER

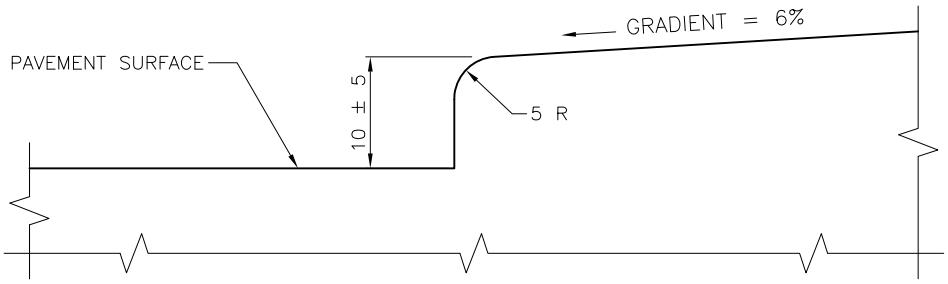
PARAPLEGIC SIDEWALK RAMP SECTIONS

DRAWN BY:	AE
DATE:	JAN 2014
SCALE:	NTS

DATE	REVISION	BY

DRAWING NO. S3

REV. NO.



DETAIL 'A'

NOTE

1) SIDEWALK RAMP SURFACE SHALL BE GIVEN A TEXTURED BROOM FINISH ACROSS THE SIDEWALK.

2) 15M TIE BARS SHALL BE PLACED PRIOR TO THE PLACING OF ANY CONCRETE. TIE BARS SHALL BE BENT AS REQUIRED AND PLACED SO AS TO ENSURE A MINIMUM CONCRETE COVER OF 50mm.

3) 15M TIE BARS SHALL BE DEFORMED AND CONFORM TO CSA STANDARD G30.12, GRADE 300, UNLESS THE BARS ARE TO BE BENT AND LATER STRAIGHTENED IN THE FIELD, IN WHICH CASE THEY SHALL CONFORM TO ASTM A307 GRADE A BOLT STEEL (227.53 MPa YIELD STRESS).

DIMENSIONS ARE IN MILLIMETERS

R.M. OF HANOVER

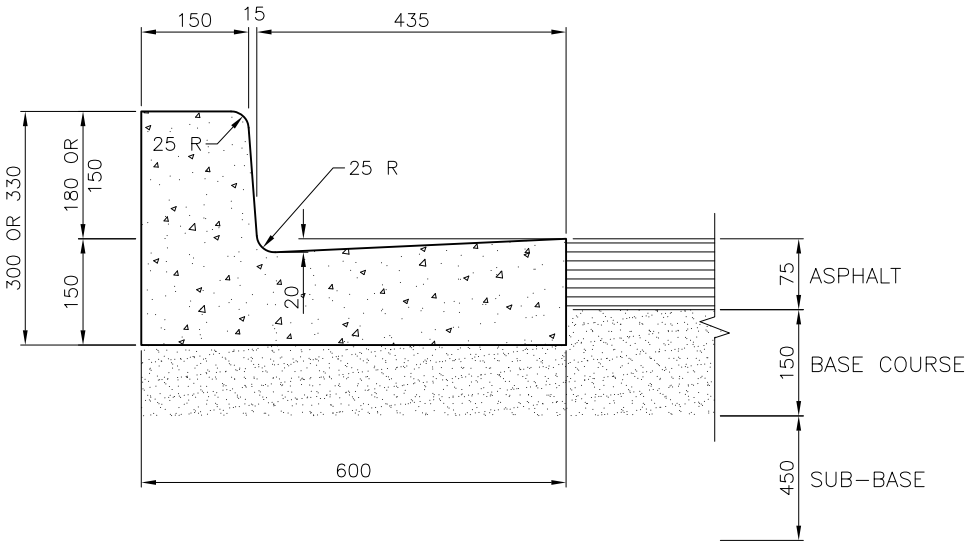
PARAPLEGIC SIDEWALK RAMP

DRAWN BY:	AE
DATE:	JAN 2014
SCALE:	NTS

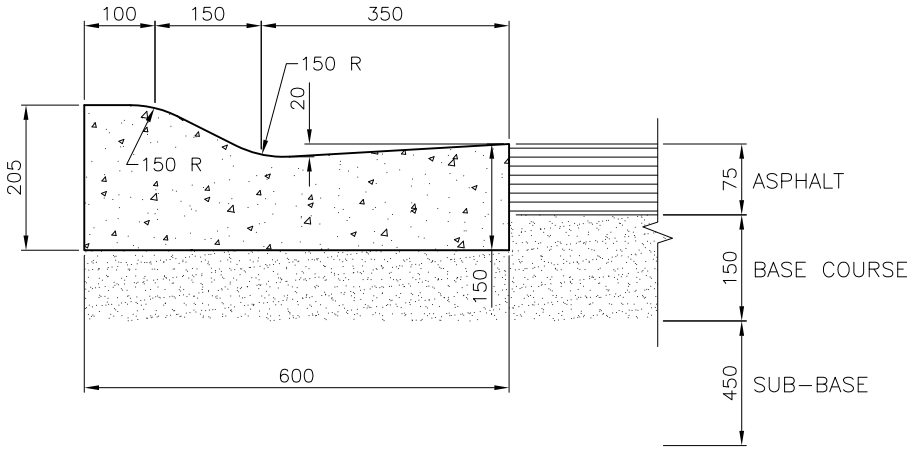
DATE	REVISION	BY

DRAWING NO. S4

REV. NO.



CONCRETE BARRIER CURB AND GUTTER SECTION



CONCRETE MOUNTABLE CURB AND GUTTER SECTION

DIMENSIONS ARE IN MILLIMETERS

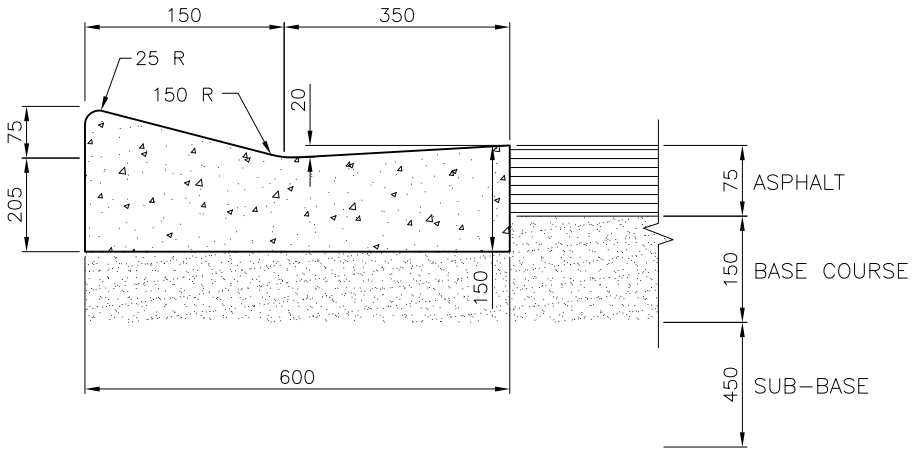
R.M. OF HANOVER

STANDARD CURB
AND GUTTER SECTIONS
WITH ASPHALTIC PAVEMENTS

DRAWN BY:	AE
DATE:	JAN 2014
SCALE:	NTS

DATE	REVISION	BY

DRAWING NO.	REV. NO.
S5	



LIP CURB AND GUTTER SECTION

DIMENSIONS ARE IN MILLIMETERS

R.M. OF HANOVER

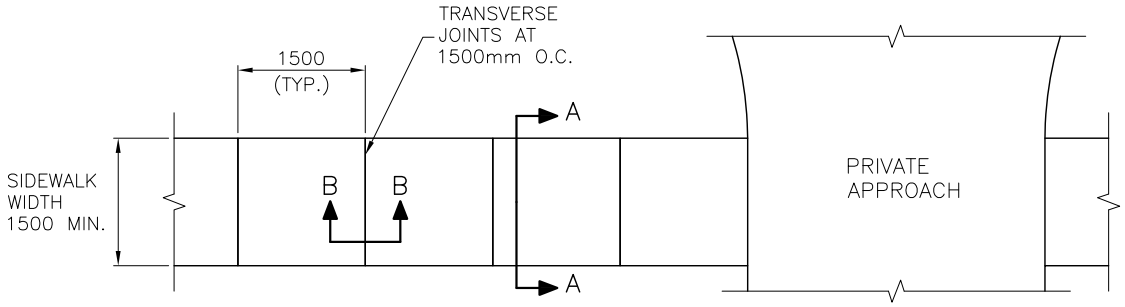
75mm LIP CURB

DRAWN BY:	AE
DATE:	JAN 2014
SCALE:	NTS

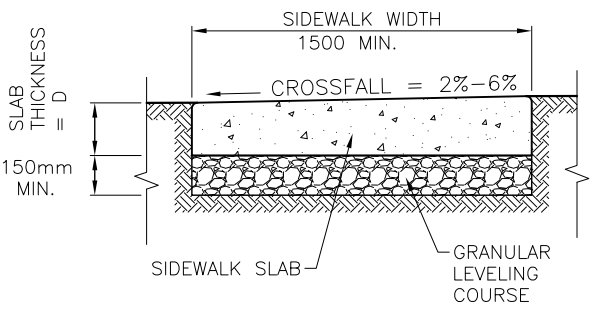
DATE	REVISION	BY

DRAWING NO. S6

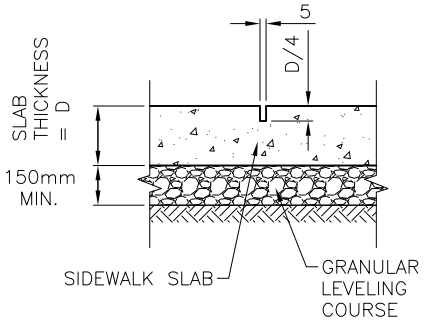
REV. NO.



PLAN



SECTION A–A



SECTION B–B

NOTE: SIDEWALK SLAB SURFACE SHALL BE GIVEN A TEXTURED BROOM FINISH. NO EDGER MARKS SHALL BE LEFT.

DIMENSIONS ARE IN MILLIMETERS

R.M. OF HANOVER

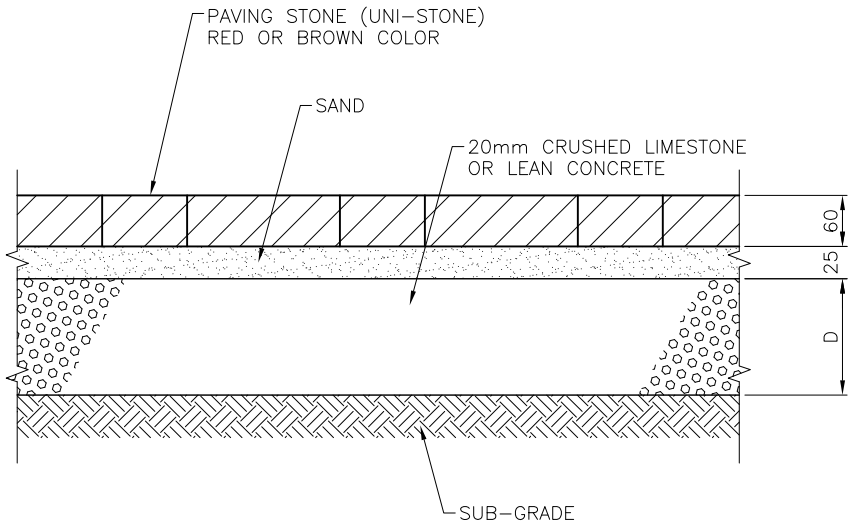
PORTLAND CEMENT
CONCRETE SIDEWALK

DRAWN BY:	AE
DATE:	JAN 2014
SCALE:	NTS

DATE	REVISION	BY

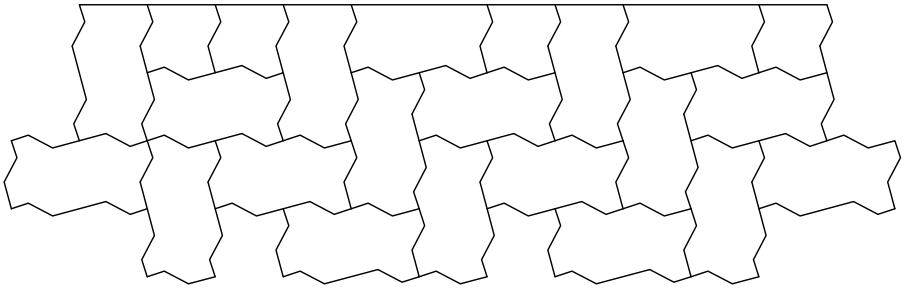
DRAWING NO. S7

REV. NO.



FOR SIDEWALK D=150mm MIN.

FOR RESIDENTIAL APPROACHES D=300mm MIN.



LAYING PATTERN

DIMENSIONS ARE IN MILLIMETERS

R.M. OF HANOVER

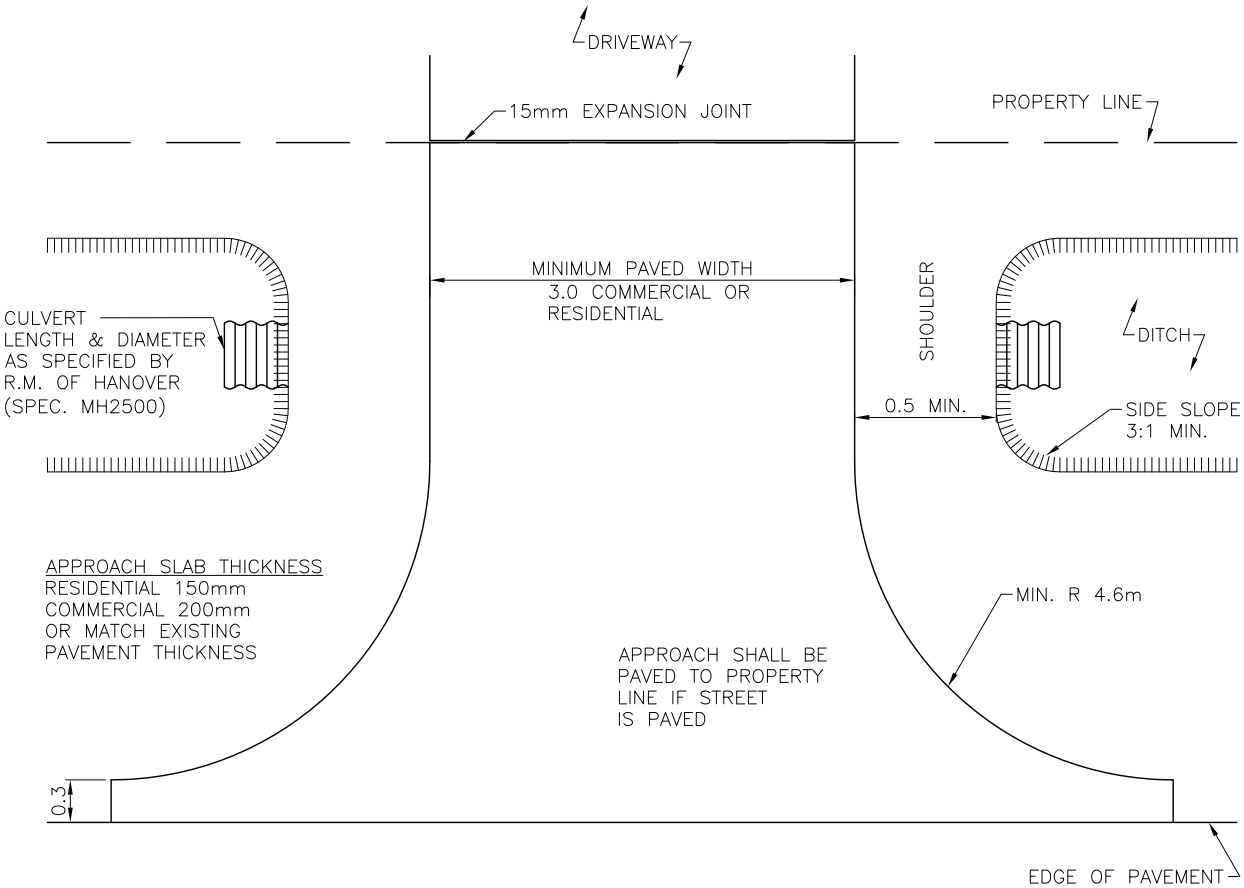
INTERLOCKING PAVING STONE DETAIL FOR SIDEWALKS AND PRIVATE APPROACHES ON GRANULAR OR LEAN CONCRETE BASE

DRAWN BY:	AE
DATE:	JAN 2014
SCALE:	NTS

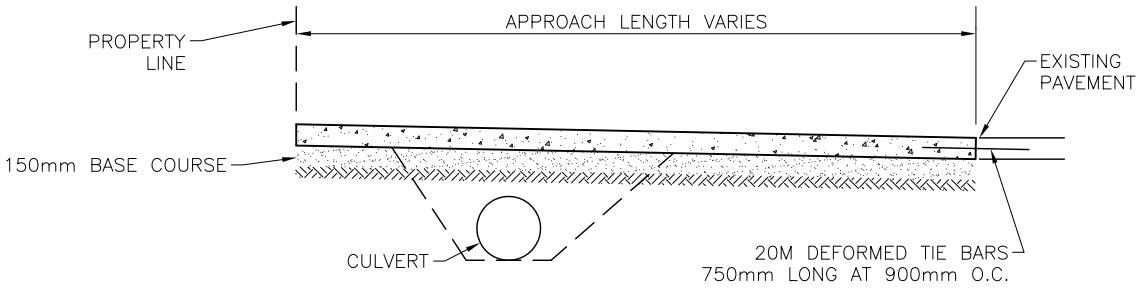
DATE	REVISION	BY

DRAWING NO. S8

REV. NO.



PLAN



TYPICAL CROSS SECTION

1) COMMERCIAL APPROACHES SHALL BE REINFORCED WITH A BAR MAT OF 12.7mm PLAIN BARS AT 600mm O.C. BOTH WAYS

DIMENSIONS ARE IN METERS

R.M. OF HANOVER

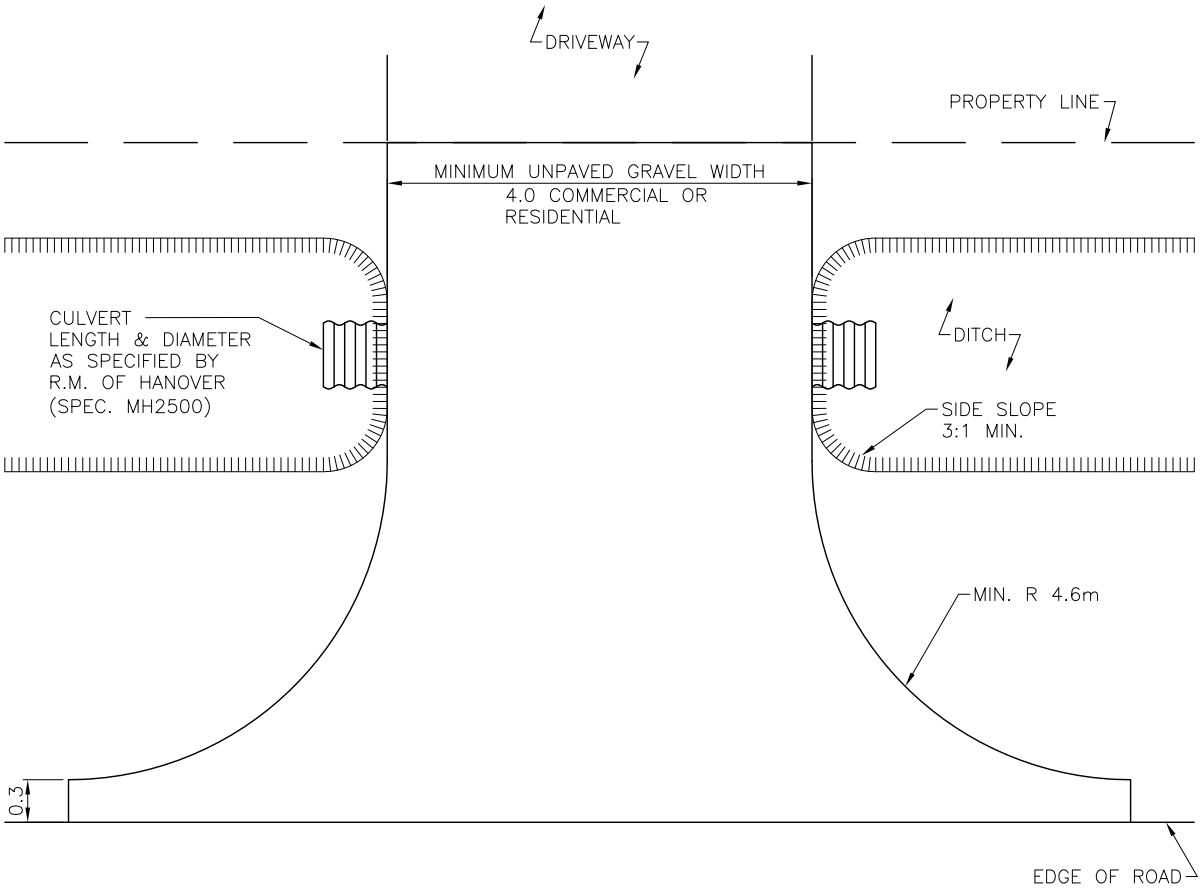
PRIVATE PAVED APPROACH FOR STREETS WITH DITCH DRAINAGE

DRAWN BY:	AE
DATE:	JAN 2014
SCALE:	NTS

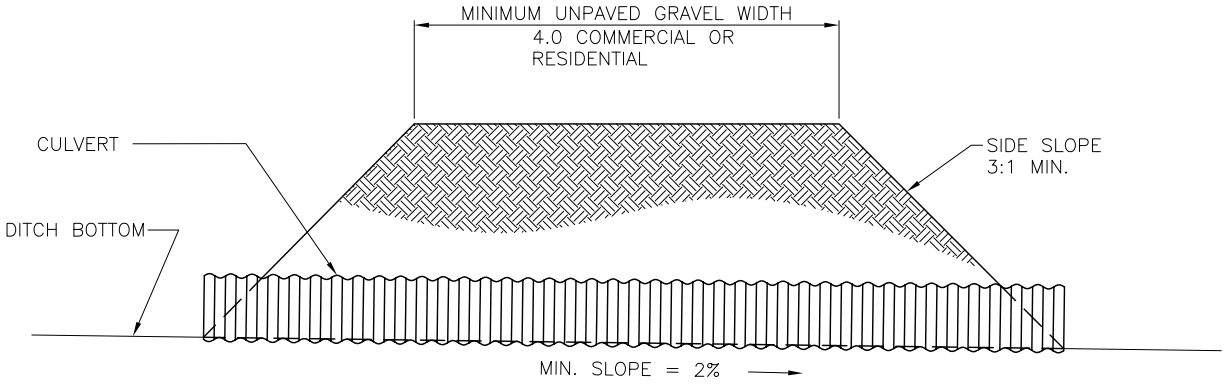
DATE	REVISION	BY

DRAWING NO. S9

REV. NO.



PLAN



TYPICAL CROSS SECTION

DIMENSIONS ARE IN METERS

R.M. OF HANOVER

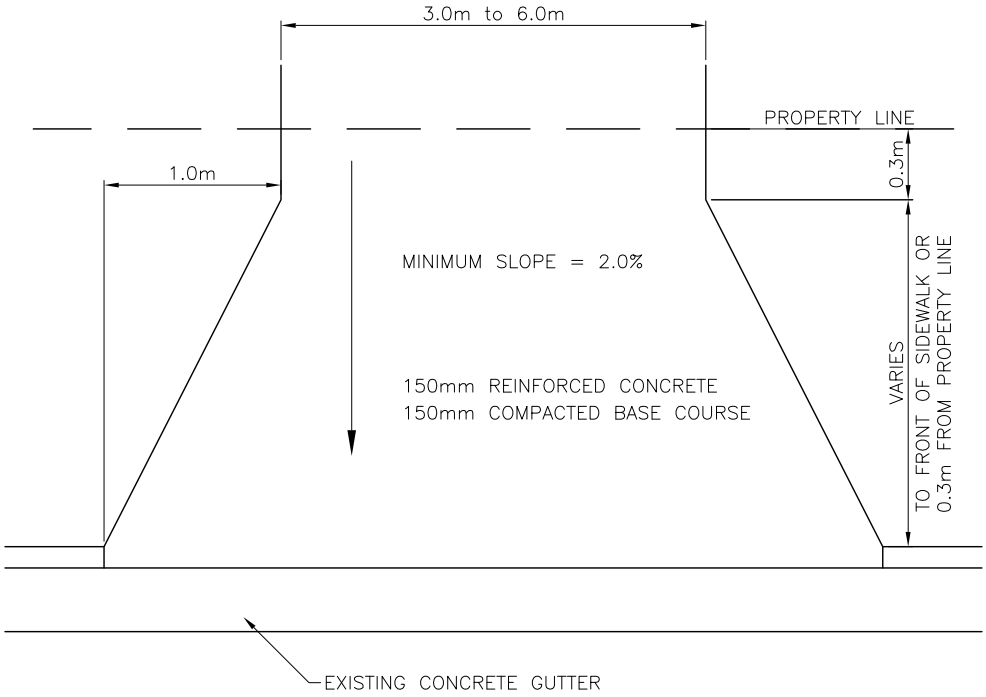
PRIVATE UNPAVED APPROACH FOR STREETS WITH DITCH DRAINAGE

DRAWN BY:	AE
DATE:	JAN 2014
SCALE:	NTS

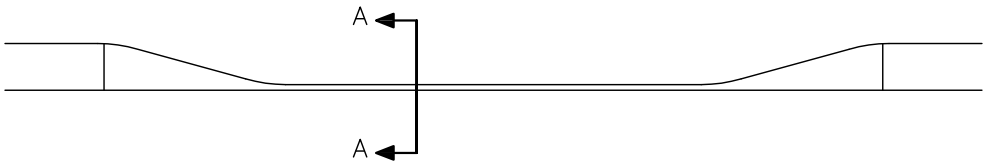
DATE	REVISION	BY

DRAWING NO. S10

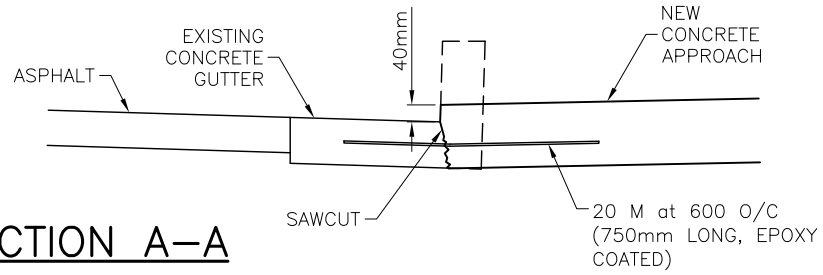
REV. NO.



TOP VIEW



FRONT VIEW



SECTION A–A

DIMENSIONS ARE IN MILLIMETERS

R.M. OF HANOVER

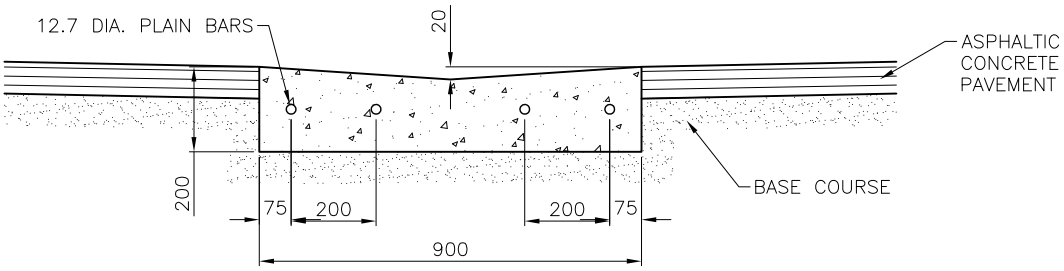
TYPICAL APPROACH OPENING
DETAIL (RESIDENTIAL)

DRAWN BY:	AE
DATE:	JAN 2014
SCALE:	NTS

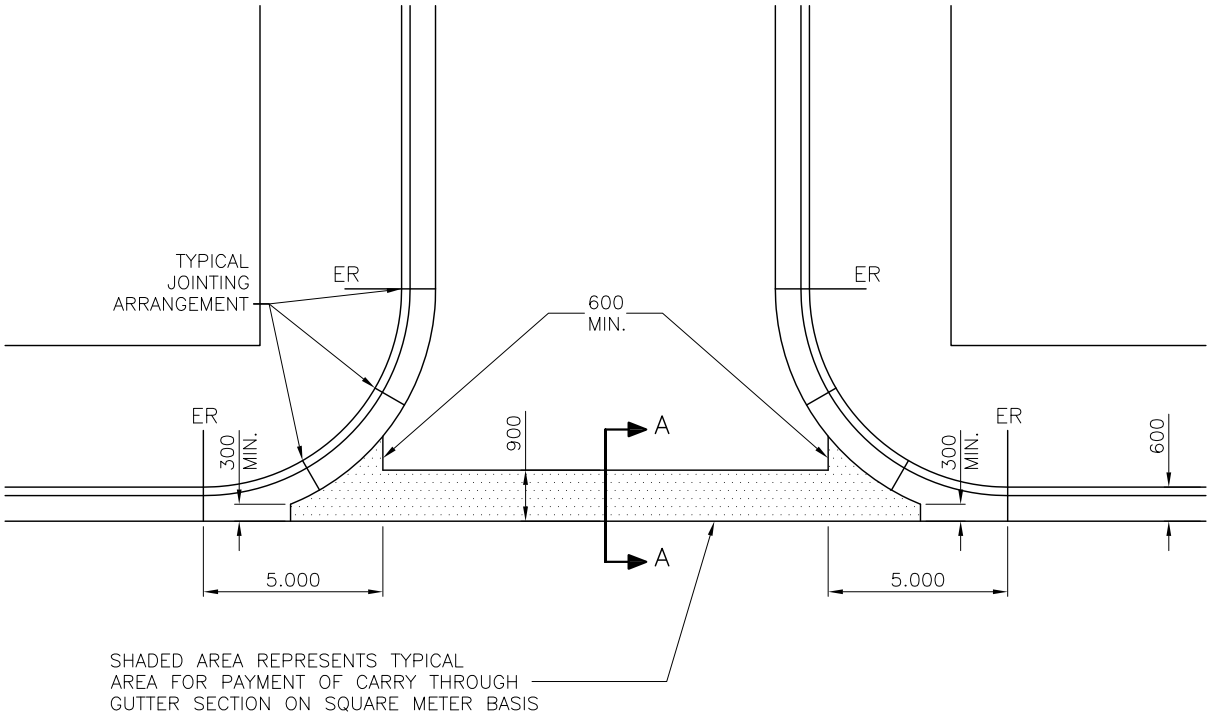
DATE	REVISION	BY

DRAWING NO. S11

REV. NO.



CROSS SECTION A–A



TYPICAL DRAINAGE CHANNEL

DIMENSIONS ARE IN MILLIMETERS

R.M. OF HANOVER

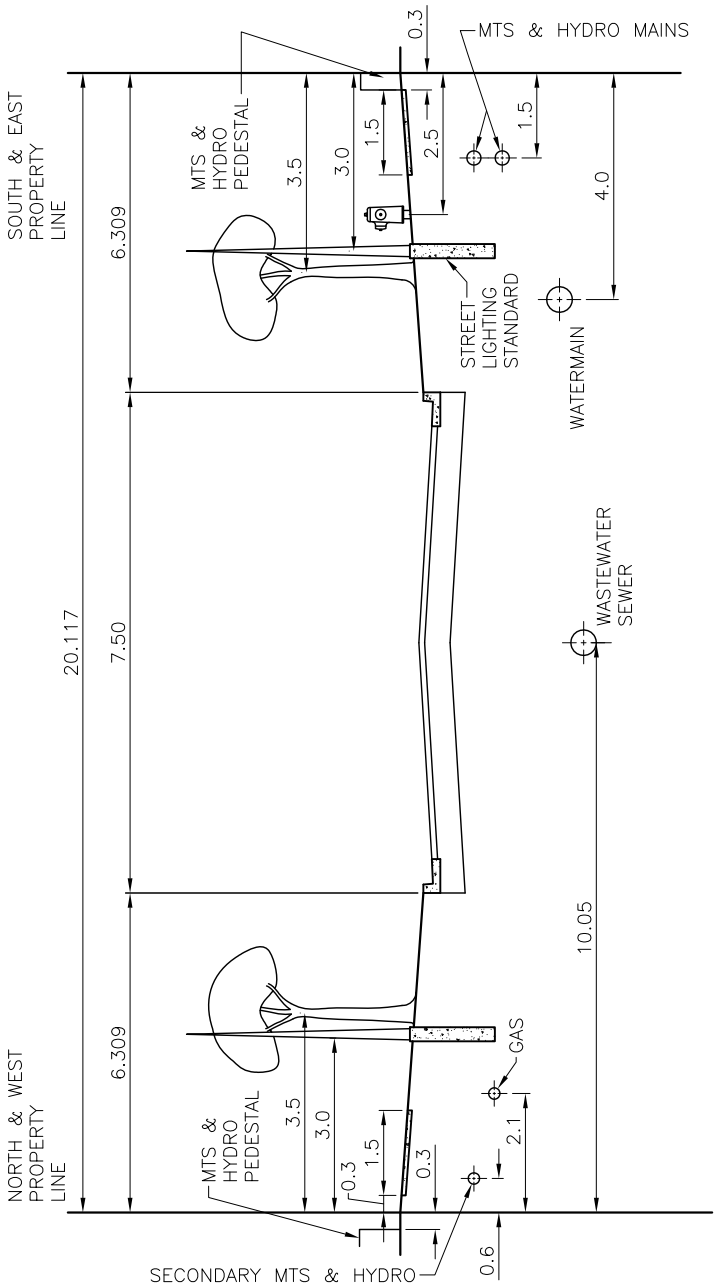
CONCRETE CARRY THROUGH GUTTER SECTION

DRAWN BY:	AE
DATE:	JAN 2014
SCALE:	NTS

DATE	REVISION	BY

DRAWING NO. S12

REV. NO.



DIMENSIONS ARE IN METERS

R.M. OF HANOVER

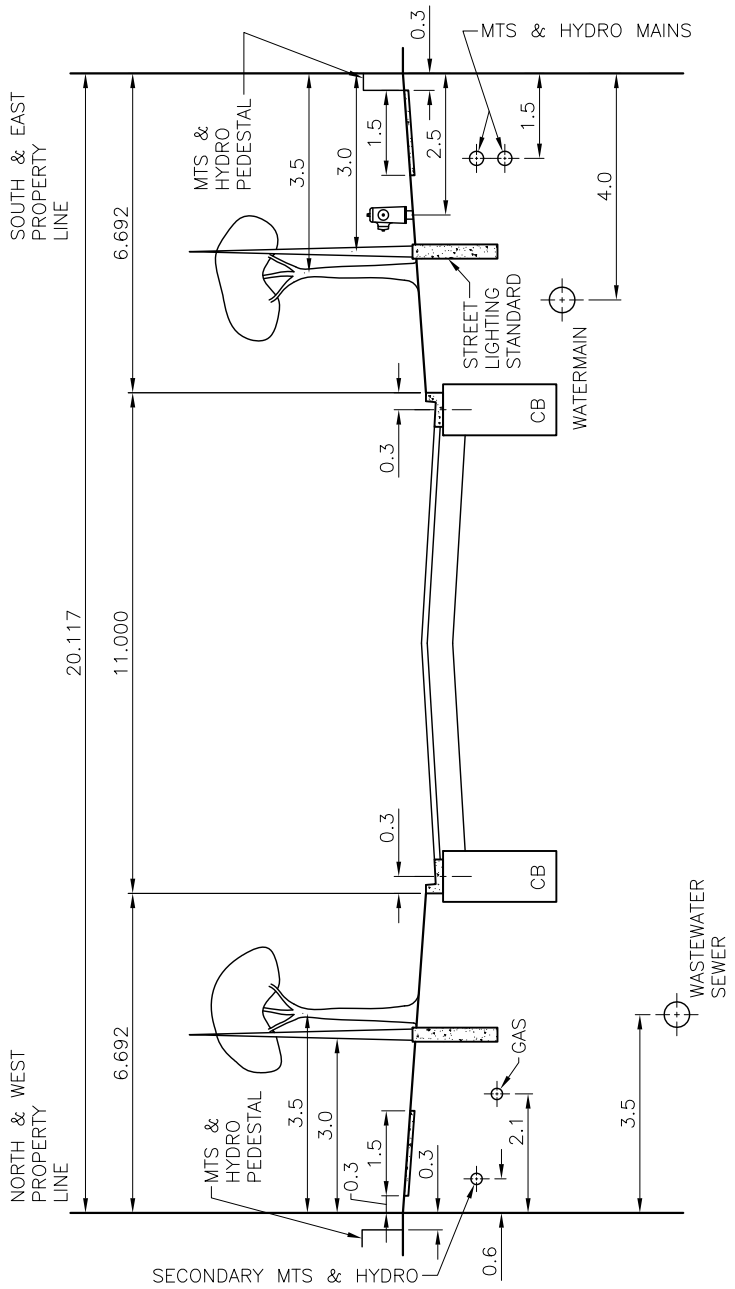
STANDARD LOCATIONS FOR UTILITY STRUCTURES LOCAL URBAN RESIDENTIAL STREET

DRAWN BY:	AE
DATE:	JAN 2014
SCALE:	NTS

DATE	REVISION	BY

DRAWING NO. S13

REV. NO.



