This document reflects the combined efforts of the Province of Newfoundland & Labrador, Department of Municipal Affairs, the Newfoundland and Labrador Road Builders/Heavy Civil Association, Water and Sewer Contractors Division, and the Professional Engineers & Geoscientists of Newfoundland and Labrador, Consulting Practices Committee, who formed a joint committee on Municipal Contract Documents in response to problems voiced within the Municipal Servicing Industry.

The Committee members for 2008 are:

Randy Dillon, P. Eng. ....Dept. of Municipal Affairs
Bruce McGrath, P. Eng. ....Dept. of Municipal Affairs
Robert Picco, P. Eng. ....Dept. of Municipal Affairs
Wayne Manuel, P. Eng. ....BAE-Newplan Group
Jeff Saunders, P. Eng. ....Grand Falls-Windsor Town Council
Wayne Cranford, P. Eng. ... .Cougar Engineering & Construction Ltd.
Tom Kendall, P. Eng. ....Kendall Engineering Ltd.
Perry Barrett, P. Eng. ....Modern Paving Ltd.

Past members of this Committee have been:

Wayne Churchill, P. Eng. ... .Dept. of Municipal & Provincial Affairs
Robert Newhook, P. Eng. .. ..Dept. of Municipal & Provincial Affairs
Albert Williams ... .BAE-Newplan Group
Charlie Sheppard, P. Eng. ... .Sheppard Green Engineering & Associates
Keith Smith, P. Eng. .. ..Lancaster Construction
Mike Edge, P. Eng. ....Dept. of Municipal & Provincial Affairs
Gerald Ballett. ....B.C.L. Construction Ltd.
Tom Beresford, P. Eng. ....Dept. of Municipal & Provincial Affairs
Jerome Coady, P. Eng. ....Coady Construction & Excavating Ltd.
Warren Quinton,P. Eng. ....Nfld. Design Associates
Derek Greenslade. ....Greenslade's Construction Ltd.

Thanks are due the Newfoundland & Labrador Road Builders/Heavy Civil Association, Water & Sewer Contractors Division, for its support of this project.

Appreciation is expressed for the many hours that past and present Committee members spent away from their offices in serving on this committee. The contribution made by these committee members should not go unnoticed by the municipal services industry.

This document represents the **second printing** of the Government of Newfoundland & Labrador, Municipal Water, Sewer and Roads Master Construction Specifications. It is not intended to be a final document. Continual changes in the industry will necessitate periodic review of the standard to keep pace with new technologies and construction methods. All parties are encouraged to provide input for improvements and additions.

Further sections of this standard specification shall be released for incorporation into this master document. All individuals holding a registered copy of the Standard for Municipal Contracts will receive updates and additions as they are released each year. There may be an additional charge for these updates.

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Introduction

This specification has been prepared for use as a standard on municipal services contracts in the Province of Newfoundland.

The preparation of this document was undertaken with the prime objective of bringing about significant reductions in the cost of design and construction of municipal services through:

.1 The development of uniform practices;

.2 The elimination of the need to prepare full specification documents for each project;

.3 The reduction of retraining of key personnel transferred from one point to another;

.4 The elimination of disputes arising over misinterpretation of specifications;

Its use should simplify the preparation and improve the average quality of specifications for municipal services.

THE ENGINEER MUST BE AWARE THAT THIS DOCUMENT DOES NOT ELIMINATE THE NECESSITY FOR DETAILED DESIGN. ANY ENGINEER WHO USES THIS DOCUMENT IN PREPARING CONTRACT DOCUMENTS MUST RECOGNIZE THAT HE RETAINS FULL RESPONSIBILITY FOR THE OVERALL COMPLETENESS OF HIS CONTRACT DOCUMENTS.

The Consulting Engineer shall not re-type any part of this Master Specification for use in his documents. The original Master Document must be used at all times. This includes both the Technical Specification and all associated Drawings, Forms included in the Master Document.

The Consulting Engineer must, however, re-type the "Schedule of Quantities and Prices" for use in their particular project documents. In this instance the Consultant must use the same numbering system, format and units as provided in the sample Schedule of Quantities & Prices. Items in the sample Schedule of Quantities & Prices which are not work items under the proposed contract must be omitted from the tendered Schedule of Quantities & Prices.

Preparation of Project Documents

Project documents are the documents which are prepared to supplement the Standard Specifications. Project documents are the only documents to be prepared and issued for each specific project. They include the following:

Instruction to Bidders of Unit Price Contract or Stipulated Price Contract
Form of Tender of Unit Price Contract or Stipulated Price Contract
Form of Agreement of Unit Price Contract or Stipulated Price Contract
General Conditions of Unit Price Contract or Stipulated Price Contract
Supplementary General Conditions (Use sample included in Master Spec)
Supplementary Specifications
Schedule of Quantities and Prices (Unit Price Contract)
Addenda
Contract Drawings
Miscellaneous Standard Forms (Use samples included in Master Spec)

It is recommended for the purpose of understanding during the tender process, that the following statement should be included immediately inside the front cover of the Project Documents:

"THESE PROJECT DOCUMENTS HAVE BEEN PREPARED FOR USE WITH AND REQUIRE BEING READ IN CONJUNCTION WITH THE *MUNICIPAL WATER, SEWER AND ROADS MASTER CONSTRUCTION SPECIFICATIONS*, LATEST REVISION, AS PUBLISHED BY THE DEPARTMENT OF MUNICIPAL AFFAIRS PROVINCE OF NEWFOUNDLAND AND LABRADOR. THIS PUBLICATION IS AVAILABLE ON THE DEPARTMENT'S WEB SITE UNDER PUBLICATIONS AT THE FOLLOWING LINK:

http://www.ma.gov.nl.ca/ma/publications/index.html "

Supplementary Specifications

.1 Supplementary Specifications are prepared to modify the existing Standard Specification when necessary, or to add new sections as required. Supplementary Specifications are similar to an addendum except they are issued with the tender documents rather than after tender call. **Supplementary Specifications are not to be used to modify the Standard Specifications but to add additional sections when required.**

.2 Supplementary Specifications which modify existing Sections should only be prepared after consultation and approval with Department of Municipal Affairs officials. These modifications should refer to the same Section and subsection numbers and should be presented using the same format. Clearly state the subsection to be deleted and present the new subsection to replace the existing one.

.3 New specification Sections being added using the Supplementary Specifications are to be numbered using the appropriate sections and section numbers of the CSC/CSI Master Format.

.4 Make every effort to keep Supplementary Specifications to a minimum. Certain supplements are required for all projects as follows:

.1 Project description
.2 Project Schedule and Requirements
.3 Site access conditions
.4 Technical Sections for items not included in the Standard Specifications.
.5 Bonding and Insurance requirements (special circumstances)
.6 Measurement for payment for additional items.

Drawings

.1 The specifications are to be accompanied by a detailed set of engineering drawings used in conjunction with the typical drawings in the specifications.

Tender Advertisement

.1 Place Tender Advertisement in section of newspaper reserved for this purpose.

.2 Place the Provincial Crest in the top left hand corner of the advertisement.

.3 Place the words **"GOVERNMENT OF NEWFOUNDLAND & LABRADOR"** to the right of the Provincial Crest.

.4 Place the Provincial Flag to the right of the words Government of Newfoundland & Labrador.

.5 Items 2, 3 and 4 should be completely enclosed in a boxed outline.

.6 Insert the heading **"DEPARTMENT OF MUNICIPAL AFFAIRS"** immediately under the boxed outline referenced in item 5 above.

.7 Place the word **"TENDER FOR (descriptive outline of project)"** in bold type across the next section of the advertisement. Include the Phase of the project and the name of the Community.

.8 Insert the following statement "Sealed tenders for the above project clearly marked as to contents only and addressed to the Deputy Minister, Department of Municipal Affairs, c/o Tendering and Contracts, 5th Floor, West Block, Confederation Complex, P.O. Box 8700, St. John's, Newfoundland, A1B 4J6, will be received up until 1400 hours, local time, (Day of Month, Month, Year), at which time tenders will be opened in public.

.9 Identify the type and scope of work indicating the approximate quantities of major items.

.10 Identify where Tender Documents may be obtained and locations where they may be viewed.

.11 State that the fee for the Tender Documents will be as indicated in the advertisement.

.12 Identify the amount of Tender Security required to be included with any Tender.

.13 State, in bold letters, that **"The Tender Documents shall be read in conjunction with the *Municipal Water, Sewer and Roads Master Construction Specifications,* latest revision, as published by the Department of Municipal Affairs Province of Newfoundland and Labrador. This publication is available on the Department's web site under Publications at the following link:**

http://www.ma.gov.nl.ca/ma/publications/index.html "

.14 Insert the statement "Contractors are advised that the Owner does not bind itself to accept the lowest or any tender."

.15 The last lines of the advertisement shall include the following:

Honourable (Minister's Name)
Minister
Department of Municipal Affairs

.16 Items 6 to 15 should be completely enclosed in a boxed outline.

.17 See sample ads, next three (3) pages.

.18 For projects funded under the Canada/Newfoundland Infrastructure Program the above instructions shall be modified to conform to the sample ad on the next page.

Tender

Department of Municipal Affairs

Invitation to Tender

Tenders will be received up to the date and time indicated below for the following project:

Project # (description), Town of (name of town).

Purchase price: $20

Closing date: (month, day, year) @ 14:00 hours

Upon receipt of the purchase price indicated above, (Non-refundable HST included) plans and specifications may be obtained from (consultant's name, address, telephone # & fax #) and viewed at the offices of the Newfoundland and Labrador Construction Association. Tenders addressed to the Deputy Minister of Municipal Affairs must be delivered to Tendering and Contracts at Ground Floor, East Block, Confederation Building, P. O. Box 8700, St. John's, NL, A1B 4J6 (Ph.: 709.729.3786, Fax: 709.729.6729), and be submitted on forms and in sealed envelopes provided, clearly marked as to the contents. Tenders will be opened immediately after the tender closing time.

The Tender Documents shall be read in conjunction with the *Municipal Water, Sewer and Roads Master Construction Specifications,* latest revision, as published by the Department of Municipal Affairs Province of Newfoundland and Labrador. This publication is available on the Department's web site under Publications at the following link:
http://www.ma.gov.nl.ca/ma/publications/index.html

The scope of this work generally involves (description).

A bid security of 10% will be required.

The owner does not bind itself to accept the lowest or any tender for the project.

HONOURABLE (MINISTER'S NAME & TITLE)
MINISTER OF MUNICIPAL AFFAIRS

Newfoundland Labrador

Tender

Canada/Newfoundland and Labrador Municipal Rural Infrastructure Fund

Invitation to Tender

Tenders will be received up to the date and time indicated below for the following project:

Project # (description), Town of (name of town).

Purchase Price: $20

Closing date: (month, day, year) @ 14:00 hours.

THIS PROJECT IS BEING FUNDED THROUGH THE CANADA/NEWFOUNDLAND AND LABRADOR MUNICIPAL RURAL INFRASTRUCTURE FUND.

Upon receipt of the purchase price indicated above, (Non-refundable HST included) plans and specifications may be obtained from (consultant's name, address, telephone # & fax #) and viewed at the offices of the Newfoundland and Labrador Construction Association. Tenders addressed to the Deputy Minister of Municipal Affairs must be delivered to Tendering and Contracts at Ground Floor, East Block, Confederation Building, P. O. Box 8700, St. John's, NL, A1B 4J6 (Ph.: 709.729.3786, Fax: 709.729.6729), and be submitted on forms and in sealed envelopes provided, clearly marked as to the contents. Tenders will be opened immediately after the tender closing time.

The Tender Documents shall be read in conjunction with the *Municipal Water, Sewer and Roads Master Construction Specifications,* latest revision, as published by the Department of Municipal Affairs Province of Newfoundland and Labrador. This publication is available on the Department's web site under Publications at the following link:
http://www.ma.gov.nl.ca/ma/publications/index.html

The scope of this work generally involves (description).

A bid security of 10% will be required.

The owner does not bind itself to accept the lowest or any tender for the project.

Newfoundland Labrador

Canada

Tender

Canada/Newfoundland Infrastructure Program Agreement

Invitation to Tender

Tenders will be received up to the date and time indicated below for the following project:

Project # (description), Town of (name of town).

Purchase price: $20

Closing date: (month, day, year) @ 14:00 hours

THIS PROJECT IS BEING FUNDED THROUGH THE CANADA/NEWFOUNDLAND INFRASTRUCTURE PROGRAM AGREEMENT.

Upon receipt of the purchase price indicated above, (Non-refundable HST included) plans and specifications may be obtained from (consultant's name, address, telephone # & fax #) and viewed at the offices of the Newfoundland and Labrador Construction Association. Tenders addressed to the Deputy Minister of Municipal Affairs must be delivered to Tendering and Contracts at Ground Floor, East Block, Confederation Building, P. O. Box 8700, St. John's, NL, A1B 4J6 (Ph.: 709.729.3786, Fax: 709.729.6729), and be submitted on forms and in sealed envelopes provided, clearly marked as to the contents. Tenders will be opened immediately after the tender closing time.

The Tender Documents shall be read in conjunction with the *Municipal Water, Sewer and Roads Master Construction Specifications,* latest revision, as published by the Department of Municipal Affairs Province of Newfoundland and Labrador. This publication is available on the Department's web site under Publications at the following link:

http://www.ma.gov.nl.ca/ma/publications/index.html

The scope of this work generally involves (description)

A bid security of 10% will be required.

The owner does not bind itself to accept the lowest or any tender for the project.

Newfoundland Labrador

Canada

TABLE OF CONTENTS DIVISION #3

STANDARD FORMS
STANDARD DRAWINGS

The quantities set out in this schedule are estimated quantities only and are not to be taken as final quantities by the Contractor. The unit prices bid shall include all labour, plant, materials, overhead, duties, and profit and all other obligations and liabilities under the contract. H.S.T., is to be applied in accordance with SGC 1.0. Totals shall be determined by multiplying the quantity by the tendered unit price.

SECTION	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
DIVISION #1					
1005	Maintain Existing Services				
	1. maintain existing water system	L.S.	Unit	_____	_____
	2. maintain existing sewer system	L.S.	Unit	_____	_____
01010	Mobilization & Demobilization (not greater than 5% if on the Island, or 10% if in Labrador, or 15% north of Cartwright, of item a. "sub-total" on last page)	L.S.	Unit	_____	_____
01020	Cash Allowance (to be entered by engineer)				
	1. Pole Relocation/shoring/bracing	Allowance			_____
	2. Contribution in Aid (Hydro)	Allowance			_____
	3. Supply of water (Section 01005.14)	Allowance			_____
	4. Supply of sewer service (Section 01005.15)	Allowance			_____
	5. Overhaul	Allowance			_____
	6. Public Announcements	Allowance			_____
	7. Other (Specify)	Allowance			_____
	8. Overhaul	m^3km	_____	_____	_____
	9. Survey equipment	Allowance			_____
01500	Temporary Facilities				
	Engineers Site Office	L.S.	Unit	_____	_____
	Engineers Equipment	L.S.	Unit	_____	_____
01560	Environmental Requirements				
	Silt Fence	m	_____	_____	_____
01570	Traffic Regulations				
	Flagpersons Wages	Hour	_____	_____	_____
01580	Projects Signs				
	Project Sign	L.S.	Unit	_____	_____

SECTION		DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
01582		Sign and Signpost Installations				
	1.	Type A - X (specify sign)	Each	_____	_____	_____
	2.	Type B - X (specify sign)	Each	_____	_____	_____
	3.	Type C - L/W (specify sign)	Each	_____	_____	_____
	4.	Type D - L/W (specify sign)	Each	_____	_____	_____
	5.	Other Signs	Each	_____	_____	_____
01710		Reinstatement and Cleaning				
	1.	Fencing	m	_____	_____	_____
	2.	Ditching	m	_____	_____	_____
	3.	Remove, relocate and/or replace culverts	m	_____	_____	_____
	4.	Other structures (specify)	(Specify)	_____	_____	_____
	5.	Manual Seeding	m^2	_____	_____	_____
	6.	Temporary cover for seed protection	m^2	_____	_____	_____
	7.	Hydraulic Seeding & Mulching	m^2	_____	_____	_____
	8.	Supply & Placing Topsoil	m^2	_____	_____	_____
	9.	Supply & Placing Agricultural Limestone	m^2	_____	_____	_____
	10.	Supply & Application of Fertilizer	m^2	_____	_____	_____
	11.	Supply & Placement of Sods	m^2	_____	_____	_____
	12.	Shrub & Tree Preservation	Each	_____	_____	_____
DIVISION #2						
02070		Sitework, Demolition & Removal of Structures				
		Removal of Concrete Base	m^2	_____	_____	_____
		Removal of Concrete Pavement	m^2	_____	_____	_____
		Removal of Asphalt Covered Concrete Pavement	m^2	_____	_____	_____
		Removal of Curb & Gutter	m	_____	_____	_____

SECTION	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
	Removal of Catch Basins, Manholes & Ditch Inlets	Each	_____	_____	_____
	Removal of Fences	m	_____	_____	_____
	Removal of Guide Rails	m	_____	_____	_____
	Removal of Sanitary Sewers	m	_____	_____	_____
	Removal of Water Lines	m	_____	_____	_____
	Removal of Culverts	m	_____	_____	_____
	Removal of Storm Sewers	m	_____	_____	_____
	Removal of Bridges	Each	_____	_____	_____
	Removal of Mass Concrete	m^3	_____	_____	_____
	Removal of Asbestoes Cement Pipe	m	_____	_____	_____
	Removal of Other Items	(Specify)	_____	_____	_____
02104	Landscaping, Seeding, Sodding & Tree Preservation				
	Manual Seeding	m^2	_____	_____	_____
	Temporary cover for seed protection	m^2	_____	_____	_____
	Hydraulic Seeding & Mulching	m^2	_____	_____	_____
	Supply & Placing Topsoil	m^2	_____	_____	_____
	Supply & Placing Agricultural Limestone	m^2	_____	_____	_____
	Supply & Application of Fertilizer	m^2	_____	_____	_____
	Supply & Placement of Sods	m^2	_____	_____	_____
	Shrub & Tree Preservation	Each	_____	_____	_____
02111	Clearing & Grubbing				
	Clearing	ha	_____	_____	_____
	Grubbing	ha	_____	_____	_____
	Close Cut Clearing	ha	_____	_____	_____

SECTION	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
	Underbrush Clearing	ha	_____	_____	_____
	Clearing & Grubbing Isolated Trees	each	_____	_____	_____
02215	Site Work & Site Grading				
	Mass Rock Excavation	m^3	_____	_____	_____
	Mass Common Excavation	m^3	_____	_____	_____
	Imported Mass Common Backfill	m^3	_____	_____	_____
	Supply, Placing & Spreading Topsoil	m^2	_____	_____	_____
02223	Excavation, Trenching & Backfilling				
	Main Trench Excavation				
	1. Rock	m^3	_____	_____	_____
	2. Common	m^3	_____	_____	_____
	Service Trench Excavation				
	1. Rock	m^3	_____	_____	_____
	2. Common	m^3	_____	_____	_____
	Imported Common Backfill	m^3	_____	_____	_____
	Sheeting & Bracing Left in Place	m^2	_____	_____	_____
	Granular Pipe Bedding				
	1. Type 1	m^3	_____	_____	_____
	2. Type 2	m^3	_____	_____	_____
	3. Type 3	m^3	_____	_____	_____
	Rock UnderBedding	m^3	_____	_____	_____
	Trucking, handling, stockpiling, filling, conditioning and reuse of common material	m^3	_____	_____	_____
	Supply & Placement of Marking Tape				
	1. Plastic Tape	m	_____	_____	_____
	2. Metallic Tape	m	_____	_____	_____

SECTION	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
02224	Roadway Excavation, Embankment & Compaction				
	Mass Excavation & Backfill				
	1. Rock	m^3	_____	_____	_____
	2. Common	m^3	_____	_____	_____
	Imported Backfill				
	1. Rock	m^3	_____	_____	_____
	2. Common	m^3	_____	_____	_____
	Placing & Spreading Topsoil	m^2	_____	_____	_____
02231	Scarifying & Reshaping				
	Scarifying & Reshaping incl. Compaction	m^2	_____	_____	_____
02233	Selected Granular Base & Sub Base Materials				
	1. Class "A" Granular Base	tonne	_____	_____	_____
	2. Class "B" Granular Sub-Base	tonne	_____	_____	_____
02270	Rip-Rap Protection				
	Rip-Rap Hand Laid Dry Wall	m^3	_____	_____	_____
	Rip-Rap Hand Laid with Sod	m^3	_____	_____	_____
	Rip-Rap Grouted	m^3	_____	_____	_____
	Rip-Rap Random	m^3	_____	_____	_____
02271	Armour Stone Protection				
	Supply & Placement of Armour Stone	m^3	_____	_____	_____
02272	Gabions				
	Supply & Placement of Gabions incl. Fill	m^3	_____	_____	_____

SECTION	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
02282	Supply & Installation of Guide Rail				
	Standard Type Guide Rail	m	_____	_____	_____
	Guide Rail with Additional Posts	m	_____	_____	_____
	Type "A" Guide Rail	m	_____	_____	_____
	Type "B" Guide Rail	m	_____	_____	_____
02283	Salvage & Reinstallation of Guide Rail				
	Salvage & Reinstallation of Guide Rail				
	1. On New Posts	m	_____	_____	_____
	2. On Salvaged Posts	m	_____	_____	_____
02284	Supply & Installation of Hand Rail				
	Standard Steel Pipe Posts & Rail	m	_____	_____	_____
02410	Sub-Drains				
	Supply & Placement of Bedding Gravel	m^3	_____	_____	_____
	Supply & Placement of Granular Filter Material	m^3	_____	_____	_____
	Supply & Placement of Sub-Drains (size)	m	_____	_____	_____
02434	Pipe Culverts				
	Supply & Placement of Pipe Culvert				
	1. (size) (thickness) (type)	m	_____	_____	_____
	Supply & Placement of Debris Racks	Each	_____	_____	_____
	Supply & Placement of Concrete Head Walls	m^3	_____	_____	_____
	Supply & Placement of Cut-off Collars	Each	_____	_____	_____
	Supply & Placement Prefab. End Sections	Each	_____	_____	_____

SECTION	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
02481	Channel Excavation, Cleaning & Deepening				
	Channel Excavation				
	1. Rock	m^3	_____	_____	_____
	2. Common	m^3	_____	_____	_____
	Cleaning & Deepening of existing Channels	m	_____	_____	_____
02496	Timber Crib work				
	Timber Crib work	m^3	_____	_____	_____
02528	Concrete Walk, Curb & Gutters				
	Supply & Place Granular Base Material	m^3	_____	_____	_____
	Concrete Walks				
	1. (width) (thickness)	m	_____	_____	_____
	Combined Curb & Sidewalk				
	1. (width) (thickness)	m	_____	_____	_____
	Driveway Ramps				
	1. with curb (width) (thickness)	m	_____	_____	_____
	2. without curb (width) (thickness)	m	_____	_____	_____
	Curb & Gutter	m	_____	_____	_____
	Curb	m	_____	_____	_____
02547	Asphalt Tack Coat				
	Supply & Placement of Asphalt Tack Coat	m^2	_____	_____	_____
02552	Hot Mix Asphalt Concrete Paving				
	Asphaltic Concrete				
	1. Base Course	tonnes	_____	_____	_____
	2. Surface Course	tonnes	_____	_____	_____

SECTION	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
	Asphaltic Concrete Walkways 1. (thickness) (width)	m^2	_____	_____	_____
	Asphaltic Concrete Ditch 1. (thickness) (width)	m	_____	_____	_____
02577	Pavement Crack Cleaning & Filling				
	Pavement Crack Cleaning & Filling	m	_____	_____	_____
02574	Reshaping & Patching Asphalt Pavement				
	Removal of Asphalt Pavement	m^2	_____	_____	_____
	Patching of Asphalt Pavement	m^2	_____	_____	_____
	Removal and Replacement of Asphalt Pavement (for Road Projects only)	m^2	_____	_____	_____
	Temporary Patching of Asphalt Pavement	m^2	_____	_____	_____
	Cutting of Asphalt Pavement	m	_____	_____	_____
02580	Pavement Marking				
	Pavement Marking	L.S.	Unit		
02601	Manholes, Catch basins, Ditch Inlets & Valve Chambers				
	Supply & Placement of ___ diameter Pre-Cast Manholes				
	1. 2 m or less	Each	_____	_____	_____
	2. 2 m to 2.5 m	Each	_____	_____	_____
	3. 2.5 m to 3 m	Each	_____	_____	_____
	4. 3 m to 3.5 m	Each	_____	_____	_____
	5. 3.5 m to 4.0 m	Each	_____	_____	_____
	6. 4.0 m to 4.5 m	Each	_____	_____	_____
	7. 4.5 m to 5.0 m	Each	_____	_____	_____
	8. 5.0 m to 5.5 m (etc.)	Each	_____	_____	_____

SECTION	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
	Supply & Placement of Manhole Inflow Protectors	Each	_____	_____	_____
	Outfall Structures	Each	_____	_____	_____
	Drop Manholes	Each	_____	_____	_____
	Special Manholes	Each	_____	_____	_____
	Catch Basins	Each	_____	_____	_____
	Cast-in-Place Manholes	Each	_____	_____	_____
	Adjustment of Manhole/Catch Basin Tops	Each	_____	_____	_____
	Adjustment of Manhole Covers	Each	_____	_____	_____
	Sealing Existing Manhole/Catch Basin Tops	Each	_____	_____	_____
	Safety Landings for Deep Manholes	Each	_____	_____	_____
02650	Sewage Pumping Stations				
	(Station), (Station size), (Pumps), (Size in K.W.) & (Impeller)	Each	_____	_____	_____
	Supply and commission portable diesel generator	Each	_____	_____	_____
02702	Pipe Sewer Construction				
	Supply & Placement of Sanitary Sewer				
	1. Main Line				
	1. (size) (type) (thickness) (insulation)	m	_____	_____	_____
	2. Service Line				
	1. (size) (type) (thickness) (insulation)	m	_____	_____	_____
	2. long radius bends	Each	_____	_____	_____
	Supply & Placement of Storm Sewer				
	1. (size) (type) (thickness)	m	_____	_____	_____
	Supply & Install Tees c/w. Bends	Each	_____	_____	_____
	Supply & Installation of End Caps	Each	_____	_____	_____

SECTION	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
	Supply & Installation of Plugs	Each	_____	_____	_____
	T.V. Camera Inspection Services	m	_____	_____	_____
	Break into & connect to existing manholes	Each	_____	_____	_____
	Locate and Connect to Existing Sewer Mains	Each	_____	_____	_____
	Locate and Connect to Existing Sewer Stubs	Each	_____	_____	_____
02704	Sanitary Sewer Outfall Pipe				
	Sewer pipe 1. (size) (type) (thickness)	m	_____	_____	_____
	Concrete for bedding, encasement	m^3	_____	_____	_____
	Other bedding (specify)	m^3	_____	_____	_____
	Tees, Caps, Plugs, Other Fittings Concrete head blocks, cradles, supports (specify)	Each	_____	_____	_____
	Underwater Video and/or Photo Inspection	Each	_____	_____	_____
02710	Foundation & Under Slab Drainage				
	Supply & Installation Foundation & Under Slab Drain	L.S.	Unit	_____	_____
02713	Water Mains				
	Supply & Installation of Water Main				
	1. (type) (class) (size) (insulation)	m	_____	_____	_____
	Supply & Installation of Service Pipe to R.O.W.				
	1. (type) (class) (size) (insulation)	m	_____	_____	_____
	Supply & Installation of Fitting (size) (insulation)				
	1. Wyes	Each	_____	_____	_____
	2. Crosses	Each	_____	_____	_____
	3. Reducers	Each	_____	_____	_____

SECTION	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
	4. End Caps/Plugs	Each	_____	_____	_____
	5. Bends	Each	_____	_____	_____
	6. Tees	Each	_____	_____	_____
	7. Corp. Stops	Each	_____	_____	_____
	8. Saddles	Each	_____	_____	_____
	9. Curb Stops & Boxes	Each	_____	_____	_____
	10. Sleeve-type couplings	Each	_____	_____	_____
	Supply & Install of Fire Hydrants (depth) (insulation)	Each	_____	_____	_____
	Colour coded painting of hydrants	Each	_____	_____	_____
	Supply & Placement of Conc. Thrust Blocks	m^3	_____	_____	_____
	Supply & Placement of Joint Restraints (size)	Each	_____	_____	_____
	Supply & Install of Hydrant Ext. (length) (insulation)	Each	_____	_____	_____
	Supply & Install of Valve Chambers	Each	_____	_____	_____
	Supply & Install Combination Air Release - Vacuum Relief Valves (size)	Each	_____	_____	_____
	Supply & Install Valves including Valve Boxes 1. (size) (insulation)	Each	_____	_____	_____
	Supply & Install Valve Box Extensions	Each	_____	_____	_____
	Adjust existing valve boxes to grade	Each	_____	_____	_____
	Supply & Install Sounding point/marker 1. (size)	Each	_____	_____	_____
	Swabbing of water lines 1. (size)	m	_____	_____	_____
	Locating & connecting to existing system	Each	_____	_____	_____
02724	Sewage Force mains				
	Supply & Installation of Sewage Force main 1. (size) (class) (type) (insulation)	m	_____	_____	_____

SECTION	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
	Supply & Installation Combination Air Release - Vacuum Relief Valve and Chamber	Each	_____	_____	_____
	Supply & Installation of Fittings				
	1. Bends (size) (insulation)	Each	_____	_____	_____
	Swabbing of Force main (size)	m	_____	_____	_____
	Break into & connect to existing manhole	Each	_____	_____	_____
02729	Water Wells				
	Drilling Unconsolidated Formation	m	_____	_____	_____
	Drilling in Consolidated Formation	m	_____	_____	_____
	Supply & Installation of Casing	m	_____	_____	_____
	Supply & Install Drive Shoe	Each	_____	_____	_____
	Supply & Installation of Well Screen	L.S.	Unit	_____	_____
	Supply & Placement of Gravel Packing	kg.	_____	_____	_____
	Supply & Placement of Grouting (40 kg bags)	Each	_____	_____	_____
	Well Development	Hour	_____	_____	_____
	Disinfection of Well	L.S.	Unit	_____	_____
	Test Pumping of Well	Hour	_____	_____	_____
	Water quality testing	L.S.	Unit	_____	_____
	Supply & Installation of Well Seals	Each	_____	_____	_____
02831	Chain Link Fences & Gates				
	Supply & Erection of Chain Link Fence, Incl brace panels & Gate openings	m	_____	_____	_____
	Supply & Install Barb Wire & Brackets	m	_____	_____	_____
	Supply & Erection of Chain Link Gates	Each	_____	_____	_____
02832	Farm Wire Fences				
	Supply & Erection of Wire Fences	m	_____	_____	_____
	Supply & Erection of Wire Gates	Each	_____	_____	_____

SECTION	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
02897	Filter Fabrics				
	Supply & Install Filter Fabric	m^2	____	____	____
03300	Cast-In-Place Concrete				
	Cast-In-Place Concrete	m^3	____	____	____
	Concrete Bedding	m^3	____	____	____
	Concrete Pipe Encasement	m^3	____	____	____
	Concrete Supports	m^3	____	____	____
	Concrete Thrust Blocks	m^3	____	____	____
	Concrete cut off walls	m^3	____	____	____
03306	Underwater Concreting				
	Underwater Concrete	m^3	____	____	____
	Underwater Video and/or Photo Inspection	Each	____	____	____
	a.	Sub-Total			____
	b.	H.S.T. 13% of a.			____
	c.	Grand Total (carry forward to page 1 of Tender Form)			____

The Unit Prices in the Schedule of Quantities and Prices for a "Materials Supply Only Contract" shall include all plant, materials, overhead and duties and all other obligations under the contract to deliver the materials f.o.b. to a location specified in the contract. H.S.T. is to be added to the subsequent Sub-Total to provide a Grand Total in the above format.

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Additional excavation:

means all excavation ordered in writing by the Engineer beyond that specified.

Aquifer:

part of a formation or a group of formations that is water bearing.

Available Draw down:

difference in elevation between static level and top of screen, or between static level and 2 m. above bottom of well in case of wells with no screen.

Borrow:

means common material derived from excavation outside site and approved for incorporation into work.

Back slope:

means the slope in a cut between the invert of the roadside ditch and the point where the slope intersects original ground.

Clearing:

means the cutting of all standing trees, brush, bushes and other vegetation at or below 150 mm above original ground and the disposal of felled materials, windfalls and surface litter.

Close-cut clearing:

means the cutting of all standing trees, stumps, brush, bushes and other vegetation at ground level and disposal of felled material, windfalls and other surface litter.