DIMENSIONS ARE IN METERS

R.M. OF HANOVER

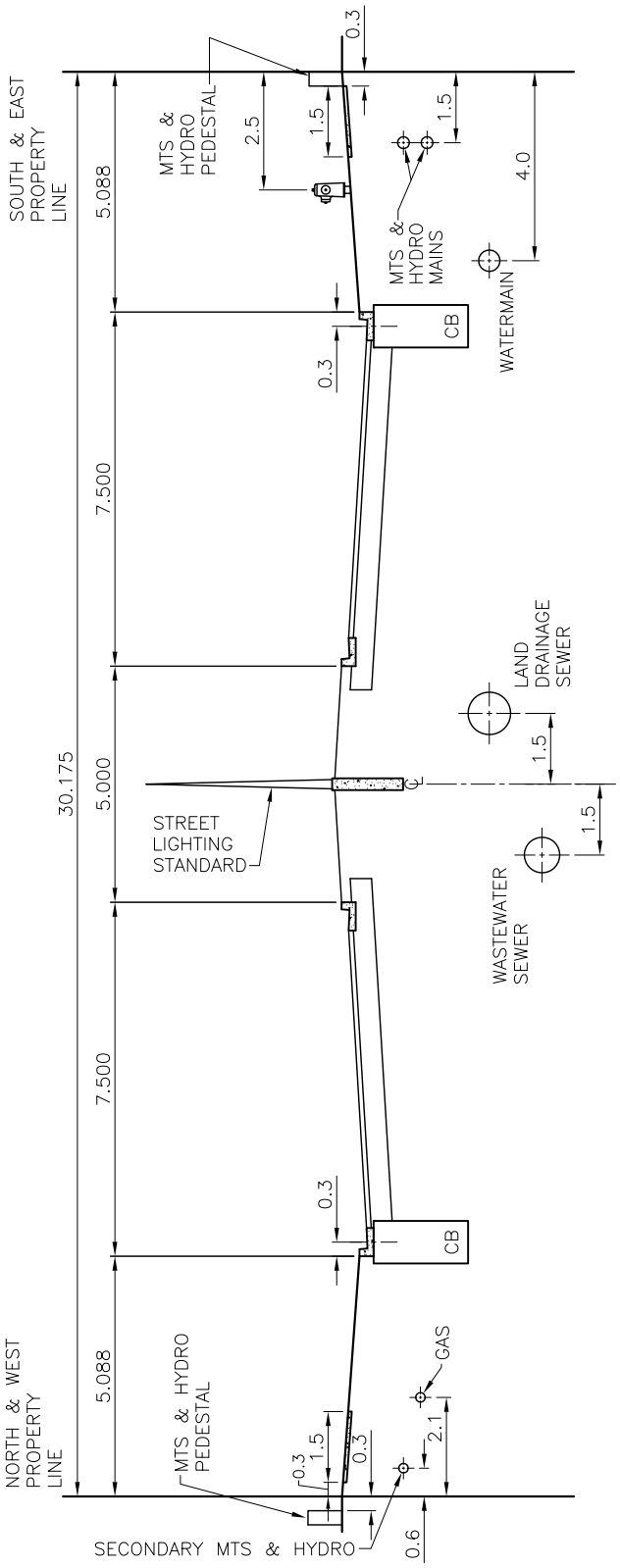
STANDARD LOCATIONS FOR UTILITY STRUCTURES LOCAL INDUSTRIAL OR RESIDENTIAL COLLECTOR

DRAWN BY:	AE
DATE:	JAN 2014
SCALE:	NTS

DATE	REVISION	BY

DRAWING NO. S14

REV. NO.



DIMENSIONS ARE IN METERS

R.M. OF HANOVER

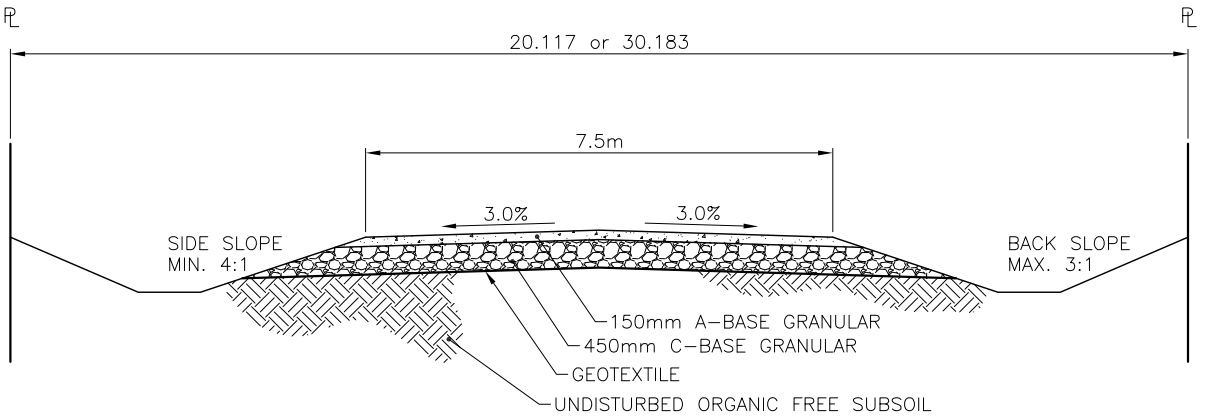
STANDARD LOCATIONS FOR UTILITY STRUCTURES MINOR ARTERIAL AND INDUSTRIAL COLLECTOR

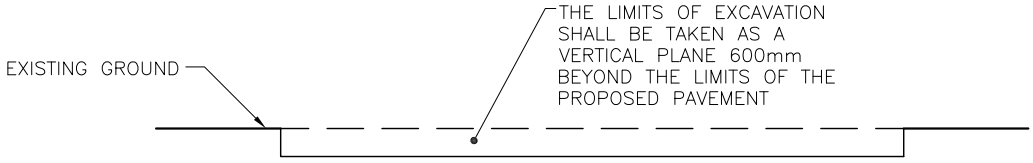
DRAWN BY:	AE
DATE:	JAN 2014
SCALE:	NTS

DATE	REVISION	BY

DRAWING NO. S15

REV. NO.





R.M. OF HANOVER

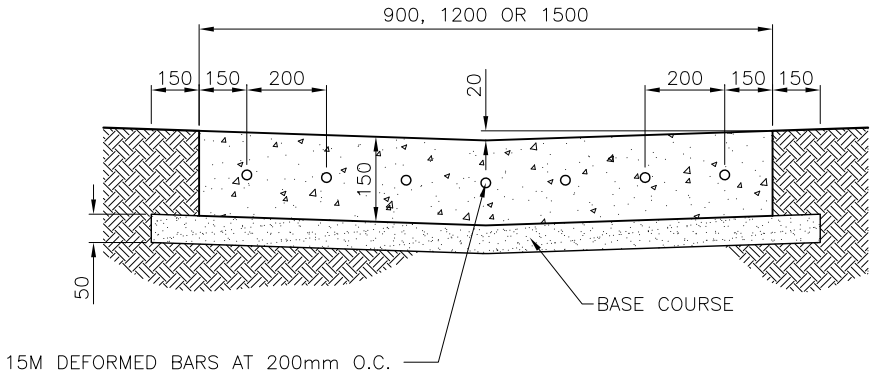
RURAL MUNICIPAL ROADWAY

DRAWN BY:	AE
DATE:	JAN 2014
SCALE:	NTS

DATE	REVISION	BY

DRAWING NO. S16

REV. NO.



NOTE: SAWCUT JOINTS EVERY 3.0m

TYPICAL DRAINAGE CHANNEL

R.M. OF HANOVER

CONCRETE DRAIN CHANNEL

DRAWN BY:	AE
DATE:	JAN 2014
SCALE:	NTS

DATE	REVISION	BY
09/01/17	Added total width of sidewalk	AE

DRAWING NO. S17

REV. NO.

UNDERGROUND WORKS
TABLE OF CONTENTS

STANDARD DETAILS

U1 - Symbols Legend
U2 - Standard Beddings and Backfills
U3 - Standard Beddings and Backfills
U4 - Standard Manhole Frame (Titan TF 101M)
U5 - Cast Iron Manhole Cover (Solid) (Titan TF 101M)
U6 - Cast Iron Manhole Cover (Grated) (Titan TF 101M)
U7 - Cast Iron Lifter Ring (Titan TF 101LR)
U8 - Barrier Curb and Gutter Inlet (Titan TF 103-4)
U9 - Lip Curb and Gutter Inlet (Titan TF 102)
U10 - Standard Manhole (for up to 525 mm pipe)
Ul1 - Standard Manhole (for 600 to 1500 mm pipe)
U12 - Precast Shallow Manhole
U13 - Main Valve Box
U14 - Curb Stop Box
U15 - Standard Fire Hydrant Assembly
U16 - Short Fire Hydrant Assembly
U17 - PVC Water Service Connection (25 to 50 mm dia.)
U17A - HDPE Water Service Connection (25 to 50 mm dia.)
U18 - Cast Iron Catch Basin Hood, Steel Hinge and Pin
U19 - Standard Catch Basin
U20 - Standard Catch Basin with Curb and Gutter Inlet
U21 - Horizontal Thrust Block Details
U22 - Vertical Thrust Block Details
U23 - Sewer Service Riser
U24 - New Gravity WWS Service Connection to Existing Main
U25 - Typical Low Pressure WWS Service Tie In to Low Pressure Main
U26 - Low Pressure WWS Service Connection to Gravity Main
U27A - Low Pressure Sewer Cleanout Assembly (On-Line) Detail
U27B - Low Pressure Sewer Cleanout Assembly (Off-Line) Detail

SPECIFICATION FOR EXCAVATION AND BACKFILL

1. GENERAL CONDITIONS

All standards in this edition, attached hereto, shall apply to and be a part of this Specification.

2. DESCRIPTION

This Specification shall cover all phases of excavation and backfill for the installation of Underground Works.

The work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies and all things necessary for and incidental to the satisfactory performance and completion of all work as shown on drawings and hereinafter specified.

3. MATERIALS

3.1 Supply, Handling and Storage of Materials

The Contractor shall be responsible for the supply, safe storage and handling of all materials set forth in this Specification. All materials shall be handled in a careful and workmanlike manner, to the satisfaction of the Engineering Manager.

3.2 Testing and Approval

All materials supplied under this Specification shall be subject to inspection and testing by the Engineering Manager or by the Testing Laboratory designated by the Engineering Manager. There shall be no charge to the Municipality for any materials taken by the Engineering Manager for testing purposes.

All materials shall be approved by the Engineering Manager before any construction is undertaken. If in the opinion of the Engineering Manager, such materials, in whole or in part, do not conform to the Specification detailed herein or are found to be defective in manufacture or have become damaged in transit, storage or handling operations, then such material shall be rejected by the Engineering Manager and replaced by the Contractor at his expense.

3.3 Granular Material

Granular material shall consist of sound, hard, pit run or crushed rock or crushed gravel and shall be free from organic or soft material, which would disintegrate through decay or weathering. The granular material to be supplied by the Contractor shall be well graded throughout and shall conform to the following grading requirements:

Canadian Metric Sieve Size	Percent of Total Dry Weight Passing
75 000	100%
25 000	80% - 100%
5 000	40% - 70%
2 000	25% - 50%
315	10% - 35%
80	5% - 30%

The material passing the 315 m sieve shall have a liquid limit not greater than twenty-five (25) and a plasticity index not greater than six (6).

3.4 Sand

Sand for bedding and backfilling shall be clean and free running. Under freezing conditions, dry sand shall be used. Sand shall conform to the requirements of CAN3-A23.1-M77.

Sand shall consist of evenly graded particles and shall conform to the following grading requirements:

Canadian Metric Sieve Size	Percent of Total Dry Weight Passing
10 000	100%
5 000	90% - 100%
630	25% - 60%
80	0% - 3%

4. EQUIPMENT

All equipment, implements, tools and facilities used shall be of a type approved by the Engineering Manager. The Contractor shall have sufficient standby equipment available at all times.

5. CONSTRUCTION METHODS

5.1 Excavation

Excavation shall include the required excavation, loading, hauling and disposal of all unsuitable in-situ material encountered, such as topsoil, frost-heaving clays, silts and rubbish, as well as surplus suitable subgrade material unless otherwise specified herein or in the Special Provisions.

Disposal of material shall comply with the requirements of Clause 5.3 of this Specification. The excavation shall not extend beyond the specified limits of excavation. The maximum width of the trench shall be 1000 mm or the maximum outside diameter of the pipe plus 750 mm, whichever is greater, from a point 300 mm above the top of the pipe to the bottom of the trench.

Excavation shall be to the alignment and grades shown on the drawings and as set in the field by the Engineering Manager. Vertical walls on all trenches shall be maintained, if at all possible without contravening any safety regulations or requirements. If, in the opinion of the Engineering Manager, it is impossible to maintain vertical walls or deep trenches, a "Y" type of excavation will be permitted to a point 300 mm above the top of the pipe. Trench walls below this point shall be maintained vertical by the use of special cages and protective devices as required by and to comply with the requirements of the latest revision of the Workplace Safety and Health Act.

At locations where unsuitable soil is encountered in the bottom of the trench, the Contractor shall remove and replace such soil with approved compacted granular material. The Engineering Manager shall determine the depth to which unsuitable soil will be removed. The granular material shall be compacted to 95% of Standard Proctor Density.

The ground adjacent to all excavation shall be graded to prevent water running into the trench. While the work is in progress, it shall be the Contractor's responsibility to keep all excavations, trenches, tunnels, and installed pipe free from water at all times at his expense. Written permission shall be secured from the Municipality before any water may be disposed of through municipal sewers.

The grades specified shall represent the invert elevations of the pipe. Sand bedding is required and the Contractor shall excavate to a depth of 100 mm below the bottom of the pipe. If the bottom of the excavation is taken out beyond the required depth, the over-excavation shall be refilled at the Contractor's expense with approved compacted granular material. The granular material shall be compacted to 95% of Standard Proctor Density.

If the work is stopped on the whole or any part of the trench, and the trench is left open for an unreasonable length of time in advance of the installation of the pipe, the Contractor shall, when directed by the Engineering Manager, refill such trench or part thereof until he is ready to proceed with the installation of the pipe.

If the Contractor should refuse, neglect, or fail to refill completely such trench with 48 hours of receipt of notice in writing to do so, the Engineering Manager shall have the trench refilled and the cost thereof shall be charged to the Contractor.

Alignment and grading of the bottom of all trenches shall be accurately maintained.

5.2 Bracing, Shoring and Cribbing

The Contractor shall furnish, put in place and maintain such sheeting, bracing and shoring as may be required to support the sides of the excavation and to prevent any movement which can in any way injure the pipes or masonry, diminish the necessary width of he excavation or otherwise injure or delay the work or endanger adjacent pavements, buildings or other structures. All bracing and shoring shall be installed in accordance with the requirements of the latest revision of the Workplace Safety and Health Act.

All bracing, shoring and cribbing shall be removed from the trench as backfilling proceeds unless ordered left in place by the Engineering Manager.

All bracing, shoring and cribbing is ordered to be left in place by the Engineering Manager, it shall be cut off at an elevation not less than 1000 mm below grade or as otherwise directed by the Engineering Manager.

5.3 Disposal of Material

Disposal of material shall be the hauling of material from the site to an approved disposal area, and the unloading and grading of the material in a manner satisfactory to the Engineering Manager. A disposal area shall be located by the Contractor and approved by the Engineering Manager. The Municipality shall reserve the right to direct excavated material to a local site of it's choosing.

Any material dropped or spilled during the hauling operations shall be promptly cleaned up by and at the expense of the Contractor, to the satisfaction of the Engineering Manager.

5.4 Backfill

For all pipe installations, sand backfill shall extend to a depth of 200 mm above the top of the pipe for the full trench width.

After the above initial backfilling has been completed and approved, the trench shall be backfilled to one of the backfill classes described below. The class of backfill to be used shall be as specified.

The Contractor shall make arrangements for a water supply source for construction operations. All costs for the supply of water shall be included in the price bid for watermains and/or sewers.

No boulders or rocks larger/than 150 mm, ice, snow, frozen material, organic material, or debris shall be permitted in the trench. These unsuitable materials shall be hauled away.

All surplus excavated material shall be hauled away and disposed of.

Where granular material is required, it shall be in accordance with Section 3 of this Specification.

The Contractor shall be held responsible for any subsequent settlement that occurs during the maintenance period of the Contract. Any damage resulting from the subsidence of the backfill shall be repaired by or paid for by the Contractor.

5.4.1 Class 1 Backfill

Class 1 backfill shall consist of backfilling the trench with compacted granular material to a depth of 1000 millimetres over the compacted sand. The remainder of the trench shall be unshrinkable fill to 300 millimetres below the specified grade for backfill. Unshrinkable fill shall be a blend of fine concrete aggregate, cement and water. A maximum of 70 kilograms of cement per cubic metre shall be used, unless otherwise specified by the Engineering Manager. Unless otherwise specified, the top 300 millimetres of the trench shall be backfilled with suitable excavated material and compacted to a density equivalent to that of the surrounding unexcavated material.

5.4.2 Class 2 Backfill

Class 2 backfilling shall consist of backfilling the trench to 300 mm below the grade specified for backfill with approved granular material in even layers and compacting each layer by mechanical means to a density of 90% of the maximum dry density as determined by the Standard Proctor Test. The Engineering Manager shall give approval to each compacted layer prior to proceeding with the next layer. Unless otherwise specified, the top 300 mm of the

trench shall be backfilled with excavated material and compacted to a density equivalent to that of the surrounding unexcavated material.

5.4.3 Class 3 Backfill

Class 3 backfilling shall consist of backfilling the trench with approved granular material to 300 mm below the grade specified for backfill, followed by jetting and flooding; then, unless otherwise specified, backfilling the top 300 mm of the trench with excavated material. Jetting and flooding shall be as specified in Clause 5.4.8 except that tamping with a drop hammer will not be required. Additional granular material as required shall be placed in the trench after each jetting and flooding operation to maintain the specified surface elevation. After the jetting and flooding operation has been completed, the final 300 mm depth of trench shall be backfilled with excavated material and shall be compacted by mechanical means to the level of the existing surface, or/specified grade, and to a density equivalent to that of the surrounding unexcavated material. This compaction shall be carried out over the full width and length of trench.

5.4.4 Class 4 Backfill

Class 4 backfilling shall consist of backfilling the trench with excavated material to the grade specified for backfill, in layers not exceeding 300 mm in thickness and compacting each layer of mechanical means to a density equivalent to that of the surrounding unexcavated material. Before proceeding with the next layer, the Engineering Manager shall give approval to the preceding layer of compacted backfill.

5.4.5 Class 5 Backfill

Class 5 backfilling shall consist of backfilling the trench with the excavated material to the grade specified for backfill, jetting, flooding, tamping, and then compacting the surface material to a density equivalent to that of the surrounding unexcavated material. Jetting, flooding, tamping and compacting shall be as specified in Clause 5.4.8 of this Specification.

After the upper surface of the trench has dried sufficiently, the Contractor shall backfill as required and compact the full width and length of the trench surface by mechanical means to the level of the existing surface or specified grade, and to a density equivalent to that of the surrounding unexcavated material.

5.4.6 Class 6 Backfill

Class 6 backfilling shall consist of backfilling the trench with the excavated material to the grade specified for backfill, jetting, flooding, and then compacting the surface material to a density equivalent to that of the surrounding unexcavated material. Jetting, flooding, and

compacting shall be as specified in Clause 5.4.8 of this Specification, except that tamping with a drop hammer is not required.

After the upper surface of the trench has dried sufficiently, the Contractor shall backfill as required and compact the full width and length of the trench surface by mechanical means to the level of the existing surface or specified grade, to a density equivalent to that of the surrounding unexcavated material.

5.4.7 Class 7 Backfill

Class 7 backfilling shall consist of backfilling the trench with the excavated material.

Surplus material shall be mounded over the trench to such height as permitted by the Engineering Manager, or shall be hauled/away and disposed of in accordance with Clause 5.3 of this Specification. If the material mounded over the trench is not sufficient to replace all subsidence, the Contractor shall import suitable material at his expense.

5.4.8 Jetting, Flooding and Tamping of Backfill

Where specified for each class of backfill, jetting, flooding and tamping of the granular or excavated material backfill shall be performed.

Pipes having a diameter of 25 mm and a minimum length of two (2.0) metres shall be connected by hoses to a water supply with sufficient pressure to permit water to be jetted into the trench backfill. The maximum interval between pipe locations shall be 1.5 m and pipes shall penetrate to a minimum depth of two (2.0) metres into the backfill. This interval shall apply both longitudinally and laterally, so that if the trench is 1.5 m or less in width, one pipe shall be inserted in the centre of the trench and on 1.5 m centres longitudinally. If the trench is from 1.5 m to 3.0 m wide, pipes shall be inserted in two rows across the width of the trench and on 1.5 m centres longitudinally; if the trench is from 3.0 m to 4.0 m wide, three rows of pipes shall be inserted across the width of the trench and on 1.5 m centres longitudinally. Wider trenches shall have proportionately more rows of pipes. Jetting and flooding shall be continued until settlement in the trench backfill has ceased. Additional material as required shall be placed in the trench after each jetting and flooding operation to maintain the specified surface elevation. During and following this jetting and flooding operation, the trench backfill shall be further compacted by tamping with a 1000 kg drop hammer dropping a minimum of three (3.0) metres onto the backfill. The compaction shall be carried out over the full width and length of trench until the degree of compaction is satisfactory to the Engineering Manager.

5.5 Backfill for Trenches Where Mains or Services Cross or Are in Close Proximity

At locations where mains or services cross or where a main or services crosses an existing trench that may settle, backfill and compaction shall be carried out as specified below.

Under no circumstances will the fill between crossing mains or services be other than compacted granular material. This shall apply to street mains and house connection piping between existing services or services previously installed by the Contractor.

5.5.1 New Mains or Services Crossing Above Existing Services

For the open cut installation of a new main or service which crosses an existing trench, where directed by the Engineering Manager, the Contractor shall remove the material from the existing trench down to the existing main or service to a maximum width of 1000 mm or the maximum outside diameter of the existing main or service exposed shall be 1500 mm or 500 mm beyond the outer edges of the new main or service to be installed, whichever is greater.

The trench, so excavated, shall be backfilled as "Class 2 Backfill". The compacted granular material shall extend to the underside of the bedding required for the new main.

5.5.2 New Mains or Services Crossing Below Existing or Proposed Mains or Services

For open cut installation of a new main or service, which is to be located lower than existing or proposed mains or services, the trench shall be backfilled as specified to the underside of the existing or proposed main or service. This trench backfill shall extend laterally for a minimum of 500 mm beyond either side of the outer edge of the existing or proposed service.

Existing services must be bedded and backfilled with sand to 200 mm above the pipe. The balance of the backfill above the existing services shall be as specified for the new main or service.

5.5.3 Installation of Parallel Mains

Where the alignments of sewers and/or watermains located in boulevard area have a very small separation and the trench width of the lower service causes the ground under the higher service to be disturbed, the lower trench is to be backfilled with granular material to the invert of the higher service.

At locations where an existing trench may settle, the Engineering Manager may direct the Contractor to consolidate the material in the trench by jetting, flooding, tamping and compacting the surface material, all as specified in Clause 5.4.5.

6. QUALITY CONTROL

6.1 Inspection

All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Engineering Manager including all operations from the selection and production of the materials through to final acceptance of the specified work. The Contractor shall be wholly responsible for the control of all operations incidental thereto not withstanding any inspection or approval that may be previously given. The Engineering Manager reserves the right to reject any materials or works that are not in accordance with the requirements of this Specification.

6.2 Access

The Engineering Manager shall be afforded full access for the inspection and control testing of constituent materials both at the site of work and at any plant used for the production of the materials, to determine whether the material is being supplied in accordance with this Specification.

6.3 Materials

All materials supplied under this Specification shall be subject to testing and approval by the Engineering Manager in accordance with Section 3 of this Specification.

SPECIFICATION FOR INSTALLATION OF WATERMAINS

1. GENERAL CONDITIONS

All standards in this edition, attached hereto, shall apply to and be a part of this Specification.

2. DESCRIPTION

This Specification shall cover the preparation of the pipe bed to receive the pipe, including the supply of bedding material, and the supply and placement of the pipe and accessories, as specified or shown on the drawings.

The work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies and all things necessary for and incidental to the satisfactory performance and completion of all work hereinafter specified.

3. MATERIALS

3.2 Supply, Handling and Storage of Materials

The Contractor shall be responsible for the supply, safe storage and handling of all materials set forth in this Specification. All materials shall be handled in a careful and responsible manner, to the satisfaction of the Engineering Manager

3.2 Testing and Approval

All materials supplied under this Specification shall be subject to inspection and testing by the Engineering Manager or by the Testing Laboratory designated by the Engineering Manager. There shall be no charge to the Municipality for any materials taken by the Engineering Manager for testing purposes.

All materials shall be approved by the Engineering Manager before any construction is undertaken. If in the opinion of the Engineering Manager, such materials, in whole or in part, do not conform to the Specification detailed herein or are found to be defective in manufacture or have become damaged in transit, storage or handling operations, then such material shall be rejected by the Engineering Manager and replaced by the Contractor at his expense.

3.3 Pipe, Fittings and Accessories

Polyvinyl Chloride (PVC) Pipe

PVC pipe for water distribution shall conform to AWWA Standard ANSI/AWWA C900-81, "Polyvinyl Chloride (PVC) Pressure Pipe 4 inch through 12 inch for Water". Pipe joints shall be push on type with rubber gasket seals capable of withstanding pressure equal to the rated pressure of the pipe and withstanding thermal expansion and contraction. Gaskets shall be oil and gas resistant type and shall conform to ASTM F477-76 and shall be supplied by the manufacturer of the pipe.

Fittings

All PVC watermain fittings shall be Class 150 for use with AWWA C900 PVC pipe and shall conform to ASTM D1598, ASTM D2837, and ASTM D1599.

Without limiting the generality of the foregoing "Fittings" shall be taken to mean tees, elbows of all angles, crosses, caps, plugs, increasers or reducers, "Y" connections and all other such appurtenances excepting valves and hydrants. Fittings installed in the ground shall be equipped with connections compatible with the type of pipe in use. Fittings installed in valve chambers shall have Victaulic joints. All nuts and bolts exposed to the ground on all fittings shall be T-316 Stainless Steel and plainly marked. All other exterior nuts and bolts to be minimum T-304 Stainless Steel.

3.4 Thrust Blocks

Thrust blocks shall be installed at all tees, wyes, elbows, bends, plugs, and crosses where required. Thrust blocks shall consist of concrete as specified in Specification MH 1600.

3.5 Sand

Sand for bedding and backfill shall be in accordance with Specification MH 1000.

4. EQUIPMENT

All equipment, implements, tools and facilities used shall be of a type approved by the Engineering Manager. The Contractor shall have sufficient standby equipment available at all times.

5. CONSTRUCTION

5.1 Excavation

Excavation shall be in accordance with Specification MH 1000.

5.2 Installation

5.2.1 Installation of Pipe

All pipe shall be installed on a thoroughly compacted 100 mm thick bed of sand placed in the bottom of the trench prior to installation of the pipe in the trench. This bed of sand shall be fully compacted and leveled throughout the full width of the trench to the exact grade specified, so that the barrel of the pipe shall be uniformly and fully supported throughout its full length. Compacted sand backfill shall extend to a minimum depth of 200 mm above the top of the pipe for the full trench width. The sand for bedding and backfill supplied by the Contractor, shall be well graded throughout and shall conform to the requirements detailed in Specification MH 1000.

The pipe shall be laid and fitted together so that, when complete, the watermain will have a smooth and uniform invert. The trench shall be free of water while the pipe is being installed and bedded. The excavation of the trench shall be fully completed a sufficient distance in advance so as not to interfere with the laying of the pipe. The exposed end of the pipe shall be fully protected with an approved stopper to prevent earth or foreign matter from entering the pipe. The interior of the pipe shall be kept free from all dirt, cement or superfluous material of every description as the work proceeds. Damaged pipes and those not meeting specifications shall not be used, and shall immediately be removed from the work site by the Contractor at his expense.

5.2.2 Installation of Hydrants and Valves

Installation of hydrants and valves shall be in accordance with Specification MH 1200.

5.2.3 Installation of Service Connections

New corporation stops of the proper size and located where specified to serve properties shall be installed in the new main according to Specification MH 1700 prior to testing and chlorination of the new main.

Service connection installation shall be carried out in accordance with Specifications MH 1700 and MH 1800.

5.2.4 Thrust Blocks

The thrust block shall bear against undisturbed soil only and the soil shall be cut smooth and at the proper angle to the pipe. No horizontal struts or braces required for trench bracing shall remain in the concrete thrust block. A bond breaker consisting of six (6) mil polyethylene sheeting shall be installed between fittings, valves, hydrants, or plugs and the concrete of the thrust block to allow future removal of the thrust block without disturbing the fitting, valve, hydrant or plug. Before any concrete is placed, all thrust block formwork shall be inspected and approved by the Engineering Manager.

5.3 Joints

Joints shall be compatible with this manual and made in strict accordance with the recommendations of the manufacturer.

5.4 Pipe Bedding and Backfill

The bedding and backfill shall be as specified and in accordance with this manual.

5.5 Connection to Existing Watermain

Operation of all line valves shall be in accordance with Standard Provision 10.

5.5.1 Tie Into Existing Watermain

At the specified location, the Contractor shall locate, excavate and expose existing plugs in tees, crosses, elbows or stubs. Existing thrust blocks shall be removed as required. Connect the new watermain to the existing tee, cross, elbow or stub.

5.5.2 Break Into Existing Watermain

At the specified location, the Contractor shall locate, excavate for and expose the existing watermain, break out and remove the necessary length of existing watermain, and install the required fittings, valve, new watermain pipe, thrust blocks and any other material necessary to complete the connection. Any damage to the existing main due to the carrying out of this work shall be repaired by the Contractor at his expense and to the satisfaction of the Engineering Manager.

5.6 Method of Backfilling

For all pipe installations sand backfill shall extend to a depth of 200 mm above the top of the pipe for the full trench width.

After the above initial backfilling has been completed and approved, the trench shall be backfilled as specified and to the requirements of Specification MH 1000.

5.7 Augering

Where specified or authorized by the Engineering Manager, the Contractor shall install the watermain by augering.

Excavation of shafts shall be in accordance with Specification MH 1000.

Shafts required for augering shall be straight wall type and shall be properly shored to ensure the safety of workmen and to prevent slippage and movement of the surrounding soils.

The size and location of such shaft shall be subject to approval by the Engineering Manager. No excavation shall be made until approval has been granted. The nearest edge of a shaft shall be a minimum of one (1.0) metre from the nearest edge of a pavement, approach or other structure under which the augering is to take place.

Augered holes shall not exceed the largest outside diameter of the pipe by more than 25 mm.

All joints in the pipe shall be made before the pipe is pushed into the auger hole. If, for any reason, a length of pipe has to be withdrawn from the augered hole, then the entire length of pipe already in the hole shall be moved back so as to ensure that the whole joint can be remade outside of the augered hole.

No method of installation whereby tension is applied to the pipe shall be permitted.

Where the alignment and/or grade of the augered hole does not meet the requirements of this Specification, the Contractor shall re-auger the hole. The Contractor will not be permitted to use pipe, fittings, bends, etc., to correct any such deviations in alignment or grade.

Pipe bedding and backfilling in the shafts shall conform to the requirements of this Specification.

5.8 Testing and Disinfection

Hydrostatic and leakage testing shall be in accordance with Specification MH 1910. Disinfection shall be in accordance with Specification MH 1920.

5.9 Flushing and Swabbing

Each section of the system shall be thoroughly cleaned by passing a foam swab, of appropriate diameter, through the pipe, followed by adequate flushing, where required.

6. QUALITY CONTROL

6.1 Inspection

All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Engineering Manager including all operations from the selection and production of materials through to final acceptance of the specified work. The Contractor shall be wholly responsible for the control of all operations incidental thereto notwithstanding any inspection or approval that may have been previously given. The Engineering Manager reserves the right to reject any materials or works that are not in accordance with the requirements of this Specification.

6.2 Access

The Engineering Manager shall be afforded full access for the inspection and control testing of construction materials, both at the site of work and at any plant used for the production of the materials to determine whether the material is being supplied in accordance with this Specification.

6.3 Materials

All materials supplied under this Specification shall be subject to testing and approval by the Engineering Manager in accordance with Section 3 of this Specification.

6.4 Line and Grade

The pipe supplied shall be installed to the specified line and grade and as set in the field by the Engineering Manager. Vertical variance from grade shall not exceed 50 mm and horizontal variance from line shall not exceed 100 mm. Sharp bends will not be permitted even though the pipe remains within these tolerances. Tees and bends shall be installed to the grades and the locations specified or where required to connect to existing watermains.

SPECIFICATION FOR INSTALLATION OF HYDRANTS AND VALVES

1. GENERAL CONDITIONS

All standards in this edition, attached hereto, shall apply to and be a part of this Specification.

2. DESCRIPTION

This Specification shall cover all phases of construction for the installation of hydrants and valves. Work to be included shall be the supply and installation of all hydrants complete with hydrant leads, tees and control valves, valves, and appurtenances, all excavation and backfill, and the construction of any valve pits required.

The work to be done by the Contractor under this Specification shall include the supply of all materials, and the furnishing of all superintendence, labour, overhead, equipment, tools, supplies and all other things necessary for and incidental to the satisfactory performance and completion of all work as hereinafter specified.

3. MATERIALS

3.1 Supply, Handling and Storage of Materials

The Contractor shall be responsible for the supply, safe storage and handling of all materials set forth in this Specification. All materials shall be handled and stored in a careful manner, in accordance with the manufacturer's recommendations and to the satisfaction of the Engineering Manager.

3.2 Gate Valves

Gate valves shall have resilient seals and shall conform to AWWA Standard ANSI/AWWA C509 3 inch through 12 inch for Water and Sewer Systems. Connections shall be bell-tite. Valves and fittings in valve pits shall have victaulic joints.

Gate valves shall be non-rising stem type with right hand to close threads. Gate Valves shall be capable of safely withstanding a working pressure of 1,000 kPa, and safely withstand a pressure of 2,000 kPa when open or closed. The operating nut shall be a 50 mm nut with an extension spindle extending no less than 450 mm below finished grade.

The gland and bonnet nuts and bolts and any other nuts and bolts, exposed to the atmosphere or ground, shall be T-316 stainless steel plainly marked.

Each gate valve shall be equipped with a vertically adjustable valve casing installed plumb and vertical. Valve casing shall be of sufficient length to accommodate specified cover with possible adjustment of 0.3 metres up or down. Valve casings shall have an inside diameter of not less than 150 mm and shall have a hinged cast iron lid. Lower valve casing body shall be complete with iron stone disc and WD 46 PVC casing centering disc. Valve casings upper section shall be Titan Foundry or approved equal, while lower sections shall be C900 PVC material.

Prior to backfilling, the Contractor shall wrap the valve and bottom one (1 m) metre of the valve casing with 6-mil polyethylene film to prevent any debris from entering the bottom of the valve casing.

3.3 Hydrant Connection

Hydrants shall conform to AWWA standard Dry Barrel Fire Hydrants for Ordinary Water Works Service, number ANSI/AWWA C502-80.

Every hydrant shall be compression type with nominal 150 mm valved connection to the main. Main connection shall be of the standard type of the watermain material.

Every hydrant shall have one 100 mm nominal pumper connection and two 64 mm nominal hose connections. Outlet nozzle caps shall be provided with steel chain connections. Hydrant shall be installed with pumper connection facing the street. All hydrants will have no more than one extension installed on the operating stem. Hydrant body above grade shall be painted with two coats of red paint. Hydrant barrel and bottom below grade shall be factory coated with coal tar pitch.

All hydrants shall have right hand to close operation. All flange bolts and nuts and any other nuts and bolts exposed to the ground shall be T-316 stainless steel plainly marked. All hydrants shall be self-draining unless specifically required to the contrary for areas with a high water table. All other exterior nuts and bolts are to be minimum T-304 stainless steel.

3.4 Base Block or Foundation

The pre-cast base block or foundation for hydrants shall be Sulphate-Resistant Cement concrete.

3.5 Thrust Blocks

Thrust blocks shall be installed at all bends, tees and crosses, and at the base of all hydrants. Thrust blocks at the rear of the hydrant base shall be installed in such a manner as not to interfere with the base flanged barrel bolts. A bond breaker consisting of 6 mil polyethylene sheeting shall be installed between fittings, valves, hydrants, or plugs and the

concrete of the thrust block to allow future removal of the thrust block without disturbing the fitting, valve, hydrant or plug. The entire face of the excavation against which the block will bear shall be undisturbed soil and shall be flat and at the proper angle with the pipe.

Concrete used for thrust blocks shall be Sulphate-Resistant Cement concrete.

The size and type of thrust blocks shall be in accordance with the Standard Details.

3.6 Valve Pits

Valve pits shall be constructed to the lines, grades and dimensions specified constructed using Sulphate-Resistant Cement concrete.

Valve chambers shall be constructed of precast concrete sections conforming to ASTM Standard C-76 Class 2. Sections shall be installed using gaskets, supplied by the manufacturer of the manhole sections.

4. CONSTRUCTION METHODS

4.1 General

The interior of all hydrants, valves, pipe fittings and other accessories shall be kept free from dirt and foreign matter at all times.

4.2 Hydrant Installation

Excavation, bedding and backfill shall be as specified in Specification MH 1000. The hydrants and hydrant leads shall be installed in accordance with the Standard Details. Hydrants shall be installed plumb.

All hydrant connection valves shall be installed so that the centre line of the control valve shall be a minimum of 900 mm and maximum 1200 mm from the centre line of the hydrant.

4.3 Valve Installation

Except for valves installed in a nit or for tanning valves, the base or bedding material shall be the same as used for the watermain. There shall be no lumber or concrete base material used.

All valves greater than 300 mm diameter shall be installed in concrete valve pits.

Valves in pits shall be provided with valve boxes as shown on the drawings of the valve pit.

All valves not installed in valve pits shall have a valve box of approved design.

All valves are to be installed with a valve spindle as shown in the Standard Details.

Backfill around valves shall be the same material and of the same standards as used to backfill the watermain. The valve box and valve shall be wrapped in polyethylene as specified in AWWA C-105 as shown in the Standard Details.

5. QUALITY CONTROL

5.1 Line and Grade

Hydrants and valve and any appurtenances required for their installation shall be installed to the line and grade specified or as set in the field by the Engineering Manager. Vertical variance from grade shall not exceed 50 mm and horizontal variance from line or location shall not exceed 100 mm.

SPECIFICATION INSTALLATION OF WATERMAINS RENEWALS

1. GENERAL CONDITIONS

All standards in this edition, attached hereto, shall apply to and be a part of this Specification.

2. DESCRIPTION

This Specification shall cover the preparation of the pipe bed to receive the pipe, including the supply of bedding material, and the supply and placement of the pipe and accessories.

The work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies and all other things necessary for and incidental to the satisfactory performance and completion of all work hereinafter specified.

3. MATERIALS

3.1 Supply, Handling and Storage of Materials

The Contractor shall be responsible for the supply, safe storage and handling of all materials set forth in this Specification. All materials shall be handled in a careful and responsible manner, to the satisfaction of the Engineering Manager.

3.2 Testing and Approval

All materials supplied under this Specification shall be subject to inspection and testing by the Engineering Manager or by the Testing Laboratory designated by the Engineering Manager. There shall be no charge to the Municipality for any materials taken by the Engineering Manager for testing purposes.

All materials shall be approved by the Engineering Manager before any construction is undertaken. If in the opinion of the Engineering Manager, such materials, in whole or in part, do not conform to the Specification detailed herein or are found to be defective in manufacture or have become damaged in transit, storage or handling operations, then such material shall be rejected by the Engineering Manager and replaced by the Contractor at his expense.

3.3 Pipe, Fittings and Accessories

Polyvinyl Chloride (PVC) Pipe

PVC pipe for water distribution shall conform to AWWA Standard ANSI/AWWA C900-81, "Polyvinyl Chloride (PVC) Pressure Pipe 4 inch through 12 inch for Water". Pipe joints shall be push on type with rubber gasket seals capable of withstanding pressure equal to the rated pressure of the pipe and withstanding thermal expansion and contraction. Gaskets shall be oil and gas resistant type and shall conform to ASTM F477-76 and shall be supplied by the manufacturer of the pipe.

Fittings

All PVC watermain fittings shall be Class 150 for use with AWWA C900 PVC pipe and shall conform to ASTM D1598, ASTM D2837, and ASTM D1599.

Without limiting the generality of the foregoing "Fittings" shall be taken to mean tees, elbows of all angles, crosses, caps, plugs, increasers or reducers, "Y" connections and all other such appurtenances excepting valves and hydrants. Fittings installed in the ground shall be equipped with connections compatible with the type of pipe in use. Fittings installed in valve chambers shall have Victaulic joints. All nuts and bolts exposed to the ground on all fittings shall be T-316 Stainless Steel and plainly marked. All other exterior nuts and bolts to be minimum T-304 Stainless Steel.

3.4 Thrust Blocks

Thrust blocks shall be installed at all tees, wyes, elbows, bends, plugs, and crosses where required. Thrust blocks shall consist of concrete as specified in Specification MH 1600.

3.5 Sand

Sand for bedding and backfill shall be in accordance with Specification MH 1000.

4. EQUIPMENT

All equipment, implements, tools and facilities used shall be of a type approved by the Engineering Manager. The Contractor shall have sufficient standby equipment available at all times.

5. CONSTRUCTION METHODS

5.1 Excavation

Excavation shall be in accordance with Specification MH 1000.

5.2 Existing Watermains and Services

For watermains installed on the same alignment as the existing main, the section of watermain to be renewed shall be turned off Existing valves which are to be left in place and sections of existing watermain not being renewed, to which water services are connected, shall be properly plugged and/or braced to maintain normal water pressure.

The existing watermain pipe shall be removed during excavation and the Contractor shall make arrangements at his own expense to supply any residences or business affected by the shutdown with a temporary pressurized water supply.

Where the new main is to be offset from the existing watermain, the existing watermain is to be kept in service and maintained until the new main is installed. If the Contractor should of necessity abandon the existing watermain prior to complete installation of the new watermain, the Contractor shall make arrangements at his own expense to supply any businesses or residences affected by the shutdown with an approved temporary pressurized water supply.

All turn-offs and turn-ons shall be in accordance with Standard Provision 10.

The existing water services shall be reconnected to the watermain renewal in accordance with Specifications MH 1700 and MH 1800.

This work includes locating the existing service, cutting or extending the existing service pipe as required, and reconnecting the service line to the new corporation stop.

Where directed by the Engineering Manager, the Contractor shall install a new service complete with a new stop and service box and shall connect to the watermain in accordance with Specifications MH 1700 and MH 1800.

5.3 Installation

5.3.1 Installation of Pipe

All pipe shall be installed on a thoroughly compacted 100 mm thick bed of sand placed in the bottom of the trench prior to installation of the pipe in the trench. This bed of sand shall be fully compacted and levelled throughout the full width of the trench to the exact grade specified, so that the barrel of the pipe shall be uniformly and fully supported throughout its full length. Compacted sand backfill shall extend to a minimum depth of 200 mm above the top of the pipe for the full trench width. The sand for bedding and backfill supplied by the Contractor, shall be well graded throughout and shall conform to the requirements detailed in Specification MH 1000.

The pipe shall be laid and fitted together that when complete the watermain will have a smooth and uniform invert. The trench shall be free of water while the pipe is being installed and bedded. The excavation of the trench shall be fully completed a sufficient distance in advance so as not to interfere with the laying of the pipe. The exposed end of the pipe shall be fully protected with an approved stopper to prevent earth or foreign matter from entering the pipe. The interior of the pipe shall be kept free from all dirt, cement or superfluous material of every description as the work proceeds. Damaged pipes and those not meeting specifications shall not be used, and shall immediately be removed from the work site by the Contractor at his expense.

5.3.2 Installation of Hydrants and Valves

Installation of hydrants and valves shall be in accordance with Specification MH 1200.

5.3.3 Installation of Service Connections

New corporation stops of the proper size and located where specified to serve properties shall be installed in the new main according to Specification MH 1700 prior to testing and chlorination of the new main. Testing and Chlorinating to be done in accordance with Specifications MH 1910 and MH 1920.

Service connection installation shall be carried out in accordance with Specifications MH 1700 and MH 1800.

5.3.4 Thrust Blocks

The thrust block shall bear against undisturbed soil only and the soil shall be cut smooth and at the proper angle to the pipe. No horizontal struts or braces required for trench bracing shall remain in the concrete thrust block. A bond breaker consisting of 6 mil polyethylene sheeting shall be installed between fittings, valves, hydrants, or plugs and the concrete of the thrust block to allow future removal of the thrust block without disturbing

the fitting, valve, hydrant or plug. Before any concrete is placed, all thrust block formwork shall be inspected and approved by the Engineering Manager.

5.4 Joints

Joints shall be compatible with this manual and made ill strict accordance with the recommendations of the manufacturer.

5.5 Pipe Bedding and Backfill

The bedding and backfill shall be as specified and in accordance with Specification MH 1000.

5.6 Connection to Existing Watermain

Operation of all line valves shall be in accordance with Standard Provision 10.

5.6.1 Tie Into Existing Watermain

At the specified location, the Contractor shall locate, excavate and expose existing plugs in tees, crosses, elbows or stubs. Existing thrust blocks shall be removed as required. Connect the new watermain to the existing tee, cross, elbow or stub.

5.6.2 Break Into Existing Watermain

At the specified location, the Contractor shall locate, excavate for and expose the existing watermain, break out and remove the necessary length of existing watermain, and install the required fittings, valve, new watermain pipe, thrust blocks and any other material necessary to complete the connection. Any damage to the existing main due to the carrying out of this work shall be repaired by the Contractor at his expense and to the satisfaction of the Engineering Manager.

5.7 Plugging Existing Watermains

Where existing watermains are to be cut off and abandoned, the abandoned section shall be effectively blocked at each end with a dry concrete mixture to the satisfaction of the Engineering Manager.

Where existing watermains are to be cut off and put back in service, they shall be plugged with a cast iron plug or cap to suit the type of pipe being blocked, held in place with a mild steel retaining clamp, which shall be protected against corrosion by wrapping with polyethylene as specified in AWWA C-l05, and braced with a concrete thrust block.

5.8 Repairs to Existing Watermains

The Contractor shall repair all breaks in existing watermains that occur within the contract area. These watermain breaks shall be defined as follows:

If a watermain break occurs during the installation of the watermain or water house connection service, due to actual physical contact with a piece of construction equipment, or due to a slide or cave-in caused by a lack of shoring and bracing or due to any other circumstances which could have been prevented by the Contractor, then the Contractor shall supply all labour and material and bear all costs in connection with the repairs to the breaks.

In any case, the Engineering Manager shall be the sole judge as to the classification of watermain breaks and his decision will be final.

5.9 Existing Valve, Valve Box and Hydrant Removal

Where there are existing valves on the existing watermain to be abandoned, the Contractor shall remove the valve, valve box and stem extensions. Excavation and backfill shall be in accordance with Specification MH 1000.

At the specified location the Contractor shall excavate and expose the existing hydrant and hydrant valve from the hydrant tee and hydrant drain.

Should the existing hydrant and/or hydrant valve, in the opinion of the Engineering Manager, be damaged by the Contractor's negligence, then the Contractor shall repair the existing hydrant and/or valve to the satisfaction of the Engineering Manager or if the damage is such that the hydrant and/or valve cannot be repaired, the Contractor shall replace the hydrant and/or valve all at his own expense.

All valves, fittings, pipe, hydrant assemblies, etc., salvaged from the existing mains due to disconnection of the existing watermains, shall be loaded and hauled to the Public Works yard.

5.10 Existing Sewer Services

Where a wastewater sewer connection is to be replaced to clear the new watermain, the Contractor shall install pipe as required and backfill to conform with the requirements of Specification MH 1900.

5.11 Method of Backfilling

For all pipe installations sand backfill shall extend to a depth of 200 mm above the top of the pipe for the full trench width.

After the above initial backfilling has been completed and approved, the trench shall be backfilled as specified and to the requirements of Specification MH 1000.

5.12 Augering

Where specified or authorized by the Engineering Manager, the Contractor shall install the watermain by augering.

Excavation of shafts shall be in accordance with Specification MH 1000.

Shafts required for augering shall be straight wall type and shall be properly shored to ensure the safety of workmen and to prevent slippage and movement of the surrounding soils.

The size and location of such shaft shall be subject to approval by the Engineering Manager. No excavation shall be made until approval has been granted. The nearest edge of a shaft shall be a minimum of 1.0 m from the nearest edge of a pavement, approach or other structure under which the augering is to take place.

Augered holes shall not exceed the largest outside diameter of the pipe by more than 25 mm.

All joints in the pipe shall be made before the pipe is pushed into the auger hole. If, for any reason, a length of pipe has to be withdrawn from the augered hole, then the entire length of pipe already in the hole shall be moved back so as to ensure that the whole joint can be remade outside of the augered hole.

No method of installation whereby tension is applied to the pipe will be permitted.

Where the alignment and/or grade of the augered hole does not meet the requirements of this Specification, the Contractor shall re-auger the hole. The Contractor will not be permitted to use pipe, fittings, bends, etc., to correct any such deviations in alignment or grade.

Pipe bedding and backfilling in the shafts shall conform to the requirements of this Specification

5.13 Testing and Disinfection

Hydrostatic and leakage testing shall be in accordance with Specification MH 1910. Disinfection shall be in accordance with Specification MH 1920.

.

6. QUALITY CONTROL

6.1 Inspection

All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Engineering Manager including all operations from the selection and production of materials through to final acceptance of the specified work. The Contractor shall be wholly responsible for the control of all operations incidental thereto notwithstanding any inspection or approval that may have been previously given. The Engineering Manager reserves the right to reject any materials or works that are not in accordance with the requirements of this Specification.

6.2 Access

The Engineering Manager shall be afforded full access for the inspection and control testing of construction materials, both at the site of work and at any plant used for the production of the materials to determine whether the material is being supplied in accordance with this Specification.

6.3 Materials

All materials supplied under this Specification shall be subject to testing and approval by the Engineering Manager in accordance with Section 3 of this Specification.

6.4 Line and Grade

The pipe supplied shall be installed to the line and grade specified and as set in the field by the Engineering Manager. Vertical variance from grade shall not exceed 50 mm and horizontal variance from line shall not exceed 100 mm. Sharp bends will not be permitted even though the pipe remains within these tolerances. Tees and bends shall be installed to the grades and the locations shown on the plans or where required to connect to existing watermains.

SPECIFICATION FOR INSTALLATION OR RECONSTRUCTION OF GRAVITY TYPE WASTEWATER SEWER AND LAND DRAINAGE SEWER

1. GENERAL CONDITIONS

All standards in this edition, attached hereto, shall apply to and be a part of this Specification.

2. DESCRIPTION

This Specification shall cover the supply and placement of wastewater and land drainage sewer pipe and accessories, all as specified or shown on the drawings.

The work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies and all other things necessary for and incidental to the satisfactory performance and completion of all work as shown on the drawings and hereinafter specified.

3. MATERIALS

3.1 Supply, Handling and Storage of Materials

The Contractor shall be responsible for the supply, safe storage and handling of all materials set forth in this Specification. All materials shall be handled and stored in a careful manner, in accordance with the manufacturer’s recommendations and to the satisfaction of the Engineering Manager.

3.2 Testing and Approval

All materials supplied under this Specification shall be subject to inspection and testing by the Engineering Manager or by the Testing Laboratory designated by the Engineering Manager. There shall be no charge to the Municipality for any materials taken by the Engineering Manager for testing purposes.

All materials shall be approved by the Engineering Manager before any construction is undertaken. If in the opinion of the Engineering Manager, such materials, in whole or in part, do not conform to the Specification detailed herein or are found to be defective in manufacture or have become damaged in transit, storage or handling operations, then such material shall be rejected by the Engineering Manager and replaced by the Contractor at his expense.

3.3 Pipe

For pipe diameters of 100 mm to 900 mm, PVC DR35 pipe shall conform to ASTM Standard D3034, and be certified to CSA B182.2. For pipe diameters of 450 mm to 900 mm, PVC large diameter ribbed gravity sewer pipe shall conform to ASTM F794-83 and be certified to CSA B182.4. Joints in polyvinyl chloride pipe shall be bell and spigot with rubber gaskets unless otherwise specified.

Precast Concrete Sewer Pipe

For pipe diameters of 450 mm and larger, concrete sewer pipe and specials shall conform to ASTM Standards C-76-76 arid C-361-76. All concrete sewers shall be installed using rubber gasket joints.

3.4 Cement Mortar

Cement Mortar shall consist of equal parts of Sulphate Resistant Portland Cement manufactured in accordance with CAN3-AS-M77 and Specification MH 1600, and clean sharp mortar sand mixed dry with only enough water added to make the mixture workable. Mortar that has begun to set shall not be used.

3.5 Sand

Sand for bedding and backfill shall be in accordance with Specification MH 1000.

3.6 Appurtenances

Tees, wyes and bends shall be injection molded or fabricated types. Their special shape shall be constructed with the same materials, and be of the same class, as the sewer pipe to which they are connected. PVC approved products: 250 mm and larger diameter fittings shall be the fabricated type only.

Where precast or preformed tees or wyes cannot be installed in the sewer main, special connections may be permitted. These special connections shall be made in accordance with the requirements of Specification MH 1900.

The precast or preformed junctions (Tee or Wye type) shall require the same bedding and backfilling as is required for the pipe itself Junctions installed for future connections shall be sealed with an approved plug prior to backfilling of the trench.

4. EQUIPMENT

All equipment, implements, tools and facilities used shall be of a type approved by the Engineering Manager. The Contractor shall have sufficient standby equipment available at all times.

5. CONSTRUCTION METHODS

5.1 Excavation

Excavation shall be in accordance with Specification MH 1000.

5.2 Installation of Pipe

All pipe shall be installed on a thoroughly compacted 100 mm thick bed of sand placed in the bottom of the trench prior to installation of the pipe in the trench. This bed of sand shall be fully compacted and leveled throughout the full width of the trench to the exact grade specified, so that the barrel of the pipe shall be uniformly and fully supported throughout its full length. Compacted sand backfill shall extend to a minimum depth of 200 mm above the top of the pipe for the full trench width. When flexible pipes such as PVC, Polyethylene or corrugated metal pipes are installed, the sand backfill shall be compacted to a minimum of 90% of Standard Proctor Density. Sand bedding and backfill in auger shafts shall be compacted to 90% Standard Proctor Density. The sand for bedding and backfill supplied by the Contractor shall be well graded throughout and shall conform to the requirements detailed in Specification MH 1000.

All bell and spigot pipe shall be laid with the bell upgrade. Sections of pipe shall be so laid and fitted together that when complete the sewer will have a smooth and uniform invert. All appurtenances shall be installed to the pipe as specified.

The trench shall be free of water while the pipe and appurtenances are being installed and bedded. The excavation of the trench shall be fully completed a sufficient distance in advance of the laying of the pipe so as not to interfere with the laying. The exposed end of the pipe shall be fully protected with an approved stopper to prevent earth or foreign matter from entering the pipe. The interior of the pipe shall be kept free from all dirt, cement or superfluous material of every description as the work proceeds. Damaged pipes and those not meeting specifications shall not be used, and shall immediately be removed from the work site by the Contractor at his expense.

5.3 Joints

Joints shall be compatible with this manual and made in strict accordance with the recommendations of the manufacturer.

5.4 Existing Sewer Flow Services During Reconstruction

Where a portion of an existing sewer is to be reconstructed, at the same grade and alignment, the existing pipe shall be removed during excavation and sewer flow diverted around the section under reconstruction. Written permission shall be obtained from the Engineering Manager to allow flow through the section under construction. All existing service connections shall be reconnected to junctions provided in the new sewer pipe unless written permission is received from the Engineering Manager allowing the use of service saddles. The Contractor may request permission from the Engineering Manager to plug and abandon the sewer being replaced if the alignment does not interfere with the reconstruction work.

5.5 Connection to Existing Stubs

The Contractor shall remove existing plugs and connect to existing sewers where shown on the construction drawings. Where required, trench shoring shall be used to protect existing pavement.

5.6 Break Into Existing Manholes or Sewers

The Contractor shall break into existing manholes or sewers at locations shown on the construction drawings. This work shall be performed according to the requirements of this Specification. Existing manhole floors shall be rechanneled and properly benched, the junction area shall be grouted to form a smooth joint, all debris including concrete and excavated material shall be removed and the vicinity of the connection shall be left in a tidy condition. Flow shall be maintained in the existing manhole or sewer.

When the installation of the pipe is by the open cut method or the auger method, the Contractor shall cut a neat hole in the sewer or manhole wall. The location shall be determined by the required alignment and grade of the new sewer pipe. An appropriate saddle shall be installed on the sewer pipe or a hole shall be cut in the manhole wall. The hole in the manhole wall shall be 25 mm larger than the outside diameter of the connecting pipe. The connecting pipe shall be set into the saddle or the hole in the manhole. Where the connecting pipe is set into the manhole, it shall make a watertight and structurally sound joint.

5.7 Plugging Existing Sewers

Where existing sewers are to be abandoned at a manhole or cut-off and abandoned, the abandoned section shall be effectively blocked at each end with a stiff concrete mixture to the satisfaction of the Engineering Manager.

5.8 Existing Sewer or Services

Where existing sewers are to be abandoned or regraded to clear the new sewer, the Contractor shall reinstall the service pipe as required and shall bed and backfill the pipe in accordance with Specification MH 1000.

Where sewer or water services are removed and replaced for the Contractor's convenience, the Contractor shall replace these services at his own expense. The Contractor shall also replace any damaged services at his expense.

Where sewer or water services must be removed, relocated, or replaced in order to allow installation of the new sewer main, the Engineering Manager will provide the Contractor with a written request to remove and replace or relocate the existing services.

5.9 Augering

Where specified herein, shown on the drawings, or authorized by the Engineering Manager during the course of the work, the Contractor shall install the sewer by augering. Excavation of shafts shall be in accordance with Specification MH 1000.

Shafts required for augering shall be straight wall type and shall be properly shored to ensure the safety of workmen and to prevent slippage and movement of the surrounding soils.

No excavation shall be made until approval has been granted by the Engineering Manager. The nearest edge of a shaft shall be a minimum of 1.0 m from the nearest edge of a pavement, approach or other structure under which the augering is to take place.

Augered holes shall not exceed the largest outside diameter of the pipe by more than 25 mm.

Where the alignment and/or grade of the augered hole is not in accordance with this Specification, the Contractor shall re-auger the hole. The Contractor will not be permitted to use pipe, fittings, bends, etc., to correct any such deviations in alignment or grade.

All joints in the pipe shall be made before the pipe is pushed into the hole. If, for any reason, a length of pipe has to be withdrawn form the augered hole, then the entire length of pipe already in the hole shall be moved back so as to ensure that the whole joint can be remade outside of the augered hole.

No method of installation whereby tension is applied to the pipe shall be permitted.

Pipe bedding and backfilling in the shafts shall conform to the requirements of this Specification.

5.10 Method of Backfilling

For all pipe installations sand backfill shall extend to a depth of 200 mm above the top of the pipe for the full trench width.

After the above initial backfilling has been completed and approved, the trench shall be backfilled as specified and to the requirements of Specification MH 1000.

6. QUALITY CONTROL

6.1 Inspection

All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Engineering Manager, including all operations from the selection and production of materials through to final acceptance of the specified work. The Contractor shall be wholly responsible for the control of all operations incidental thereto notwithstanding any inspection or approval that may have been previously given. The Engineering Manager reserves the right to reject any materials or works that are not in accordance with the requirements of this Specification.

6.2 Access

The Engineering Manager shall be afforded full access for the inspection and control testing of construction materials, both at the site of work and at any plant used for the production of the materials to determine whether the material is being supplied in accordance with this Specification.

6.3 Materials

All materials supplied under this Specification shall be subject to testing and approval by the Engineering Manager in accordance with Section 3.2 of this Specification.

6.3.1 Reinforced Concrete Pipe - 3 Edge Bearing Test

Reinforced concrete pipe that has been tested in 3 edge bearing to the 0.3 mm (0.01") crack criteria in accordance with ASTM C497 shall be accepted for use in the Work provided cracks do not extend through the pipe wall exposing the reinforcing steel and bells, spigots or joint grooves are not damaged.

6.4 Line and Grade

Sewer pipe shall be installed to the line and grade shown on the drawings and as set in the field by the Engineering Manager. Vertical variance from grade shall not exceed the following limits; the invert of the pipe shall not be more than 12 mm below the design grade nor more than 10 mm above the design grade and there shall be no dips which will allow ponding of water to a depth of more than 25 mm. Horizontal variance from line shall not exceed 100 mm. Sharp bends will not be permitted even though the sewer pipe remains within these tolerances. Electronic grade control shall be used throughout the duration of pipe installation.

Manholes, tees, wyes, reducers and bends shall be installed to the grades and the locations shown on the drawings. The allowable tolerance from the line and grade shall not exceed those specified for sewer pipe.

6.5 Testing

Upon completion of backfilling, the interior of the sewer shall be cleaned of all foreign material and shall be tested for alignment, obstructions, and infiltration. The Contractor shall provide for all labour, tools, rope, ball, lights, mirrors, and any other equipment necessary to examine all work as required by the Engineering Manager.

Where applicable the sewer shall be tested for alignment by a light test. The sewer shall not show any misalignment or displacement of pipe beyond the tolerances specified in this Specification, or any other defects.

The maximum allowable infiltration into the sewer for concrete pipe shall not exceed 50 L/24 h/100 mm diameter of pipe/100 m of pipe, including manholes. For PVC pipe the maximum allowable infiltration into the sewer shall not exceed 4.8 L/24 h/100 mm diameter of pipe/l00 m of pipe, including manholes. This shall be measured by a weir or current meter. Infiltration testing shall be carried out at the discretion of the Engineering Manager.

6.6 Television Inspection

Television inspection shall apply to sections greater than 30 metres in length or otherwise specified.

Where directed by the Engineering Manager, the Contractor shall provide a television inspection complete with videotape recording of any completed sewer system. The television inspection shall be done by personnel skilled and qualified in the use of the television inspection equipment. All televising and videotape equipment shall be of a type approved by the Engineering Manager. Inspection shall be between manholes or other appropriate locations where the equipment may be installed or removed from. The section to be inspected shall not be broken down into units smaller than the distance between

manholes or other appropriate locations as detailed above. All manhole benching shall be completed and the sewer shall be flushed or cleaned before the television inspection is done.

6.7 Deflection Testing of Flexible Sewer Pipe

A suitably designed device as defined below shall be pulled through the flexible sewer pipe to demonstrate that the pipe deflection does not exceed (0.15 x Dimension Ratio) percent of the base inside diameter of the pipe as defined in the ASTM standard to which the pipe is made. The device shall be pulled manually through the pipe not sooner than 24 hours after the completion of backfilling and installation of service connections and subsequent to and as a separate operation from the closed circuit television inspection.

The suitably designed device shall be a mandrel, cylindrical in shape, and constructed with an odd number of arms. The minimum diameter of the circle scribed around the outside of the mandrel arms shall be equal to the allowable computed deflected diameter -1.0 mm. The contact length of the mandrel shall be measured between the points of contact on the mandrel arm or between sets of prongs. This length shall not be less than that shown in the following table:

Nominal Pipe Size (millimetres)	Contact Length (millimetres)
250	200
300	250
350	300
375	300
400	300
450	350
525	450
600	500

The mandrel shall be checked with a go-no-go proving ring. The proving ring shall have a diameter equal to the computed deflected diameter +/- 0.1 mm. An acceptable mandrel shall not pass through the proving ring. The proving ring shall be fabricated from 6 mm minimum thick steel.

Any section of pipe that does not allow the mandrel to pass shall be considered to have failed the deflection test.

SPECIFICATION FOR INSTALLATION OF LOW PRESSURE TYPE WASTEWATER SEWERS AND SERVICES

1. GENERAL CONDITIONS

All standards in this edition, attached hereto, shall apply to and be a part of this Specification.

2. DESCRIPTION

This Specification shall cover the preparation of the pipe bed to receive the pipe, including the supply of bedding material, and the supply and placement of the pipe and accessories, as specified or shown on the drawings.

The work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies and all things necessary for and incidental to the satisfactory performance and completion of all work hereinafter specified.

3. MATERIALS

3.1 Supply, Handling and Storage of Materials

The Contractor shall be responsible for the supply, safe storage and handling of all materials set forth in this Specification. All materials shall be handled in a careful and responsible manner, to the satisfaction of the Engineering Manager

3.2 Testing and Approval

All materials supplied under this Specification shall be subject to inspection and testing by the Engineering Manager or by the Testing Laboratory designated by the Engineering Manager. There shall be no charge to the Municipality for any materials taken by the Engineering Manager for testing purposes.

All materials shall be approved by the Engineering Manager before any construction is undertaken. If in the opinion of the Engineering Manager, such materials, in whole or in part, do not conform to the Specification detailed herein or are found to be defective in manufacture or have become damaged in transit, storage or handling operations, then such material shall be rejected by the Engineering Manager and replaced by the Contractor at his expense.

3.3 Pipe, Fittings and Accessories

Polyvinyl Chloride (PVC) Pipe

PVC pipe for low pressure wastewater sewermains shall be PVC SDR26 Series 160 Potable Water certified to CSA B137.3, 100 mm to 300 mm. Pipe joints shall be push on type with rubber gasket seals capable of withstanding pressure equal to the rated pressure of the pipe and withstanding thermal expansion and contraction. Gaskets and lubricants used to join pipes shall be of a type compatible with the particular pipe or fitting being used.

High Density Polyethylene (HDPE) Pipe

HDPE pipe and fittings for low pressure wastewater sewermains shall be made from a PE 3408 high density polyethylene resin compound meeting cell classification 345434C per ASTM D3350; and meeting Type lll, Class C, Category 5, Grade P34 per ASTM D1238. HDPE pipe and accessories 4-inch diameter and larger, shall be 160 psi at 73.4°F meeting the requirements of Standard Dimension Ration (SDR) 17 as minimum strength.

Fittings

All PVC low pressure sewer fittings shall be rated for 200 psi for use with Series 160 PVC pipe and shall be certified to CSA B137.2 or B137.3.

Without limiting the generality of the foregoing "Fittings" shall be taken to mean tees, elbows of all angles, crosses, caps, plugs, increasers or reducers, "Y" connections and all other such appurtenances excepting valves. Fittings installed in the ground shall be equipped with connections compatible with the type of pipe in use. Fittings installed in valve chambers shall have Victaulic joints. All nuts and bolts exposed to the ground on all fittings shall be T-316 Stainless Steel and plainly marked. All other exterior nuts and bolts to be minimum T-304 Stainless Steel.

3.4 Thrust Blocks

Thrust blocks shall be installed at all tees, wyes, elbows, bends, plugs, and crosses where required. Thrust blocks shall consist of concrete as specified in Specification MH 1600.

3.5 Sand

Sand for bedding and backfill shall be in accordance with Specification MH 1000.

4. EQUIPMENT

All equipment, implements, tools and facilities used shall be of a type approved by the Engineering Manager. The Contractor shall have sufficient standby equipment available at all times.

5. CONSTRUCTION METHODS

5.1 Excavation

Excavation shall be in accordance with Specification MH 1000.

5.2 Installation

5.2.1 Installation of Pipe

All pipe shall be installed on a thoroughly compacted 100 mm thick bed of sand placed in the bottom of the trench prior to installation of the pipe in the trench. This bed of sand shall be fully compacted and levelled throughout the full width of the trench to the exact grade specified, so that the barrel of the pipe shall be uniformly and fully supported throughout its full length. Compacted sand backfill shall extend to a minimum depth of 200 mm above the top of the pipe for the full trench width. The sand for bedding and backfill supplied by the Contractor, shall be well graded throughout and shall conform to the requirements detailed in Specification MH 1000.

The pipe shall be laid and fitted together so that, when complete, the low pressure sewer will have a smooth and uniform invert. The trench shall be free of water while the pipe is being installed and bedded. The excavation of the trench shall be fully completed a sufficient distance in advance so as not to interfere with the laying of the pipe. The exposed end of the pipe shall be fully protected with an approved stopper to prevent earth or foreign matter from entering the pipe. The interior of the pipe shall be kept free from all dirt, cement or superfluous material of every description as the work proceeds. Damaged pipes and those not meeting specifications shall not be used, and shall immediately be removed from the work site by the Contractor at his expense.

5.2.2 Installation of Valves

Installation of valves shall be in accordance with Specification MH 1200. Valve box lids are to be marked "S" for sewer.

5.2.3 Installation of Service Connections

New corporation stops of the proper size and located where specified to serve properties shall be installed in the new main according to Specification MH 1700 prior to testing of the new main.
Service connection installation shall be carried out in accordance with Specifications MH 1700, and the Standard Details. Minimum service size to be 38 mm CTS.

5.2.4 Thrust Blocks

The thrust block shall bear against undisturbed soil only and the soil shall be cut smooth and at the proper angle to the pipe. No horizontal struts or braces required for trench bracing shall remain in the concrete thrust block. A bond breaker consisting of six (6) mil polyethylene sheeting shall be installed between fittings, valves, or plugs and the concrete of the thrust block to allow future removal of the thrust block without disturbing the fitting, valve, or plug. Before any concrete is placed, all thrust block formwork shall be inspected and approved by the Engineering Manager.

5.3 Joints

Joints shall be compatible with this manual and made in strict accordance with the recommendations of the manufacturer.

5.4 Pipe Bedding and Backfill

The bedding and backfill shall be as specified and in accordance with this manual.

5.5 Existing Sewer Flow and Services During Reconstruction

Where a portion of an existing sewer is to be reconstructed, at the same grade and alignment, the existing pipe shall be removed during excavation and sewer flow diverted around the section under reconstruction. Written permission shall be obtained from the Engineering Manager to allow flow through the section under construction. All existing service connections shall be reconnected to junctions provided in the new sewer pipe unless written permission is received from the Engineering Manager allowing the use of service saddles. The Contractor may request permission from the Engineering Manager to plug and abandon the sewer being replaced if the alignment does not interfere with the reconstruction work.

5.6 Connection to Existing Stubs

The Contractor shall remove existing plugs and connect to existing sewers where shown on the construction drawings. Where required, trench shoring shall be used to protect existing pavement.

5.7 Break Into Existing Manholes or Sewers

The Contractor shall break into existing manholes or sewers at locations shown on the construction drawings. This work shall be performed according to the requirements of this Specification. Existing manhole floors shall be rechanneled and properly benched, the junction area shall be grouted to form a smooth joint, all debris including concrete and

excavated material shall be removed and the vicinity of the connection shall be left in a tidy condition. Flow shall be maintained in the existing manhole or sewer.

When the installation of the pipe is by the open cut method or the auger method, the Contractor shall cut a neat hole in the sewer or manhole wall. The location shall be determined by the required alignment and grade of the new sewer pipe. An appropriate saddle shall be installed on the sewer pipe or a hole shall be cut in the manhole wall. The hole in the manhole wall shall be 25 mm larger than the outside diameter of the connecting pipe. The connecting pipe shall be set into the saddle or the hole in the manhole. Where the connection pipe is set into the manhole, it shall make a watertight and structurally sound joint.

5.8 Plugging Existing Sewers

Where existing sewers are to be abandoned at a manhole or cut-off and abandoned, the abandoned section shall be effectively blocked at each end with a stiff concrete mixture to the satisfaction of the Engineering Manager.

5.9 Existing Sewer or Water Services

Where existing sewers are to be abandoned or regraded to clear the new sewer, the Contractor shall reinstall the service pipe as required and shall bed and backfill the pipe in accordance with Specification MH 1000.