Clearing isolated trees:

means cutting off to not more than a specified height above ground of trees designated and disposing of felled trees and debris.

Common excavation:

excavation of materials of whatever nature, which are not included under definitions of rock excavation, including dense tills, hardpan, frozen materials, soft or previously blasted rock or broken stone, and partially cemented materials which can be ripped and excavated with heavy construction equipment.

Cohesionless soil:

For compaction purposes is:

.1 Materials having less than 20% passing 0.075 mm sieve, regardless of plasticity of fines.

.2 Materials containing between 20% and 50% passing 0.075 mm sieve and having a liquid limit less than 25 and a plasticity index less than 6 when tested to ASTM D4318.

Cohesive soil:

For compaction purposes, is soil not having properties to be classified as cohesionless.

Consolidated Formation:

A geologic formation of bedrock.

Department:

unless the context indicates otherwise, means the department presided over by the Minister of Municipal Affairs. The Department may appear as the Department of Municipal and Provincial Affairs in these specifications.

Ditching:

means the excavation in earth or rock for all water courses. The term will include roadside ditches, all excavation lying beyond the end of drainage structures, and stream and watercourse diversions and corrections.

Draw down:

difference in elevation, between static level and pumping level.

Earth:

means all soils, and any other material to be excavated not classified as rock.

Embankment:

means material derived from usable excavation and placed above original ground or stripped surface up to subgrade elevation.

Equivalent opening size - E.O.S.:

means diameter in micrometers of the standard sieve having openings closest in size to the diameter of uniform particles, which will have 95% by mass retained by the geotextile, when shaken in the prescribed manner.

Excavation classes:

only two classes of excavation will be recognized, rock excavation and common excavation.

.1 Rock excavation: excavation of material from solid beds or masses of igneous, sedimentary or metamorphic rock which, prior to its removal was integral with its parent mass, and which cannot normally be excavated without blasting, ripping or hydraulic hammer and boulders or rock fragments having individual volume in excess of 0.5 m^3 determined from three mutually perpendicular dimensions. Removal of rock with teeth on a bucket is not rock excavation.

.2 Common excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation, including dense tills, hardpan, frozen materials and partially cemented materials which can be ripped and excavated with heavy construction equipment.

Existing rock surface:

means the rock surface, as measured after removal of overburden, but before rock excavation.

Filtration:

means the process of allowing water to easily escape from the soil, while retaining soil in place.

Free haul:

means distance that excavated material is to be hauled without compensation. Free haul distance to be 2 km.

Front slope:

means the slope in a cut section between the edge of shoulder and the invert of the roadside ditch.

Geotextile:

means a synthetic textile structure which is produced by weaving, or by a process such as spun bonding, needle punching, or by other similar processes.

Grubbing:

means the excavation and disposal of stumps and roots, boulders and rock fragments to not less than 150 mm below original ground surface.

Overhaul:

means authorized hauling of excavated material in excess of 2 km from the point of excavation.

Over excavation:

means all excavation beyond that specified, performed without the written order of the Engineer.

Overbreak:

means that portion of any rock which is excavated, displaced, or loosened outside and beyond the established payment lines regardless of whether the overbreak is due to the inherent character of any rock formation encountered, or to any other cause.

Pavement structure:

means combination of layers of unbound or stabilized granular sub-base, base, and asphalt or concrete surfacing.

Pumping Level:

difference in elevation between well datum and water level when well is being pumped at stated l/s rate.

Recovery:

means the time taken for water level to return from pumping level to static level after pumping stops.

Right-of-Way:

A legal right of passage on/under another persons land.

Rock Excavation:

Excavation of material from solid beds or masses of igneous, sedimentary or metamorphic rock which, prior to its removal was integral with its parent mass, and which cannot normally be excavated without blasting, and boulders or rock fragments having individual volume in excess of 0.5 m^3 determined from three mutually perpendicular dimensions.

Structure:

means any bridge, concrete culvert, retaining wall, building, sign support, pipe sewer, manhole, catch basin, ditch inlet, pavement, concrete base cement, treated base, curb and gutter system, side walk, fence, guide rail and guide post.

Side slope:

means the slope in a fill between the edge of shoulder and the point where the slope intersects original ground.

Stripping:

means the removal of top soil and other material from fill areas, and the removal of top soil from the surface of the excavation areas.

Suitable material:

means common material derived from excavation and approved for incorporation into work.

Sub-grade elevation:

means elevation immediately below pavement structure.

Static level:

difference in elevation between well datum and level of water in well when no pumping has been conducted for at least 6 hours.

Specific Capacity:

ratio of pumping rate to draw down, expressed in litres per minute per metre of draw down.

Topsoil:

material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.

Underbrush clearing:

consists of removal from treed areas of undergrowth, deadwood, and disposing of all fallen timber and surface debris.

Unsuitable material:

means common material derived from excavation and unsuitable for incorporation into work.

Waste material:

means material unsuitable for use in work or surplus to requirements.

Well Datum:

top of outer casing or similar fixed point of well head with elevation tied to geodetic or suitable local datum.

Work Permit:

A statutory requirement of a Federal and/or Provincial Government agency and/or Local Authority approving the methodology of work.

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The work to be done under this Contract consists of supplying all materials and equipment, plant and labour necessary for the construction and installation of the works as summarized on the List of Drawings and Description of Work pages.

1.0 DOCUMENTS REQUIRED

.1 Maintain at job site, one copy each of following:

- .1 Contract Documents.
- .2 Reviewed shop drawings.
- .3 Change orders.
- .4 Other modifications to Contract.
- .5 Field test reports.
- .6 Copy of approved work schedule.
- .7 Manufacturers' installation and application instructions.
- .8 Occupational Health and Safety Act Regulations.
- .9 Department of Fisheries Approvals.
- .10 Department of Environment Approvals.
- .11 Department of Transportation Permit.
- .12 Trench Excavation Safety Guide.
- .13 WHIMIS Regulations
- .14 TDG Certificates
- .15 Applicable Explosive Permits

2.0 DATUM

.1 All levels refer to the datum defined on the Drawings.

.2 Establish bench marks on the site which may be checked and confirmed by the Engineer.

3.0 PRIVATE LANDS

.1 The Contractor shall not enter upon or occupy with men, equipment, tools, or materials of any nature any lands other than public streets and roadways, except for the rights-of-way shown on the drawings, or other areas designated by the Engineer and required for the performance of the Work, without the written permission of the owner of the land to be used.

.2 The overall widths of the rights-of-way shall not be greater than that shown on the drawings, unless the Contractor has obtained consent from the proper parties and a certified copy of such consent shall be furnished to the Engineer.

4.0 CODES AND NATIONAL STANDARDS

.1 Perform work in accordance with National Building Code of Canada (NBC) (Latest Revision) and any other code of National, Provincial or local application provided that in any case of conflict or discrepancy, the more stringent requirements shall apply.

.2 Materials and workmanship must conform to or exceed applicable standards of Canadian Government Specification Board (CGSB) and the American Society for Testing and Material (ASTM) and other referenced organizations.

.3 Conform to latest revisions of dated referenced standards, as reaffirmed or revised to date of submission of bids. Standards or Codes not dated shall be deemed editions in force on date of specifications.

5.0 SETTING OUT OF WORK

.1 Engineer will provide only those survey control points and set such stakes as necessary to define general location, alignment and elevations of work. Give Engineer reasonable notice of requirements for such control points and stakes.

.2 Before the commencement of any work, the accuracy of the lines, positions, elevations, and grades shown on the drawings shall be checked and agreed on the site jointly by the Contractor and Engineer.

.3 Set grades and lay out work in detail from control points and grades established by engineer.

.4 Assume full responsibility for and execute complete layout of work to locations, lines and elevations indicated.

.5 Provide devices needed to lay out and construct work.

.6 Supply such devices as straight edges and templates required to facilitate Engineer's inspection of work.

.7 Supply stakes and other survey markers required for laying out work.

.8 The checking of, or setting out, of lines or levels by the Engineer shall not in any way relieve the Contractor of his responsibility for the correctness thereof and the Contractor shall carefully protect and preserve all bench marks, profiles and other things used in setting out the Works. If at any time during the progress of the works, any error shall appear or arise in the Works, the Contractor shall at his own expense rectify such error to the satisfaction of the Engineer, unless such error is based on incorrect data supplied in writing by the Engineer.

.9 The Contractor shall keep the Engineer informed a reasonable time in advance of the time and places at which he wishes to do the Work in order that information lines, elevations and grades may be confirmed and necessary measurements for record and payment purposes may be made with the minimum of inconvenience. No payment shall be made for the cost to the Contractor of any work or delay occasioned by establishing or checking lines and grades or making other measurements and no extensions of time shall be allowed for any delay occasioned thereby.

6.0 NATURE OF SITE

.1 Investigate and become familiar with the nature of the ground in which the Works are to be constructed and all other matters affecting the installation of the works.

.2 The ground water table on part of the site may be at such a level as to cause flotation of other damage to the structures. Observe all precautions against flotation of the structures during construction, and be responsible for any damage caused by flotation.

.3 Excavate any trial holes and do any other work necessary for locating existing structures, pipelines, cables and other obstructions, shown on the contract documents, affecting the construction of the Works.

7.0 LOCATION OF EQUIPMENT AND FIXTURES

.1 Location of equipment, fixtures and outlets indicated or specified are to be considered as approximate.

.2 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space and in accordance with manufacturer's recommendations for safety, access and maintenance.

.3 Inform Engineer of impending installation and obtain his approval for actual location.

.4 Submit field drawings to indicate relative position of various services and equipment when required by Engineer.

8.0 CONCEALMENT

.1 Conceal pipes, ducts and wiring in floor, wall and ceiling construction of finished areas except where indicated otherwise.

.2 Before installation, inform the Engineer if there is a contradictory situation. Install as directed by Engineer.

9.0 EXISTING UNDERGROUND SERVICES

.1 Where Work involves breaking into or connecting to existing services, carry out work at times directed by governing authorities, with minimum of disturbance to pedestrian and vehicular traffic.

.2 Before commencing Work, establish location and extent of known service lines, pipelines, cables, structures and other obstructions in area of Work and notify Engineer of findings. Protect all known underground services affected by operations under this Contract and repair any damage caused by such operations, either directly or indirectly, and pay all costs.

.3 Submit schedule to and obtain approval from Engineer for any shut-down or closure of active service or facility. Adhere to approved schedule and provide notice to affected parties.

.4 Where unknown services are encountered, immediately advise Engineer and confirm findings in writing and establish a method of payment.

.5 Remove abandoned service lines within 2 m. of structures. Cap or otherwise seal lines at cut-off points as directed by Engineer.

.6 Record locations of maintained, re-routed and abandoned service lines.

.7 Protect, relocate or maintain existing active services as required. When inactive services are encountered, cap off in a manner approved by authorities having jurisdiction over service.

.8 Should it be necessary to connect to lines which are controlled by another Utility Company other than the Owner, carry out such connections in accordance with the specific instructions of the representative of the Utility concerned.

.9 No valve or other control on any existing water system or other utility shall be operated for any purpose by the Contractor without the prior written approval of the owner. Such approval requires 4 days written notice unless otherwise specified by the Engineer. The Engineer or Representatives of the Owner or Operator of the utility will be present when these controls are operated.

.10 Where a Contractor is required to install storm or sanitary sewer mains beginning at an existing manhole or section of main, the Contractor shall install temporary 6 mm mesh screen over the outlet pipe of the first downstream manhole to prevent silt and gravel from entering the existing system from the new work. If this location is not appropriate, the Engineer may chose a more suitable location.

10.0 ALTERATIONS, ADDITIONS OR REPAIRS

.1 Execute work with least possible interference or disturbance to occupants, public and normal use of premises. Arrange with Engineer to facilitate execution of work.

.2 Where security has been reduced by work of Contract, provide temporary means to maintain security.

.3 Provide temporary dust screens, barriers, warning signs in locations where renovation and alteration work is adjacent to areas used by public.

11.0 RELICS AND ANTIQUITIES

.1 Relics and antiquities and items of historical or scientific interest such as cornerstones and contents, commemorative plaques, inscribed tablets, and similar objects found on site or in buildings to be demolished, shall remain property of Owner. Protect such articles and request directives from Engineer.

.2 Give immediate notice to Engineer if evidence of archaeological finds are encountered during construction, and await his written instructions before proceeding with work in this area.

12.0 EQUIPMENT RENTAL

.1 Make available to the Engineer upon written request, available equipment which the Engineer may wish to rent to carry out work beyond the scope of bid items. Rental rates will be in accordance with current Province of Newfoundland and Labrador Department of Works, Services & Transportation rental rate schedule. Hourly rental of equipment will be measured in actual working time and necessary travelling time of equipment within limit of project.

13.0 EXCESS EXCAVATION

.1 The priority of claim for use of waste material shall be:

.1	First:	Other areas of the project where there is a deficiency of material.
.2	Second:	Areas designated in the contract drawings. (Maximum quantities shall be specified.)
.3	Third:	Other locations selected by the owner as a dump site.
.4	Fourth:	Other locations selected by the contractor and approved as a dump site by the owner.

Overhaul shall only apply to items 13.1.1 and 13.1.3 listed above and 13.1.2 when maximum quantities are exceeded and only to that portion over the quantities specified.

.2 The dump site or sites shall be graded by the Contractor and left in a condition acceptable to the Engineer. The Contractor shall also ensure that approved disposal sites are available so that the work shall not be delayed.

14.0 TEMPORARY SUPPLY OF WATER TO OCCUPANTS

.1 Where buildings have wells which are used as a source of potable water and should loss of water occur in individual wells as a result of lowering of the ground water table due to carrying out the Work, the Owner will supply affected occupants with water on a temporary basis. If the Owner requires that the Contractor supply water on a temporary basis, the Contractor shall be paid for this additional work as a Cash Allowance item. The Method of Payment shall be as detailed in Section 01020. The Contractor will not be responsible for finding an alternative supply. The Contractor will test the temporary system as required by the Engineer.

.2 Where buildings are supplied potable water by a piped system that is indicated on the drawings, the Contractor shall be responsible to maintain the existing system. The Method of Payment to the Contractor for maintaining the existing system shall be a Lump Sum item as per the Schedule of Quantities and Prices.

.3 If it is not feasible, as determined by the Engineer, to maintain the existing system and the Contractor is required to install and operate a temporary system; the Contractor shall be paid for this additional work as a Cash Allowance item. The Method of Payment shall be as detailed in Section 01020.

15.0 TEMPORARY SEWER SERVICES TO OCCUPANTS

.1 Where buildings are serviced by a piped system that is indicated on the drawings, the Contractor shall be responsible to maintain the existing system. The Method of Payment to the Contractor for maintaining the existing system shall be a Lump Sum item as per the Schedule of Quantities and Prices.

.2 If it is not feasible, as determined by the Engineer, to maintain the existing system and the Contractor is required install and operate a temporary system, the Contractor shall be paid for this additional work as a Cash Allowance item. The Method of Payment shall be as detailed in Section 01020.

16.0 FIRE COMMISSIONER'S BULLETINS

.1 All work and installations shall comply with installation, safety and fire requirements of the Provincial Fire Commissioner.

17.0 ATTENDANCE UPON THE ENGINEER'S REPRESENTATIVE

.1 The Contractor shall provide, at the Engineer's request, whatever assistance is required to aid the Engineer in his measurement and inspection of the Works.

18.0 COMPACTION DENSITIES

.1 Unless specified otherwise all compaction densities are 95% standard Proctor Density to ASTM D698-91 (reapproved in 1998) Method D and corrected as noted in Section 02501.

19.0 BASIS FOR PAYMENT

.1 Unless otherwise specified no separate or direct payment will be made for work specified in this Section. Costs of all work specified in this Section are deemed to be included in the lump sum and unit prices quoted in the Schedule of Quantities and Prices.

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The Section is intended to include the work required for Mobilization and Demobilization.

1.0 GENERAL

.1 Mobilization shall be defined as the loading, transportation, unloading of all plant, materials, and equipment necessary to complete the work associated with the Contract.

.2 Demobilization shall be defined as the loading, transportation, unloading of all plant, materials, and equipment after the work associated with the Contract is completed.

2.0 BASIS OF PAYMENT

.1 The unit price for this item, on the Island portion of the Province, shall not be greater than 5% of the initial contract price including this item but not including HST.

.2 The unit price for this item, in the Labrador portion of the Province, shall not be greater than 15% of the initial contract price including this item but not including HST for projects north of Cartwright and not greater than 10% for projects in all other parts of Labrador.