Where sewer or water services are removed and replaced for the Contractor's convenience, the Contractor shall replace these services at his own expense. The Contractor shall also replace any damaged services at his expense.

Where sewer or water services must be removed, relocated, or replaced in order to allow installation of the new sewer main, the Engineering Manager will provide the Contractor with a written request to remove and replace or relocate the existing services.

5.10 Method of Backfilling

For all pipe installations sand backfill shall extend to a depth of 200 mm above the top of the pipe for the full trench width.

After the above initial backfilling has been completed and approved, the trench shall be backfilled as specified and to the requirements of Specification MH 1000.

5.11 Augering

Where specified or authorized by the Engineering Manager, the Contractor shall install the sewermain by augering.

Excavation of shafts shall be in accordance with Specification MH 1000.

Shafts required for augering shall be straight wall type and shall be properly shored to ensure the safety of workmen and to prevent slippage and movement of the surrounding soils.

The size and location of such shaft shall be subject to approval by the Engineering Manager. No excavation shall be made until approval has been granted. The nearest edge of a shaft shall be a minimum of one (1.0) metre from the nearest edge of a pavement, approach or other structure under which the augering is to take place.

Augered holes shall not exceed the largest outside diameter of the pipe by more than 25 mm.

All joints in the pipe shall be made before the pipe is pushed into the auger hole. It for any reason, a length of pipe has to be withdrawn from the augered hole, then the entire length of pipe already in the hole shall be moved back so as to ensure that the whole joint can be remade outside of the augered hole.

No method of installation whereby tension is applied to the pipe shall be permitted.

Where the alignment and/or grade of the augered hole does not meet the requirements of this Specification, the Contractor shall re-auger the hole. The Contractor will not be permitted to use pipe, fittings, bends, etc., to correct any such deviations in alignment or grade.

Pipe bedding and backfilling in the shafts shall conform to the requirements of this Specification.

5.12 Testing

Hydrostatic and leakage testing shall be in accordance with Specification MH 1910, except that the test duration will be 2 hours, at a test pressure of 0.65 Mpa and with only one hour's worth of leakage allowed.

5.13 Flushing and Swabbing

Each section of the system shall be thoroughly cleaned by passing a foam swab, of appropriate diameter, through the pipe, followed by adequate flushing, where required.

6. QUALITY CONTROL

6.1 Inspection

All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Engineering Manager including all operations from the selection and production of materials through to final acceptance of the specified work. The Contractor shall be wholly responsible for the control of all operations incidental thereto notwithstanding any inspection or approval that may have been previously given. The Engineering Manager reserves the right to reject any materials or works that are not in accordance with the requirements of this Specification.

6.2 Access

The Engineering Manager shall be afforded full access for the inspection and control testing of construction materials, both at the site of work and at any plant used for the production of the materials to determine whether the material is being supplied in accordance with this Specification.

6.3 Materials

All materials supplied under this Specification shall be subject to testing and approval by the Engineering Manager in accordance with Section 3 of this Specification.

6.4 Line and Grade

The pipe supplied shall be installed to the specified line and grade and as set in the field by the Engineering Manager. Vertical variance from grade shall not exceed 50 mm and horizontal variance from line shall not exceed 100 mm. Sharp bends will not be permitted even though the pipe remains within these tolerances. Tees and bends shall be installed to the grades and the locations specified or where required to connect to existing sewermains.

SPECIFICATION FOR INSTALLATION OF SEWER MANHOLES AND CATCHBASINS

1. GENERAL CONDITIONS

All standards in this edition, attached hereto, shall apply to and be a part of this Specification.

2. DESCRIPTION

This Specification shall cover the supply and installation of manholes on new or existing sewers, and catch basins, all as specified or shown on the drawings.

The work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies and all other things necessary for and incidental to the satisfactory performance and completion of all work as shown on the drawings and hereinafter specified.

3. MATERIALS

3.1 Supply, Handling and Storage of Materials

The Contractor shall be responsible for the supply, safe storage and handling of all materials set forth in this Specification. All materials shall be handled and stored in a careful manner, in accordance with the manufacturer's recommendations and to the satisfaction of the Engineering Manager.

3.2 Testing and Approval

All materials supplied under this Specification shall be subject to inspection and testing by the Engineering Manager or by the Testing Laboratory designated by the Engineering Manager. There shall be no charge to the Municipality for any materials taken by the Engineering Manager for testing purposes.

All materials shall be approved by the Engineering Manager before any construction is undertaken. If in the opinion of the Engineering Manager, such materials, in whole or in part, do not conform to the Specification detailed herein or are found to be defective in manufacture or have become damaged in transit, storage or handling operations, then such material shall be rejected by the Engineering Manager and replaced by the Contractor at his expense.

3.3 Manholes

Manholes shall be constructed of monolithic concrete, reinforced monolithic concrete, or precast reinforced concrete. Precast reinforced concrete manhole sections shall be constructed in accordance with ASTM Specification C76 Class II or C478. Sulphate-Resistant Portland cement shall be used in the manufacture of all manholes. The cement shall be manufactured in accordance with Specification CAN3-A5-M77 and the concrete shall conform to the requirements stated in Specification MH 1600. The manholes shall be in accordance with the Standards Drawings.

3.4 Catch basins

Catchbasins shall be constructed of monolithic concrete, reinforced monolithic concrete, or precast reinforced concrete as shown in the Standard Details. Sulphate-Resistant Portland cement shall be used in the manufacture of catchbasins. The cement shall be manufactured in accordance with CAN3-AS-M77 and the concrete shall conform to the requirements stated in Specification MH 1600.

3.5 Frames and Covers

Frames and covers for manholes and catchbasins shall conform to the dimensions in the Standard Details.

All frames and covers to be installed in roadways are to be machined.

All units are to be true to the required pattern, free of cracks, gas holes, flows and excessive roughness. Patterns shall be Titan Foundry's TF101M, TF102, TF103-4, as required, or approved equal. Cover opening shall be bicycle-safe.

3.6 Cement Mortar

Cement Mortar shall consist of equal parts of Sulphate-Resistant Portland Cement manufactured in accordance with CAN3-A5-M77 and clean sharp mortar sand mixed dry with only enough water added to make the mixture workable, all in accordance with Specification MH 1600. Mortar that has begun to set shall not be used.

4. EQUIPMENT

All equipment, implements, tools and facilities used shall be of a type approved by the Engineering Manager. The Contractor shall have sufficient standby equipment available at all times.

5. CONSTRUCTION METHODS

5.1 Excavation

Excavation shall be in accordance with Specification MH 1000.

5.2 Installation

At the locations specified, the Contractor shall install a manhole or catchbasin on new or existing sewers and connect the new or the existing sewers to the manhole or catch basin. Manholes and catchbasins shall be constructed as specified. The size and type of catchbasin shall be as specified.

As an alternative to the precast type of manhole base, the Contractor may use an open type base to straddle the existing sewer. The bottom of the manhole may then be cast-in-place after the reinforcing has been placed as required for a precast manhole. The top of the sewer must then be broken out and a smooth channel formed along the bottom of the manhole.

The Contractor shall maintain existing sewer flows at all times.

Should the existing sewer be damaged in any way due to the Contractor's operation, the Contractor shall repair any such damage and clean out the existing sewer as directed by the Engineering Manager.

5.2.1 Manhole Gaskets

Preformed bituminous gaskets such as Ram-NEK, flexible butyl rubber joint sealant such as Kent Seal No.2 or approved equal shall be used between all precast concrete manhole sections including adjusting rings and shall be placed between the cover frame and the concrete on all manholes so as to provide a watertight manhole. This shall apply to manholes on both wastewater and storm sewers.

5.2.2 Wrapping of Manholes

All manholes shall be wrapped with one layer of 6-mil polyethylene sheet from immediately below the cover to a depth of three metres (3.0 m) below the ground surface.

5.3 Method of Backfilling

The space between the outside of the manhole or catchbasin and the wall of the excavated area shall be backfilled to the requirements of Specification MH 1000.

6. QUALITY CONTROL

All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Engineering Manager, including all operations from the selection and production of materials through to final acceptance of the specified work. The Contractor shall be wholly responsible for the control of all operations incidental thereto notwithstanding any inspection or approval that may have been previously given. The Engineering Manager reserves the right to reject any materials or works that are not in accordance with the requirements of this Specification.

6.2 Access

The Engineering Manager shall be afforded full access for the inspection and control testing of construction materials, both at the site of work and at any plant used for the production of the materials to determine whether the material is being supplied in accordance with this Specification.

6.3 Materials

All materials supplied under this Specification shall be subject to testing and approval by the Engineering Manager in accordance with Section 3 of this Specification.

6.4 Line and Grade

Manhole or catch basins shall be installed to the line and grade specified and as set in the field by the Engineering Manager. Vertical variance from grade and horizontal variance from line shall not exceed the requirements of Specification MH 1400.

SPECIFICATIONS FOR CONCRETE TO BE USED IN UNDERGROUND WORKS

1. GENERAL CONDITIONS

All standards in this edition, attached hereto, shall apply to and be a part of this Specification.

2. DESCRIPTION

This Specification shall cover the preparation of sulphate-resistant concrete for, and all concreting operations relating to, the construction of monolithic tunnel sewers, structures, pipe cradles, skin coats, thrust blocking buttresses, anchors and other related concrete works. This Specification is applicable to both reinforced and non- reinforced concrete construction, but not prestressed concrete. Sulphate-resistant cement shall be used for all concrete that is below ground level.

The work to be done by the Contractor under this Specification shall include the supply of all materials, and the furnishing of all superintendence, overhead, labour, equipment, tools, supplies and all other things necessary for and incidental to the satisfactory performance and completion of all work as hereinafter specified.

3. MATERIALS

3.1 General

The Contractor shall be responsible for the supply and safe storage and handling of all materials set forth in this Specification.

3.2 Handling and Storage of Materials

All materials shall be handled and stored in a careful and responsible manner, to the satisfaction of the Engineering Manager. Storage of materials shall be in accordance with the requirements of CAN3-A23.1-M77 Section 9, Storage of Materials, except as otherwise specified herein.

3.3 Testing and Approval

All materials supplied under this Specification shall be subject to inspection and testing by the Engineering Manager or by the Testing Laboratory designated by the Engineering Manager. There shall be no charge to the Municipality for any materials taken by the Engineering Manager for testing purposes.

All materials shall conform to CAN3-A23.1-M77.

All materials shall be approved by the Engineering Manager before any construction is undertaken. If: in the opinion of the Engineering Manager, such materials, in whole or in part, do not conform to the Specification detailed herein or are found to be defective in manufacture or have become damaged in transit, storage or handling operations, then such material shall be rejected by the Engineering Manager and replaced by the Contractor at his expense.

3.4 Portland Cement Concrete Constituent Materials

3.4.1 Aggregates

The Contractor shall furnish in writing to the Engineering Manager the location of the sources where aggregate will be obtained ill order that it may be inspected and tentatively approved by the Engineering Manager. Changes in the source of aggregate supply during the course of the Contract shall not be permitted without notification in writing to and the express approval of the Engineering Manager.

(a) Fine Aggregate

Fine aggregate shall conform to the requirements of CAN3-A23.1-M77, Section 5, Aggregates.

(b) Coarse Aggregate

Coarse aggregate shall conform to the requirements of CAN3-A23.1-M77, Section 5, Aggregates.

The grading of coarse aggregates shall conform to the requirements of Table 3, Group 1 Aggregate, CAN3-A23.1-M77.

3.4.2 Cement

All cement used shall be Type 50 Sulphate-Resistant Portland Cement conforming to the requirements of CAN3-A5-M77, Portland Cement.

Cement shall be kept in weathertight storage that will protect it from moisture and contamination, and in such a manner as to permit inspection, sampling and identification, where required, of each lot.

Check tests of cement which has been previously approved by the Engineering Manager will be made from time to time by the Engineering Manager and any cement which fails to comply with the requirements of CAN3-A5-M77 shall be rejected, notwithstanding any certificate of acceptance that may have been previously given. Cement that has been

TABLE MH 1600

CONCRETE REQUIREMENTS FOR UNDERGROUND WORKS

Portion of Structure	Maximum Size of Aggregate Based on Square Openings (mm)	Cement Type	Maximum Water Cement Ratio	Minimum Specified Compressive Strength at 28 days (MPa)	Maximum Allowable Slump (mm)	Air Cement (%)	Minimum Cement (kg/m^3)
A) Monolithic Sewers, Structures, All Other Concrete not included in "B"							
i) For Thickness less than 200 mm	20	50 Sulphate-Resistant	0.45	30	80	3-6	320
ii) For thickness equal to or greater than 200 mm	4	50 Sulphate-Resistant	0.45	30	80	3-6	320
B) Pipe cradles, Skin Coats, Thrust Blocks, Buttresses, Anchors	40	50 Sulphate-Resistant	0.55	20	100	3-6	240

rejected for any reason must be removed immediately by the Contractor at his expense.

3.4.3 Water

Water used for mixing concrete and for curing shall be clean and free from injurious amounts of oil, acid, alkali, organic matter or other deleterious substances. It shall be equal to potable water in physical and chemical properties.

3.4.4 Admixtures

No admixture, other than Air-Entraining Agent and Type WN Water Reducing Agent, shall be used without the written authorization of the Engineering Manager, unless otherwise specified.

(a) Air-Entraining Agent

The Air-Entraining Agent shall conform to the requirements of CAN3-A266.1-M.

(b) Water-Reducing Agent

The Water-Reducing Agent shall be Type WN and shall conform to the requirements of CAN3-A266.2-M.

(c) Other Admixtures

No other admixtures will be authorized for use in Portland Cement Concrete unless specifically authorized in writing by the Engineering Manager.

3.4.5 P.V.C. Waterstops

Except in monolithic sewer construction, the Contractor shall provide an approved type of waterstop for all construction joints, including the joining of successive days pours. Except where specified, waterstops shall be 125 mm wide by 9.5 mm thick polyvinyl-chloride Arctic grade Duraseal, Keroseal or approved equal. Waterstops shall be set and spliced in accordance with the manufacturer's recommendations.

3.4.6 Reinforcing Steel

Reinforcing steel shall be deemed to include all reinforcing bars, tie bars, dowel bars and bar mat reinforcement, including all bar accessories.

All reinforcing steel shall be supplied according to the type and dimensions as specified.

All reinforcing steel shall conform to the requirements of CSA Standard G30.12, Billet-Steel Bars for Concrete Reinforcement. If, in the opinion of the Engineering Manager, any reinforcing steel provided for the concrete works exhibits flaws in manufacture or fabrication, such material shall be immediately removed from the site and replaced with acceptable reinforcing steel.

The reinforcing steel shall be supplied in accordance with the following requirements:

(a) Deformed Reinforcing Bars shall be Grade 40 deformed bars.
(b) Tie Bars shall be Grade 40 deformed bars.
(c) Dowel Bars shall be Grade 40 plain bars.
(d) Bar Accessories shall be of a type approved by the Engineering Manager.

All reinforcing steel shall be straight and free from paint, oil, millscale and injurious defects. Rust, surface seams, or surface irregularities will not be cause for rejection provided that the minimum dimensions, cross-sectional area and tensile properties of a hand wire-brushed specimen are not less than the requirements of CSA Standards G30.12M.

3.4.7 Curing Compound

Curing compound shall be a liquid membrane-forming curing compound conforming to the requirements of ASTM C309.

3.4.8 Grout

Grout shall consist of one part Type 50 cement and one part sand with sufficient water to produce a mortar-like consistency.

3.4.9 Bonding Agents

Bonding agents shall be of a type approved by the Engineering Manager.

3.4.10 Form Coating

Form coating shall be of a type approved by the Engineering Manager.

3.4.11 Emulsified Asphalt Waterproofing

Preparation of concrete surfaces for waterproofing shall be carried out at the locations shown on the drawings, as specified, or as designated by the Engineering Manager. Surface shall be clean and free from dust, oil, grease, salt and loose or spalled material. Surfaces shall be smooth, even and free from projecting mortar, concrete fins, honeycombs, and other irregularities.

Waterproofing shall be carried out at the locations shown on the drawings, as specified or as designated by the Engineering Manager. Unless otherwise specified, waterproofing shall be in accordance with CGSB Specification 37-GP-3a-1967 or latest revision thereof; "Recommended Methods of Application of Emulsified Asphalts for Dampproofing or Waterproofing".

3.4.12 Mix Design Statement

For each type of concrete to be used, the Contractor shall provide the Engineering Manager with a Mix Design Statement certifying the constituent materials and mix proportions that will be used in the Sulphate-Resistant Portland Cement Concrete. The Contractor shall also supply reasonable evidence to the Engineering Manager that the mix proportions selected will produce concrete of the specified strength, workability and Yield.

A water-reducing agent as approved by the Engineering Manager and not exceeding the manufacturer's recommended quantity may be used. Where additional water-reducing agent is required, written approval shall be required from the Engineering Manager.

The Mix Design Statement must be submitted to the Engineering Manager prior to the delivery of any concrete to the site. Once approved by the Engineering Manager, all concrete shall be supplied in accordance with this statement, which shall be called the Job Mix Formula.

No changes in Mix Design will be permitted without following the above procedures.
Proportioning of fine aggregate, coarse aggregate, cement, water, air-entraining agent, and water-reducing admixture shall be such as to Yield concrete having the required strength, water-cement ratio, slump, air content, cement content and workability, as specified in Table MH 1600.

3.4.13 Concrete Supply

Unless otherwise specified, the use of a ready-mixed concrete plant shall only be permitted. Concrete shall be proportioned, mixed and delivered in accordance with the requirements of CAN3-A23.1-M77, Section 18, Production of Concrete, except that the transporting of ready-mixed concrete in non- agitating equipment shall not be permitted without the written authorization of the Engineering Manager.

Unless otherwise directed by the Engineering Manager, the discharge of ready- mixed concrete shall be completed with 1-1/2 hours after the introduction of the mixing water to the cement and aggregates, unless an extension of time is authorized by the Engineering Manager. All delivery tickets shall indicate the time of batching.

The Contractor shall maintain all equipment used for handling and transporting the concrete in a clean condition and proper working order.

4. EQUIPMENT

All equipment shall be of a type approved by the Engineering Manager. The equipment shall be in good working order, kept free from hardened concrete or foreign materials, and shall be cleaned at frequent intervals.

The Contractor shall have at all times sufficient standby equipment available.

5. CONSTRUCTION METHODS

5.1 Forming

Forms shall be built true to line and grade, mortar tight, sufficiently rigid to prevent displacement or sagging between supports and to properly withstand action of vibrators. They shall be constructed of wood, steel, or other approved materials. All exposed concrete surfaces shall be formed with 19 mm Douglas Fir plywood made with waterproof glue and specially manufactured for concrete formwork. The surface of these forms shall be absolutely level and smooth.

For unexposed surfaces and rough work, square-edge lumber may be used. "Unexposed" means any concrete surface that will not be exposed to view upon completion of the project. All edges shall be square, all sheets uniform in thickness and of such size as to provide as few joints as possible. Joints shall be tight and flush, backed solidly and rendered watertight.

All formwork shall be provided with adequate cleanout openings to permit inspection and easy cleaning after all reinforcement has been replaced. Interior and exterior comers shall have a 20 mm minimum fillet or chamfer strip.

Forms shall be tight so as to prevent the leakage of mortar or water. They shall be properly braced or tied together by means of tie rods or bolts. The type of tie to be used shall be subject to the approval of the Engineering Manager. Any holes or recesses left in the concrete shall be filled or plugged in a manner satisfactory to the Engineering Manager. No tie shall be used which leaves a hole entirely through the concrete wall. Use of tie wires will not be permitted.

Unless otherwise called for, or unless written instructions to the contrary are given by the Engineering Manager, earth structures shall not be used to form concrete, except that thrust blocks shall be poured against undisturbed soil.

5.2 Cleaning of Forms

Before placing concrete within the forms they shall be thoroughly cleaned of all shavings, sawdust and debris of every nature. Before re-using, all form surfaces shall be carefully cleaned.

The surface of forms for exposed concrete shall be coated with a non-staining mineral oil.

5.3 Form Openings

The Contractor shall provide special forms for openings in walls and floors for the installation of pipes, gates, flanges, etc., after the concrete has been poured. All such approved openings shall be provided with a waterstop and keyway in the face of the openings so that a watertight anchorage of the filling concrete may be obtained.

5.4 Stripping Forms

Forms shall remain in place a sufficient time to allow the concrete to set properly and the Contractor shall assume all responsibility for removal of forms. In no case shall forms be removed until concrete has attained sufficient strength to carry its own weight and the loads upon it with safety. Forms for walls shall not be removed sooner than two days after concreting. The Engineering Manager, may, when he deems it advisable, order the forms to remain in place for a longer time.

Special care shall be taken in stripping forms so as not to break concrete edges. Any portion of concrete damaged while stripping forms may be ordered tom down and recast at the discretion of the Engineering Manager. Upon the removal of forms, the Engineering Manager shall be notified by the Contractor. The Engineering Manager, after inspecting the newly stripped surface, will designate how the slightly damaged portions of concrete, if any, may be pointed up or touched in any manner before having been inspected by the Engineering Manager.

5.5 Placing Concrete

Prior to the placing of any concrete, the Contractor shall submit for approval his proposed construction schedule, including location of all construction joints. No deviations from this approved schedule shall be permitted except as shall be approved in writing by the Engineering Manager.

Concrete shall be conveyed as rapidly as possible from the mixer or truck to the place of final deposit using methods that will prevent the separation or loss of the materials.

Before placing concrete in forms or excavated areas for foundations or footings, they shall be thoroughly cleaned of all loose and foreign material and the forms thoroughly wetted or

otherwise treated to prevent adherence of concrete to forms. Chemicals shall not be used to remove ice or foreign materials from the forms.

All water shall be removed from the excavations before concrete is deposited and any flow of water shall be diverted through proper side drains or be removed by other approved methods so as to prevent washing of the freshly deposited concrete.

Concrete shall be deposited as nearly as practicable in its final position to avoid segregation due to rehandling or flowing. Concreting shall be carried on at such a rate that the concrete is at all times plastic and flows readily into the spaces between the bars. No concrete that has partially hardened or been contaminated by foreign material shall be deposited on the work.

When concreting is once started, it shall be carried on as a continuous operation until the placing of the panel or section is completed. Top surfaces shall generally be level. When construction joints are necessary, they shall be made in accordance with this Specification.

5.6 Vibrating

Vibrating shall be used whenever concrete is placed. Vibration shall be sufficiently intense to cause the concrete to flow or settle readily into place. Vibrators shall not be used to flow or place concrete horizontally. Form vibrators shall be used when sections are too small for the internal type of vibrator. A sufficient number of vibrators shall be employed so that the required rate of placement, vibration throughout the entire volume of each layer of concrete and complete compaction are secured. At least one extra vibrator shall be kept on hand at all times for emergencies. Vibration shall not be continued on anyone spot to the extent that pools of grout or water are formed. Care shall be taken to avoid any disturbances of concrete that has become too stiff to regain plasticity when vibrated. Vibration shall not be applied to steel that has been inserted into partially hardened concrete.

Chuting of concrete will be allowed only as approved by the Engineering Manager. No concrete shall have a free fall of over one metre (1.0 m), and if this height is exceeded, it shall be conveyed in place by approved spouts or chutes.

Surfaces that are to be finished shall be brought to proper grade, struck off: and finished in a workmanlike manner. No honeycombing, rough spots or protruding stones shall be left exposed. When a section of slab concrete is once placed, it shall be left entirely undisturbed until the concrete is thoroughly hardened.

5.7 Construction Joints

Joints must be approved by the Engineering Manager and shall be so made and located as to least impair the strength of the structure.

Before depositing new concrete on or against concrete that has set, the existing surfaces shall be thoroughly roughened by hammers, and cleaned of laitance, foreign matter and loose particles. The existing surfaces shall be dried where possible, followed by 25 mm of grout consisting of one part cement to one part sand with sufficient water to produce a mortar consistency. New concrete shall be placed before this grout has obtained its initial set.

5.8 Finishing Concrete

On all surfaces the cavities produced by form ties and all other small pits or openings shall, after inspection by the Engineering Manager, be cleaned of loose particles and thoroughly saturated with water, after which all such cavities, pits, or openings shall be neatly stopped with pointing mortar consisting of cement and fine aggregate mixed in the same proportions as used in the concrete. The mortar shall be mixed in small quantities and shall be used only when plastic.

The top surface of slabs shall be screeded and bullfloated to the proper profile and smoothed with magnesium float. Care shall be taken to avoid an excess of water in the concrete and to drain or otherwise promptly remove any water that comes to the surface. Sprinkling or dusting the surface with a dry mixture of cement or sand shall not be permitted.

All surfaces after finishing shall be cured as specified herein.

5.9 Curing of Concrete

Before actual concrete placement begins, the Contractor shall have all equipment needed for adequate curing of the concrete on hand and ready to use. Concrete curing shall conform to CAN3-A23.1-M77, Clause 21.1.

All concrete shall be adequately protected from injurious action by the sun. Fresh concrete shall be protected from heavy rains, flowing water and mechanical injury. All concrete shall be kept wet for a period of not less than seven (7) days by covering with water or with an approved water-saturated covering or by means of a commercial membrane curing compound. Where wood forms are left in place for curing, they shall be kept wet at all times to prevent opening at the joints and drying out of the concrete. If a commercial membrane curing compound is to be used, it shall meet the requirements of the CAN3-A23.1-M77, shall be approved by the Engineering Manager and applied in strict accordance with the manufacturer's recommendations. The membrane material shall be so applied that the concrete surface is completely coated and sealed at one application.

5.10 Cold Weather Requirements

The requirements of CAN3-A23.1-M77 shall govern except where amended herein. The Municipality reserves the right to order all work stopped with the onset of winter weather. When placing concrete at or below a temperature of five degrees centigrade (5°C) or

whenever, in the opinion the Engineering Manager, the atmospheric temperatures will probably fall below this limit within the twenty-four (24) hours after placing concrete, all aggregate and water shall be pre-heated and all reinforcement, forms and ground with which the concrete is to come in contact shall be defrosted. No concrete shall be placed on frozen ground.

The Contractor shall have on the job, ready to install, adequate equipment for heating the materials and the freshly placed concrete and for enclosing the work so as to maintain a temperature in the enclosure of at least ten degrees centigrade (10°C) or greater for a period of five (5) days after placing.

The entire structure shall be enclosed by means of tarpaulins supported on frameworks or by means approved by the Engineering Manager. Freshly placed concrete and the surrounding air shall be maintained at a temperature of at least ten degrees centigrade (10°C) for a period of five (5) days after placing. Within this enclosure, such means of artificial heat shall be provided as will maintain the temperature specified continuous and with a reasonable degree of uniformity in all parts of the enclosure. All exposed concrete surfaces within the heated areas shall be wetted with a hose whenever instructions are received from the Engineering Manager to do so. All heaters shall be vented by a chimney and no direct fired heaters shall be allowed. Heating appliances shall not be placed in such a manner as to endanger formwork or expose any area of the concrete to drying out or other injury due to excessive temperatures. The Contractor shall provide adequate fire protection accessible at all times at each location where heating is in progress and shall maintain watchmen or other attendants to keep the heating units in continuous operation.

5.11 Concrete Placing Against Existing Structures

Where new concrete is to be placed against existing concrete, the existing surface shall be thoroughly cleaned to remove loose sand, gravel, dirt, grease and other foreign material. Immediately before pouring the concrete, the horizontal surfaces shall be treated as specified in Clause 5.7, "Construction Joints", in this section, and vertical surfaces shall receive a brush coat of mortar.

Where existing reinforcing steel is to extend into new concrete, it shall be thoroughly cleaned and. wire brushed to remove all oil, dirt, rust, scale and other foreign material immediately before new concrete is poured.

5.12 Placing Reinforcement

Reinforcement shall be placed at locations as specified or as subsequently ordered by the Engineering Manager. All reinforcement details shall be in accordance with CAN3-A23.3-M77.

All splices used shall have laps of at least 24 bar diameters or 300 mm (whichever is greater) to transfer the stresses between bars by bond.

Reinforcing shall be adequately supported by means of concrete blocks, chairs, or spacers and secured against displacement during concrete placing. Brick, wood, gypsum, tile or similar materials shall not be used to support the reinforcement.

6. QUALITY CONTROL

6.1 Inspection

All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Engineering Manager, including all operations from the selection and production of materials through to final acceptance of the specified work. The Contractor shall be wholly responsible for the control of all operations incidental thereto notwithstanding any inspection or approval that may have been previously given. The Engineering Manager reserves the right to reject any materials or works that are not in accordance with the requirements of this Specification.

6.2 Access

The Engineering Manager shall be afforded full access for the inspection and control testing of concrete and constituent materials, both at the site of work and at any plant used for the production of concrete, to determine whether the concrete is being supplied in accordance with this Specification.

6.3 Materials

All materials supplied under this Specification shall be subject to testing and approval by the Engineering Manager in accordance with Section 3 of this Specification.

6.4 Concrete Quality

Quality control tests will be used to determine the acceptability of the concrete supplied by the Contractor.

The Contractor shall provide, without charge, the samples of concrete and of the constituent materials required for quality control tests and provide such assistance and use of tools and construction equipment as is required.

The frequency and number of concrete quality control tests shall be in accordance with the requirements of CAN3- A23 .1- M77.

An outline of the quality control tests is as follows:

Slump tests shall be made in accordance with CAN3-A23.2-5C, Slump of Concrete. If the measured slump falls outside the limits specified in Section 3 of this Specification, a second test shall be made. In the event of a second failure, the Engineering Manager reserves the right to reject the use of the batch of concrete represented.

Air content determinations shall be made in accordance with CAN3-A23.2-4C, Air Content of Plastic Concrete by the Pressure Method. If the measured air content falls outside the specified limits, a second test shall be made at any time within the specified discharge time limit for the mix. In the event of a second failure, the Engineering Manager reserves the right to reject the batch of concrete represented.

Samples of concrete for test specimens shall be taken in accordance with CAN3-A23.2-1C, Sampling Plastic Concrete.

Test specimens shall be made and cured in accordance with CAN3-A23.3C, Making and Curing Concrete Compression and Flexure Test Specimens.

Compressive strength tests at twenty-eight (28) days shall be the basis for acceptance of all concrete supplied by the Contractor. For each twenty-eight (28) day strength test, the strength of two companion standard-cured test specimens shall be determined in accordance with CAN3-A23.2-C, Compressive Strength of Cylindrical Concrete Specimens, and the test result shall be the average of the strengths of the two specimens.

Compressive strength tests on specimens cured under the same conditions as the concrete works shall be made to check the strength of the concrete and to check the adequacy of curing and/or cold weather protection. For each field-cured strength test, the strength of two field-cured specimens shall be determined in accordance with CAN3-A23.9C, Compressive Strength of Cylindrical Concrete Specimens, and the test result shall be the average of the strengths of the two specimens.

The costs of concrete testing will be borne by the Owner, unless otherwise specified.

6.5 Addition of Water

After initial mixing, no water may be added except if, at the start of discharge the measured slump of the concrete is less than specified and no more than 60 minutes have elapsed from the time of batching to the start of discharge. Water added shall not exceed 12 litres per cubic metre. The mixer drum shall be turned a minimum of 30 revolutions at mixing speed and the slump and air content shall be tested.

6.6 Corrective Action

Acceptance criteria for compressive strengths of laboratory-cured cylinders shall conform to Sections 17.5 and 17.6 of CAN3-A23.1-M77. The Contractor shall, at his own expense, correct such work or replace such materials found to be defective under this Specification in an approved manner to the satisfaction of the Engineering Manager.

SPECIFICATION FOR INSTALLATION OF WATER SERVICES (19 mm to 50 mm)

1. GENERAL CONDITIONS

All standards in this edition, attached hereto, shall apply to and be a part of this Specification.

2. DESCRIPTION

This Specification shall cover all phases of the construction of 19 mm to 50 mm water services. The work involved shall include the tapping or cutting into the watermain and the supply and installation of the corporation stops, service clamps, cast iron split sleeves, tees, retaining clamps, water service pipe and curb stops and boxes.

The work to be done by the Contractor under this Specification shall include the supply of all materials, and the furnishing of all superintendence, overhead, labour, equipment, tools, supplies and all other things necessary for and incidental to the satisfactory performance and completion of all work as hereinafter specified.

3. MATERIALS

3.1 Building Water Service Pipe and Appurtenances

Building water service pipe shall be Polyethylene Water Service Pipe (160 psi) and shall conform to ASTM D-1248 and be certified to CSA BI37.1, 160 psi. The minimum size shall be 19 mm diameter. Stainless steel inserts shall be used at all compression fitting connections.
All pipes shall be "Copper Tube Size" (CTS).

In the case where a water service is being installed within 15 metres of a post, existing or future petroleum products storage and/or sales property, building water service pipe shall be copper Type K annealled, conforming to ASTM B88-78. The minimum size shall be 25 mm diameter.

Main stops shall be Standard Waterworks type with compression copper connections. Main stops shall be all brass or bronze construction.

Main line service clamps shall be Robar 2616 DB full stainless steel. All materials shall be a minimum T316 stainless steel.

The metal parts of repair saddles for plastic mains must be T316 stainless steel.

Curb stops shall be cast bronze body and shall be either press-fitted plug type or ball valve type. All parts shall be brass or bronze, or stainless steel. Curb stops shall open and close completely in 90° of turn and shall have straight through unobstructed flow when fully open. The starting or operating torque of the stop shall not exceed 7 Newton-metres. The operating plug or ball shall have a rectangular-shaped head, aligned with the parts to provide a direct indication of the position of the valve. Curb stops shall be electrically continuous between their operating head and both connections.

Curb stops to have a service box with bituminous coated, cast iron end sections and blackpipe riser section with stainless steel stem to suit depth of bury. Top of cast iron box to be marked "Water". Plastic sidewalk collars shall be installed on the box immediately below the box top.

4. CONSTRUCTION METHODS

4.1 Direct Tapping of Corporation Stops

Direct tapping of corporation stops will be allowed on watermains for the sizes of watermains and service lines shown in Table MH 1700.

The corporation stops shall be tightened into asbestos cement and ductile iron watermains with 70 N.m to 80 N.m of torque with 1 to 3 threads showing and into PVC Class Pipe with 35 N.m to 40 N.m of torque. The thread of the corporation stops used on PVC class watermain and ductile iron watermains shall be wrapped with three to four wrappings of Teflon pipe thread tape before installation of the corporation stop.

4.2 Service Clamps and Stainless Steel Tapping Sleeves

Service clamps and stainless steel tapping sleeves will be required as detailed in Table MH 1700. Service clamps shall have double bolts and be of an approved design. Stainless steel tapping sleeves shall be of an approved design.

4.3 Table MH 1700

Watermain Material & Size		Service Size		
		19-25 mm	38 mm	50 mm
(i)	Asbestos Cement			
	100 mm	SC	NA	NA
	150 mm - Class 150	SC	SC	SC
	150 mm - Class 200	ST	SC	SC
	200 mm - 400 mm	ST	SC	SC
(ii)	Ductile & Cast Iron			
	100 mm	ST	Tee	Tee
	150 mm	ST	SC	SC
	200 mm - 300 mm	ST	SC	SC
(iii)	PVC - C900			
	150 mm - 300 mm	ST	SC	SC

ST - Standard direct tap allowed
SC - Service clamp required (Robar 2616 DB)
Tee - Tee required in main

4.4 Excavation, Bedding and Backfill

Excavation, bedding and backfill shall be done in accordance with Specification MH 1000.

4.5 Installation of Water Service Pipe

19 mm corporation stops shall be installed in the top quadrant of the watermain at an angle of between 0° and 30° to the horizontal. 50 mm corporation stops shall be installed horizontally into the watermain. A combination horizontal and vertical goose neck shall be made without kinking the service pipe or exceeding the pipe manufacturer's maximum recommended curvature and also so as to provide maximum cover to the service. Do not use pipe that has been kinked or buckled.
Couplings will not be permitted on service installations.

4.6 Corporation Stops, Curb Stops and Curb Stop Boxes

Corporation stops, curb stops and curb stop boxes of an approved design shall be installed for each service connection. A 0.05 cubic metre sump consisting of 20 mm to 25 mm clean crushed stone shall be constructed for each curb stop.

4.7 Curb Stop Markers

Curb stop markers shall be installed as specified.

4.8 50 mm Service Connections to a 100 mm Watermain

A 100 mm x 100 mm x 100 mm tee shall be installed by cutting into the 100 mm watermain. A 100 mm plug, which has been tapped to receive the 50 mm corporation stop, shall be installed in the tee outlet and shall be held onto the tee with a steel retaining clamp of approved design and materials and shall be provided with approved corrosion protection.

4.9 Installation and Backfill

Under paved areas or areas proposed for pavement, service connections shall be installed by augering or by a method approved by the Engineering Manager. In other areas, installation shall be made by using either the open cut method or augering. All service installation trenches or shafts shall be backfilled as specified and must conform to Specification MH 1000.

SPECIFICATION FOR INSTALLATION OF LARGE WATER SERVICES (larger than 50 mm)

1. GENERAL CONDITIONS

All standards in this edition, attached hereto, shall apply to and be a part of this Specification.

2. DESCRIPTION

This Specification shall cover all phases of the construction of water services larger than 50 mm. The work involved shall be the connection to the watermain, supply and installation of control valve, valve spindle, valve box, water service pipe and other fittings as required.

The work to be done by the Contractor under this Specification shall include the supply of all materials, and the furnishing of all superintendence, overhead, labour, equipment, tools, supplies and all other things necessary for and incidental to the satisfactory performance and completion of all work as hereinafter specified.

Classes of Services

Large water service shall be classified as one of the following:

(a) Domestic Service
(b) Combined fire standpipe and domestic service
(c) Sprinkler service
(d) Combined sprinkler and fire standpipe service.

3. MATERIALS

3.1 Supply, Handling and Storage of Materials

The Contractor shall be responsible for the supply, safe storage and handling of all materials set forth in this Specification. All materials shall be handled in a careful and responsible manner, to the satisfaction of the Engineering Manager.

3.2 Testing and Approval

All materials supplied under this Specification shall be subject to inspection and testing by the Engineering Manager or by the Testing Laboratory designated by the Engineering Manager. There shall be no charge to the Municipality for any materials taken by the Engineering Manager for testing purposes.

All materials shall be approved by the Engineering Manager before any construction is undertaken. If in the opinion of the Engineering Manager, such materials, in whole or in part, do not conform to the Specification detailed herein or are found to be defective in manufacture or have become damaged in transit, storage or handling operations, then such material shall be rejected by the Engineering Manager and replaced by the Contractor at his expense.

3.3 Pipe, Fittings and Accessories

Polyvinyl chloride (PVC) Pipe

PVC pipe for water distribution shall conform to AWWA Standard ANSI/AWWA C900-81, "Polyvinyl Chloride (PVC) Pressure Pipe 4 inch through 12 inch for Water". Pipe joints shall be push on type with rubber gasket seals capable of withstanding pressure equal to the rated pressure of the pipe and withstanding thermal expansion and contraction. Gaskets shall be oil and gas resistant type and shall conform to ASTM F477-76 and shall be supplied by the manufacturer of the pipe.

Fittings

All PVC watermain fittings shall be Class 150 for use with AWWA C900 PVC pipe and shall conform to ASTM D1598, ASTM D2837, and ASTM D1599.

Without limiting the generality of the foregoing "Fittings" shall be taken to mean tees, elbows of all angles, crosses, caps, plugs, increasers or reducers, "Y" connections and all other such appurtenances excepting valves and hydrants. Fittings installed in the ground shall be equipped with connections compatible with the type of pipe in use. Fittings installed in valve chambers shall have Victaulic joints. All nuts and bolts exposed to the ground on all fittings shall be T-316 Stainless Steel and plainly marked. All other exterior nuts and bolts to be minimum T-304 Stainless Steel.

3.4 Thrust Blocks

Thrust blocks shall be installed at all tees, wyes, elbows, bends, plugs, and crosses where required. Thrust blocks shall consist of concrete as specified in Specification MH 1600.

3.5 Sand

Sand for bedding and backfill shall be in accordance with Specification MH 1000.

4. EQUIPMENT

All equipment, implements, tools and facilities used shall be of a type approved by the Engineering Manager. The Contractor shall have sufficient standby equipment available at all times.

5. CONSTRUCTION METHODS

Connection to watermains of large services shall be done by one of the following methods, such method to be approved by the Engineering Manager.

(a) Connecting to an existing tee
(b) Cutting out a section of the watermain and installing a tee
(c) Installing a stainless steel tapping sleeve and valve.

5.2 Position of Control Valves

5.2.1 Domestic Services

Domestic services shall have the control valve installed at a point in the Street right-of-way 300 mm from the property line.

5.2.2 Combined Fire Standpipe and Domestic Service, Sprinkler Service, or Combined Sprinkler and Fire Standpipe Services

Combined fire standpipe and domestic service, sprinkler service, or combined sprinkler and fire standpipe services shall have the control valve installed at a point in the Street as close to the watermain as possible.

5.3 Services of the Same Size as the Watermain

Services of the same size as the watermain shall be installed by cutting out a section of the watermain and installing a tee.

5.4 Service Connections to a 100 mm Watermain

Service connections to a 100 mm watermain shall be installed by cutting out a section of the watermain, installing a 100 mm x 100 mm x 100 mm tee and an reducer to 150 mm and installing a 150 mm service line.

5.5 Service Installation

Installation of the service line shall be as specified in Specification MH 1100. Valves and hydrants shall be installed as specified in Specification MH 1200.

5.6 Installation and Backfill

Under paved areas or areas proposed for pavement, service connections shall be installed by augering or by a method approved by the Engineering Manager. In other areas, installation shall be by using either the open cut method or augering.

All service installation, trenches or shafts shall be backfilled as specified and must Specification MH 1000. Large services shall not be installed in the same trench with any sewer.

5.7 Hydrostatic Testing and Disinfection

Hydrostatic testing and disinfection shall be performed on all services as described in Specifications MH 1910 and MH 1920.

SPECIFICATION FOR INSTALLATION OF GRAVITY SEWER SERVICES

1. GENERAL CONDITIONS

All standards in this edition, attached hereto, shall apply to and be a part of this Specification.

2. DESCRIPTION

This Specification shall cover all phases of the construction of sewer services.

The work to be done by the Contractor under this Specification shall include the supply of all materials, and the furnishing of all superintendence, overhead, labour, equipment, tools, supplies and all other things necessary for and incidental to the satisfactory performance and completion of all work as shown on the drawings and herein specified.

3. MATERIALS

3.1 Pipe, Fittings and Accessories

Sewer service pipe shall be polyvinyl chloride (PVC) plastic pipe and shall conform to ASTM Standard D-3034-77C with "Plas-tyton" type rubber gasket joints. Plastic sewer service pipes shall have a Standard Dimension Ratio (SDR) of 35 or smaller.

Sewer service tees and saddles shall be of the same type and material as the sewer service pipe. Plastic saddles shall be secured to the sewermain with stainless steel straps around the sewer main. Tees shall be used on all new main installations. All sewermain fittings shall be the fabricated type only.

Sewer service couplers used to connect two pipes of similar or dissimilar material must have rubber gasket joints. The manufacturer of the coupler or adaptor must specifically state that the coupler or adapter will mate the two different pipe types used. Non-sealed slip-on joints or solvent weld joints will not be permitted.

Tees, wyes and bends shall be preformed injection molded or fabricated types and shall be constructed with the same materials and be of the same class as the sewer pipe to which they are connected. PVC approved products for 250 mm and larger diameter fittings shall be the fabricated type only.

Maximum standard bend fitting angle is 22 degrees. Larger angled bends (45 & 90 degree) must be the long-sweep type fitting.

3.2 Cement Mortar

Cement mortar shall be in accordance with the requirements of Specification MH 1600.

3.3 Sand

Sand for bedding and backfilling shall be in accordance with Specification MH 1000.

4. EQUIPMENT

All equipment, implements, tools and facilities used shall be of a type approved by the Engineering Manager. The Contractor shall have sufficient standby equipment available at all times.

5. CONSTRUCTION METHODS

5.1 Excavation and Backfill

Excavation and backfill shall be in accordance with Specification MH 1000.

5.2 Bracing, Shoring and Cribbing

Bracing, shoring and cribbing for the construction of sewer services shall be in accordance with Specification MH 1000, and in accordance with the latest revision of the "Workplace, Safety and Health Act".

5.3 Connection to Sewer Mains

Where precast junctions exist in the sewer mains, connections shall be made to these junctions as specified in Clause 5.3 of this Specification.

Bedding and backfilling for saddles and junctions shall be as specified in this Specification. Precast or preformed junctions, saddles and risers installed for future connection and sewer services installed to the property line shall be sealed with an approved plug prior to backfilling the trench.

Where precast or preformed junctions do not exist on the sewer main, special connections may be permitted. The method to be used must be approved by the Engineering Manager and shall consist of one of the methods described in Clause 5.3.1, 5.3.2 or 5.3.3.

5.3.1 Insertion of Tee or Wye Junction

A section of sewer main shall be removed and a tee or wye junction compatible with the sewer main shall be installed. The service pipe shall then be connected to the tee or wye in a watertight and structurally sound manner. This method shall be used on all new main installations.

5.3.2 Installation of Service Saddle

A neat circular hole of sufficient size to accept an approved saddle should be cut in the sewer main with a hole saw designed for that purpose and a service saddle shall be installed into the main in accordance with the manufacturer's recommendations. The service saddle and the service pipe connection to the saddle shall be installed in a watertight and structurally sound manner. The saddle shall be so installed that it does not protrude into the sewer main beyond the inside wall of the sewer main. Saddles may not be used on clay tile sewermains.

Saddles shall be installed with the outlet pipe at the angle from vertical equal to that of the connection it is to serve. The minimum angle shall be one degree up from horizontal.

5.3.3 Other Methods

Other methods that provide a watertight and structurally sound connection of the sewer service pipe to the sewer main may be approved by the Engineering Manager.

5.4 Installation of Pipe

All pipe shall be installed on a thoroughly compacted 100 mm thick bed of sand placed in the bottom of the trench prior to installation of the pipe in the trench. This bed of sand shall be fully compacted and levelled throughout the full width of the trench to the exact grade specified, so that the barrel of the pipe shall be uniformly and fully supported throughout its full length. Compacted sand backfill shall extend to a minimum depth of 200 mm above the top of the pipe for the full trench width.

All bell and spigot pipe shall be laid with the bell upgrade. Sections of pipe shall be so laid and fitted together that when complete the sewer will have a smooth and uniform invert. The trench shall be free of water while the pipe and appurtenances are being installed and bedded.

The excavation of the trench shall be fully completed a sufficient distance in advance of the laying of the pipe so as not to interfere with the laying. The exposed end of the pipe shall be fully protected with an approved stopper to prevent earth or foreign matter from entering the pipe. The interior of the pipe shall be kept free from all dirt, cement or superfluous material of every description as the work proceeds. Damaged pipes and those not meeting specifications shall not be used, and shall immediately be removed from the work site by the Contractor at his expense.

5.5 Augering

Augering of sewer services shall be in accordance with Specification MH 1400.

5.6 Risers for Service Connections

Risers may be used where the sewer main is in excess of 4.25 m deep. Risers shall be installed to a minimum depth of 3.35 m below the finished grade and at a maximum angle of 45 degrees from horizontal. Care shall be taken to provide proper compaction of the backfill material around the riser to prevent settlement and failure of the horizontal portion of the sewer service at its connection with the riser.

5.7 Pipe Bedding and Backfill

The bedding and backfill shall be as specified and shall be in accordance with Specification MH 1000.

6. QUALITY CONTROL

6.1 Line and Grade

Sewer service pipe shall be installed to the line and grade as specified and as set in the field by the Engineering Manager. Vertical variance from grade shall not exceed 25 mm and horizontal variance from line shall not exceed 100 mm. Sharp bends will not be permitted even though the sewer service pipe remains within these tolerances. Bends on sewer pipe shall not exceed manufacturers recommended tolerances.

6.2 Inspection, Access and Materials

Inspection, access and materials shall be in accordance with Specification MH 1400.

SPECIFICATION FOR HYDROSTATIC AND LEAKAGE TESTING OF WATERMAINS

1. GENERAL CONDITIONS

All standards in this edition, attached hereto, shall apply to and be a part of this Specification.

2. DESCRIPTION

This Specification shall cover all phases of the hydrostatic testing and leakage testing of watermains.

The work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, equipment, tools, supplies and all other things necessary for and incidental to the satisfactory performance and completion of all hydrostatic testing and leakage testing of watermains as hereinafter specified.

3. MATERIALS

3.1 Corporation Stops

Corporation stops used in testing watermains shall be of approved type and shall conform to the requirements of this manual.

4. EQUIPMENT

All equipment, implements, tools, supplies and facilities necessary for testing of the watermain shall be of a type approved by the Engineering Manager and shall include a high-pressure meter and pressure recorder.

The water meter shall be tested and certified as to accuracy and the certified accuracy curve shall be submitted to the Engineering Manager. If any adjustments or repairs are required to the water meter, the meter shall be retested and recertified.

5. CONSTRUCTION METHODS

The watermain shall be filled and flushed before any testing is done. All air shall be removed from the watermain before testing and all testing shall be conducted before the watermain is chlorinated. Watermains shall be flushed in accordance with AWWA Specification C 651-86. For flushing purposes, connection to the existing system will be allowed at one location only.

Flushing through a hydrant will be allowed if that hydrant is at the extreme downstream end of the watermain being flushed.

For the purpose of testing the watermain, a 20 mm or 25 mm corporation stop shall be installed in the top of the last length of watermain pipe on the downstream end of the watermain. The corporation stop shall be installed as specified in Specification MH 1700.

A 20 mm or 25 mm copper service pipe or high-pressure hose of sufficient length to reach the testing equipment shall be connected to the corporation stop.

Prior to the testing, all air shall be expelled from the section under test by opening all available outlets and filling the section slowly from the supply source.

5.2 Testing Procedure

Maximum lengths to be tested shall be 360 metres unless otherwise approved by the Engineering Manager.

Testing shall be carried out at 1.0 MPa unless otherwise approved by the Engineering Manager. Allowable leakage per 100 couplings or joints per hour is outlined in Table MH 1910 for various pipe sizes. If the leakage exceeds these values, the Contractor must make such repairs as required in order to meet these values. The pressure shall not be allowed to drop more than 0.1 MPa at any time during the test.

At no time will testing by compressed air be allowed.

Under no circumstances shall pressure testing be allowed through a hydrant.

After all air has been expelled and the watermain flushed; all discharge outlets shall be tightly closed, and the supply source shall be shut off.

A recording pressure gauge and a high-pressure water meter shall be installed in the testing equipment on the discharge line from the pressure pump. The gauge and meter must be

protected from freezing at all times. The pressure gauge shall be of a recording type and shall have the time indicated on the chart.

Where test caps or plugs with corporation stops are used, the section left out for closure shall not exceed four metres (4.0 m) in the length.

Tests shall be of no less than one-hour duration and the meter shall be read and recorded each time the pump is started and again when the pump is stopped. The time that the pump is started and stopped shall also be recorded.

After the tests have been completed, all corporation stops used for testing or air release shall be closed.

6. QUALITY CONTROL

6.1 Allowable Leakage

A leakage test for a watermain shall be acceptable when the leakage is less than that specified in Table MH 1910 for the size, test pressure and number of couplings in the test section. The Contractor shall make repairs and shall retest the watermain until an acceptable leakage test is obtained.

7. REPORTING PROCEDURE

7.1 Witness of Testing

The Contractor shall give the Engineering Manager 24 hours notice that he intends to test the watermain. The Engineering Manager or Engineering Consultant shall be present at all times during the hydrostatic and leakage testing. He shall ensure that the Contractor does not operate any valves on the existing water system.

Valves on the existing watermain system or new valves tied into the existing system are to be operated by Municipal Waterworks Crews only. In addition, new valves on newly installed watermains, which have been tied into the existing system, shall be operated by Municipal Crews only.

7.2 Notification to Municipal Office

All tests, whether they are acceptable or not, shall be recorded on Form 1910 by the Contractor and shall be submitted in conjunction with the pressure meter chart properly completed and signed to the Engineering Manager or Engineering Consultant who has witnessed the test.

The Engineering Manager or Engineering Consultant shall submit this form with the water meter accuracy curve to the Municipality.

Upon receipt of Form 1910, the pressure meter chart, the meter accuracy curve, Form 1920, and written communication stating that the tests results are acceptable, the Municipal Office shall put the subject watermains into service.

TABLE MH 1910

PIPE DIAMETER MILLIMETRES (mm)	LEAKAGE TESTING OF POLYVINYL CHLORIDE (PVC) WATERMAINS TEST PRESSURE MEGAPASCALS (MPa)						
			0.65	0.85	1.00	1.35	1.50
	ALLOWABLE LEAKAGE – LITRES / HOUR (l/h) PER 100 JOINTS						
150			1.7	1.9	2.1	2.4	2.6
200			2.3	2.5	2.8	3.2	3.4
250			2.8	3.2	3.5	4.0	4.3
300			3.4	3.8	4.2	4.8	5.1

Form 1910

MAINS LEAKAGE TEST FORM
FOR
THE RURAL MUNICIPALITY OF HANOVER

DATE: _____

LOCATION: _____

FROM: _____

TO: _____

SIZE/TYPE OF PIPE: _____

LENGTH: _____

NUMBER OF JOINTS: _____

ALLOWABLE LEAKAGE PER HOUR AT _____ MPa _____ Litres

ACTUAL LEAKAGE PER HOUR AT _____ MPa _____ Litres

Start Time	Meter Reading	Finish Time	Meter Reading	Total Loss

---

METER # _____ BRAND NAME _____

OPERATOR SIGNATURE: _____

COMPANY: _____

COMPANY ADDRESS: _____

_____

_____

ENGINEERING MANAGER
SIGNATURE

SPECIFICATION FOR DISINFECTION OF W ATERMAINS

1. GENERAL CONDITIONS

All standards in this edition, attached hereto, shall apply to and be a part of this Specification.

2. DESCRIPTION

This Specification shall cover all phases of disinfection of watermains and large water services. Large water services shall be as defined in Specification MH 1800.

The work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, equipment, tools, supplies and all other things necessary for and incidental to the satisfactory performance and completion of all work as herein specified.

The Contractor shall give the Engineering Manager 24 hours notice of his intention to disinfect the watermain or large water service. The Engineering Manager or Consulting Engineer shall be present at all times during the disinfection operation.

3. MATERIALS

The Contractor shall be responsible for the supply, safe storage and handling of all materials required for disinfecting watermains and large water services.

4. EQUIPMENT

The Contractor shall supply all equipment, tools, and supplies required for the disinfection of watermains and large water services. The chlorinator shall be a chlorine solution feed type of chlorinator and shall be approved by the Engineering Manager.

5. CONSTRUCTION METHODS

5.1 Chlorine Feed Rate

The chlorine feed rate shall be as shown in Table MH 1920, for the watermain size, chlorine concentration desired, and the discharge rate used. The discharge rate should normally not exceed 450 L/min.

5.2 Chlorination

The only approved method of disinfection is by the use of a chlorine solution feed type of chlorinator.

After the watermain or large water service has been thoroughly flushed as specified in Specification MH 1910, the chlorine solution shall be induced into the watermain through the corporation stop used for the leakage test or other connection. Normal water supply for the chlorinator shall be from a hydrant, but if a water tank is used, a pump must be used to inject the chlorine solution into the watermain. Discharge from the watermain shall be from the corporation stop used for discharge during the leakage test or from a hydrant.

Chlorination shall continue for at least the length of time specified in Table MH 1920, for the watermain size, length and discharge rate indicated. The watermain containing chlorine solution shall be isolated and shall be left for 24 hours.

5.3 Chlorine Residual

The required minimum chlorine residual after 24 hours is 50 ppm and the initial solution into the line shall be 75 ppm The Engineering Manager shall determine the chlorine residual after the 24-hour retention time.

5.4 Determination of Chlorine Residual

The "drop dilution" method shall be used for determining chlorine residuals, or alternately, the chlorine residual can be determined as specified in A.W.W.A. Specification 601-68.

5.5 Flushing of the Watermain

At the end of the required retention period and after the actual chlorine residual has been determined and is acceptable, the watermain or large water service shall be flushed from the test corporation stop or from a hydrant until the chlorine residual is equal to the residual of the normal water supply and in no case shall exceed 2 ppm Testing for chlorine residual shall be done by the Engineering Manager.

5.6 Bacteriological Sample

After the flushing of the watermain, the Engineering Manager shall take a bacteriological sample in a manner approved by the Health Authority and shall submit this sample and Provincial Form HU55 supplied with the sample bottle to the ALS Laboratory Group, 1329 Niakwa Road East, Winnipeg, Manitoba, R2J 3T4, phone 255 - 9720.

Samples shall be taken from the risers installed in the main used for the leakage test.

5.7 Placing Watermains in Service

Watermains or large water services shall not be put into service for human consumption by the Municipality until Form MH 1920 has been received.

The Contractor shall at no time operate any valves on the existing system or put the watermain into service.

6. QUALITY CONTROL

6.1 Bacteriological Test Results

The disinfection of the watermain or large water service shall be acceptable when the bacteriological test results show the absence of coliform organisms and the total chlorine residual does not exceed two (2) ppm after flushing of the watermain. If the bacteriological test is not acceptable, the Contractor shall redisinfect the watermain or large water service until an acceptable test has been achieved.

7. REPORTING PROCEDURE

7.1 Witness of Disinfection

The Contractor shall give the Engineering Manager 24 hours notice that he intends to test the watermain. The Engineering Manager or Consulting Engineer shall be present at all times during the disinfection procedure. He shall ensure that the Contractor does not operate any valves on the existing water system Valves on the existing watermain system or new valves tied into the existing system are to be operated by Municipal Waterworks Crews only. In addition, new valves on newly installed watermains, which have been tied into the existing system, shall be operated by Municipal Water Crews only.

7.2 Notification of Municipal Office

All tests, whether they are acceptable or not, shall be recorded on Form 1920 by the Contractor and shall be submitted, properly completed and signed, to the Engineering Manager or the Engineering Consultant who has witnessed the test. The Engineering Manager or Engineering Consultant shall submit this form to the Municipal Office.

Upon receipt of Form 1910, the pressure meter chart, the meter accuracy curve, Form 1920, and written communication stating that the tests results are acceptable, the Municipal Office shall put the subject watermains into service.

Form 1920

MAINS DISINFECTION REPORT
FOR
THE RURAL MUNICIPALITY OF HANOVER

DATE: _____

LOCATION: _____

FROM: _____

TO: _____

SIZE/TYPE OF PIPE: _____

LENGTH: _____

LOCATION OF #1 FLUSH AND CHLORINATION CORPORATION _____

LOCATION OF #2 FLUSH AND CHLORINATION CORPORATION _____

CHLORINE FEED _____ kg/day DATE _____

RESIDUAL AT FINISH _____mg/litre TIME _____

CHLORINE RESIDUAL _____ mg/litre DATE _____

TIME _____

BACTERIOLOGICAL SAMPLE NUMBER	LOCATION TAKEN	TIME AND DATE TAKEN	TOTAL COLOIFORMS

OPERATOR SIGNATURE: _____

COMPANY: _____

COMPANY ADDRESS: _____

_____

_____

ENGINEERING MANAGER SIGNATURE

TABLE MH 1920 (METRIC)

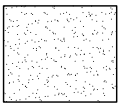
WATERMAIN DISINFECTION CHART

NOM I NAL SIZE OF PIPE mm		150	200	250	300	350	400	450	500	600	750	900
Litres of Water per 100 m of Pipe		1827	3248	5075	7308	9948	12993	16444	20303	29237	45683	65784
kg of Chlorine per 100 m of pipe To Disinfect at	50 mg/L	0.091	0.162	0.254	0.365	0.499	0.650	0.822	1 .015	1.462	2.284	3.289
	75 mg/L	0.137	0.243	0.381	0.548	0.746	0.974	1.233	1.523	2.193	3.426	4.934
	100 mg/L	0.183	0.325	0.507	0.731	0.995	1.299	1.644	2.030	2.294	4.568	6.578
	150 mg/L	0.274	0.487	0.761	1.096	1.496	1.948	2.467	3.045	4.386	6.852	9.868

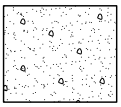
DISCHARGE RATE L/min.	mg/L				Approximate Flow Through Time for 100 m of Pipe Hours-Minutes										
	50	75	100	150											
	Feed Rate kg/day				150	200	250	300	350	400	450	500	600	750	900
100	7.2	10.8	14.4	21.6	0-18	0-32	0-51	1-13	1-39	2-09	2-44	3-23	4-59	7-37	10-58
150	10.8	16.2	21.6	32.4	0-12	0-21	0-33	0-49	1-06	1-29	1-50	2-15	3-15	5-05	7-19
200	14.4	21.5	28.8	43.2	0-09	0-16	0-25	0-37	0-50	1-05	1-22	1-41	2-26	3-48	5-29
250	18.0	27.0	36.0	54.0	0-07	0-13	0-20	0-29	0-40	0-52	1-06	1-21	1-57	3-03	4-23
300	21.6	32.4	43.2	64.8	0-06	0-11	0-17	0-24	0-35	0-43	0-55	1-08	1-37	2-32	3-39
350	25.2	37.8	50.4	75.6	0-05	0-09	0-15	0-21	0-28	0-37	0-47	0-58	1-24	2-10	3-08
400	28.8	43.2	57.6	86.4	0-05	0-08	0-13	0-18	0-25	0-32	0-41	0-51	1-13	1-54	2-45
450	32.4	48.6	64.8	97.2	0-05	0-07	0-11	0-16	0-22	0-29	0-36	0-45	1-05	1-42	2-26
600	43.2	64.8	86.4	129.6	0-03	0-05	0-09	0-12	0-17	0-21	0-27	0-34	0-49	1-16	1-50
750	54.0	81.0	108.0	162.0	0-02	0-04	0-07	0-10	0-13	0-17	0-22	0-27	0-39	1-01	1-28
900	64.8	97.2	129.6	194.4	0-02	0-04	0-06	0-08	0-11	0-14	0-18	0-22	0-32	0-51	1-13

STANDARD

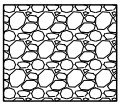
DETAILS



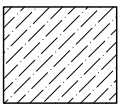
SAND



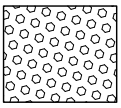
UNSHRINKABLE FILL



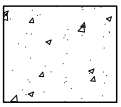
COMPACTED GRANULAR FILL



EXCAVATED MATERIAL



CRUSHED STONE



CONCRETE

GROUND LINE

DIMENSIONS ARE IN MILLIMETERS

R.M. OF HANOVER

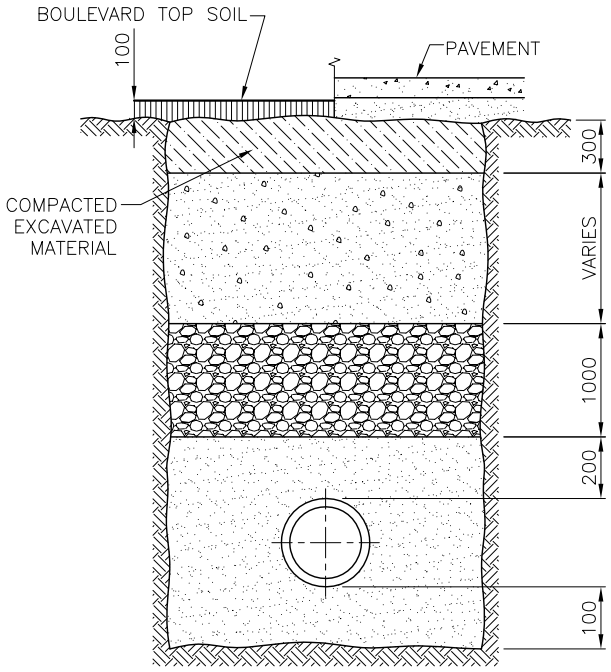
SYMBOLS LEGEND

DRAWN BY:	AE
DATE:	JAN 2014
SCALE:	NTS

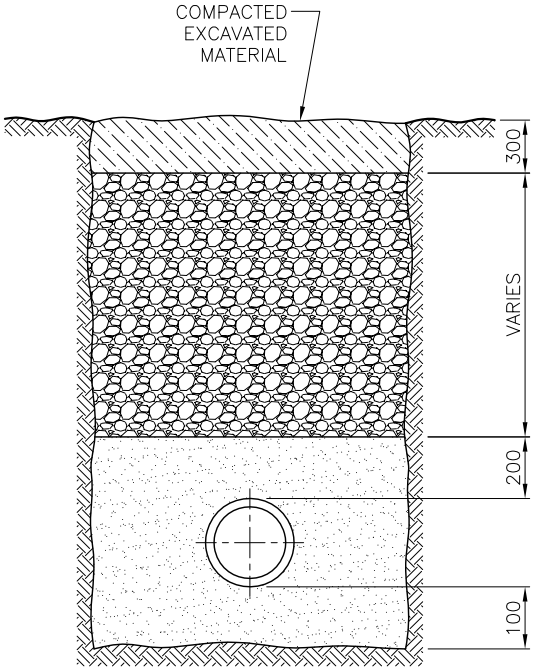
DATE	REVISION	BY

DRAWING NO. U1

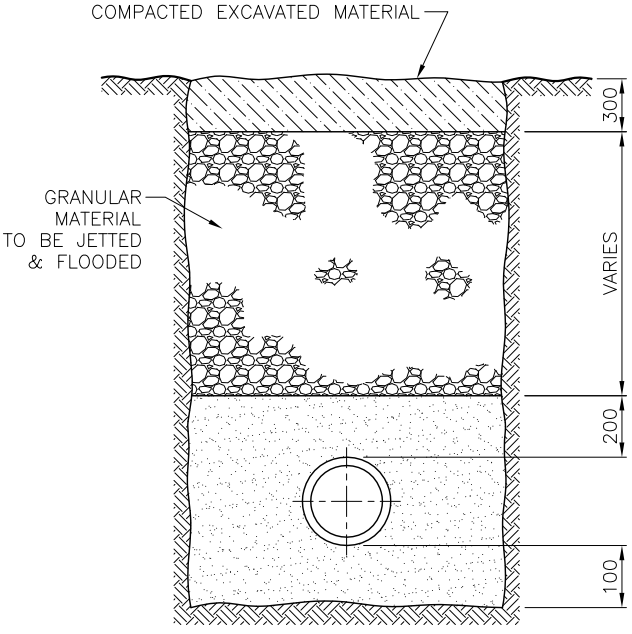
REV. NO.



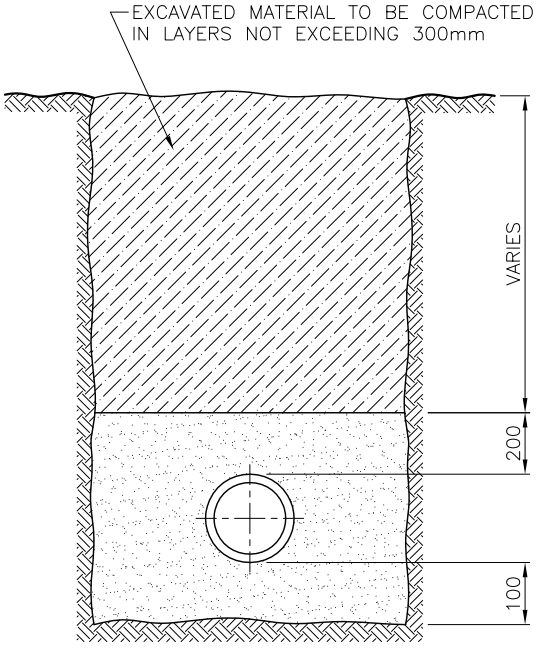
CLASS 1



CLASS 2



CLASS 3



CLASS 4

DIMENSIONS ARE IN MILLIMETERS

R.M. OF HANOVER

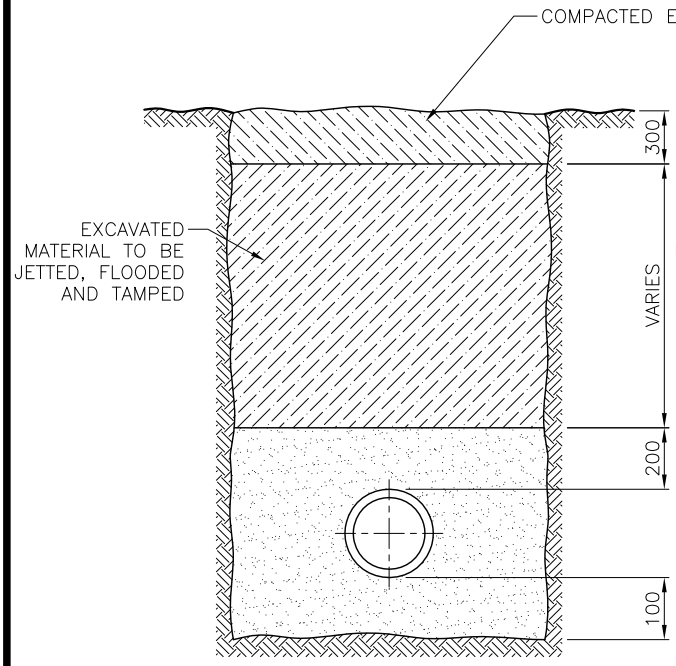
STANDARD BEDDINGS AND BACKFILLS

DRAWN BY:	AE
DATE:	JAN 2014
SCALE:	NTS

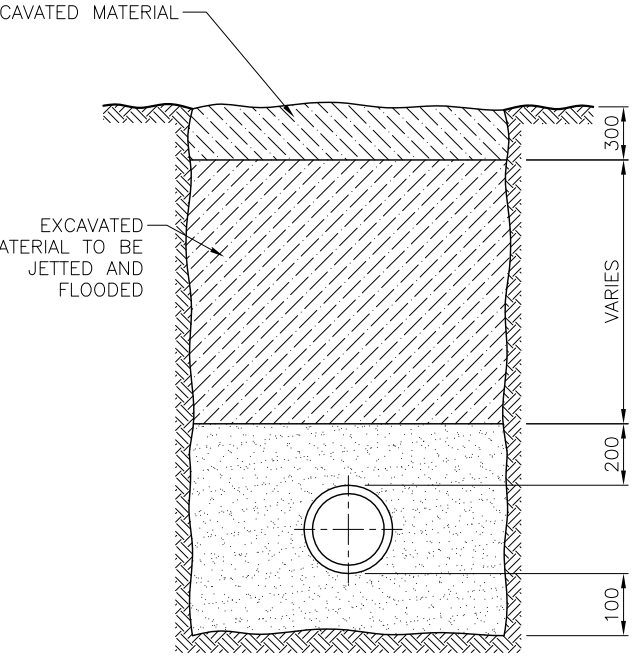
DATE	REVISION	BY

DRAWING NO. U2

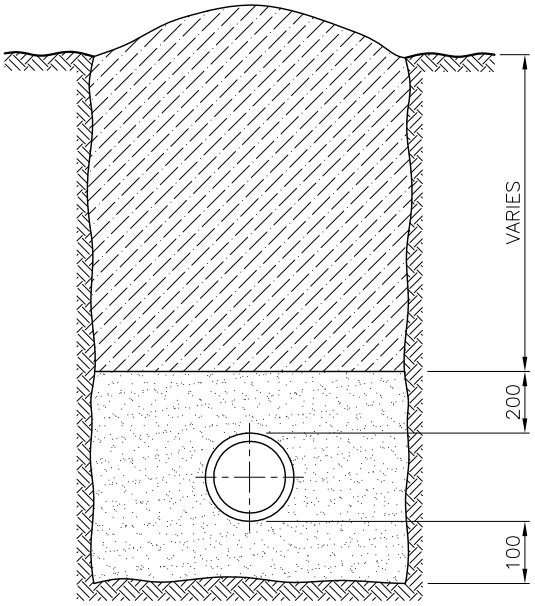
REV. NO.