.3 50% of the total for this item shall be paid on mobilization and 50% on final demobilization.

.4 There will be no change in the price for Mobilization and Demobilization due to contract extensions.

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The Section is intended to cover payment for materials and equipment delivered to the site which will be incorporated into the work.

1.0 GENERAL

.1 Materials and equipment delivered to the site of the work shall be defined as the purchase and transportation to the job site, of materials and equipment to be incorporated as part of the work during the current construction season or as otherwise agreed to by the Engineer.

.2 Materials and equipment delivered to site will be stored according to Section 01600, Clauses 5.3 and 5.4.

.3 Materials and equipment delivered to site shall be stored on property owned or leased by the Owner or at a location approved or directed by the engineer.

.4 Storage of materials and equipment shall be in accordance with all Regulatory Agencies, Manufacturer's recommendations or as directed by the Engineer.

2.0 MEASUREMENT FOR PAYMENT

.1 Measurement for payment will be the F.O.B. value of materials and equipment on site and not yet incorporated in the works, not exceeding the quantities specified in the Schedule of Quantities and Prices.

.2 Pipes, fittings and pre-cast manholes not incorporated in the work, up to quantities specified in the Schedule of Quantities and Prices, shall be purchased by the Owner or return costs shall be paid by the Owner.

.3 Granular material shall be measured for payment, up to the quantity included in the Schedule of Quantities and Prices, only if it will not be incorporated into the work in the current construction season.

3.0 BASIS OF PAYMENT

.1 Payment will be made on the basis of a completed Materials on Site Form c/w backup invoices for materials and equipment and as approved by the Engineer.

.2 Payment for granular materials shall not exceed 50% of the unit price.

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This Section is intended to include the method of claim for work performed under a Cash Allowance item as specified in the Schedule of Quantities and Prices.

1.0 GENERAL

.1 Expend each allowance as directed. Allowances will be adjusted to actual cost as defined under GC 19 "Valuation and Certification of Changes in the Work" with exception of overhaul which will be paid as defined by 1.8 below.

.2 The Contract Price will be adjusted by written order to provide for an excess or deficit to each cash allowance.

.3 Progress payments on account of work authorized under cash allowances shall be included in the Engineer's monthly certificate for payment.

.4 A schedule shall be prepared jointly by the Engineer and Contractor to show when items called for under cash allowance are required so that the progress of the Work will not be delayed.

.5 The Contractor shall be responsible for the Co-ordination of all cash allowance items.

.6 Pole relocation, shoring and/or bracing when required by the Utility Company and/or Engineer will be paid for under this section. The normal limit for payment of 1 metre outside the theoretical trench width does not apply.

.7 Third party costs related to public announcements by radio, television, and/or newspaper, as directed by the engineer, shall be paid under this section.

.8 Overhaul distance will be measured in one kilometre units from the end of the two kilometre freehaul limit. Fractional kilometres will be allowed as full kilometres. Overhaul will be at the Unit Price bid for each cubic metre for each additional kilometre beyond the freehaul limit.

.9 Excavation as directed by the engineer for geotechnical purposes shall be paid under this section.

.10 Survey equipment required by the engineer shall be paid under this section. The equipment will be acquired and maintained by the engineer.

2.0 BASIS FOR PAYMENT

.1 Payment for the applicable allowance shall be made with each progress estimate. The amount to be paid on any given claim will be equal to the amount of work actually completed as calculated under Section 01020.1.1.

.2 For payment purposes, a Utility Company shall be considered a sub-contractor thus allowing the contractor a 10% markup as per G.C. 19.1(c).

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This Section is intended to include incidental cutting, fitting, and patching required to complete the Work or to make its many parts fit together properly.

1.0 APPROVALS

.1 Obtain Engineer's approval before cutting, boring or sleeving load-bearing members or pipes under pressure or any work that affects:
- .1 Structural integrity of any element of Project.
- .2 Integrity of weather-exposed or moisture-resistant elements.
- .3 Efficiency, maintenance, or safety of any operational elements.
- .4 Visual qualities of sight-exposed elements.
- .5 Work of Owner or separate contractor.

2.0 GENERAL

.1 Where new work connects with existing and where existing work is altered, cut and patch and make good to match existing work.

.2 Make cuts with clean, true, smooth edges. Make patches inconspicuous in final assembly.

.3 Fit the several parts together to integrate with other work.

.4 Remove and replace defective and non-conforming work.

.5 Provide openings in non-structural elements of Work for penetrations of mechanical and electrical work.

3.0 INSPECTION

.1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.

.2 After uncovering, inspect conditions affecting performance of work.

.3 Beginning of cutting or patching means acceptance of existing conditions.

4.0 PREPARATION

.1 Provide supports to assure structural integrity of surroundings, devices and methods to protect other portions of project from damage.

.2 Provide protection from elements for areas which may be exposed by uncovering work; maintain excavations free of water.

5.0 PERFORMANCE

.1 Execute work by methods to avoid damage to other work, and which will provide proper surfaces to receive patching and finishing.

.2 Use material to match existing where practical.

.3 For a change in material submit request for substitution under provisions of Section 01600-Material and Equipment and GC 44 "Materials and Substitutions".

.4 Cut materials using appropriate equipment for the trade involved.

.5 Restore work with new products in accordance with requirements of Contract Documents.

.6 Fit work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

.7 At penetration of fire-rated wall, ceiling, or floor construction, completely seal voids with fire-rated or fire-resistant material, as may be required by the Provincial Fire Commissioner's Office, to full thickness of the construction element.

.8 Refinish surfaces to match adjacent finishes: for continuous surfaces refinish to nearest intersection; for an assembly, refinish entire unit.

6.0 METHOD OF PAYMENT

1.0 No separate or direct payment will be made for work under this section. The work will be considered incidental to work under this Contract. Costs will be deemed to be included in the unit and lump sum prices quoted in the Schedule of Quantities and Prices.

This Section specifies requirements for truck weigh sales for weighing of materials where measurement for payment is based on weight or mass.

1.0 REGULATORY AGENCIES

.1 Prior to use, have weigh scales certified as meeting requirements of Statutes of Canada, Chapter 36, Weights and Measures Act 1971 and subsequent amendments. Display certificate in a prominent position.

2.0 EQUIPMENT

.1 Weigh Scales: Of sufficient capacity to weigh loaded vehicles in a single operation. The weigh scale shall be calibrated in SI units.

.2 Scale House:

.1 To enclose mass indicator and in which Engineer's representative can perform work and maintain records.

.2 To be waterproof and have a minimum 750 luxes of illumination, one sliding window facing scale platform, one other window for cross ventilation, shelf desk at least 0.6 x 1.8 metres and heat to maintain inside temperature at 20^{o} C. Entrance door not to fact onto scale platform.

.3 Provide sufficient number of approved weigh tickets, in triplicate, with consecutive serial numbers.

3.0 INSTALLATION

.1 Provide, install and maintain scales and scale house convenient to project site at location approved by Engineer.

.2 Remove scales and scale house when no longer required. Level approach ramps.

4.0 OPERATION

.1 Provide scale operator unless otherwise directed by Engineer, in which case Engineer's representative at scales will weigh materials.

5.0 MAINTENANCE

.1 Maintain scale platform and scale mechanism clean and free from gravel, asphalt, snow, ice and debris.

.2 Maintain approach ramps in good condition free from sags and ruts.

.3 Have scales retested and re-certified if requested by Engineer.

6.0 MEASUREMENT FOR PAYMENT

.1 All costs of providing, installing, maintaining and finally removing weigh scales complete with scales and furniture, together with all costs of testing and certification in accordance with this specification shall be borne by the Contractor as part of the work to be carried out at the contract price for items which are measured by weighing.

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This Section includes requirements for site and co-ordination meetings for all parties in contract, parties in subcontract and other contractors.

1.0 ADMINISTRATIVE

.1 Attend project meetings, scheduled and administered by the Engineer, throughout the progress of the Work and approve times and locations proposed by the Engineer.

.2 Cooperate with the Engineer in the preparation of agendas for meetings.

.3 Distribute written notice of each meeting to Subcontractors five days in advance of meeting date.

.4 Provide physical space and make arrangements for meetings.

.5 The Engineer will record the minutes, include significant proceedings and decisions, identify 'action by' parties and submit a copy of the minutes to the Contractor within 5 days after each meeting.

.6 The Contractor shall reproduce copies of minutes forthwith and distribute to Subcontractors, meeting participants and affected parties not in attendance.

.7 Representatives of the Contractor, Subcontractor and suppliers attending meetings shall be qualified and authorized to act on behalf of the party each represents.

2.0 PRECONSTRUCTION MEETING

.1 Within 14 days after award of Contract, and prior to starting construction, request a meeting with the Engineer/Owner to discuss and resolve administrative procedures and responsibilities.

.2 Senior representatives of the Owner, Engineer, Contractor, major Subcontractors and field inspectors will be in attendance.

.3 Agenda to include the following:

- .1 Appointment of official representative of participants in the Work.
- .2 Schedule of Work, progress scheduling (Section 01300).
- .3 Schedule of submission of shop drawings, samples, colour chips, (Section 01340)
- .4 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences (Section 01500)
- .5 Delivery schedule of specified equipment (Section 01600)
- .6 Contemplated change orders, procedures, approvals required, time extensions, administrative requirements.
- .7 Owner provided Products.
- .8 Record drawings (Section 01720)
- .9 Maintenance manuals (Section 01720)
- .10 Take-over procedures, acceptance, warranties (Section 01720)
- .11 Monthly progress claims, administrative procedures. (Section 01370)
- .12 Insurances, transcript of policies, and sureties. (GC & Supplementary GC)

3.0 PROGRESS MEETINGS

.1 During course of Work and the weeks prior to project completion, schedule progress meetings monthly or as directed by the Engineer.

.2 Contractor, major Subcontractors involved in Work and Engineer are to be in attendance.

.3 Agenda to include the following:

.1 Review, approval of minutes of previous meeting.
.2 Review of Work progress and construction schedule since previous meeting.
.3 Field observations, problems, conflicts.
.4 Problems which impede construction schedule.
.5 Review of off-site fabrication delivery schedules.
.6 Corrective measures and procedures to regain projected schedule.
.7 Revisions to construction schedule, if required.
.8 Progress, schedule, during succeeding work period.
.9 Review submittal schedules: expedite as required.
.10 Maintenance of quality standards.
.11 Pending changes and substitutions.
.12 Review proposed changes for effect on construction schedule and on completion date.
.13 Other business.

4.0 METHOD OF PAYMENT

1.0 No separate or direct payment will be made for work under this Section, which will be considered incidental to work under this Contract. Costs will be deemed to be included in the unit and lump sum prices quoted in the Schedule of Quantities and Prices.

This Section details the Contractor's responsibilities in the preparation and submission of construction schedules with the form and requirements for periodic revisions.

1.0 SCHEDULES REQUIRED

1. As warranted and if requested by the Engineer submit the following schedules:

   .1 Construction Progress Schedule
   .2 Submittal Schedule for Shop Drawings and Product Data
   .3 Submittal Schedule for Samples
   .4 Submittal Schedule for timeliness of Owner furnished products
   .5 Product Delivery Schedule
   .6 Cash Allowance Schedule for purchasing products
   .7 Safety procedure

2.0 SCHEDULE FORMAT

.1 Prepare schedule using a horizontal bar chart with a separate bar for each trade or operation using a horizontal time scale identifying the first work day of each week. Format for listings to use the Table of Contents of this specification. Identification of listings to use Specification Section Numbers.

3.0 SUBMISSION

.1 Submit initial schedules within 30 days after award of Contract and prior to starting construction. Engineer will review schedule and return a copy within 10 days after receipt.

.2 Resubmit finalized schedule within 7 days after return of reviewed copy. When requested submit revised progress schedule with each application for payment.

.3 In accordance with schedule and in form acceptable to Engineer, provide within 30 working days after Contract award, and prior to starting construction, schedule showing dates for:

   .1 Submission of shop drawings, material lists and samples.
   .2 Delivery of items of equipment and materials.
   .3 Commencement and completion of work of each Section of Specification.
   .4 Final completion date within time period required by Contract documents.

.4 Interim review of work progress based on work schedule will be conducted as decided by Engineer and schedule updated by Contractor in conjunction with and to approval of Engineer.

4.0 CONSTRUCTION PROGRESS SCHEDULE

.1 Include the complete sequence of construction activities.

.2 Include the dates for the commencement and completion of each major element of construction.

5.0 METHOD OF PAYMENT

.1 No separate or direct payment will be made for work under this Section, which will be considered to be incidental to work under this contract. Costs will be deemed to be included in the unit and lump sum prices quoted in the Schedule of Quantities and Prices.

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This section specifies requirements and procedures for contractors submissions of shop drawings, product data, samples and mock-ups to Engineer for review.

1.0 GENERAL REQUIREMENTS

.1 Keep one reviewed copy of each submission on site. Do not proceed with work until relevant submissions are reviewed by Engineer.

.2 Present shop drawings, product data, samples and mock-ups in SI units. Where items or information is not produced in SI units converted values may be acceptable.

.3 Submit a minimum of eight (8) prints of shop drawings and/or product data sheets and/or brochures for each requirement requested in specification Sections and as the Engineer may reasonably request. The Engineer will retain a maximum of three (3) copies for his records.

.4 If upon review by the Engineer, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through the same procedure indicated above, shall be performed before fabrication and installation of Work may proceed.

2.0 SUBMISSIONS REQUIRED

.1 Coordinate each submission with requirements of work and Contract Documents. Individual submissions will not be reviewed until all related information is available.

.2 Allow 5 days from the date of receipt by Engineers office, for Engineers review of each submission, unless otherwise indicated in the contract documents or additional time for the Engineer to reasonably review complex shop drawings.

.3 Submissions shall include:

- .1 Other pertinent data.
- .2 Date and revision dates.
- .3 Project title and number.
- .4 Name and address of:
  - .1 Subcontractor.
  - .2 Supplier.
  - .3 Manufacturer.
- .5 Contractor's stamp, signed by Contractors authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.

.4 Details of appropriate portions of Work as applicable:

- .1 Fabrication.
- .2 Layout, showing dimensions, including identified field dimensions, and clearances.
- .3 Setting out or erection details.
- .4 Capacities.
- .5 Performance characteristics.
- .6 Standards.
- .7 Operating weight.
- .8 Wiring diagrams.
- .9 Single line and schematic diagrams.

.10 Relationship to adjacent work.

.5 After Engineer's review, distribute copies.

3.0 SHOP DRAWINGS AND PRODUCT DATA

.1 Refer to GC 41 - "SHOP DRAWINGS".

.2 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been co-ordinated, regardless of the Section under which the adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.

.3 Adjustments made on shop drawings by Engineer are not intended to change the Contract Price. If adjustments affect the value of Work, state such in writing to Engineer and obtain an approved change order prior to proceeding with the Work.

4.0 SAMPLES

.1 Submit samples for review. Label samples as to origin and intended use in the Work.

.2 At least 2 weeks prior to commencing work, inform Engineer of proposed source of fill materials and provide access for sampling.

5.0 MATERIAL CERTIFICATION

.1 At least 2 weeks prior to commencing work, submit manufacturer's test data and certification that materials meet requirements of this section.

.2 Deliver samples prepaid to Engineer's business address.

.3 Notify the Engineer in writing, at the time of submission of deviations in samples from requirements of Contract Documents.

.4 Adjustments made on samples by the Engineer are not intended to change the Contract Price. If adjustments affect the value of Work, state such in writing to the Engineer and obtain an approved change order prior to proceeding with the Work.

.5 Make changes in samples which the Engineer may require, consistent with Contract Documents.

6.0 CONCRETE MATERIAL CERTIFICATION

.1 Prior to starting concrete work, submit to Engineer manufacturer's test data and certification that following material meets requirements of this specification:

.1 Portland cement.
.2 Admixtures.
.3 Joint sealants.
.4 Curing materials.

7.0 ASPHALT MATERIAL CERTIFICATION

.1 Unless otherwise specified, asphalt cement shall conform to the requirements of ASTM D946-82 for 120/150 penetration grade asphalt, except the penetration grade shall be 150/200.

.2 Obtain from the manufacturer and furnish to Engineer, in tabular or graphic form, the temperature - viscosity relationship of the asphalt cement to be used.

.3 Submit test results showing conformance with product requirements.

.4 The following tests are required before paving commences:

.1	Coarse Aggregate:		
	.1	Los Angeles Abrasion Test	ASTM C131-81
	.2	Soundness	ASTM C 88-83
	.3	Bulk Specific Gravity	ASTM C128-84, A.S.T.M. C127-84
	.4	Percent Absorption	ASTM C127-84
	.5	Percent Crushed Particles	
	.6	Percent Flat & Elongated Particles	
.2	Combined Aggregates:		
	.1	Sieve Analysis	ASTM C117-83, ASTM C136-84a
	.2	Coating and Stripping of Asphalt	
	.3	Aggregate Mixture	ASTM D1664-85

8.0 MIX DESIGN SUBMISSION

.1 Submit mix designs to Engineer for approval 2 weeks prior to commencing work.

9.0 METHOD OF PAYMENT

.1 No separate or direct payment will be made for work under this section, which will be considered incidental to work under this Contract. Costs will be deemed to be included in the unit and lump sum prices quoted in the Schedule of Quantities and Prices.

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This Section establishes form and content for Contractor's subsequent preparation and submittal of periodic applications for payment in stipulated price contracts and unit price contracts. The Schedule then becomes basis for Engineer's evaluation of cost of work completed to cut-off date for payment under stipulated price contracts, and for certificate of payment to Owner.

1.0 GENERAL

.1 Submit to the Engineer, Schedule of Prices & Quantities, as least 10 days prior to submitting first Application for Payment.

.2 List quantities of materials specified under unit price allowances.

2.0 FORM OF SUBMITTAL - LUMP SUM CONTRACTS

.1 Submit typewritten Schedule of Values.

.1 Use Table of Contents of this Specifications as basis for format for listing costs of work for Sections under each Division.

.2 Identify each line item with number and title as listed in Table of Contents of this Specification.

3.0 REVIEW AND RESUBMITTAL

.1 After review by Engineer, revise and resubmit Schedule as directed.

4.0 MEASUREMENT FOR PAYMENT - UNIT PRICE & STIPULATED PRICE CONTRACTS

.1 Notify Engineer sufficiently in advance of operations to permit required measurements for payment.

.2 Submit applications for payment on a monthly basis as specified in article A-4, GC 20 and GC 21. These monthly progress applications shall consist of six (6) type written copies of the Contract Payment Certificate, Detail Sheets, Materials on Site Forms, Re-instatement and Testing Forms, Valuation of Extra Work Forms, any other such forms as may be required by the Engineer. These monthly certificates shall be signed by the Contractor prior to submission for payment.

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This Section establishes the general requirements for inspection and testing that is specified to be carried out by testing laboratory designated by Engineer. The appointment and direction for this inspection and testing is under direct control of the Engineer.

1.0 APPOINTMENT AND PAYMENT

.1 Engineer will approve and the Owner shall pay directly for services of testing laboratory except for the following:

- .1 Inspection and testing required by laws, ordinances, rules, regulations or orders of public authorities.
- .2 Inspection and testing performed exclusively for Contractor's convenience.
- .3 Testing, adjustment and balancing of conveying systems, mechanical and electrical equipment and systems.
- .4 Mill tests and certificates of compliance.
- .5 Tests specified in this specification to be carried out by Contractor under the supervision of Engineer.

.2 Where tests or inspections by designated testing laboratory reveal work not in accordance with contract requirements, Contractor shall pay costs for additional tests or inspections as Engineer may require to verify acceptability of corrected work.

2.0 INDEPENDENT INSPECTION AGENCIES

.1 Where required by Section 01400.1.1, Independent Inspection/Testing Agencies will be approved by the Engineer for the purpose of inspecting and/or testing portions of Work.

.2 Provide assistance to testing agency where required for executing inspection and testing by the appointed agencies.

.3 Employment of inspection/testing agencies does not relax the responsibility to perform Work in accordance with the Contract Documents.

.4 If defects are revealed during inspection and/or testing, the appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defects and irregularities as advised by Engineer at no cost to the Owner. Contractor to pay all testing and costs related to the defining and correction of all discovered defects.

3.0 PROCEDURES

.1 Notify the appropriate agency and Engineer in advance of the requirement for tests, in order that attendance arrangements can be made.

.2 Provided labour and facilities to obtain and handle samples and/or materials required for testing, as specifically requested in specifications. Act with reasonable promptness and in an orderly sequence so as not to cause delay in the Work. Provide sufficient space to store and cure test samples.

4.0 CONTRACTOR'S RESPONSIBILITY

.1 Furnish labour and facilities to:

- .1 Allow inspection/testing agencies access to the Work, or off-site manufacturing and fabrication plants.
- .2 Co-operate to provide reasonable facilities for such access.
- .3 Make good work disturbed by inspection and testing.
- .4 Provide storage on site for laboratory's exclusive use to store equipment and cure test samples.

.2 Pay costs for uncovering and making good work that is covered before required inspection or testing is completed and approved by Engineer.

5.0 BASIS OF PAYMENT

.1 No separate or direct payment will be made for work specified in this Section. Costs of all work specified is deemed to be included in the lump sum and unit prices quoted in the Schedule of Quantities and Prices.

This section specifies the requirements for the provision of the Engineer's office and associated equipment by the Contractor and the provision of temporary facilities required for the proper implementation of the contract.

1.0 ACCESS

.1 Provide and maintain adequate access to project site

.2 Build and maintain temporary roads where indicated or directed and provide snow removal during period of work.

.3 If authorized to use existing roads for access to project site, maintain such roads for duration of Contract and make good damage resulting from Contractors' use of roads.

2.0 STORAGE SHEDS

.1 Provide adequate weather tight sheds with raised floors, for storage of materials and tools.

3.0 WATER SUPPLY

.1 Provide a continuous supply of potable water for construction use.

.2 Arrange for connection with appropriate utility company and pay costs for installation, maintenance and removal.

.3 Pay for utility charge at prevailing rates.

4.0 TEMPORARY TELEPHONE

.1 Provide and pay for temporary telephones necessary for own use and use of Engineer. Long distance calls placed on this phone by Engineer will be paid for by Engineer.

5.0 SANITARY FACILITIES

.1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.

.2 Post notices and take such precautions as required by local health authorities. Keep area and premises in sanitary condition.

.3 When permanent water and drain connections are completed, provide temporary water closets and urinals complete with temporary enclosures, inside building. Permanent facilities may be used on approval of Engineer.

6.0 POWER

.1 Arrange, provide and pay for connection with the appropriate utility company for temporary power required during the construction of the works.

.2 Electrical power and lighting systems installed under this Contract may be used for construction requirements with prior approval of Engineer provided that guarantees are not affected. Make good damage. Replace lamps which have been used over period of 3 months.

7.0 HEATING AND VENTILATING

.1 Pay for costs of temporary heat and ventilation used during construction, including costs of installation, fuel, operation, maintenance and removal of equipment. Use of direct-fired heaters discharging waste products into work areas will not be permitted unless prior approval is given by Engineer.

.2 Provide temporary heat and ventilation in enclosed areas as required to:

- .1 Facilitate progress of work.
- .2 Protect work and products against dampness and cold
- .3 Prevent moisture condensation on surfaces.
- .4 Provide temperatures and humidity levels for storage, installation and curing of materials.
- .5 Provide adequate ventilation to meet health regulations for safe working environment.

.3 Maintain minimum temperature of $10^{o}C$ or higher as soon as finishing work is commenced and maintain until acceptance of structure by Engineer.

- .1 Maintain temperature and humidity levels as required for comfort of office personnel.

.4 Ventilating:

- .1 Prevent hazardous accumulations of dust, fumes, mists, vapours, or gases in areas occupied during construction.
- .2 Provide local exhaust ventilation to prevent harmful accumulation of hazardous substance into atmosphere of occupied areas.
- .3 Dispose of exhaust materials in manner that will not result in harmful exposure to persons.
- .4 Ventilate storage spaces containing hazardous or volatile materials.
- .5 Ventilate temporary sanitary facilities.
- .6 Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful elements.

.5 Maintain strict supervision of operation of temporary heating and ventilating equipment to:

- .1 Conform with applicable codes and standards.
- .2 Enforce safe practices.
- .3 Prevent abuse of services.
- .4 Prevent damage to finishes.
- .5 Vent direct-fired combustion units to outside.

8.0 SCAFFOLDING

.1 Construct and maintain scaffolding in rigid, secure and safe manner.

.2 Erect scaffolding independent of walls. Remove promptly when no longer required. Refer to Section 01545 for safety requirements for scaffolding.

9.0 REMOVAL OF TEMPORARY FACILITIES

.1 Remove temporary facilities from site when directed by Engineer.

.2 When project is closed down at end of construction season keep facilities operational until close down is approved by Engineer.

10.0 ENGINEER'S SITE OFFICE AND EQUIPMENT

.1 Provide temporary office for the Engineer. Inside dimensions minimum 4.6 m x 3.0 m x 2.4 m high, with floor 0.3 m above grade, complete with (4) 50% opening windows and one lockable door.

.2 Insulate building and provide heating system to maintain 22^{o}C insider temperature at -20^{o}C outside temperature.

.3 Finish inside walls and ceiling with plywood, hardboard or wallboard and paint in selected colours. Finish floor with 19 mm thick plywood.

.4 Install electrical lighting systems to provide min 750 Lux using surface mounted, shielded commercial fixture with 10% upward light component.

.5 Office furniture and equipment to be supplied as follows:

.1 Desk (1 m x 2 m) with lockable drawers.
.2 Drafting table (1 m x 2 m) with plan drawer and T-square to suit.
.3 Three chairs.
.4 Draftperson's stool.
.5 Lockable steel filing cabinet, legal size, 4 drawer.
.6 Six metres of shelving.
.7 Electrical outlet adjacent to drafting table.
.8 Coat rack and shelf.

6. Provide private washroom facilities adjacent to office complete with flush or chemical type toilet, lavatory and mirror and maintain supply of paper towels and toilet tissue.

.7 Clean, maintain, light and heat office and washroom throughout continuance of the Works.

11.0 METHOD OF PAYMENT

.1 With the exception of the Engineer's Site Office and associated equipment, no separate or direct payment will be made for work specified in this section. The Engineer's site office and Equipment, if required, will be included as a pay item in the unit Price Table. Cost of all other work specified in this section are deemed to be included in the lump sum and unit price quoted in the Schedule of Quantities and Prices.

.2 The pay item in the Schedule of Quantities and Prices for the Engineer's site office and equipment shall be prorated to the final contract price where a contract extension has been approved.

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1.0 CONSTRUCTION SAFETY MEASURES

.1 Observe and enforce construction safety measures required by National Building Code (latest version) Provincial Government, Occupation Health and Safety, and municipal statutes and authorities.

.2 In event of conflict between any provisions of above authorities the most stringent provision governs.

2.0 FIRE SAFETY REQUIREMENTS

.1 Comply with requirements of standard for Building Construction Operations FCC No. 301- 1982, issued by Fire Commissioner for Canada.

.2 This standard may be viewed at Regional Engineer's office address and copies may be obtained from: Fire Commissioner for Canada, Sir Charles Tupper Building, Riverside Drive, Ottawa, Canada, K1A OM2.

3.0 OVERLOADING

.1 Ensure no part of Work is subjected to a load which will endanger its safety or will cause permanent deformation.

4.0 FALSEWORK

.1 Design and construct falsework in accordance with CSA S269.1-1975.

5.0 SCAFFOLDING

.1 Design and construct scaffolding in accordance with CSA S269.2-M87.

6.0 OCCUPATIONAL HEALTH AND SAFETY

.1 Conduct operations in accordance with current Newfoundland Occupational Health and Safety (OH & S) Act and regulations.

.2 Where deemed necessary or required, provide sufficient number of capable watchmen to protect the public from injury as a result of the work.

.3 All trenches more than 1.25 metres deep shall be protected against cave-ins or wall collapse by side wall sloping to the appropriate angle of repose or an engineered shoring-sheathing system or an approved trench box. Trenches less than 1.25 metres deep shall also be effectively protected when hazardous ground movement may be expected.

.4 The protection aspects of the work shall be carried out under the supervision of a competent person who shall be responsible for ensuring that the work conforms to the requirements of the current edition of "Trench Excavation Safety Guide" published by the Occupational Health and Safety Division of the Department of Employment and Labour Relations.

.5 Trench boxes shall be designed and certified by a professional Engineer, and shall be fabricated by a reputable manufacturer and shall have the manufacturer's Depth Certification Statement permanently affixed. Trench boxes shall be used in strict accordance with the manufacturer's instruction and depth certification data.

.6 For all tench excavation deeper than six metres the contractor shall provide a certificate from a registered professional engineer stating that the protection methods proposed have been properly designed in accordance with accepted engineering practice. The engineers certificate shall verify that trench boxes, if used, are properly designed and constructed to suit the depth and soil conditions encountered.

.7 Every superintendent who is responsible for trenching operations and every crew chief, foreperson and lead hand engaged in trench operations or working in trenches shall have a copy of "Trench Excavation Safety Guide" in his/her possession at all times.

.8 "Trench Excavation Safety Guides" are available from the Occupational Health and Safety Division of the Department of Employment and Labour Relations.

7.0 METHOD OF PAYMENT

.1 No separate or direct payment will be made for work specified in this section. Costs of all work specified in this section are deemed to be included in the lump sum and unit prices quoted in the Schedule of Quantities and Prices.

This section specifies the requirements for environmental protection and general protection during the course of the work.

1.0 GENERAL

.1 All work is to be done in accordance with local, provincial and federal environmental regulations and any specific requirements for this contract are to be strictly adhered to by the Contractor.

.2 Particular attention is drawn to the requirements of the Federal Fisheries Act and regulations for works affecting fish habitat as stipulated by the Department of Fisheries and Oceans.

.3 The Contractor is responsible for obtaining all Work Permits required by the Provincial Department of Environment & Lands and the Federal Department of Fisheries and Oceans.

2.0 FIRES

.1 Fires and burning of rubbish on site permitted only when approved by governing agencies. Bury ashes and residue from burning as directed.

.2 Where fires or burning permitted, prevent staining or smoke damage to structures, materials or vegetation which is to be preserved. Restore, clean and return to new condition stained or damaged work.

.3 Provide supervision, attendance and fire protection measures as directed.

3.0 DRAINAGE

.1 Provide temporary drainage and pumping as necessary to keep excavations and site free from water.

.2 Do not pump water containing suspended materials into waterways, sewer or drainage system.

.3 Control disposal or run-off of water containing suspended materials or other harmful substances in accordance with local authority requirements.

.4 Construct temporary silt traps or silt fences with sufficient surface area, as directed by Engineer, prior to commencing excavation of any nature.

4.0 SITE CLEARING AND PLANT PROTECTION

.1 Protect trees and plants on site and adjacent properties where indicated.

.2 Wrap in burlap, trees and shrubs adjacent to construction work, storage areas and trucking lanes, and encase with protective wood framework from grade level to height of 2 metres.

.3 Protect roots of designated trees to drip line during excavation and site grading to prevent disturbances or damage. Avoid unnecessary traffic, dumping and storage of materials over root zones.

.4 Minimize stripping of topsoil and vegetation.

.5 Restrict tree removal to areas indicated or designated by Engineer.

5.0 WORK ADJACENT TO WATERWAYS

.1 All work must comply with Department of Environment & Lands requirements.

.2 Do not dump excavated material, waste material or debris in waterways.

.3 Design and construct temporary crossings to minimize erosion to waterways.

.4 Do not skid logs or construction materials across waterways.

.5 Intercept sediment laden surface water run-off during cut operations and direct to silt traps before entry into waterways.

.6 Sandbags to be used to construct sediment traps in active streams.

.7 Obtain approval in writing or permit from Department of Fisheries & Oceans of Canada prior to blasting or excavation under water or in inter-tidal zone of water courses and bodies.

.8 Coffer dams must be constructed of non-erodible materials. Water from work areas must be pumped a minimum of 50 metres from waterway into sediment traps, or as directed by the Engineer.

.9 Extreme care must be taken to prevent entry of cement, lime or fresh concrete into waterway.

.10 Works performed in and around waterways will be carried out in accordance with regulations of authorities having jurisdiction.

.11 Cuts and fills adjacent to waterways are to be stabilized, and ditch run-offs constructed to prevent entry of silt into waterway.

.12 On conclusion of construction, debris must be disposed of to prevent its entry into waterways, and stream bed returned to its original configuration or as directed by the Engineer.

.13 Do not use waterway beds for borrow material.

6.0 POLLUTION CONTROL

.1 Maintain temporary erosion and pollution control features installed under this contract.

.2 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.