CLASS 5



CLASS 6



CLASS 7

DIMENSIONS ARE IN MILLIMETERS

R.M. OF HANOVER

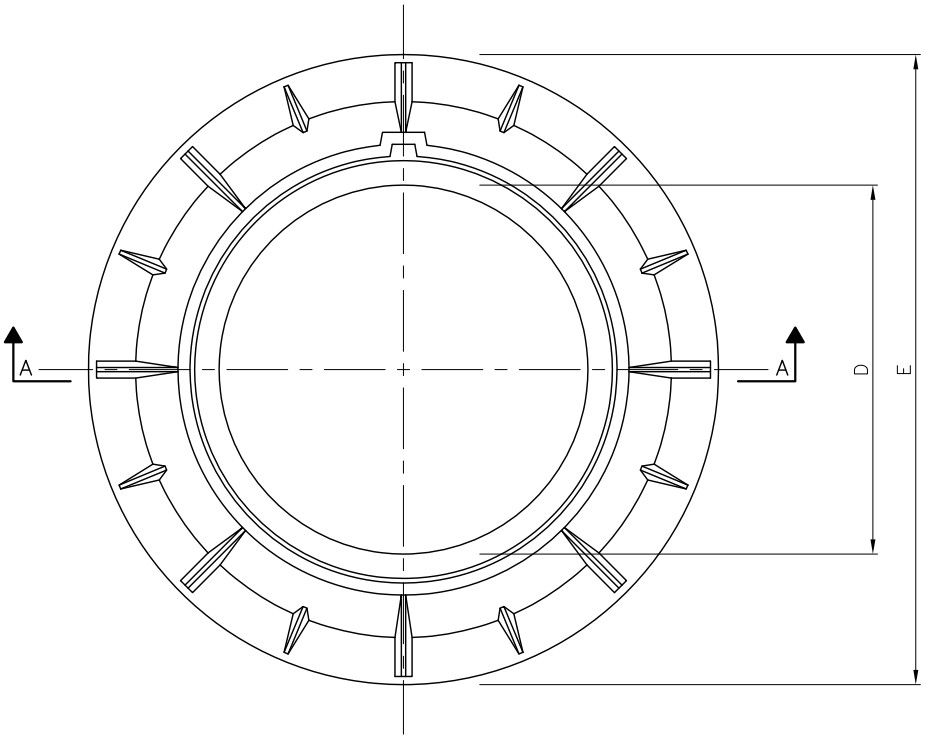
STANDARD BEDDINGS AND BACKFILLS

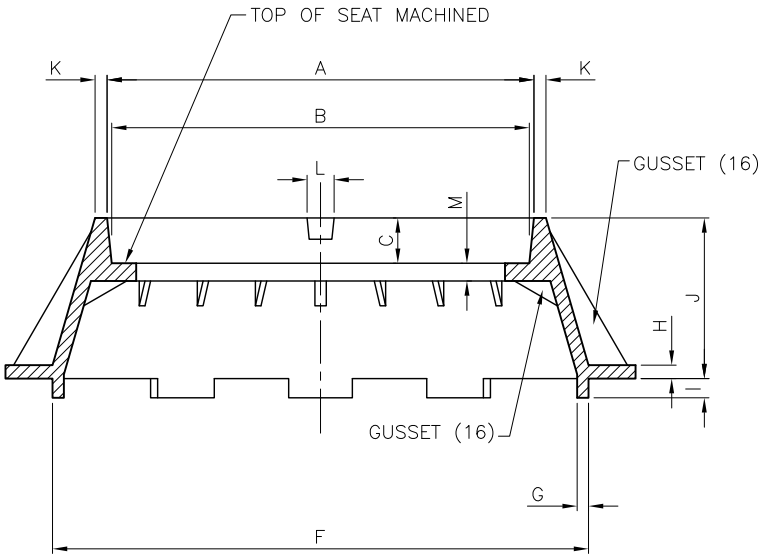
DRAWN BY:	AE
DATE:	JAN 2014
SCALE:	NTS

DATE	REVISION	BY

DRAWING NO. U3

REV. NO.





SECTION A–A

DIMENSIONS	
A	603 ± 2
B	590 ± 5
C	64 ± 1
D	521 ± 2
E	890 ± 10
F	757 ± 5
G	16 ± 4
H	19 ± 6
I	27 ± 3
J	227 ± 4
K	17 ± 4
L	38 ± 6
M	25 ± 3

DIMENSIONS IN MILLIMETERS

MASS=109kg

R.M. OF HANOVER

STANDARD MANHOLE FRAME
(TITAN TF 101M)

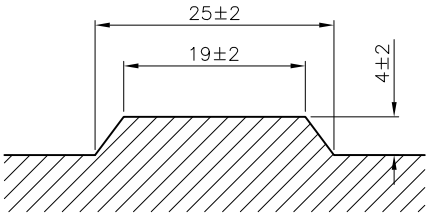
DRAWN BY:	AE
DATE:	JAN 2014
SCALE:	NTS

DATE	REVISION	BY

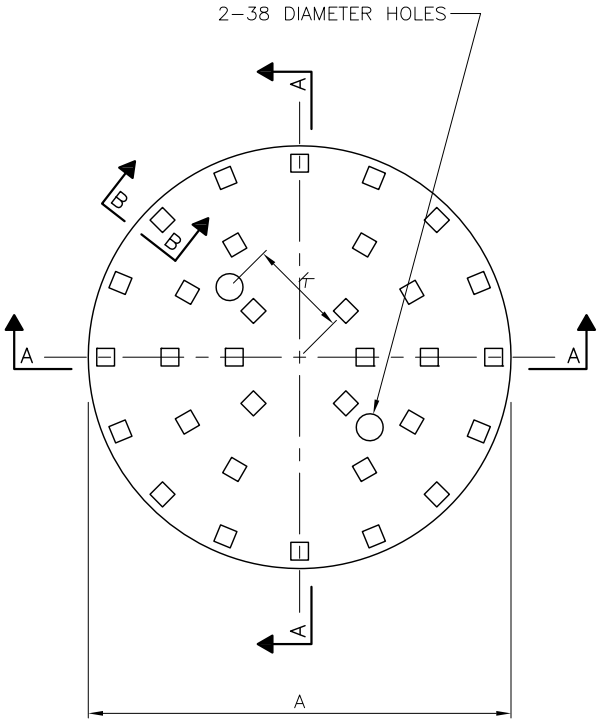
DRAWING NO. U4

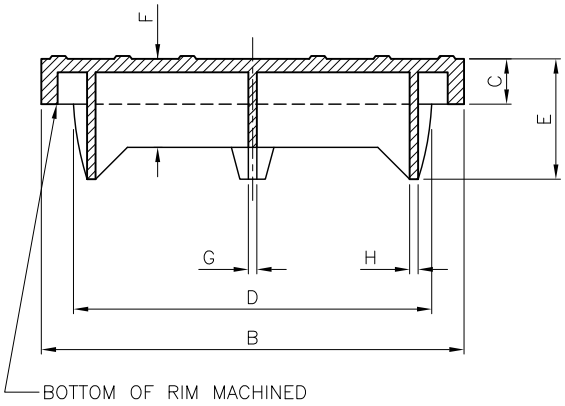
REV. NO.

*NOTE: COVERS SHALL HAVE A MINIMUM OF 32 CHECKERS. LOCATIONS OF CHECKERS SHOWN ARE TO BE CONSIDERED APPROXIMATE.

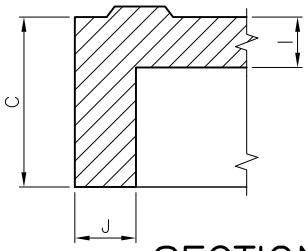


CHECKER DETAIL





SECTION A–A



SECTION B–B

DIMENSIONS	
A	597 ± 2
B	575 ± 6
C	64 ± 1
D	506 ± 12
E	170 ± 30
F	125 ± 6
G	12 ± 6
H	12 ± 6
I	19 ± 2
J	23 ± 6
K	140 ± 6

DIMENSIONS IN MILLIMETERS

MASS=77kg

R.M. OF HANOVER

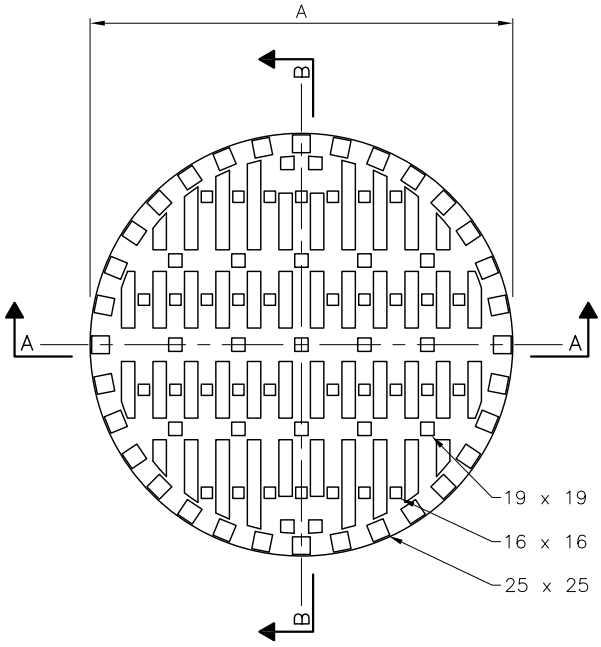
CAST IRON MANHOLE COVER
(SOLID)
(TITAN TF 101M)

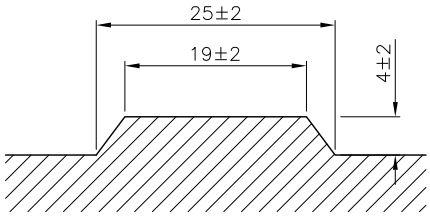
DRAWN BY:	AE
DATE:	JAN 2014
SCALE:	NTS

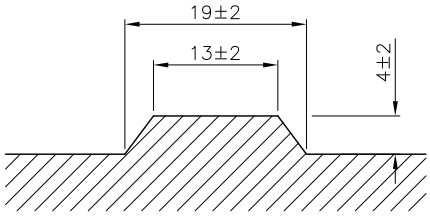
DATE	REVISION	BY

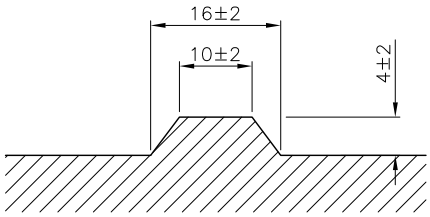
DRAWING NO. U5

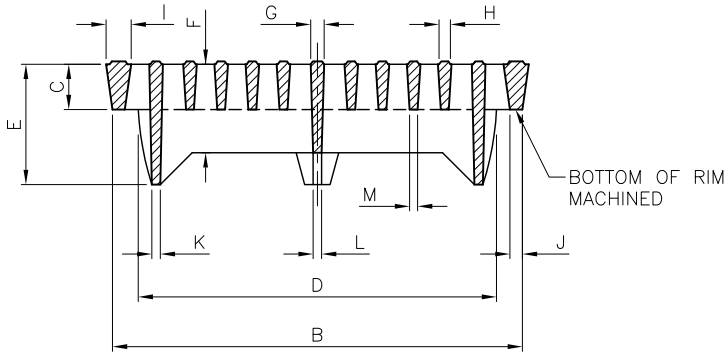
REV. NO.



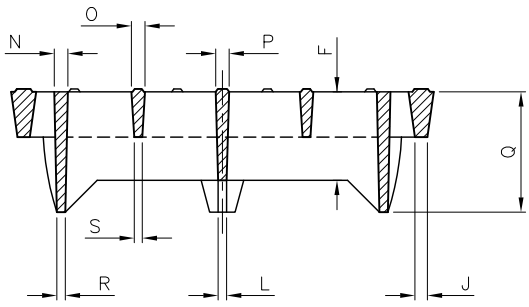








SECTION A–A



SECTION B–B

CHECKER DETAILS

DIMENSIONS	
A	597 ± 2
B	575 ± 6
C	64 ± 1
D	506 ± 12
E	170 ± 30
F	125 ± 6
G	25 ± 6
H	19 ± 2
I	40 ± 4
J	23 ± 6
K	12 ± 6
L	12 ± 6
M	13 ± 4
N	25 ± 6
O	25 ± 6
P	25 ± 6
Q	170 ± 30
R	12 ± 6
S	13 ± 4

DIMENSIONS IN MILLIMETERS

MASS=84kg

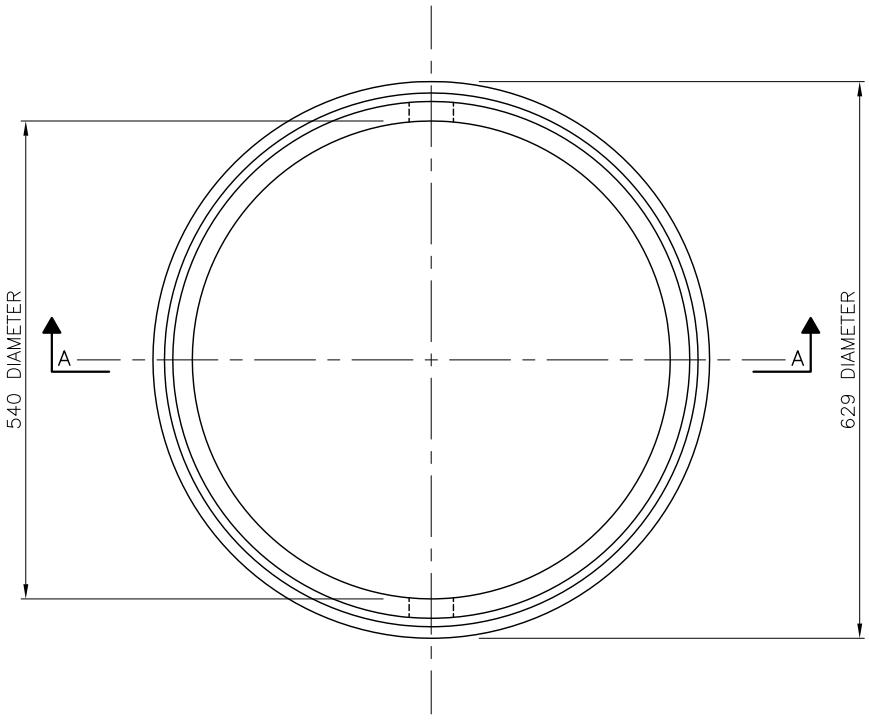
R.M. OF HANOVER

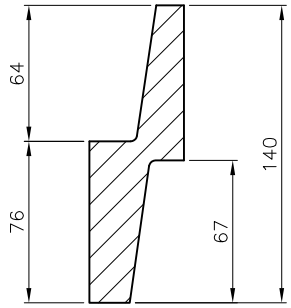
CAST IRON MANHOLE COVER
(GRATED)
(TITAN TF 101M)

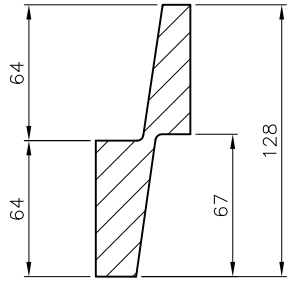
DRAWN BY:	AE
DATE:	JAN 2014
SCALE:	NTS
DRAWING NO.	U6

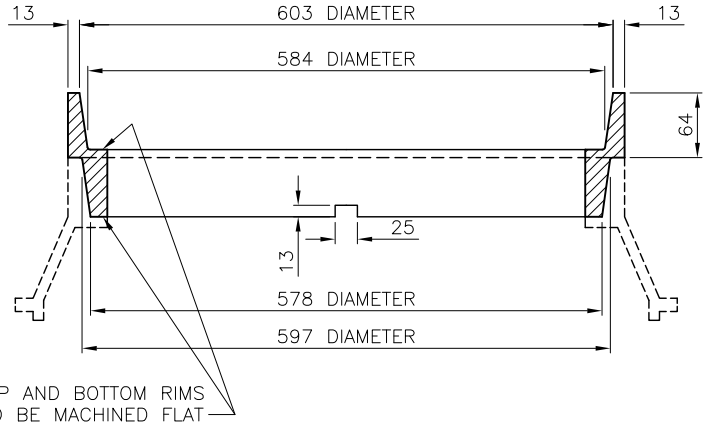
DATE	REVISION	BY

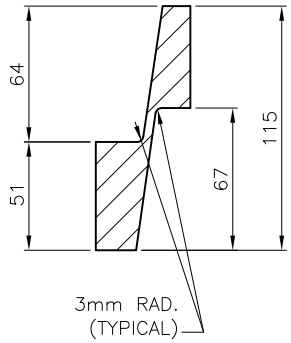
REV. NO.











SECTION A–A

DIMENSIONS ARE IN MILLIMETERS

R.M. OF HANOVER

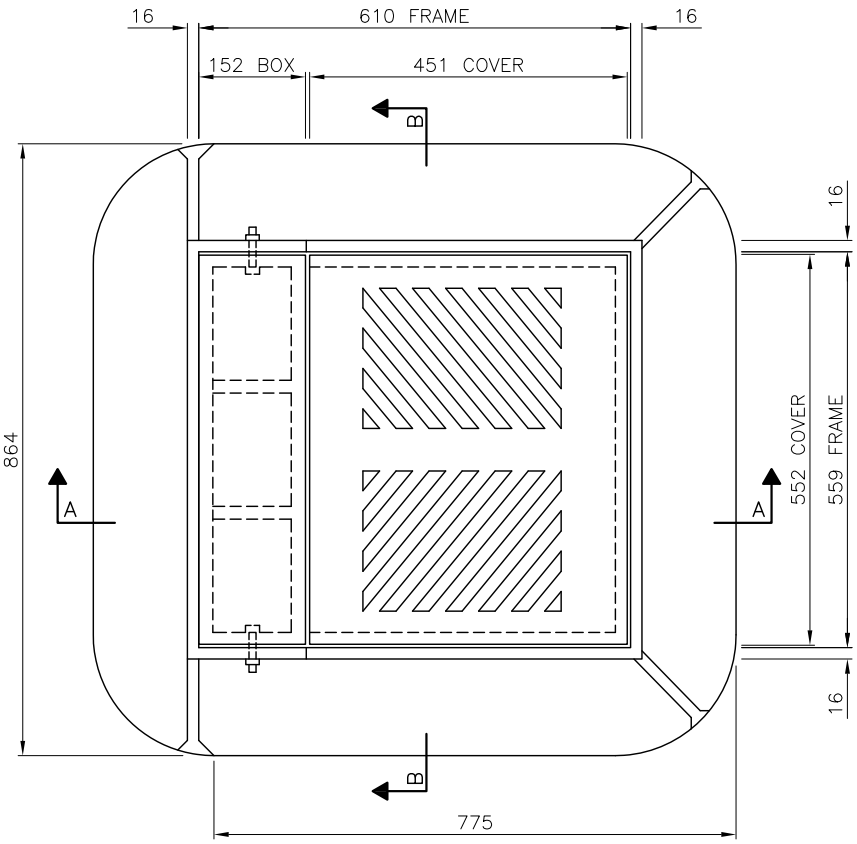
CAST IRON LIFTER RING
(TITAN TF 101LR)

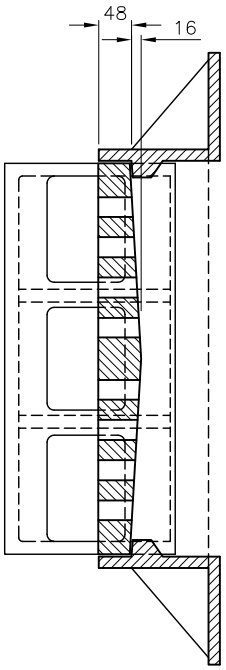
DRAWN BY:	AE
DATE:	JAN 2014
SCALE:	NTS

DATE	REVISION	BY

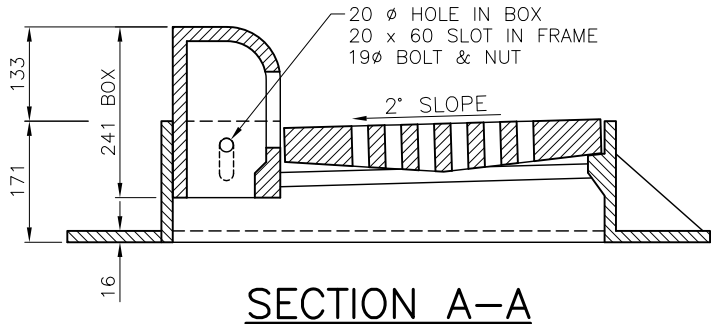
DRAWING NO. U7

REV. NO.





SECTION B–B



SECTION A–A

DIMENSIONS ARE IN MILLIMETERS

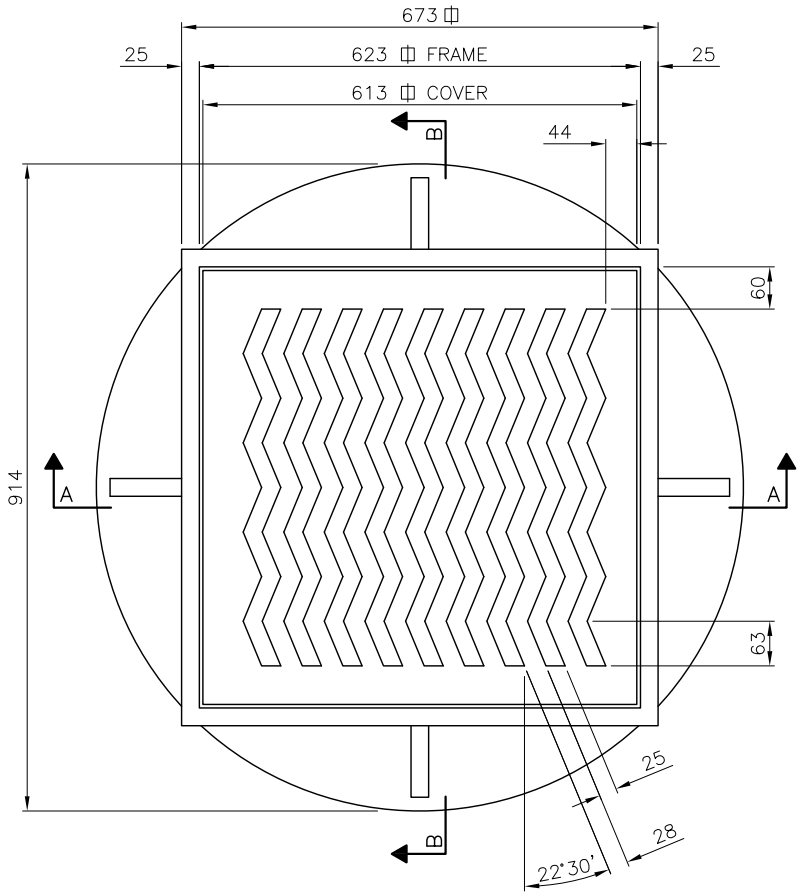
R.M. OF HANOVER

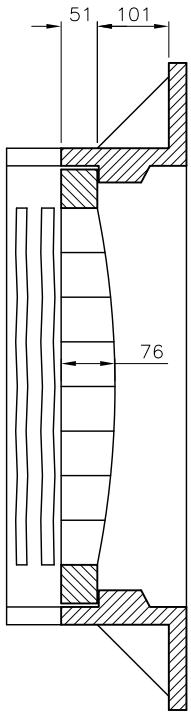
BARRIER CURB AND GUTTER INLET
(TITAN TF 103–4)

DRAWN BY:	AE
DATE:	JAN 2014
SCALE:	NTS
DRAWING NO.	U8

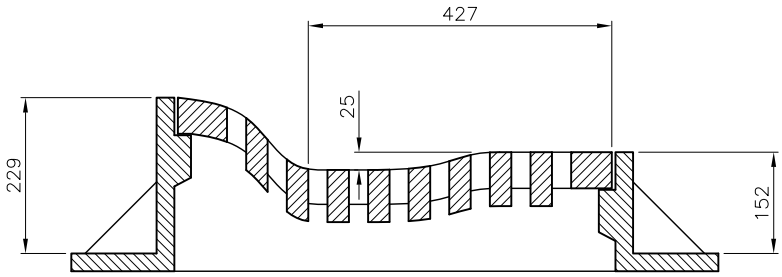
DATE	REVISION	BY

REV. NO.





SECTION B–B



SECTION A–A

DIMENSIONS ARE IN MILLIMETERS

R.M. OF HANOVER

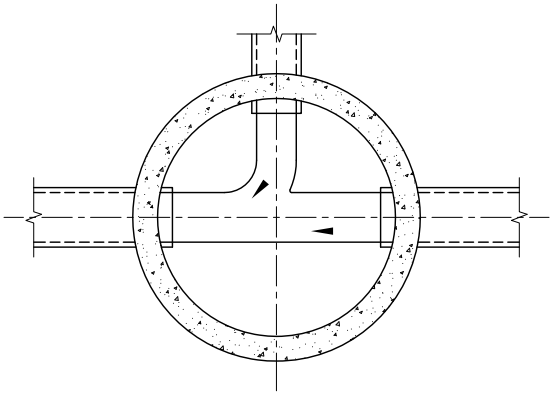
LIP CURB AND GUTTER INLET
(TITAN TF 102)

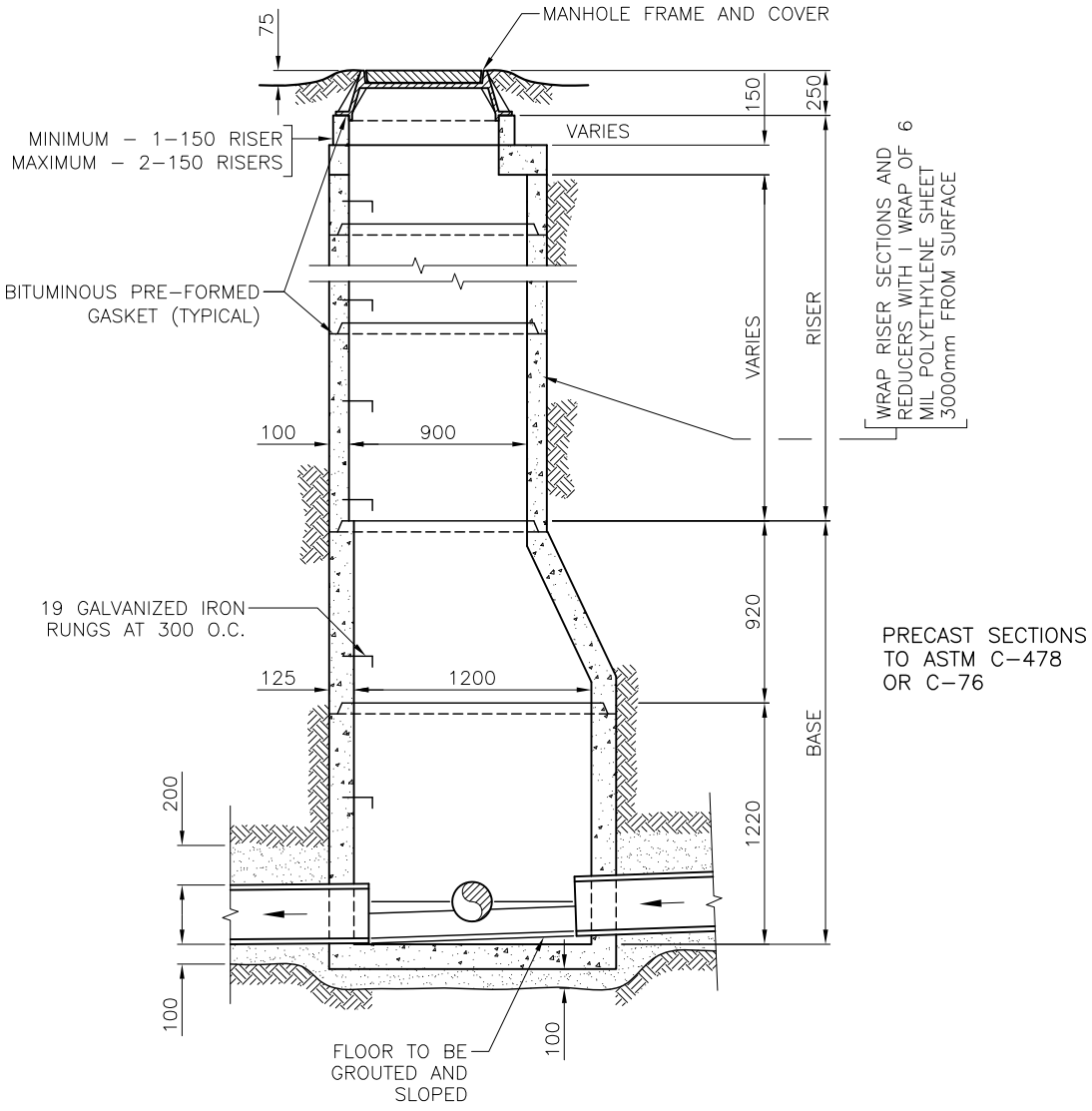
DRAWN BY:	AE
DATE:	JAN 2014
SCALE:	NTS

DATE	REVISION	BY

DRAWING NO. U9

REV. NO.





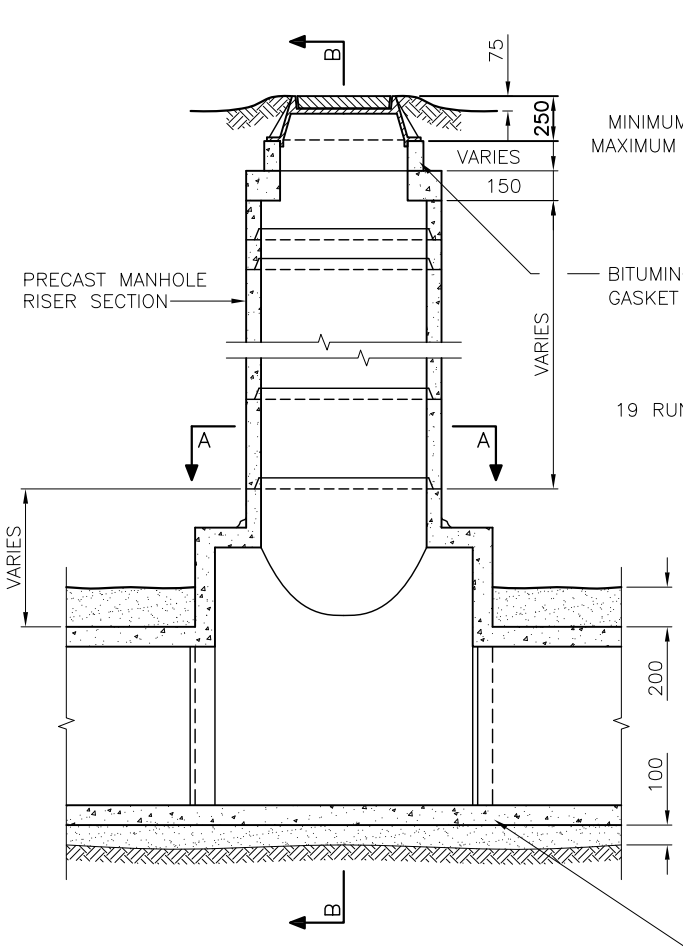
DIMENSIONS ARE IN MILLIMETERS

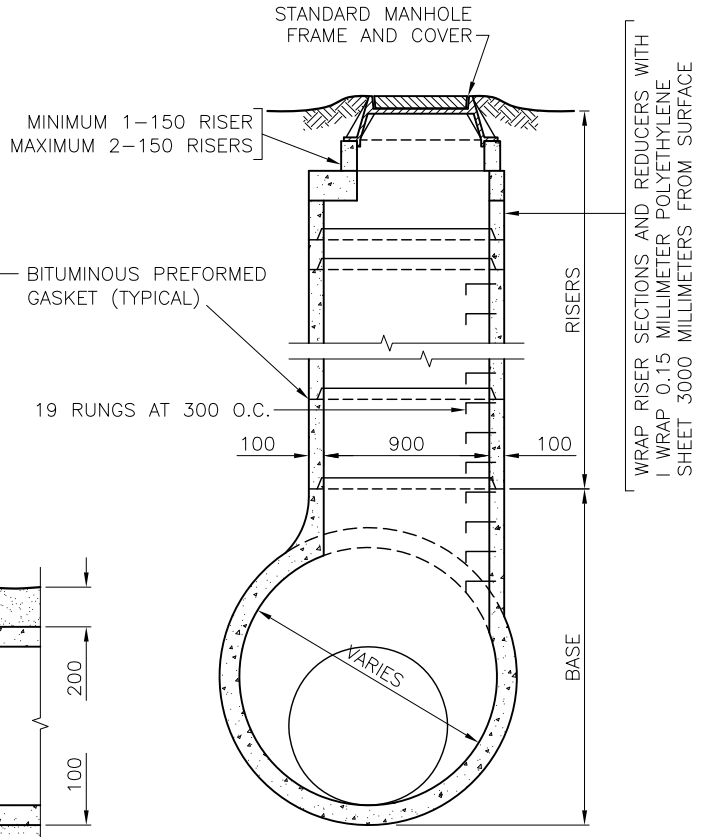
R.M. OF HANOVER

STANDARD MANHOLE (FOR UP TO 525mm PIPE)

DRAWN BY:	AE
DATE:	JAN 2014
SCALE:	NTS
DRAWING NO.	U10
REV. NO.	

DATE	REVISION	BY





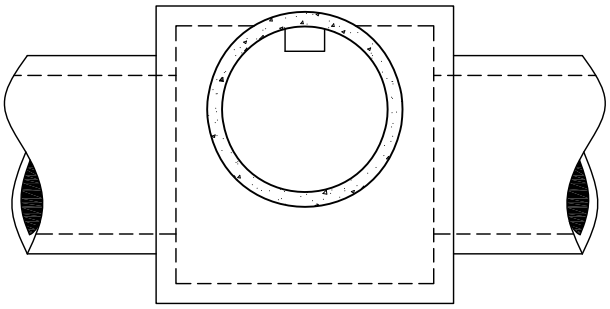
SECTION B–B

CLASS IV MANHOLE PIPE WITH
900 DIAMETER STACK

FOR 600 TO 900 SEWERS, USE
A 1200 DIAMETER x 1800 LONG
MANHOLE

FOR 1060 TO1500 SEWERS, USE
A 1500 DIAMETER x 1800 LONG
MANHOLE

RISERS TO ASTM C–478 OR C–76



SECTION A–A

ALL MANHOLES TO HAVE MONOLITHIC ENDS
CONSTRUCTED TO SUIT THE SEWER PIPE
BEING USED

DIMENSIONS ARE IN MILLIMETERS

R.M. OF HANOVER

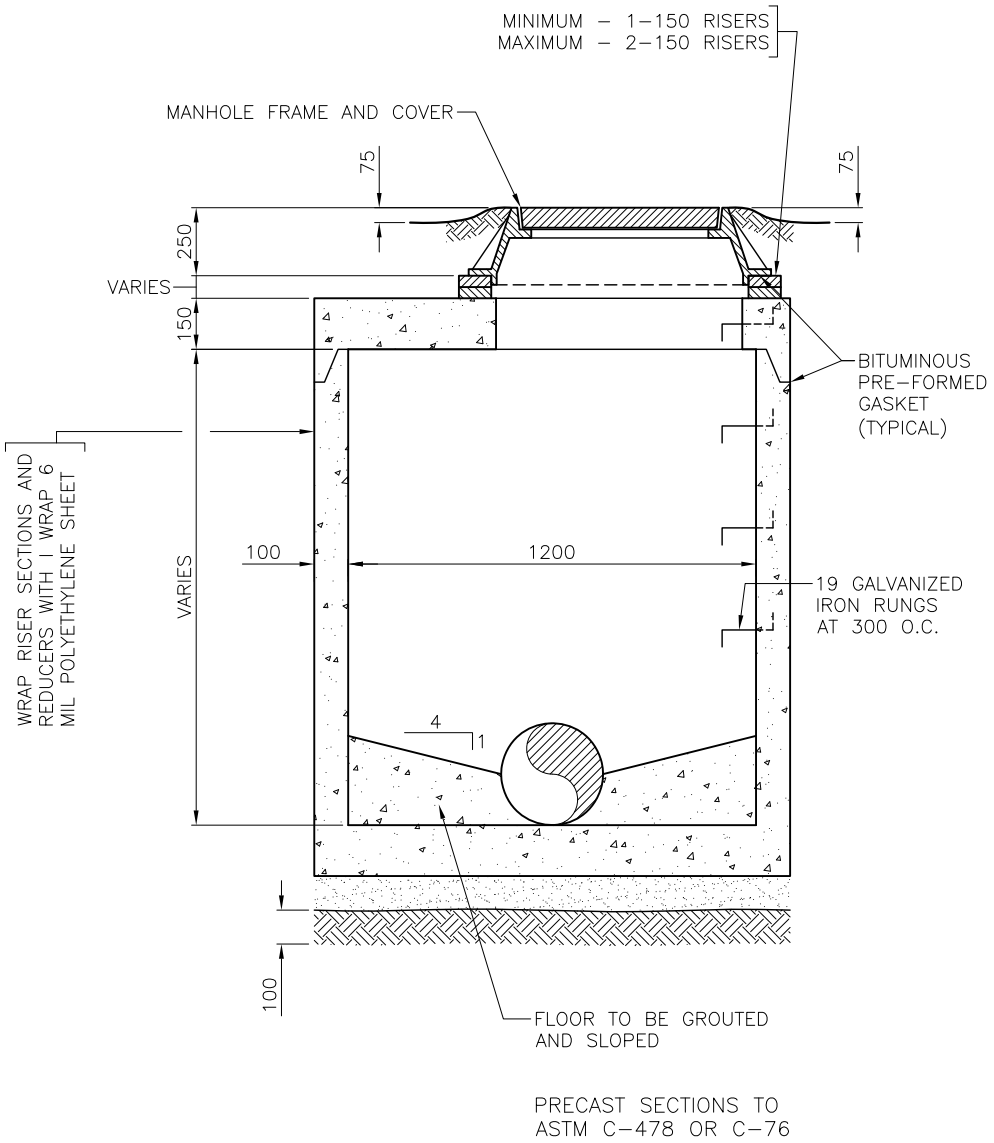
STANDARD MANHOLE
(FOR 600 MILLIMETER TO 1500
MILLIMETER PIPE)

DRAWN BY:	AE
DATE:	JAN 2014
SCALE:	NTS

DATE	REVISION	BY

DRAWING NO. U11

REV. NO.