7.0 WASTE DISPOSAL AREAS

.1 Develop waste disposal sites in a planned manner to dispose of surplus materials to satisfaction of Engineer.

.2 Clear sufficient area in advance of requirements.

.3 Establish temporary haul roads to and within designated sites to ensure disposal areas are fully utilized. Remove on completion.

.4 Establish temporary berms on lower side of waste disposal area. Ensure inside drainage pattern to appropriate point of concentration. Dump in a regular manner upstream of the drain.

.5 Establish side berms as work progresses with corresponding drainage.

.6 On completion of work, push berms in to contain waste materials and establish final perimeter outside drainage pattern. Blend berms to general contours of site and materials contained.

8.0 EROSION CONTROL

.1 Ground vegetation within 30 metres of waterway not to be disturbed until actual start of waterway crossing construction commences.

9.0 VEHICULAR MOVEMENTS

.1 Confine vehicles and equipment to existing disturbed areas (access roads, borrow pits, disposal areas, highways and future right-of-ways).

10.0 PROTECTION

.1 Prevent movement, settlement or damage of adjacent structures, services, walks, paving, trees, landscaping, adjacent grades and parts of existing buildings to remain. Provide bracing, shoring and underpinning where required. Make good damage and be liable for injury caused by demolition.

.2 Take precautions to support structures and, if safety of building being demolished or adjacent structures or services appears to be endangered, cease operations and notify Engineer.

.3 Prevent debris from blocking surface drainage system which must remain in operation.

.4 Prevent damage to fencing, trees, landscaping, natural features, bench marks, existing buildings, existing pavement, utility lines, site appurtenances, water courses, and root systems of trees which are to remain. Make good damage.

.5 Apply approved tree paint to cuts or scars suffered by vegetation designated to remain.

.6 Before commencing work the Contractor shall check locations of all services, whether above ground or underground, whether shown on drawings or not, with public utility authorities, and arrange to remove, protect or cut off utilities that may be encountered.

.7 Provide all shoring and bracing to support banks of excavation. The Contractor will be held responsible for any injury or damage caused as a result of inadequate shoring or inadequate protective measures during the execution of the Contract and will be required to make good all damage and injury without extra cost to the Owner. If in the opinion of the Engineer shoring and bracing is necessary, he will order their use, at the same time specifying his requirements, but no such orders, or absence of any such orders shall relieve the Contractor of any responsibilities under the Contract. Bear all expenses in connection with the use of close-sheeting whether used in accordance with the instructions of the Engineer or otherwise.

.8 Whenever shoring, sheeting, timbering and bracing of excavation is required, engage services of a professional engineer, registered or licensed to practice in the Province of Newfoundland and Labrador, to design and assume responsibility for adequacy of shoring and bracing. When requested submit for review drawings and calculations signed and stamped by the Engineer responsible for their preparation.

.9 Shoring and bracing shall be inspected by the Professional Engineer responsible for their preparation.

.10 Protect persons from injury and avoid property damage, by means of adequate barricades, construction signs, torches, lanterns and guards as required.

.11 Protect excavated earth to be reused from freezing by approved method.

.12 Grade around excavations to prevent surface water run-off into excavated area.

.13 Protect bottoms of excavations for foundations from inclement weather. Should softening in bottoms occur due to water or other causes, remove softened soil and replace with structural concrete or approved granular backfill material at no additional cost.

11.0 ENVIRONMENTAL REQUIREMENTS AND APPROVALS

.1 Pits and quarries shall be stripped, worked and at the completion of the work restored, all in compliance with the Department of Works, Services & Transportation Specification Section 310 "Use of Pits, Quarries and Stockpiles for Production of Materials Supplied by the Contractor".

.2 Off-specification asphalt shall be disposed of in accordance with Department of Works, Services & Transportation Specification Section 140.04 "Waste Material Disposal".

.3 Any asphalt plant being operated within a radius of 1.5 km of a regularly used building, either residential or commercial, or an organized recreational area, must control their dust emissions such that compliance is obtained with the air standards enforced by the Department of Environment & Lands. In order to comply, the efficient operation of either a baghouse dust collector or a water scrubber on the drier emissions would be necessary. These controls may be waived in an area where there are three or less regularly used buildings if the Contractor makes satisfactory arrangements wit the owners and occupiers of all buildings. Under such circumstances, a written agreement between the Contractor and owner/occupier, signed by both parties, must be submitted to both the Engineer and the Department of Environment & Lands.

.4 Hydrocarbon storage shall be in accordance with “Storage and Handling of Gasoline and Associated Products Regulations” under the Environment Act. The Contractor shall follow the procedure for spill reporting.

.5 All sections of the asphalt plant which could contribute to air or water pollution must be maintained in efficient operating condition.

.6 Where a water scrubber is used, the scrubber effluent must be given retention time in suitably sized artificial settling ponds. Such ponds must be sufficiently impermeable to enable seepage water to meet the Environment Control (water and sewage) Regulations, 1974.

.7 All storage tanks for fuel must be drained within one week after production has been completed. Fuel oil must not remain in tanks over the winter.

.8 Contractors wishing to set up an asphalt mixing plant at a site must first obtain environmental approval before proceeding.

.9 Contractors must apply in writing to the Department of Environment & Lands for a Ministerial Approval as required in Section 23 of the Department of Environment & Lands Act, 1981. The following information must be supplied with the application.

.1 Location of the proposed site and description of its surroundings within a radius of 1.5 km.
.2 Soil type and particulars of protective diking near storage tanks.
.3 Sieve analysis of cold feed aggregate or at least the % of minus 75 mm sieve.
.4 Description of the plant and associated equipment to reduce air contaminants (plans if available).
.5 Capacity of plant in tonnes per house.
.6 Source of heat (and sulphur content if it is oil).
.7 Rate of air flow through the dryer at operating conditions and diameter of the dryer.
.8 Relevant operation details of air pollution control equipment (ie. pressure drop across cyclones or scrubbers.)
.9 Air to cloth ratio if baghouse filter is used.

.10 Height of exhaust stacks.
.11 Temperature and velocity of exhaust gases from dryer and/or stack.
.12 Expected dates of operation of the plant:
- proposed starting date
- total days in operation
- hours in operation per day
- proposed completion date

.13 If using a water scrubber, the rate of use of water (l/s), the number and dimensions of settling ponds and the method of lining of the ponds.

.10 Should the Contractor wish to leave his equipment at the site beyond the completion of his work for this Department, or beyond his proposed completion date as stated in his application, then the Contractor shall state in writing his commitment to undertake the cleanup and restoration requirements of this section and those of Department of Works, Services & Transportation Specification Section 310 "Use of Pits, Quarries and Stockpiles for Production of Materials Supplied by Contractor", and also state his updated proposed completion date. Copies of this letter shall be sent to both the Department of Works, Services & Transportation and the Department of Environment & Lands.

12.0 METHOD OF PAYMENT

.1 Dust control, at the direction of the engineer, shall be paid under force account. Silt fence, if required, will be paid by the lineal meter under the unit price bid for this item. No separate of direct payment will be made for all other work specified in this Section. Costs of all other work specified in this section are deemed to be included in the lump sum and unit prices quoted in the Schedule of Quantities and Prices.

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This Section specifies requirements when roadway traffic is to be accommodated during construction. Under certain conditions, construction and maintenance activity on or along a roadway may require the use of a flagperson to expedite the work and to safely guide motorists through the work site area. This section specifies the appropriate equipment and signs to be used by the flagperson under such circumstances. The use and supervision of flagpersons shall conform to the requirements of the "Occupational Health and Safety Act 1979" and its amendments.

1.0 REFERENCE STANDARDS

.1 Do traffic regulation in accordance with Uniform Traffic Control Devices for Canada, January 1976. (Council of Uniform Traffic Devices for Canada distributed by Roads and Transportation Association of Canada), except where specified otherwise.

2.0 PROTECTION OF PUBLIC TRAFFIC

.1 Comply with requirements of Acts, Regulations and By-Laws in force for regulation of traffic or use of roadways upon or over which it is necessary to carry out work or haul materials or equipment.

.2 When working on travelled way:

- .1 Place equipment in position to present minimum of interference and hazard to travelling public.
- .2 Keep equipment units as close together as working conditions will permit and preferably on same side of travelled way.
- .3 Do not leave equipment on travelled way overnight.

.3 Do not close any lanes of road or highway without approval of Engineer. Before re-routing traffic erect suitable signs and devices in accordance with instructions contained in Part D of Uniform Traffic Control Devices for Canada, January 1976. Provide sufficient crushed gravel to ensure a smooth riding surface during work.

.4 Keep travelled way well graded, free of pot holes and of sufficient width that required number of lanes of traffic may pass.

.5 When deemed necessary by Engineer, provide well graded, gravelled or paved detours or temporary roads to facilitate passage of traffic around restricted construction area. Provide and maintain signs and lights and maintain roadway. Engineer will pay for gravel surfacing, dust palliative or paving of detour or temporary road at Contract prices appropriate to such work.

.6 Provide and maintain reasonable road access for Public Traffic and egress to property fronting along or in vicinity of work under Contract unless other reasonable means of road access exist.

3.0 INFORMATIONAL WARNING DEVICES

.1 Provide and maintain signs and other devices required to indicate construction activities or other temporary and unusual conditions resulting from project work which may require road user response.

.2 Supply and erect signs, delineators, barricades and miscellaneous warning devices as specified in Part D, Temporary Conditions Signs and Devices, of manual titled Uniform Traffic Control Devices for Canada, January 1976.

.3 Place signs and other devices in locations recommended in said manual.

.4 Meet with Engineer prior to commencement of work to prepare list of signs and other devices required for project.

.5 Continually maintain traffic control devices in use by:

.1 Checking signs daily for legibility, damage, suitability and location. Clean, repair or replace to ensure clarity and reflectance.
.2 Removing or covering signs which do not apply to conditions existing from day to day.

4.0 CONTROL OF PUBLIC TRAFFIC

.1 Provide competent flagpersons, properly supervised and equipped as specified in manual of Uniform Traffic Control Devices for Canada, January 1976, in following situations:

.1 When public traffic is required to pass working vehicles or equipment which may block all or part of travelled roadway.
.2 When it is necessary to institute one-way traffic system through construction area or other blockage where traffic volumes are heavy, approach speeds are high and traffic signal system is not in use.
.3 When workmen or equipment are employed on travelled way over brow of hills, around sharp curves or at other locations where oncoming traffic would not otherwise have adequate warning.
.4 Where temporary protection is required while other traffic control devices are being erected or taken down.
.5 For emergency protection when other traffic control devices are not readily available.
.6 In situations where complete protection for workmen, working equipment and public traffic is not provided by other traffic control devices.

5.0 FLAGPERSONS EQUIPMENT

.1 The flagpersons should wear a safety jacket, safety boots, a safety hat and should be equipped with a diamond sign. Where red flags are used to supplement the diamond sign, they shall be a minimum of 50 x 50 cm. For night operation, the flag should be replaced with a red flashlight.

6.0 FLAGPERSONS SIGNS

.1 The flagperson sign shall indicate the appropriate right-of-way to motorists approaching a work site. It shall consist of a diamond shape, displaying a red stop sign on white background facing the traffic, which is required to stop. The reverse side of the sign shall be an orange diamond. Where the sign may be used during the hours of darkness, it shall be reflectorized or illuminated to indicate the same colour and shape by night as by day.

7.0 OPERATION GUIDELINES

.1 Responsible flagpersons shall be maintained continuously for the direction and control of through traffic when construction operations and work zone conditions cause interruption, delay and hazard to traffic.

.2 Flagpersons should be visible for a distance of at least 150 metres. For this reason they must stand alone, never permitting a group of workmen to congregate around them.

.3 Flagpersons working as a team shall agree on communication signals before commencing their duties. If the flagpersons are not visible to one another, two-way radios are necessary to ensure proper communication and directing of traffic.

.4 No flagperson shall leave his (or her) post unless authorized to do so or replaced by another flagperson. As long as traffic cannot flow freely, even at meal time, the flagperson must stay on duty.

.5 Flagpersons should stand just outside the lane of traffic at a point 50 m to 75 m from the end of the working area so as to be able to protect personnel and equipment.

8.0 BASIS FOR PAYMENT

.1 The Owner will pay the Flagperson's hourly wage at the unit price quoted in the Schedule of Quantities and Prices.

.2 Contractors are advised that only employees who are trained in accordance with "Guideline for Traffic Control Persons" as published by the Department of Employment and Labour Relations, Occupational Health and Safety Branch, Education and Committees Division, can be claimed under this section.

.3 No separate payment will be made for items specified under this section except hourly wages as defined under 8.1 of this section.

.4 No payment will be made for Flagperson's wages for repairs of defective work.

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1.0 SCOPE

.1 The provisions for public protection established herein are for application by contractors employed under this contract. Traffic safety in construction zones should be an integral and high priority element of every project. The goal should be to route traffic through such areas, with temporary condition signs and devices, as nearly as possible comparable to those for normal situations.

.2 The responsibility for temporary condition signs and devices rests with the contractor. Thus, while this specification provides standards for design and application of temporary condition signs and devices installations, it is not a substitute for good judgment. The decision to use a particular device at a particular location should be made on the basis of a study of the location.

.3 The provisions for public protection established herein are for application by contractors performing any work under this contract. All costs associated with temporary condition signing to standards as outlined in the contract documents shall be the responsibility of the contractor. Cost of signs, handling, installation, materials and labour shall be paid by the contractor and no payment shall be considered by the Engineer.

2.0 GENERAL INFORMATION

.1 All traffic signs used for temporary conditions are designed and erected for the safety and convenience of travelling public, and for the safety of the workmen on the construction projects.

.2 The Engineer shall be contacted three weeks in advance for assistance in signing major construction detours.

.3 All temporary condition signs not mounted on portable sign supports shall be mounted on the right side of the roadway at a height of 1.5 metres above the road surface and not less than 2 metres from the edge of the travelled portion of the roadway. Signs mounted on portable sign supports shall be erected on the right-hand side of the road in a level position at a height of not less than 1 metre from the road surface to the bottom of the sign and not less than 1.3 metres from the edge of the travelled portion of the highway.

.4 All signs shall conform to the required standards in shape, colour, size and position, as outlined in this specification for Temporary Condition Signing.

.5 All temporary condition signs shall have a fully reflectorized background.

.6 Poorly maintained, defaced, damaged or dirty temporary condition signs are ineffective and shall be replaced, repaired or cleaned without delay.

.7 No construction work will be permitted to commence until all traffic control devices are erected in position, as shown in this specification and approved by the Engineer.

.8 After a project is completed, all traffic signs used on construction shall be removed immediately. Any erected signs not applicable during a phase of construction shall be removed or covered.

.9 Objects within the roadway or immediately adjacent to the roadway, which constitute a hazard to traffic shall be marked with "Hazard Markers".

.10 Construction Speed Zones shall be implemented only as shown in this specification.

.11 After dark all signs shall be checked for visibility and those that cannot be clearly seen shall be cleaned, replaced, adjusted or illuminated.

.12 Any signs shall meet all specifications in this specification and/or in the Manual on Uniform Traffic Control Devices for Canada, January 1976.

3.0 CLASSIFICATION OF TEMPORARY CONDITION SIGNS

.1 Regulatory Signs are as described in the Manual of Standard Signs & Devices, Dept. of Works, Services & Transportation. Reference to regulatory signs in this part will be limited to their application on portions of roadway where construction activities or other temporary and unusual conditions require road user response.

.2 Warning Signs as described in this specification are temporary condition warning signs.

.3 Information Signs are as described in the Manual of Standard Signs & Devices, Dept. of Works, Services & Transportation. Reference to information signs in this part is limited to their application for guiding traffic through portions of roadway where construction activities or other temporary and unusual conditions may otherwise create confusion. Application for guiding traffic through detours associated with the above roadway conditions is also included. In all cases, detours signing shall be continuous and complete to guide the road user back to his normal route.

4.0 SPECIFICATIONS

.1 Unless modified by the following, the specifications outlined in the Manual of Standard Signs and Devices or Metric Edition of Uniform Traffic Control Devices of Canada will apply to temporary condition signs in all details concerning symbols, lettering, illumination, reflectorization, position, erection, material, support and maintenance.

.2 One sign only shall be placed on each support with exception of tab signs erected to provide supplementary or complementary information associated with warning signs or detour signs.

5.0 COLOURS AND SHAPES

.1 Warning Signs shall have black symbols or lettering on an orange reflectorized background of High Intensity grade.

.2 Regulatory and Information Signs which may be used for temporary traffic control or guidance shall have the same colour and shape as described in the Manual of Standard Sign & Devices.

6.0 DIMENSIONS OF REGULATORY SIGNS

.1 Shall be of the same minimum dimensions outlined in the Manual of Standard Signs & Devices with the exception that when regulatory signs are used on sections of roadway where the maximum speed is 90 K.M./H., their minimum dimensions shall be as follows:

a) rectangular signs: 90 cm x 75 cm
b) square signs: 90 cm x 90 cm

7.0 DIMENSIONS OF TEMPORARY CONDITION WARNING SIGNS

.1 The minimum dimensions of this class of signs will vary with speed and with the type of road. In each case the following minimum sizes shall be maintained.

Minimum Dimensions of Warning Signs (cm)

	Condition #1*	Condition #2**
T.C.H. or Equivalent	90 x 90	90 x 90
Rural Roads	90 x 90	75 x 75
Urban Streets	75 x 75	75 x 75

*Advance signing preceding a reduction in speed
**Signs following a reduction in speed

8.0 DIMENSIONS OF INFORMATION SIGNS

.1 The size and dimensions of information signs shall be as described in the Manual of Standard Signs & Devices.

9.0 DIMENSIONS OF SIGN SUPPORTS

.1 When conditions are encountered where signs are required for only a relatively short duration of time or where they are moved at frequent intervals, the supports may be on weighted bases or folding frames provided the signs are held rigidly and maintained in a proper position, as specified under General Conditions.

10.0 DIMENSIONS OF MOUNTING HEIGHT

.1 The mounting of signs described in this part shall normally be on a single post although those wider than 1200 mm should generally be mounted on two posts.

.2 Signs mounted on portable supports are suitable for temporary conditions not longer than seven days in duration.

.3 Variations, however, may be considered only to improve the visibility of the signs.

.4 All installations of temporary condition signs shall be to approved methods as directed by the Engineer.

11.0 BASIS OF PAYMENT

.1 All costs associated with temporary condition signing to standards as outlined in this section shall be the responsibility of the contractor. Cost of the signs, handling, installation, materials, labour shall be paid by the contractor and no payment shall be considered by the Engineer.

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1.0 GENERAL

.1 Three categories of signing are distinguished with regard to location of devices relative to work sites, namely, Advance, Approach and At Site.

.2 The work site as used in this specification is defined by the beginning of tapers or the work area itself when delineation is not used.

2.0 ADVANCE SIGNING

.1 This category includes all the signs used to give advance notice to road users of an activity or road obstruction ahead. Advance signs shall be accompanied by a tab indicating the distance to the beginning of the work site.

.2 These signs are normally required only when the work fully or partially closes a traffic lane. The distance between the first sign of this category and the work site shall be:

a)On T.C.H. or equivalent	450 - 800 m
b)On rural roads other than T.C.H. or equivalent	250 - 500 m
c)On urban streets	150 - 300 m

.3 In cases of shoulder work where advance signing may be desirable, the above mentioned distance may be reduced by one-half.

3.0 APPROACH SIGNING

.1 This category includes the warning and regulatory signs placed in the immediate approach to the work site.

.2 They shall inform the road users of the nature of the activity or obstruction, and indicate any required action. All the signs shall be placed in accordance with the following distance criteria:

1. Distance between the first sign of the sequence and the work site as defined in Section D2-A shall be as follows:

Roadway Type	Minimum (m)	Maximum (m)
T.C.H. or equivalent	150	300
Rural roads other than T.C.H. or equivalent	100	250
Urban Streets	50	100

2. Distance from the last sign in the sequence to the work site shall be as follows: shall be:

Roadway Type	Minimum (m)	Maximum (m)
T.C.H. or equivalent	60	150
Rural roads other than T.C.H. or equivalent	50	100
Urban Streets	15	25

3. The maximum distance between the last sign in the advance sequence and the first sign of the approach sequence shall be 700 m.

4. The distance between two consecutive signs in the sequence is a function of the maximum speed and shall be:

Maximum	Minimum (m)	Maximum (m)
90 km/h	90	300
60 to 80 km/h	60	90
50 km/h or less	30	90

4.0 AT SITE SIGNS

.1 This category includes the warning signs required to advise the motorist of activities or obstructions. Regulatory and information signs shall be erected at the work site as required to advise the motorist of the regulations and to guide him through the work site area and to his destination.

5.0 BASIS OF PAYMENT

.1 All costs associated with temporary condition signing to standards as outlined in this Section shall be the responsibility of the contractor.

1.0 APPLICATION

.1 Delineation devices shall be used to channelize traffic when the traffic flow is impeded as a result of obstructions, work areas or a narrowing of the roadway. They form part of the general category called Traffic Control Devices and shall be used as a supplement to signs and barricades.

.2 Where the temporary condition will exist during the hours of darkness, delineation shall be achieved by the use of construction markers, oil drums, traffic cones, or similar devices. In all cases, markers used to achieve delineation during the hours of darkness shall be reflectorized or illuminated to show the same colour and shape by night as by day.

.3 Traffic cones may be used where the temporary condition will exist during daylight hours only and where the roadway will be in its normal operations, they shall be reflectorized.

2.0 LOCATION OF DELINEATION DEVICES

.1 Any construction or maintenance activity on or adjacent to a roadway which requires that the normal roadway be reduced in effective width shall be marked by delineators along the approaches to the work site. Delineation devices shall also be placed alongside the obstruction in order to guide the road user.

.2 Along the approaches to the obstruction, the angle at which the delineations are placed across the closed portion of the road is called the taper and should vary according to both the nature or the road and the maximum speed.

.3 The taper at which delineators are placed shall be established to comply with the following minimum requirements.

Maximum Speed (km/h)	Minimum Taper
90	1:30
60 to 80	1:20
60 or less	1:10

.4 If the work area effects more than one traffic land width, each traffic lane shall be closed separately and a tangent section provided between the two tapers. The minimum length of the tangent section shall be as follows:

Roadway Types	Minimum Tangent Between Tapers (m)
T.C.H. or equivalent	150
Rural roads other than T.C.H. or equivalent	80
Urban Streets	30

3.0 SPACING OF DELINEATORS

.1 The centre to centre distance between delineators varies with the taper and shall be established as follows:

Taper	Maximum Centre to Centre Spacing (m)
1:30	15
1:20	10
1:10	5

Examples of temporary conditions signing illustrate the delineation recommended for use on various temporary work sites.

4.0 DESIGN AND COLOUR

.1 Delineators, with the exception of traffic cones, shall be designed with alternating striped orange and black colour place in horizonal position. Traffic cones shall be solid orange in colour.

5.0 FORMS OF DELINEATORS

.1 A number of forms of delineation may be used, as outlined in the following:

1. Construction markers shall be of the dimension indicated. They shall be reflectorized or illuminated to indicate the same colour and shape by night as by day.

.2 Drums are normally from 100 litres to 200 litres capacity, set on end and used as delineators. Drums shall be reflectorized to indicate the same colour and shape by night as by day. The drums are to be predominately orange, but a minimum of 2 white strips (10 cm width minimum) per drum is required.

2. The dimensions of traffic cones should be related to the maximum speed on the roadway and their height comply with the following minimum requirements.

Maximum Speed km/h	Minimum Heights (cm)
50 or less	45
More than 50	70

6.0 BASIS OF PAYMENT

.1 All costs associated with temporary condition signing of standards as outlined in this Section shall be the responsibility of the contractor. Cost of the signs, handling, installation, materials, labour shall be paid by the Contractor and no payment shall be considered by the Engineer/Owner.

1.0 FUNCTION AND LOCATION OF BARRICADES

.1 For reasons of Traffic Safety and for the protection of workers, barricades shall be used to define the work area. Such protection is considered a part of the temporary signing arrangement. Barricades shall also be used to close streets or roads in the area where the work is being carried out.

.2 Barricades are always placed immediately preceding the work area in the approach side and act as a physical barrier between the road user and the obstruction or activity.

2.0 HEAVY BARRICADES

.1 Heavy barricades shall be used to provide a complete closure of a road or lane for an extended period. Their supports may consist of posts set in the ground or of weighted bases.

.2 This type of barricade shall have a minimum of two rails with alternate orange and black stripes at 45 deg. All stripes shall be 15 cm in width.

.3 These barricades shall be reflectorized or illuminated to indicate the same colour and shape by night as by day.

3.0 LIGHT BARRICADES

.1 Light barricades may be used for works of short duration to provide the closure of a traffic lane or roadway. This type of barricade shall have alternate orange and black stripes at a 45^{o} angle to the horizontal. All stripes shall be 15 cm width and shall be reflectorized or illuminated to indicate the same colour and shape by night as by day.

4.0 BASIS OF PAYMENT

.1 All costs associated with temporary condition signing to standards as outlined in this specification shall be the responsibility of the contractor. Cost of the signs, handling, installation, materials, labour shall be paid by the contractor and no payment shall be considered by the Engineer.

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1.0 APPLICATION

.1 Under certain conditions, as outlined in the following sections, a number of other warning devices, including the following, may be used to augment the standard devices outlined in the preceding Divisions.

2.0 HIGH LEVEL WARNING DEVICES

.1 High level warning devices may be used where sight lines are such that normal devices cannot be seen because of obstacles or vehicles. Such devices shall be placed inside the area protected by the delineators or barricades.

3.0 TRUCKS WITH FLASHERS

.1 Trucks with flashers may be used as a replacement for normal signing, in some cases, where the work site is of a very temporary nature and its location changes on a continuing basis. In such instances, the truck shall be equipped with a rotating amber flasher mounted on its roof and standard four-way flashers. This vehicle shall display a bumper, a minimum of 25 cm wide, with alternate orange and black stripes at 56 deg., and shall be equipped with the appropriate sign to properly guide vehicles approaching from the rear. The bumper and the sign shall be reflectorized to indicate the same shape and colour by night as by day.

4.0 MISCELLANEOUS

.1 Other miscellaneous traffic control devices, such as flares, flashlights, floodlights, lanterns, etc., may be used, as required, to supplement the signs and other devices described in this part.

5.0 PORTABLE LANE CONTROL SIGNALS

.1 Portable lane controls signals may be used to alternate traffic past a work area, in lieu of flagperson. The Engineer shall be advised, in each case, of the intent to use this device, at least four (4) weeks before application.

.2 The user will be required to adjust the timing to the approval of the Engineer.

.3 Portable signals shall be used only under conditions where the lights are clearly visible to an approaching motorist such that the vehicle can be brought to a safe stop at any approach speed. Intensity of the signal lamps shall be maintained in such a manner that the lights are clearly visible for a distance of at least 500 metres.

.4 It is essential that these devices be removed immediately when conditions no longer require their use.

6.0 AUTOMATED ROBOT FLAGPERSON

.1 With the prior approval of the Engineer, Automated Robot Flagperson can be used in construction areas. These devices shall be permitted where they are clearly visible to an approaching motorist. When these devices are no longer required or not operational they shall be removed from the construction area.

7.0 BASIS OF PAYMENT

.1 All costs associated with temporary condition signing & equipment as outlined in this Section shall be the responsibility of the contractor. Cost of the signs, handling, installation, materials, labour shall be paid by the contractor and no payment shall be considered by the Engineer.

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This work consists of the installation of a project sign in location on or near the site of the work. The location of the sign is to be determined by the Engineer.

1.0 PROJECT SIGN

.1 Materials:

.1 Timber posts shall be Eastern Spruce or Fir.
.2 All nails shall be galvanized.
.3 Plywood shall be 3/4" plywood.

.2 Construction:

.1 The standard drawing #205 illustrates the size of the sign and lettering required.
.2 The standard drawing detail #240 illustrates the size and type of sign supports required.
.3 Fasten panels to 100 mm by 100 mm posts as indicated, using 180 mm by 10 mm galvanized carriage bolts.
.4 Each 100 mm by 100 mm post shall be in one length, set vertically in the ground a minimum of 900 mm.
.5 Each 50 mm by 100 mm brace will be fastened to the post with a 180 mm by 10 mm galvanized carriage bolt.
.6 After installation backfill to the existing ground elevation and compact thoroughly.
.7 Remove any debris from the Work area.
.8 Upon completion of the project remove the sign and sign supports and restore the ground to its original condition.
.9 Top of the sign to be 2.4 m above the ground.

2.0 METHOD OF PAYMENT

.1 Payment shall be made for Project Signs only, as a lump sum amount as listed in the Schedule of Quantities. The Engineer will not approve any progress claims until the Project Sign has been erected.

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This section specifies the requirements for the supply and installation of various types of wooden signposts and the placing of signs on these signposts.

PART 1 - GENERAL

1.0 CLASSIFICATION OF SIGNPOST INSTALLATIONS

.1 There are four basic types of signpost installation namely: Type A, Type B, Type C and Type D. See Drawings 0210 to 0280 inclusively for various illustrations and details.

.2 Type A and Type B are of various dimensions, but are intended to support smaller size signs which require only one vertical member to support the sign.

.3 For Type A and Type B signpost installations the number following the letter denotes the required height of the sign to be placed on the post, measured in millimetres.

.4 Type C and Type D signpost installations are of various dimensions, but all are intended to support the larger size signs which require two vertical members to support the sign. Type C installations are intended for large signs of width less than 2400 mm and a height less than 1200 mm. Type D installations are intended for signs wider than 2400 mm and/or higher than 1200 mm.

.5 For Type C and Type D signpost installations the upper number following the letter denotes the required height of the sign board in millimetre and the lower number denotes the width of the sign board in millimetres. See Drawings 0210 to 0260 inclusively.

2.0 MEASUREMENT FOR PAYMENT

.1 Measurement for payment will be by means of the number of each type of signpost installation place at the specified locations.

.2 Signs not included in these documents shall be paid for by the each.

PART 2 - MATERIALS

2.1 PRODUCTS

.1 The Contractor shall supply all materials required to complete sign and signpost installations in accordance with these specifications.

.2 Nails shall be galvanized nails of length 100 mm.

.3 Creosote shall be good commercial quality creosote.

.4 Primer paint shall be white exterior alkaloid primer meeting standard C.G.S.B. 1-BP-189, or equivalent.

.5 Finish paint shall be white marine enamel paint meeting standard C.G.S.B. 1-BP-61, or equivalent.

.6 Lag bolts shall be galvanized lag bolts of length 800 mm and diameter 10 mm with Hex or Square Head only (Carriage Type Head are not to be used on signs).

.7 Washers shall be galvanized flat washers that fit 10 mm diameter lag bolts.

2.2 ADDITIONAL MATERIALS TYPE A INSTALLATIONS

.1 Vertical members shall be 114 mm by 114 mm lumber of length not less than that as calculated for the appropriate sign drawings as specified under Section 1.0.

.2 Footings for each post shall consist of six pieces of 38 mm by 89 mm lumber of length not less than 450 mm.

2.3 ADDITIONAL MATERIALS TYPE B INSTALLATIONS

.1 Vertical members shall be 140 mm by 140 mm lumber of length not less than that as calculated by the appropriate sign drawings as specified under Section 1.0.

.2 Footings for each post shall consist of six pieces of 38 mm by 89 mm lumber of length not less than 450 mm.

2.4 ADDITIONAL MATERIALS TYPE C INSTALLATIONS

.1 Vertical members shall be 140 mm by 140 mm lumber.

.2 Footings for each installation shall consist of 2 pieces of 38 mm by 89 mm lumber.

.3 The length of vertical members and footings shall not be less than that as calculated for the appropriate sign drawings as specified under Section 1.0.

.4 Cross bracing shall consist of two pieces of 38 mm by 89 mm lumber of sufficient length to provide cross bracing for the installation of the required size.

2.5 ADDITIONAL MATERIALS TYPE D INSTALLATIONS

.1 Vertical members shall be 184 mm by 184 mm lumber.

.2 Footings for each installation shall consist of two pieces of 38 mm by 89 mm lumber.

.3 Cross members for each installation shall consist of two pieces of 89 mm by 89 mm lumber.

.4 The length of vertical members, footings and cross members shall not be less than that as calculated for the appropriate sign board indicated by the sign drawings as specified by Section 1.0.

.5 Cross bracing shall consist of two pieces of 38 mm by 89 mm lumber of sufficient length to provide cross bracing of the installation of the required size.

.6 Nuts, bolts and washers for connecting cross members shall be galvanized. The bolt shall be of length 150 mm and be of diameter not less than 15 mm or greater than 25 mm.

2.6 MATERIALS USED FOR THE INSTALLATION OF SIGNS ONTO SIGNPOSTS

.1 Signs will be made up by the Contractor or if purchased from the Department of Works, Services and Transportation must be picked up by the Contractor.