DIMENSIONS ARE IN MILLIMETERS

R.M. OF HANOVER

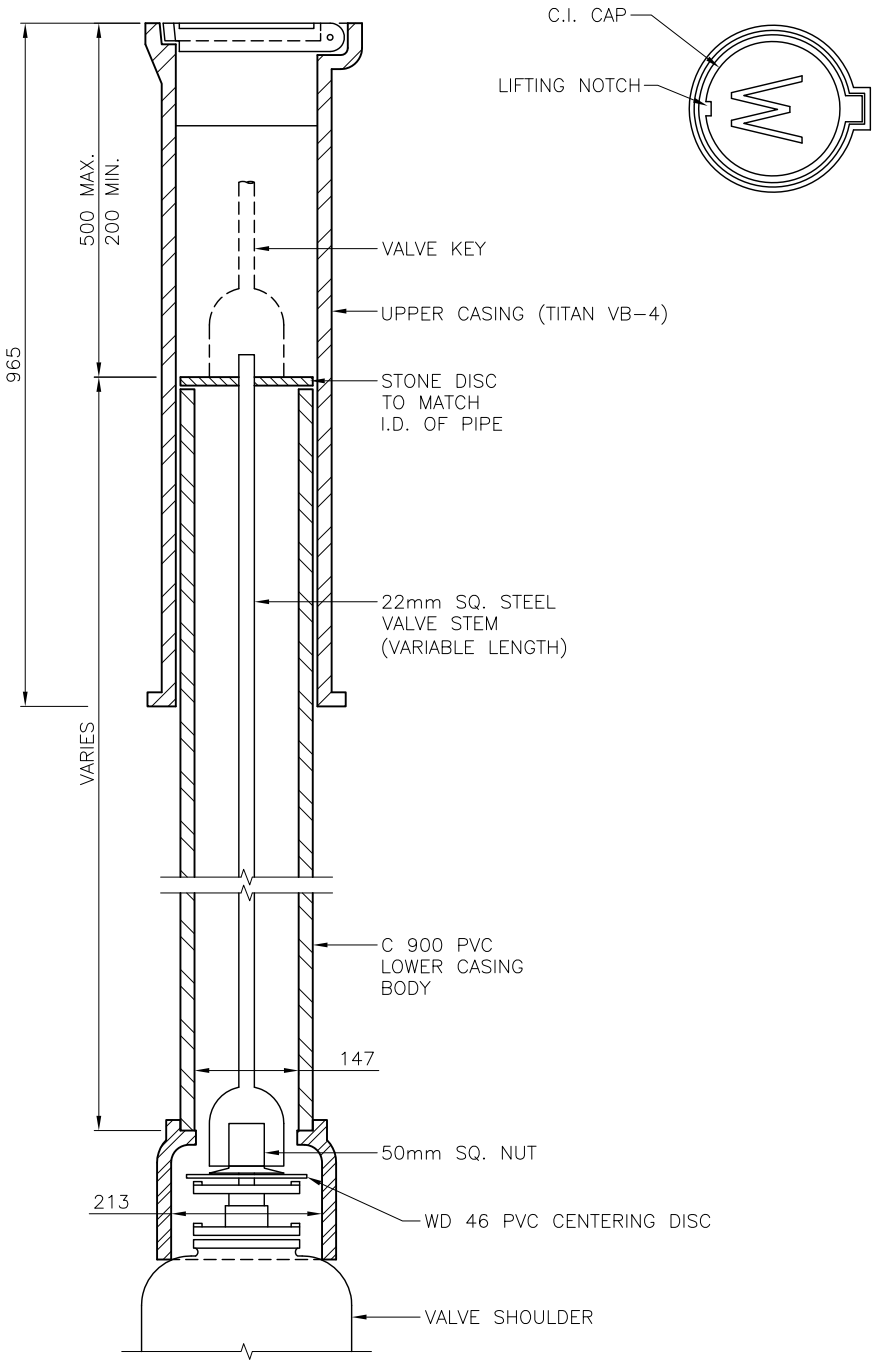
PRECAST SHALLOW MANHOLE

DRAWN BY:	AE
DATE:	JAN 2014
SCALE:	NTS

DATE	REVISION	BY

DRAWING NO. U12

REV. NO.



DIMENSIONS ARE IN MILLIMETERS

R.M. OF HANOVER

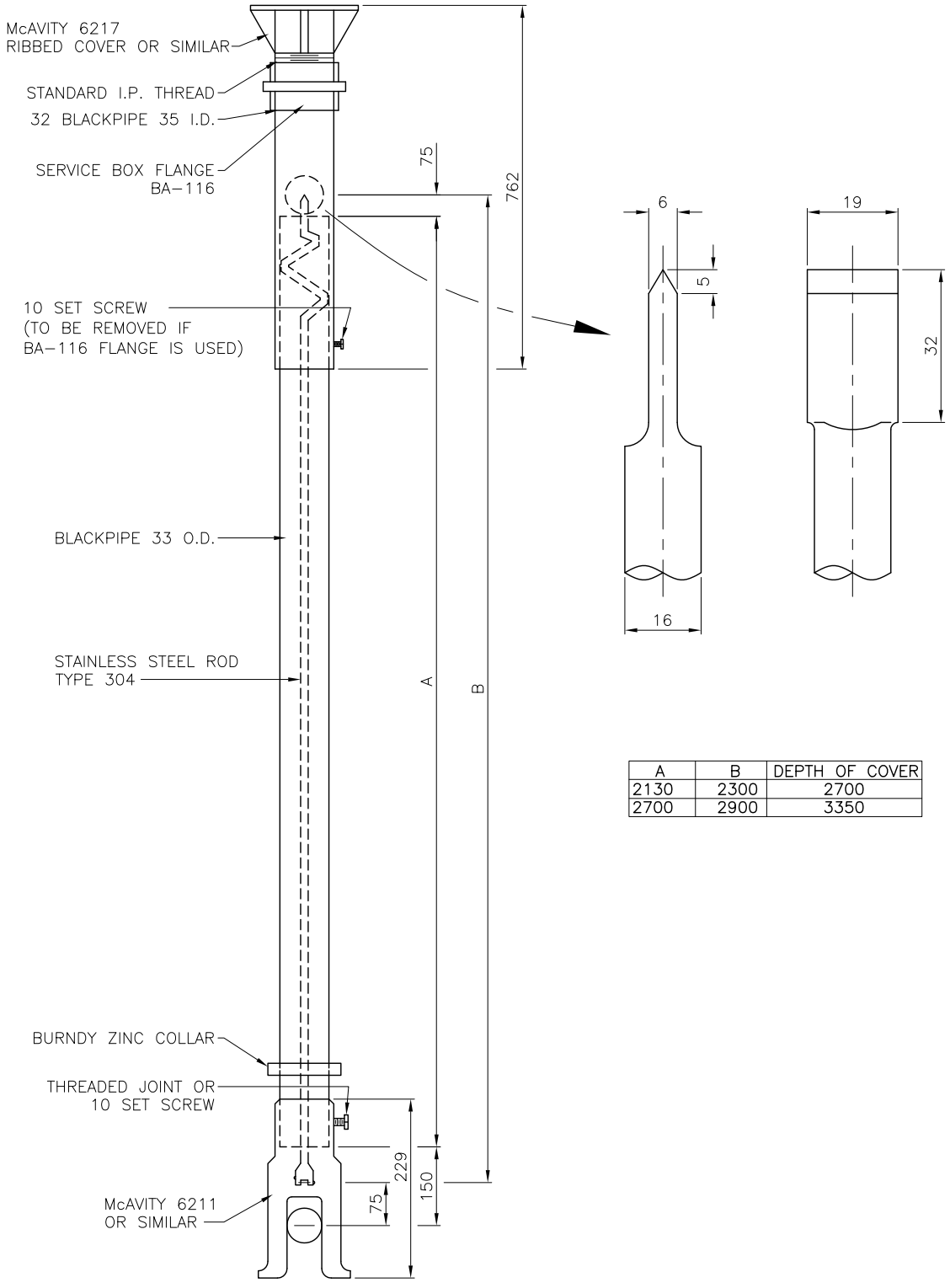
MAIN VALVE BOX

DRAWN BY:	AE
DATE:	JAN 2014
SCALE:	NTS

DATE	REVISION	BY

DRAWING NO. U13

REV. NO.



A	B	DEPTH OF COVER
2130	2300	2700
2700	2900	3350

DIMENSIONS ARE IN MILLIMETERS

R.M. OF HANOVER

CURB STOP BOX

DRAWN BY: AE

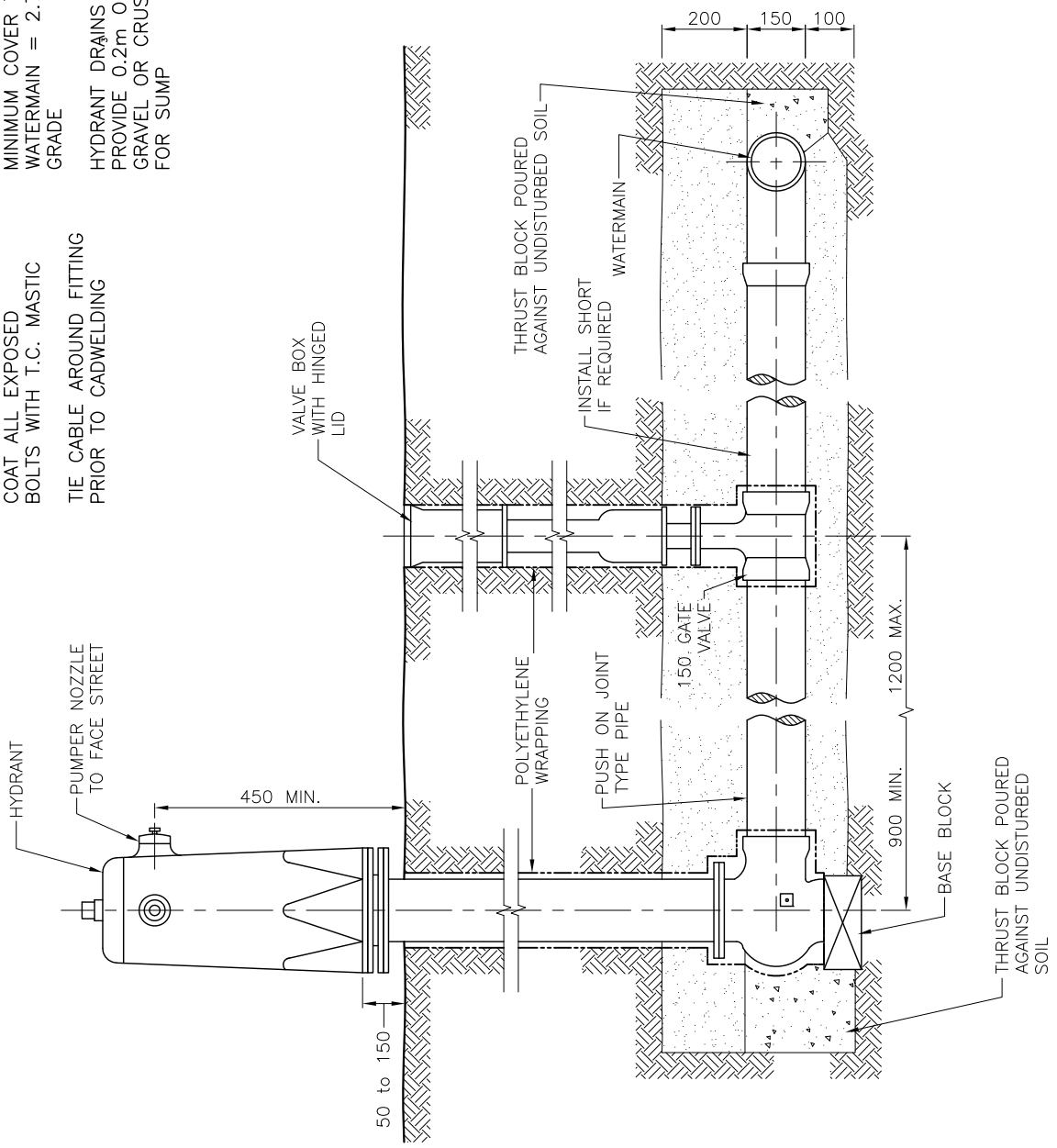
DATE: JAN 2014

SCALE: NTS

DATE	REVISION	BY

DRAWING NO. U14

REV. NO.



DIMENSIONS ARE IN MILLIMETERS

R.M. OF HANOVER

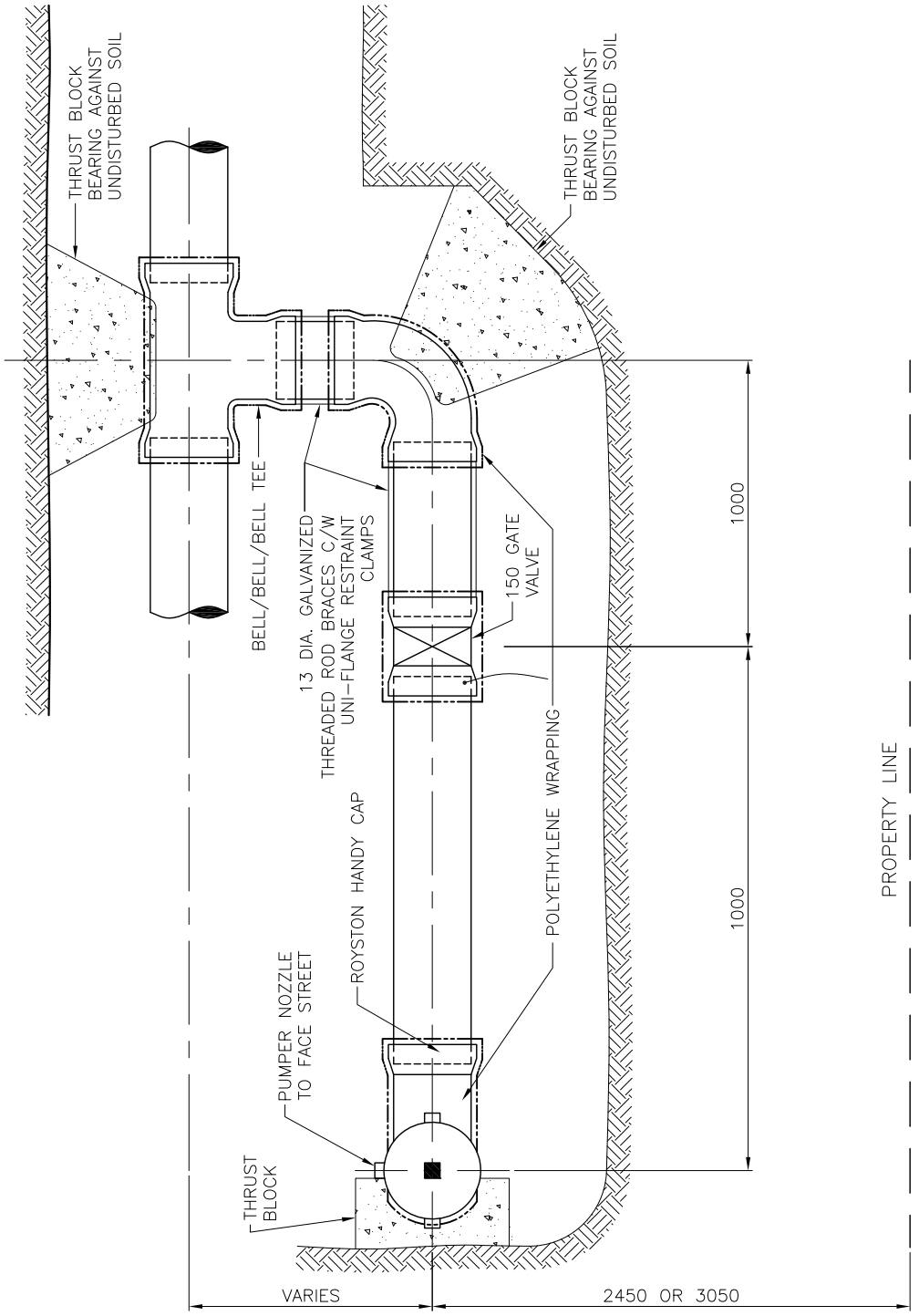
STANDARD FIRE HYDRANT ASSEMBLY

DRAWN BY:	AE
DATE:	JAN 2014
SCALE:	NTS

DATE	REVISION	BY

DRAWING NO. U15

REV. NO.



DIMENSIONS ARE IN MILLIMETERS

R.M. OF HANOVER

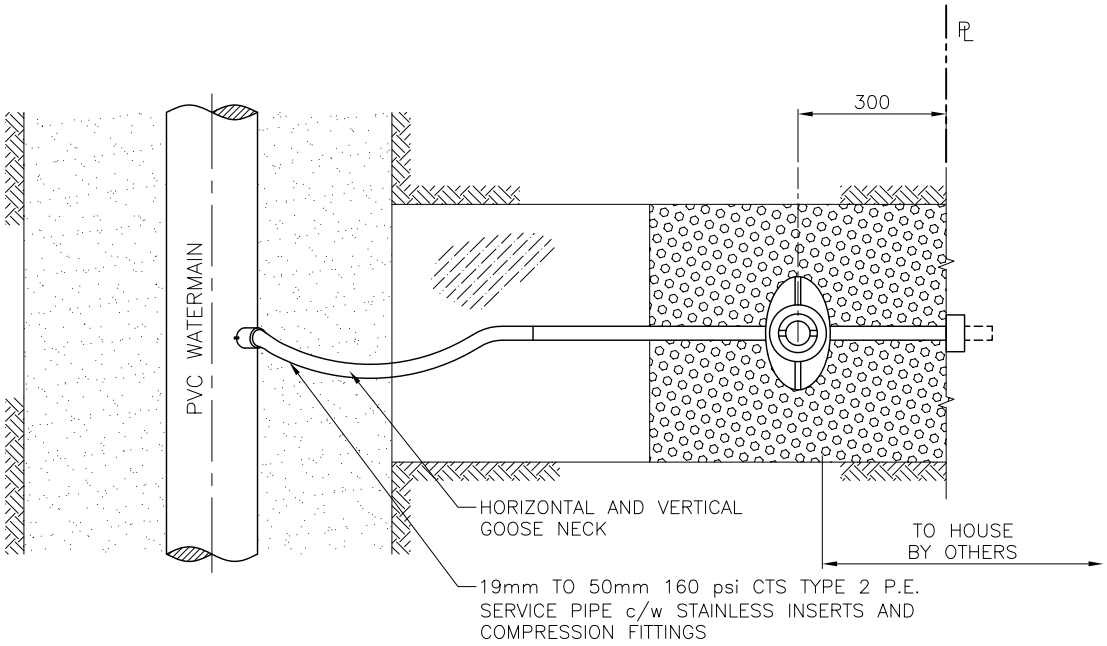
SHORT FIRE HYDRANT ASSEMBLY

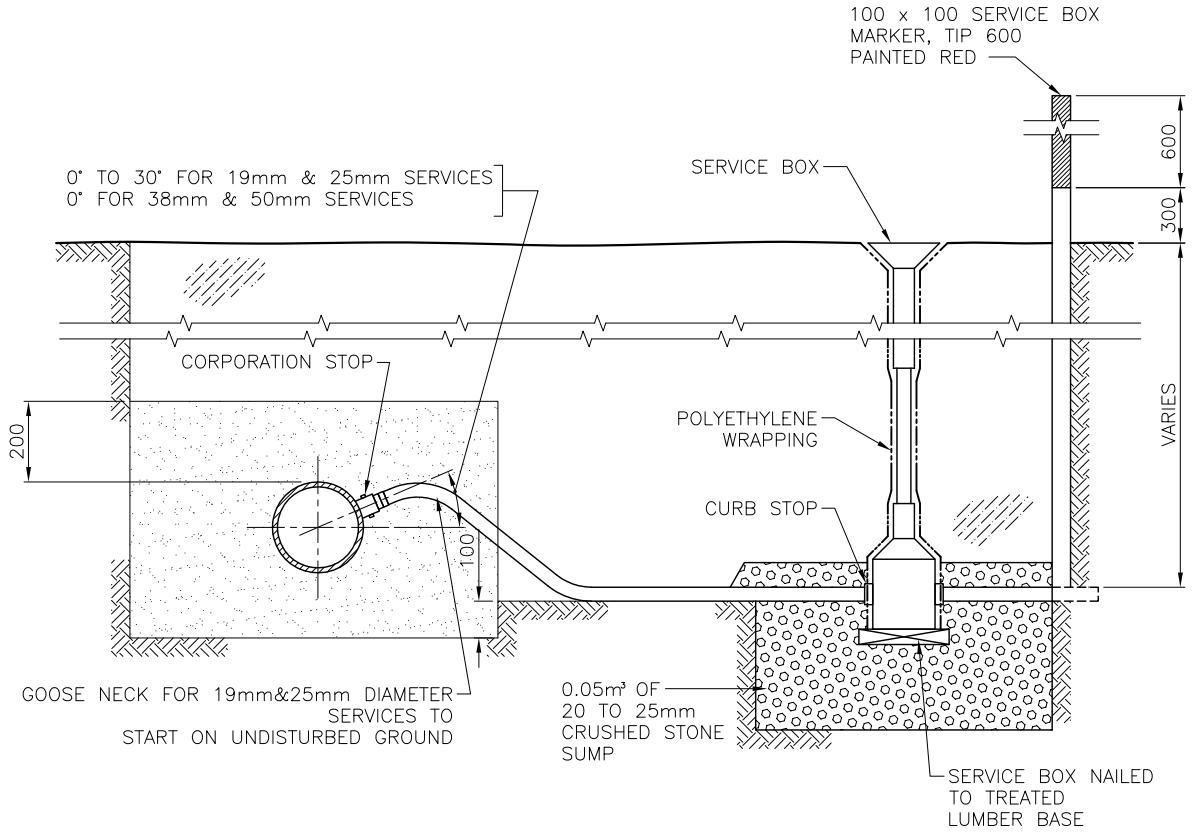
DRAWN BY:	AE
DATE:	JAN 2014
SCALE:	NTS

DATE	REVISION	BY

DRAWING NO. U16

REV. NO.



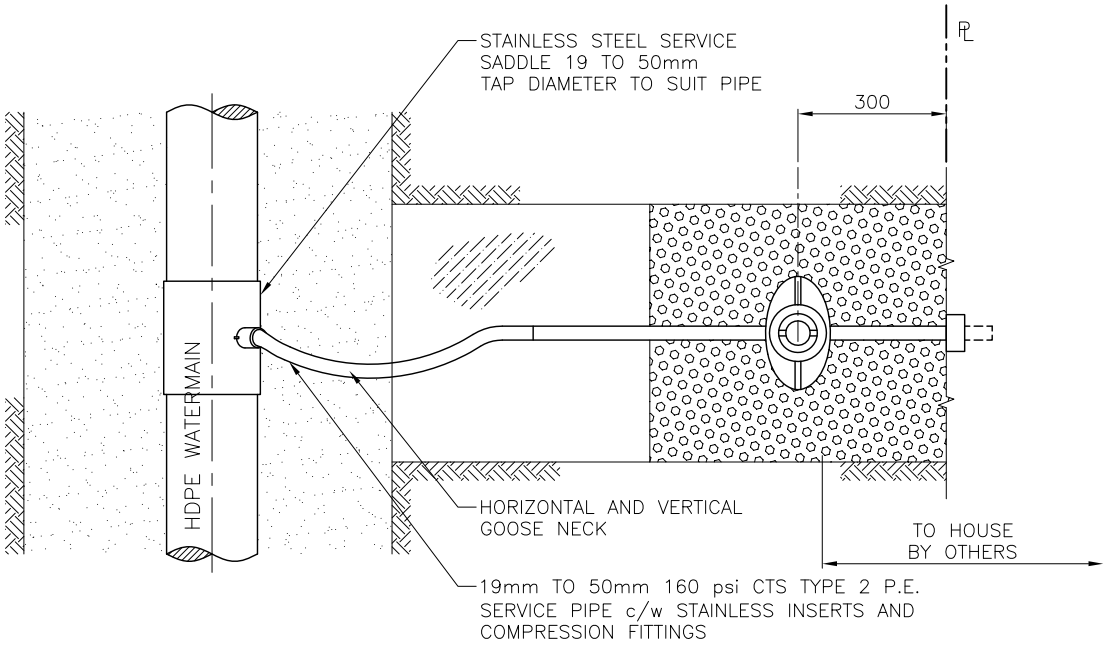


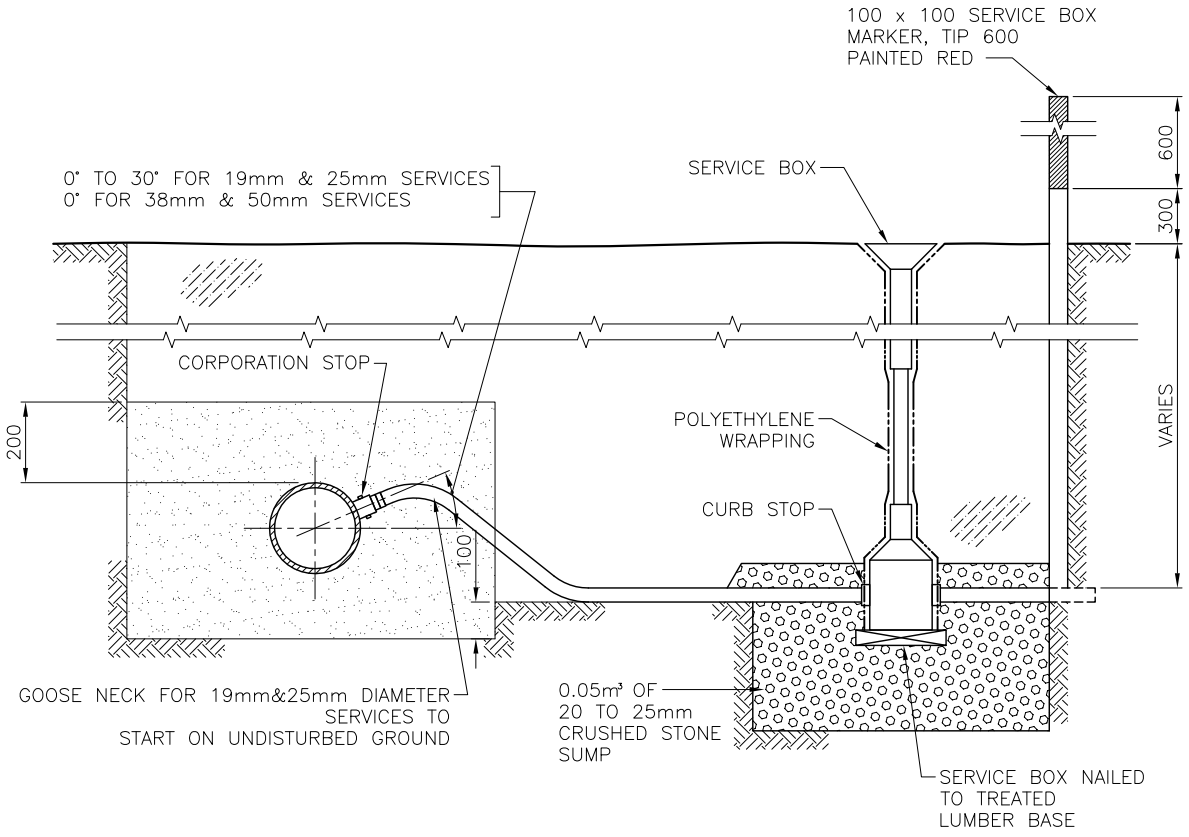
DIMENSIONS ARE IN MILLIMETERS

R.M. OF HANOVER

PVC WATER SERVICE CONNECTION (19mm TO 50mm ø)

DRAWN BY: AE	JAN 2016	TITLE	AE
DATE: JAN 2014	DATE	REVISION	BY
SCALE: NTS	DRAWING NO. U17		REV. NO. 1





DIMENSIONS ARE IN MILLIMETERS

R.M. OF HANOVER

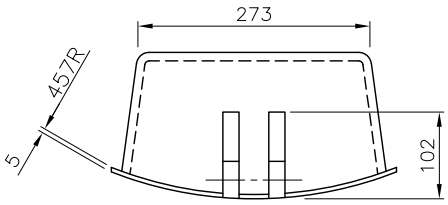
HDPE WATER SERVICE CONNECTION (19mm TO 50mm ø)

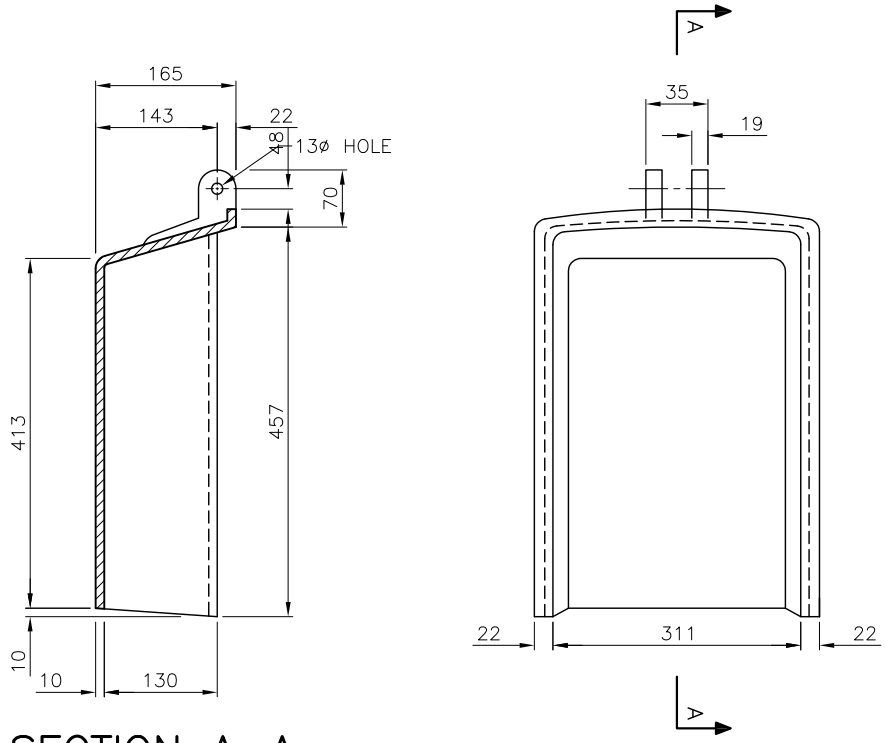
DRAWN BY:	AE
DATE:	JAN 2016
SCALE:	NTS

DATE	REVISION	BY

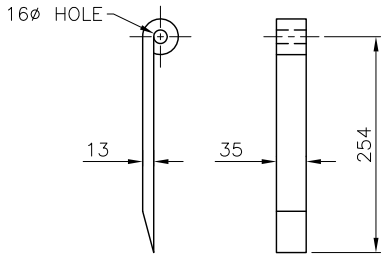
DRAWING NO. U17A

REV. NO.

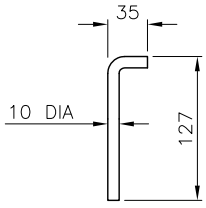




SECTION A–A



HINGE



HINGE PIN

DIMENSIONS ARE IN MILLIMETERS

R.M. OF HANOVER

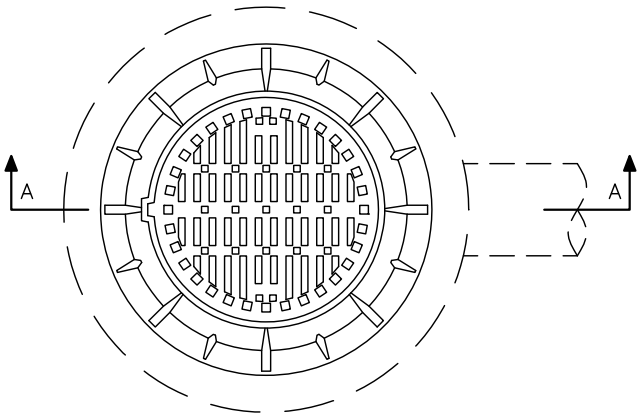
CAST IRON CATCH BASIN HOOD
STEEL HINGE AND PIN

DRAWN BY:	AE
DATE:	JAN 2014
SCALE:	NTS

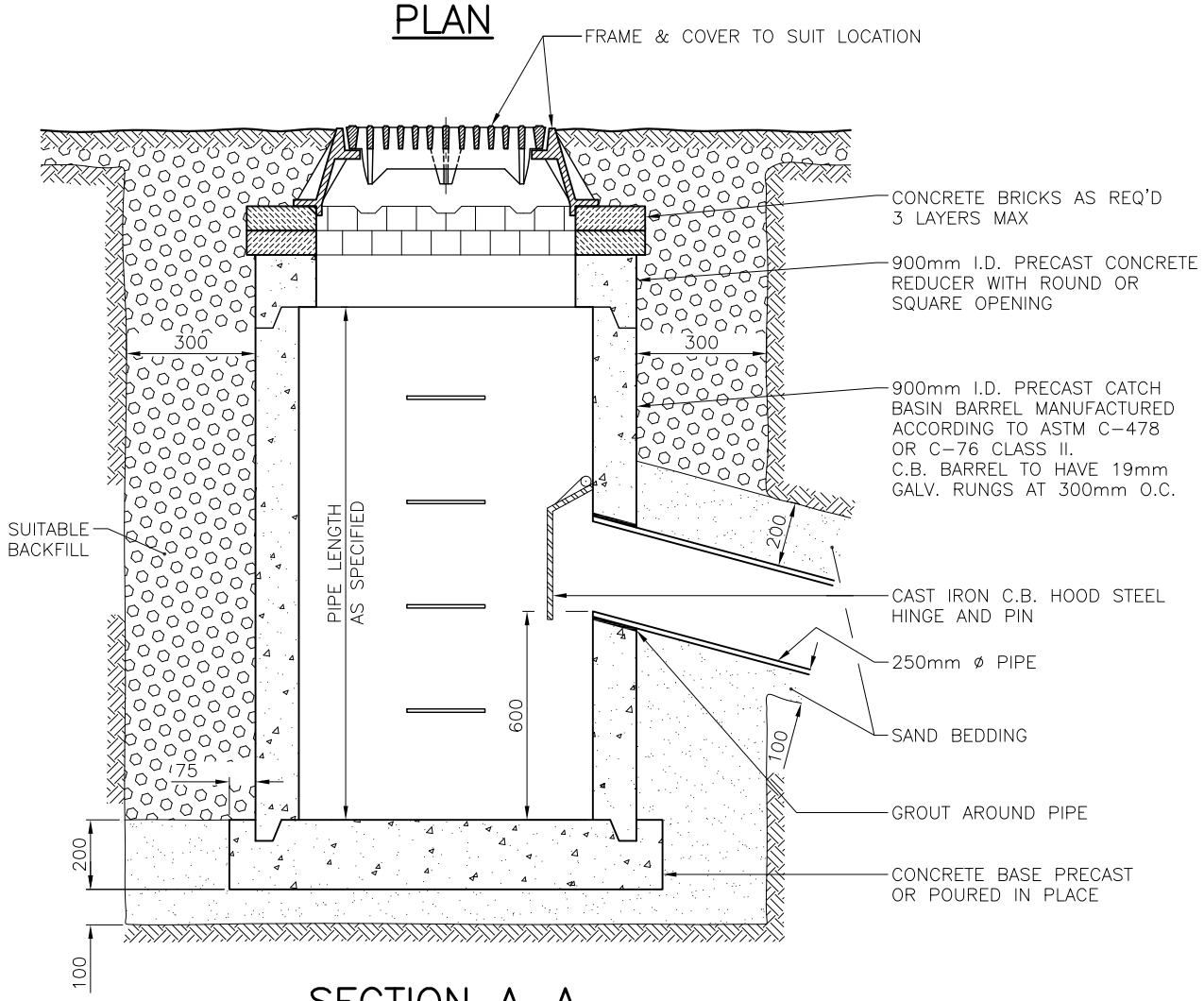
DATE	REVISION	BY

DRAWING NO. U18

REV. NO.



PLAN



SECTION A–A

DIMENSIONS ARE IN MILLIMETERS

R.M. OF HANOVER

STANDARD CATCH BASIN

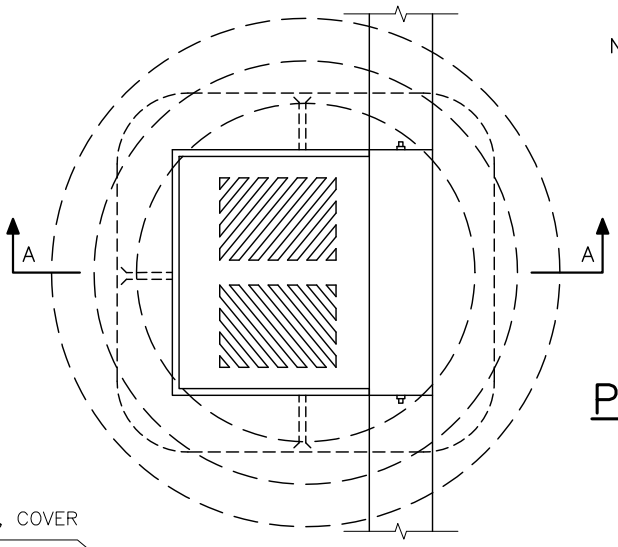
DRAWN BY:	AE
DATE:	JAN 2014
SCALE:	NTS

DATE	REVISION	BY

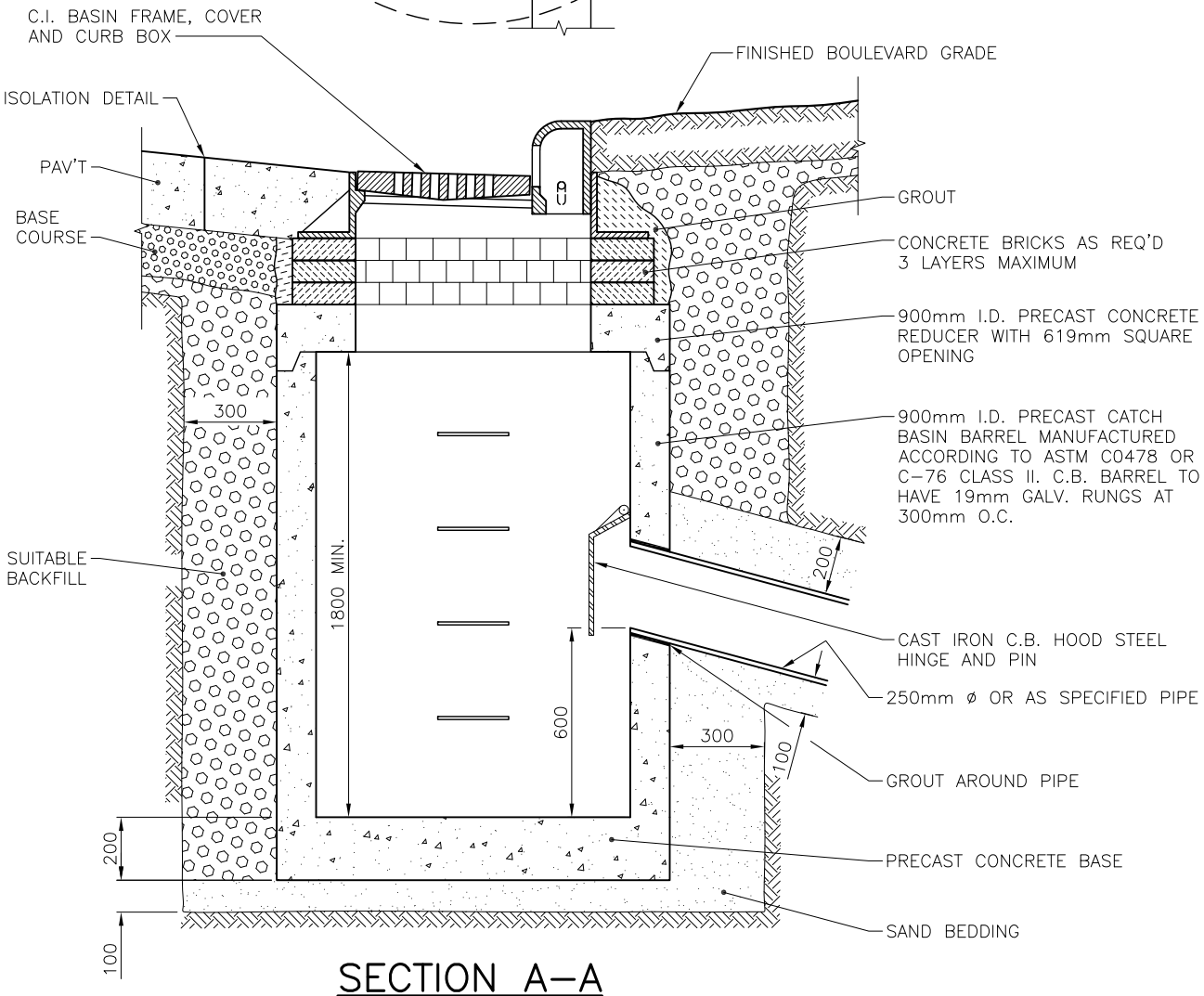
DRAWING NO. U19

REV. NO.

NOTE: CATCH BASIN WITH CURB AND GUTTER INLETS TO HAVE SEPARATE CONNECTIONS TO SEWER



PLAN



SECTION A-A

DIMENSIONS ARE IN MILLIMETERS

R.M. OF HANOVER

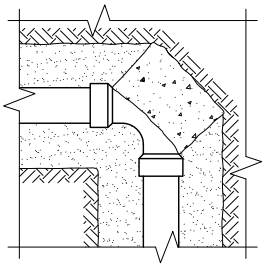
STANDARD CATCH BASIN WITH CURB AND GUTTER INLET

DRAWN BY:	AE
DATE:	JAN 2014
SCALE:	NTS

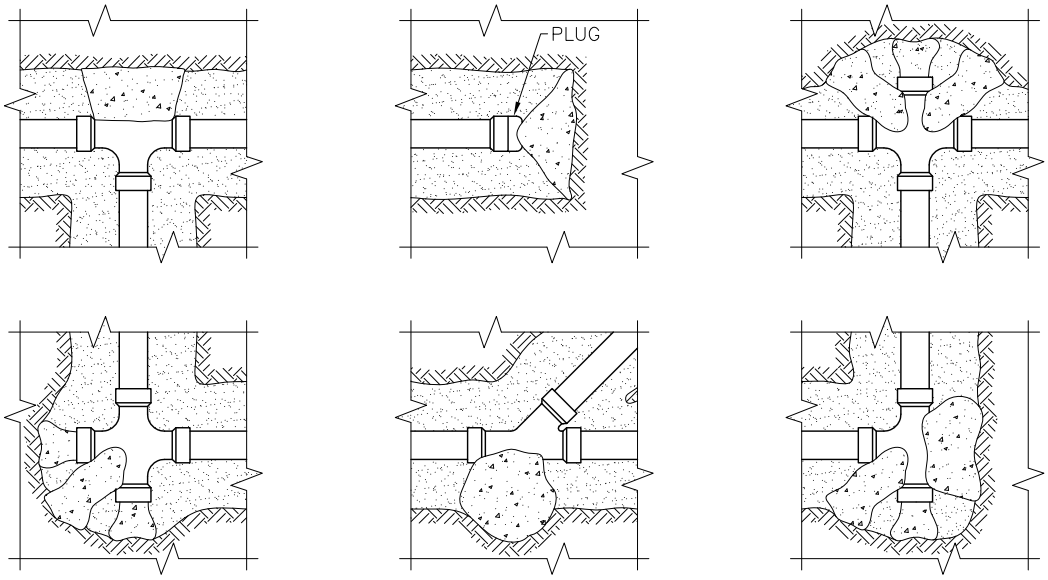
DATE	REVISION	BY

DRAWING NO. U20

REV. NO.



THRUST BLOCK AT 90° BEND



THRUST BLOCKS FOR FITTINGS

THRUST BLOCK BEARING AREAS FOR HORIZONTAL BENDS (TEST PRESSURE=1.0MPa)		
PIPE SIZE OPPOSITE BLOCK	PLUG, CROSS OR TEE BEARING AREA	ELBOW BEARING AREA
150mm	0.25 m²	0.40 m²
200mm	0.50 m²	0.70 m²
250mm	0.75 m²	1.00 m²
300mm	1.00 m²	1.50 m²
400mm	1.90 m²	2.60 m²
450mm	2.40 m²	3.30 m²

RETAINING CLAMPS TO BE USED ON ALL PLUGS

DIMENSIONS ARE IN MILLIMETERS

R.M. OF HANOVER

HORIZONTAL THRUST BLOCK DETAILS

DRAWN BY: AE

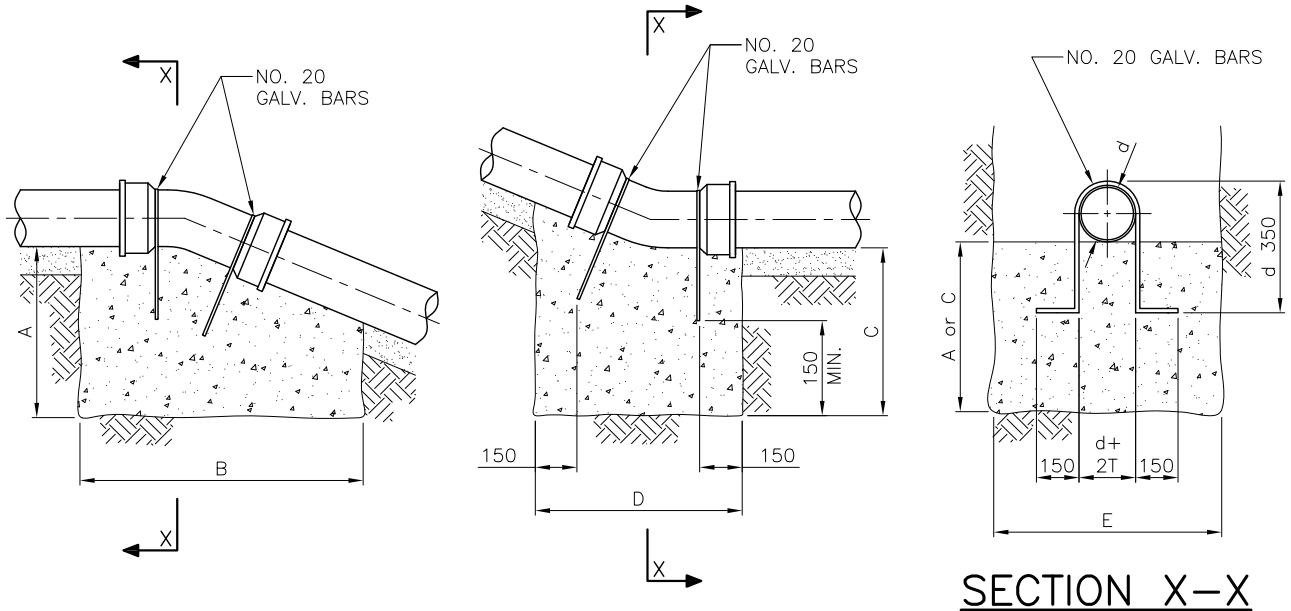
DATE: JAN 2014

SCALE: NTS

DATE	REVISION	BY

DRAWING NO. U21

REV. NO.



SECTION X–X

SIZE OF LINE	ANGLE OF BEND	A	B	C	D	E
150	11 ¼ 22 ½ 45	450 450 600	750 1000 1000	450 450 600	750 750 750	1050 1050 1050
200	11 ¼ 22 ½ 45	450 600 1000	1000 1000 1200	450 450 600	750 750 750	1050 1050 1050
250	11 ¼ 22 ½ 45	450 750 1050	1000 1200 1500	450 450 600	1000 1000 1000	1050 1050 1050
300	11 ¼ 22 ½ 45	600 750 1200	1050 1500 1800	600 600 750	1050 1050 1050	1050 1050 1050
400	11 ¼ 22 ½ 45	750 1050 1500	1500 2150 2450	1000 1050 1200	1200 1200 1200	1050 1050 1050
450	11 ¼ 22 ½ 45	1000 1200 1650	1500 2150 2900	1050 1050 1350	1350 1350 1350	1050 1050 1050

DIMENSIONS ARE IN MILLIMETERS

R.M. OF HANOVER

VERTICAL THRUST BLOCK DETAILS

DRAWN BY: AE

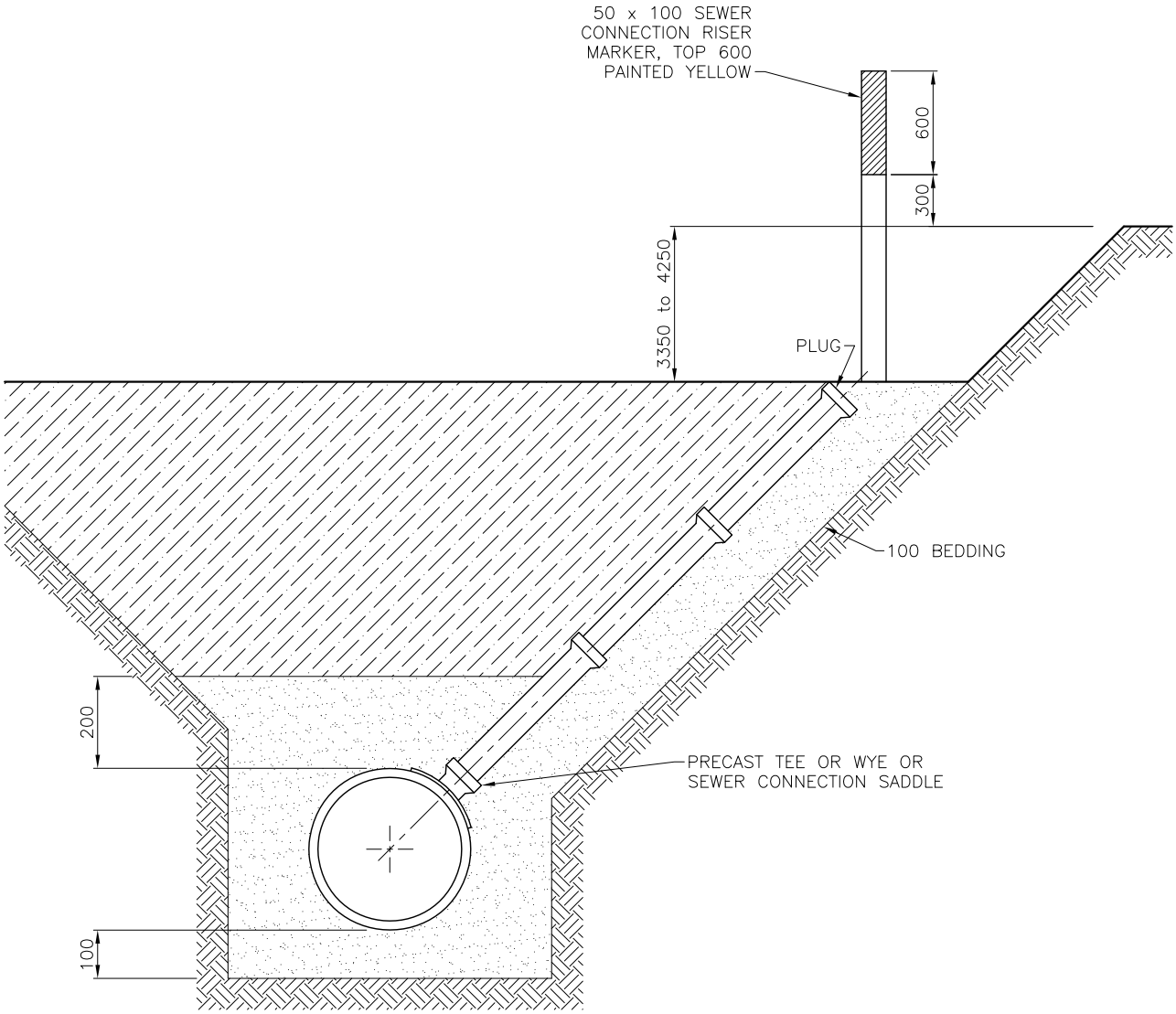
DATE: JAN 2014

SCALE: NTS

DATE	REVISION	BY

DRAWING NO. U22

REV. NO.



DIMENSIONS ARE IN MILLIMETERS

R.M. OF HANOVER

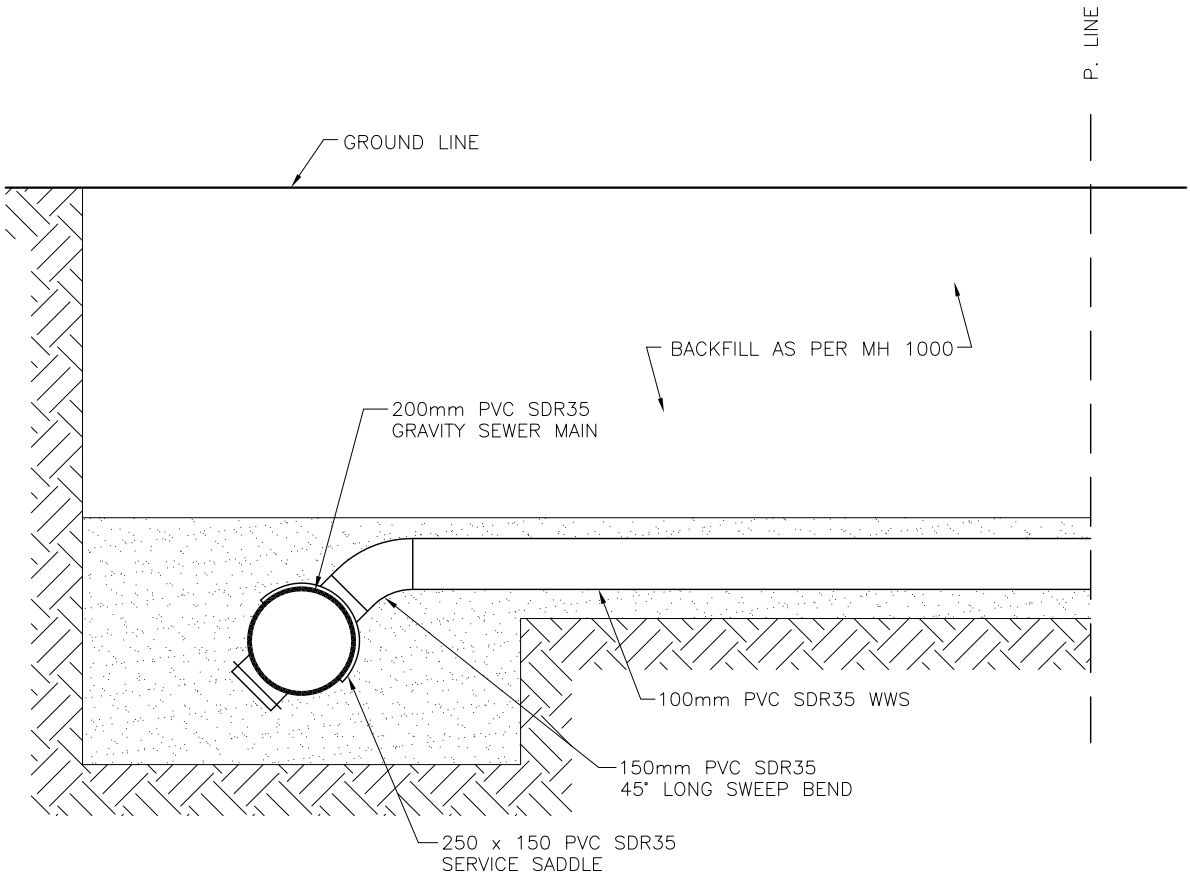
SEWER SERVICE RISER

DRAWN BY:	AE
DATE:	JAN 2014
SCALE:	NTS

DATE	REVISION	BY

DRAWING NO. U23

REV. NO.



ALL 100mm WWS SERVICE FITTINGS
TO BE FABRICATED SDR35 TYPES

DIMENSIONS ARE IN MILLIMETERS

R.M. OF HANOVER

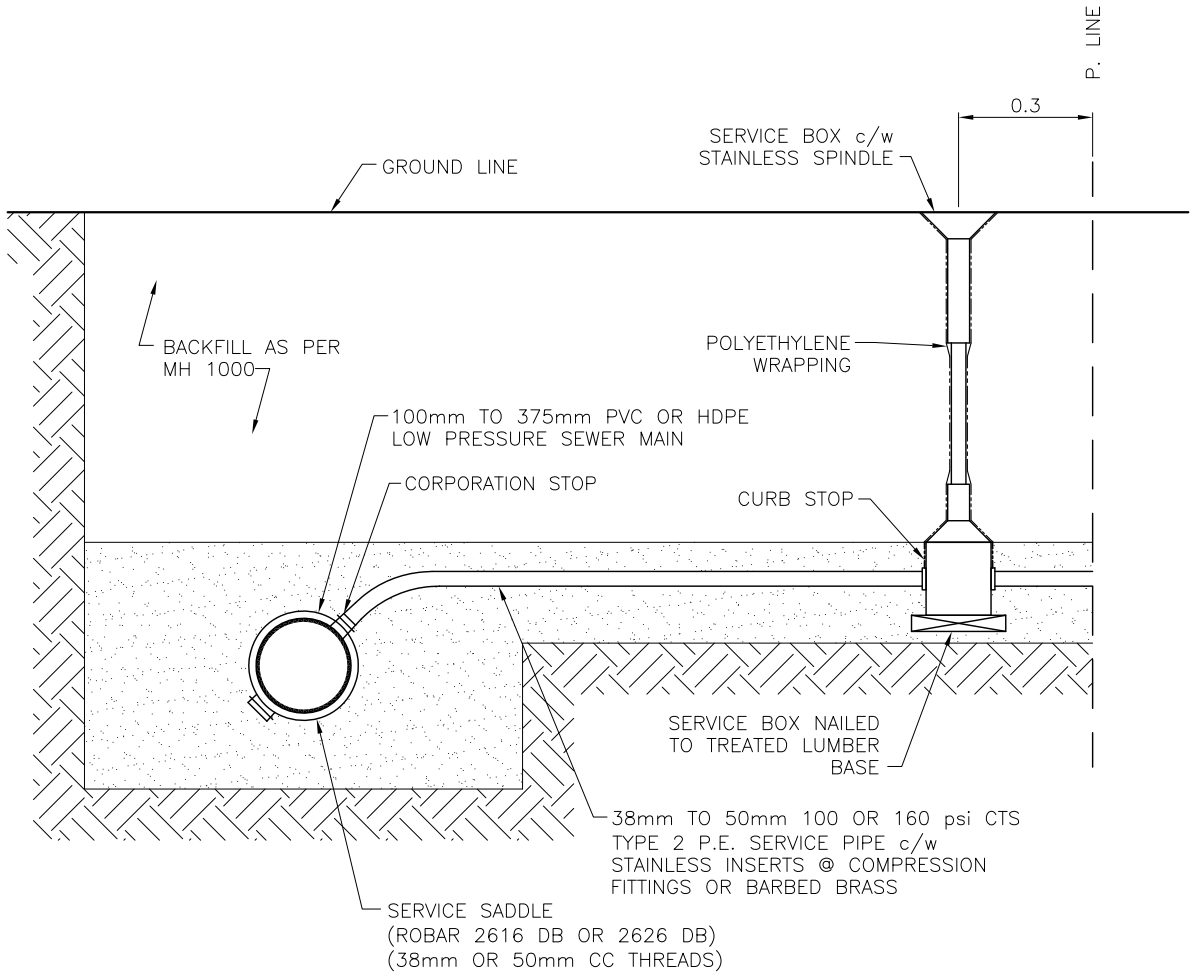
NEW GRAVITY WWS SERVICE CONNECTION TO EXISTING MAIN

DRAWN BY:	AE
DATE:	JAN 2014
SCALE:	NTS

DATE	REVISION	BY

DRAWING NO. U24

REV. NO.



DIMENSIONS ARE IN MILLIMETERS

R.M. OF HANOVER

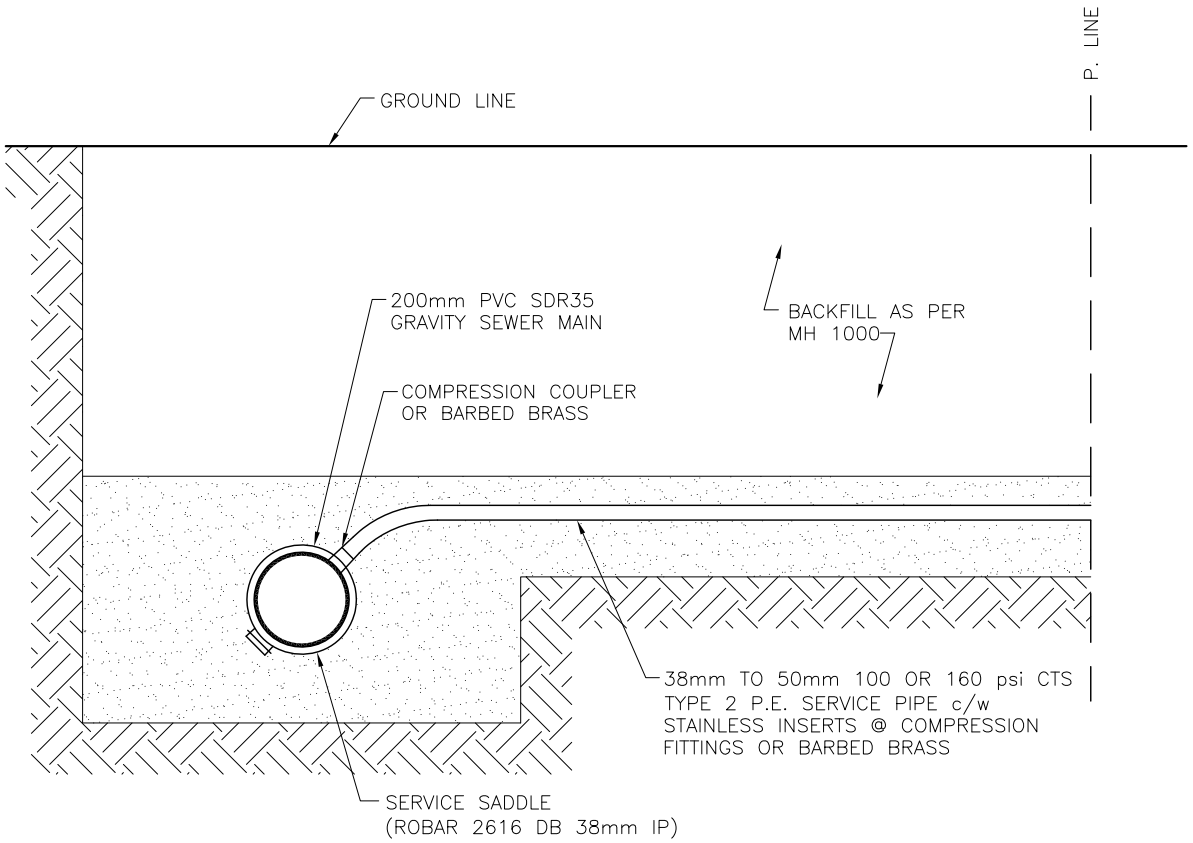
TYPICAL LOW PRESSURE WWS SERVICE TIE IN TO LOW PRESSURE MAIN

DRAWN BY:	AE
DATE:	JAN 2014
SCALE:	NTS

DATE	REVISION	BY

DRAWING NO. U25

REV. NO.



DIMENSIONS ARE IN MILLIMETERS

R.M. OF HANOVER

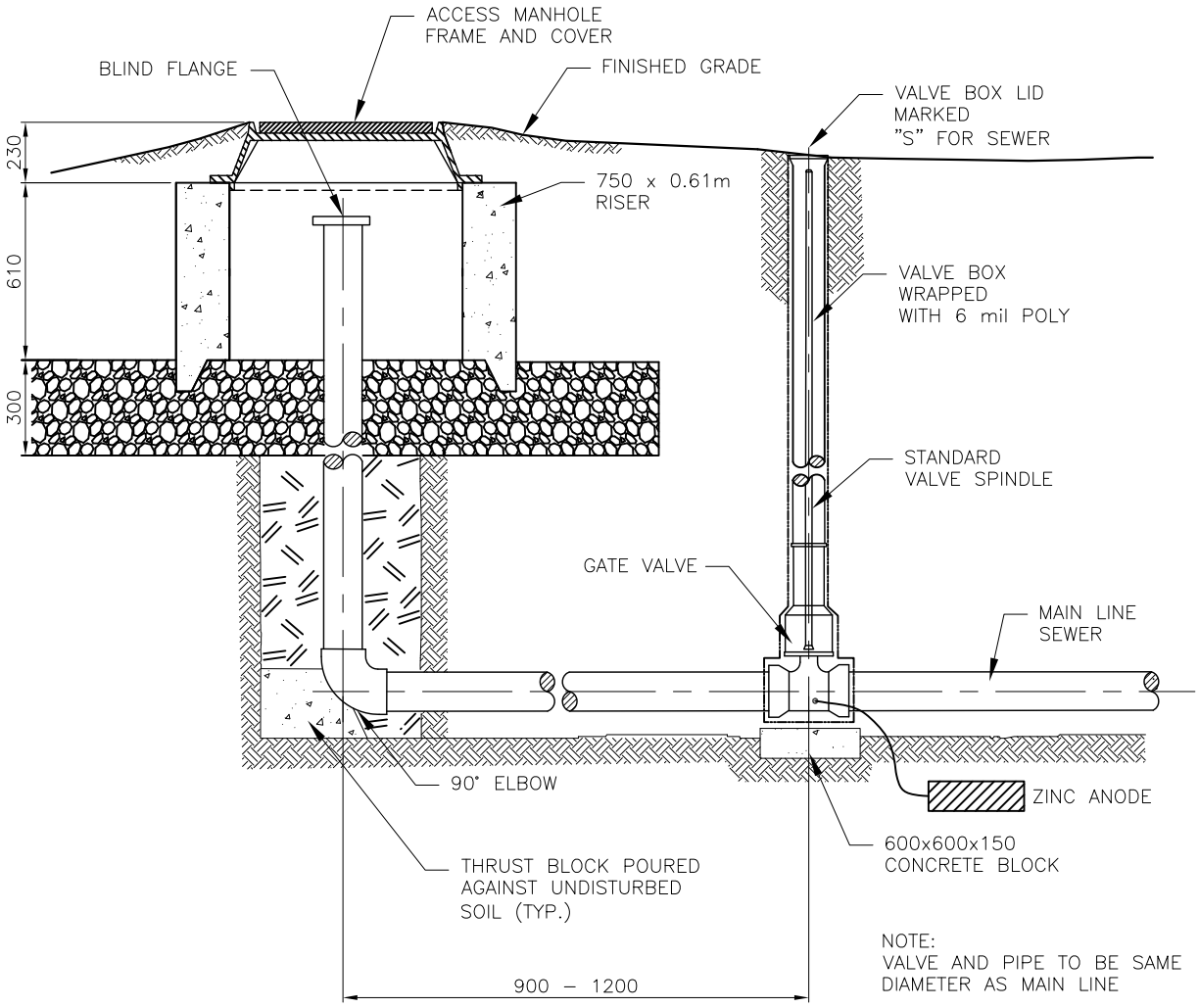
LOW PRESSURE WWS SERVICE CONNECTION TO GRAVITY MAIN

DRAWN BY:	AE
DATE:	JAN 2014
SCALE:	NTS

DATE	REVISION	BY

DRAWING NO. U26

REV. NO.



DIMENSIONS ARE IN MILLIMETERS

R.M. OF HANOVER

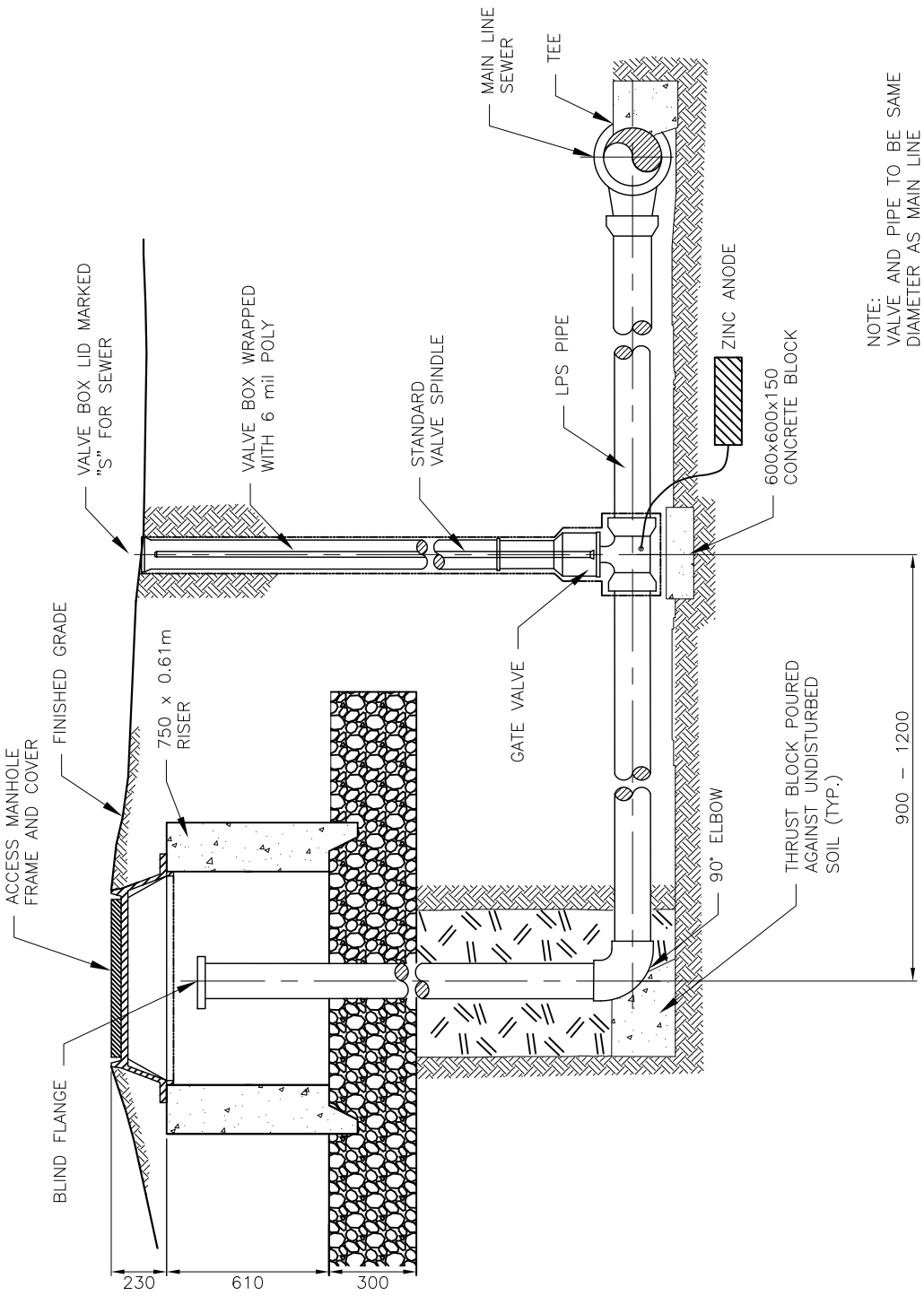
LOW PRESSURE SEWER CLEANOUT ASSEMBLY (ON–LINE) DETAIL

DRAWN BY:	AE
DATE:	JAN 2016
SCALE:	NTS

DATE	REVISION	BY

DRAWING NO. U27A

REV. NO.



DIMENSIONS ARE IN MILLIMETERS

R.M. OF HANOVER

LOW PRESSURE SEWER CLEANOUT ASSEMBLY (OFF–LINE) DETAIL

DRAWN BY:	AE
DATE:	JAN 2016
SCALE:	NTS
DRAWING NO.	U27B
REV. NO.	

DATE	REVISION	BY