.2 Signs will be available to the Contractor at the nearest main depot, (White Hills Depot, Grand Falls Depot, Deer Lake Depot or Goose Bay Depot).

.3 Signs will be placed on signposts with 80 mm by 10 mm lag bolts and washers in accordance with the drawings as specified under section 1.0.

PART 3 - ASSEMBLY

Should any piece of lumber become split or cracked during nailing or installing the sign, then the Contractor shall replace the damaged piece with sound lumber at his own expense.

3.1 ASSEMBLY OF TYPES A AND TYPES B

.1 The footings shall be secured to the vertical member at the spacing shown on the drawings.

.2 Each footing shall be nailed near its centre to the vertical member by means of two nails as shown on the drawings.

3.2 ASSEMBLY OF TYPES C

.1 The footings, cross bracing and vertical members shall be assembled and secured at the spacing shown on the drawings.

.2 Each piece of footing and cross bracing shall be secured to the vertical member with four nails, that is, two nails in each joint.

3.3 ASSEMBLY OF TYPES D

.1 The footings, cross members, and vertical members shall be assembled and secured at the spacing shown on the drawings.

.2 Cross members shall be connected to the vertical members by means of cross-lap joints.

.3 Cross-lap joints shall be cut so that a groove is cut at the required location in the 89 mm by 89 mm lumber for a depth equal to one half of the thickness of the lumber. A groove is then cut in the vertical member at the required location, such that when the joint is connected the vertical and cross members are flush with one another on the front of the signpost installation.

.4 Each joint shall be secured with a nut, bolt and washer. The head of the bolt shall be placed at the front of the installation. The head shall be counter sunk so that the top of the bolt is flush with the front of the installation.

.5 Each piece of footing and cross bracing shall be secured with four nails, that is, with two nails at each joint.

3.4 CREOSOTING AND PAINTING

.1 Footings, cross bracing, and those vertical members that are to be placed below a point 150 mm above ground level, shall be treated with two coats of hot creosote. The second coat shall not be applied before the first coat is dry.

.2 The remainder of the signpost installation shall be painted with two coats of paint. The first coat shall be the primer coat. The second coat comprising white marine enamel shall not be applied before the primer has dried the minimum time as recommended by the manufacturer.

3.5 INSTALLATION

.1 The Engineer will stake the locations where signpost installations are to be installed and designate the sign number of the signpost installation that is required for each location.

.2 The Contractor shall place signpost installations at these locations only of the required size and type for the sign as specified on the drawings.

.3 The Contractor shall excavate holes for the footings, such that when installed the installation is at least the required minimum depth in the ground.

.4 Signpost installations shall be placed with the vertical axis plumb and with at least the required minimum depth in the ground. The vertical post edge nearest the road shall be 2500 mm from the edge of the shoulder as illustrated on the drawings specified in section 1.0

.5 Footings shall be backfilled with material approved by the Engineer. Backfill material shall not contain stones larger than 150 mm in any one dimension.

.6 Backfill material shall be place in layers not greater than 150 mm in thickness. Each layer shall be thoroughly compacted before the successive layer is placed. Dry granular backfill shall be moistened before tamping.

.7 Backfill material around the signpost installations shall be brought up level with the surrounding ground and surplus excavated material together with surplus backfill material shall be disposed of on the sides of fills or as directed by the Engineer.

.8 The Contractor shall be responsible for placing each sign on the correct posts and at the location specified by the Engineer, taking care to ensure that each sign is placed undamaged, horizontally level and attached to the posts and cross members with 80 mm by 10 mm galvanized lag bolts and galvanized washers. Nails can not be substituted for this job.

.9 Sign board size, signpost type and the location of each will be specified on drawings by the Engineer.

3.6 ADDITIONAL INSTALLATION REQUIREMENTS FOR TYPES A AND TYPES B

.1 Types A and Types B signpost installations shall be place so that at least 1250 mm of the vertical member is in the ground. They shall be installed so that the face of the post that is to take the sign is perpendicular to the direction of traffic unless otherwise directed by the Engineer.

3.7 ADDITIONAL INSTALLATION REQUIREMENTS FOR TYPES C AND TYPES D

.1 Types C and Types D signpost installations shall be placed so that both vertical members are at least 1500 mm in the ground.

.2 Special care should be taken with the placing of Types D and the larger Types C signpost installations so as to minimize specular glare.

.3 On straight stretches of roadway, Types C and Types D signpost installations shall be set with the horizontal axis at an angle of 93 degrees with the traffic lane which the proposed sign will serve, or as directed by the Engineer.

.4 On horizontal curves, Types C and Types D installations shall be set with the horizontal axis at an angle of 93 degrees with a straight line between the sign and the point at which the sign is read, or as directed by the Engineer.

3.8 ADDITIONAL INSTRUCTIONS FOR THE SIGN BOARD

.1 On Types A and Types B signposts, the sign board will be mounted flush with the top of the signposts.

.2 On Types C and Types D signposts, the sign board will be mounted with the top of the sign board 100 mm above the top of the signpost.

.3 On Types A and Types B signposts, the top and bottom lag bolts must be placed 100 mm from the top and bottom edges of the sign board, **EXCEPT** for those pre-drilled sign boards supplied by the Department of Works, Services and Transportation. See drawings specified under Section 1.0.

.4 On Types C and Types D signposts, lag bolts must be placed 250 mm down from the top edge of the sign board and follow down the sign board at a maximum spacing of 600 mm apart with the lowest lag bolt placed approximately 100 mm above the bottom edge of the sign board (for each post). See drawings specified under Section 1.0.

.5 The Contractor is advised that care must be taken when installing the sign board to see that all lag bolts are seated into the frame and without the washers indenting the signs reflective sheeting. Care must be taken to see that damage to the sign while installing it to the post is minimal.

3.9 BASIS FOR PAYMENT

.1 Payment at the contract price for sign and signpost installation of a particular type shall be compensation in full for all labour, handling, materials and equipment used including the supply of all materials, purchase and handling of the sign from the Department of Works, Services and Transportation or other sources, assembly and installation, creosote and painting, excavating and backfilling of a hole for the footing including compaction of the backfill, installing the sign board and the disposal of all surplus material in accordance with this specification.

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1.0 REFERENCE STANDARDS

.1 Within the text of the specifications, reference may be made to the following standards:

ACI	American Concrete Institute
AISC	American Institute of Steel Construction
ANSI	American National Standards Institute
ASTM	American Society of Testing and Materials
CEC	Canadian Electrical Code (published by CSA)
CEMA	Canadian Electrical Manufacturer's Association
CGSB	Canadian General Standards Board
CISC	Canadian Institute of Steel Construction
CLA	Canadian Lumberman's Association
CPCA	Canadian Painting Contractor's Association
CPCI	Canadian Prestressed Concrete Institute
CRCA	Canadian Roofing Construction Association
CSA	Canadian Standards Association
EEMAC	Electrical Engineering Manufacturers Association of Canada
FM	Factory Mutual Engineering Corporation
IEEE	Institute of Electrical and Electronic Engineers
IPCEA	Insulated Power Cable Engineers Association
NAAMM	National Association of Architectural Metal Manufacturers
NBC	National Building Code
NEMA	National Electrical manufacturers' Association
TTMAC	Terrazzo, Tile and Marble Association of Canada
ULC	Underwriters' Laboratories of Canada
AWWA	American Water Works Association
Uni-Bell	Uni-Bell PVC Pipe Association

Conform to these standards, in whole or in part, as specifically requested in the specifications.

.2 If there is question as to whether any product or system is in conformance with applicable standards, the Engineer reserves the right to have such products or systems tested to prove or disprove conformance.

.3 The cost for such testing will be borne by the Engineer in the event of conformance with the Contract Documents or by the Contractor in the event of non-conformance.

.4 Conform to latest date of issue of reference standards in effect on date of submission of bids except where a specific date or issue is specifically noted.

2.0 MANUFACTURERS' INSTRUCTIONS

.1 Unless otherwise specified, comply with manufacturer's latest printed instructions for materials and installation methods.

.2 Notify Engineer in writing of any conflict between these specifications and manufacturers instructions. Engineer will designate which document is to be followed.

3.0 PERFORMANCE

.1 When material or equipment is specified by standard or performance specifications, upon request of Engineer, obtain from manufacturer an independent testing laboratory report, stating that material of equipment meets or exceeds specified requirements.

4.0 CONSTRUCTION EQUIPMENT

.1 On request, prove to the satisfaction of Engineer that the construction equipment and plant are adequate to manufacture, transport, place and finish work to quality and production rates specified. If inadequate, replace or provide additional equipment or plant as directed.

.2 Maintain construction equipment and plant in good operating order.

5.0 PRODUCTS AND WORKMANSHIP

.1 Quality

.1 Refer to GC 34 - LABOUR AND PRODUCTS
.2 Products, materials, equipment and articles shall be referred to as Products throughout the specifications.
.3 Defective Products, whenever identified prior to the completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is a precaution against oversight or error. Remove and replace defective Products at own expense and be responsible for delays and expenses caused by rejection.
.4 Should any dispute arise as to the quality of fitness of Products, the decision rests strictly with the Engineer based upon the requirements of the Contract Documents.
.5 Unless otherwise indicated in the specifications, maintain uniformity of manufacture for any particular or like item throughout the building.

.2 Availability

.1 Immediately upon signing Contract, review Product delivery requirements and anticipate foreseeable supply delays for any items. If delays in supply of Products are foreseeable, notify the Engineer of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work.
.2 In the event of failure to notify the Engineer at commencement of Work and should it subsequently appear that Work may be delayed for such reason, the Engineer reserves the right to substitute more readily available products of similar character, at no increase in Contract Price.

.3 Storage, handling and Protection

.1 Handle and store Products in a manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.
.2 Store packaged or bundled Products in original and undamaged condition with manufacturer's seals and labels intact. Do not remove from packaging or bundling until required in the Work.
.3 Store products subject to damage from weather in weatherproof enclosures.
.4 Touch-up damaged factory finished surfaces to Engineer's satisfaction. Use primer or enamel to match original. Do not paint over name plates.
.5 Security of stored materials shall be the responsibility of the contractor.

.4 Store cementitious products clear of earth or concrete floors, and away from walls and in a dry area.

.5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.

.6 Store sheet materials and lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.

.7 Store and mix paints in a heated and ventilated room. Remove oily rags and other combustible debris from site daily.

.8 Remove and replace damaged Products at own expense and to the satisfaction of the Engineer.

.9 Transportation

.1 Pay costs of transportation of Products required in the performance of Work.
.2 Transportation cost of Products supplied by the Owner will be paid for by the Owner. Unload, handle and store such Products.

6.0 WORKMANSHIP

.1 General

.1 Workmanship shall be the best quality, executed by workers experienced and skilled in the respective duties for which they are employed. Immediately notify the Engineer if required Work is such as to make it impractical to produce required results.
.2 Do no employ any unfit person or anyone unskilled in their required duties. The Engineer reserves the right to require the dismissal from the site, workers deemed incompetent, careless, insubordinate or otherwise objectionable.
.3 Decisions as to the quality or fitness of workmanship in cases of dispute rest solely with the Engineer, whose decision is final.

.2 Co-Ordination

.1 Ensure co-operation of workers in laying out Work. Maintain efficient and continuous supervision.
.2 Be responsible for co-ordination and placement of openings, sleeves and accessories.

.3 Cutting and Remedial Work

.1 Refer to GC 38 - CUTTING and REMEDIAL WORK
.2 Perform cutting and remedial work required to make the parts of the Work come together. Co-ordinate the Work to ensure this requirement is maintained.
.3 Should work performed outside this contract necessitate cutting and/or remedial work to be performed, the cost of such work will be valued by the Engineer as provided in GC 19 - VALUATION AND CERTIFICATION OF CHANGES IN THE WORK.

.4 Fastenings

.1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.
.2 Prevent electrolytic action between dissimilar metals and materials.
.3 Use noncorrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in the affected specification Section.

.4 Space anchors within their load limit or shear capacity and ensure they provide positive permanent anchorage. Wood or any other organic materials plugs are not acceptable.
.5 Keep exposed fastenings to a minimum space evenly and install neatly.
.6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

.5 Protection of Work in Progress
.1 Adequately protect Work completed or in progress. Work damaged or defaced due to failure in providing such protection is to be removed and replaced, or repaired, as directed by the Engineer, at no increase in Contract Price.
.2 Prevent overloading of any part of the building. Do not cut drill or sleeve any load bearing structural member, unless specifically indicated, without written approval of Engineer.

7.0 METHOD OF PAYMENT

.1 No separate or direct payment will be made for the work specified in this section, unless required in accordance with Section 01600.6.3. Costs of all work are deemed to be included in the lump sum and unit prices quoted in the Schedule of Quantities and Prices.

.1 This section is intended to include payment for work for which no contract unit price exists, or has not been subsequently agreed upon.

1.0 GENERAL

.1 Work required, for which no contract unit price exists, or has not been subsequently agreed upon, will be paid for in accordance with Clause 19.1(c) of the General Conditions of Unit Price Contract.

.2 Payroll Burden, calculated as 35% of Labour Cost shall be considered as a component of Actual Cost in GC 19.1(c).

.3 Board and Lodging, when the item of force account work is in excess of one normal working day and approved in writing by the Engineer, before work commences, will be considered as a component of Actual Cost in GC 19.1(c).

.4 When the Contractor or Subcontractor does work with his own forces, including his own equipment, the rental rate for equipment, including overhead and profit, shall be as specified in the current Equipment Rental Rate Schedule of the specifications of the Department of Works, Services & Transportation, Government of Newfoundland and Labrador. Additional allowance for overhead and profit in accordance with General Conditions of Contract, GC 19.1(c), shall be calculated upon materials, labour and payroll burden only.

.5 When the Contractor or Subcontractor does work with his own forces, including his own equipment, and no rental rate for that equipment is included in the current Equipment Rental Rate Schedule of the Department of Works, Services & Transportation, the rental rate allowed shall be approved, in writing, by the Engineer before work commences.

.6 When pole relocation, shoring and/or bracing is performed by a Utility Company, the Contractor shall be allowed a markup of 10% of the invoice submitted by the Utility Company.

2.0 BASIS FOR PAYMENT

.1 Payment for Force Account work shall be made with each progress payment, based on Daily Force Account Reports c/w change order, detailed invoices and markup for overhead and profit according to Clauses GC 18 and GC 19.

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This Section is intended to include criteria for and requirements of the final portion of the contract, administrative, site and document requirements to close-out the Work.

1.0 PROJECT CLOSE-OUT

.1 Final Cleaning

.1 Refer to GC 37-CLEANUP and FINAL CLEANING of WORK.

.2 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures and walls.

.3 Vacuum clean and dust building interiors, behind grilles, louvres and screens.

.4 Wax, seal, shampoo or prepare floor finishes, as recommended by manufacturer.

.5 Broom clean and wash exterior walks, steps and surfaces.

.6 Remove dirt and other disfigurations from exterior surfaces.

.2 Documents

.1 Collect reviewed submittal and assemble documents executed by Subcontractors, suppliers and manufacturers.

.2 Submit material prior to final Application for Payment.

.3 Submit operation and maintenance data, record (as-built) drawings.

.4 Provide warranties and bonds fully executed and notarized.

.5 Execute Performance and Labour and Materials Payment Bond to warranty period requirements.

.6 Consultant will issue a final change order reflecting approved adjustments to Contract Price not previously made.

.3 Inspection/Takeover Procedures

.1 Refer to GC 21-CERTIFICATES and PAYMENTS for specifics to application.

2.0 METHOD OF PAYMENT

.1 No separate or direct payment will be made for work specified in this section. Costs of all work specified in this section are deemed to be included in the lump sum and unit prices quoted in the Schedule of Quantities and Prices.

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1.0 GENERAL CONDITIONS

.1 Conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws.

.2 Store volatile wastes in covered metal containers, and remove from premises daily.

.3 Prevent accumulation of wastes which create hazardous conditions.

.4 Provide adequate ventilation during use of volatile or noxious substances.

.5 On a daily basis maintain project site and adjacent public and private properties free from debris and waste material.

.6 Remove waste materials, noxious or offensive matter, and rubbish from site and provide legal disposal. Comply with any directions or precautions issued by the Engineer.

2.0 GENERAL REINSTATEMENT

.1 Reinstate, restore and make good all roads, ditches, other trenches, footpaths, sodded and other surfaces disturbed or damaged during the construction of the Work, to the satisfaction of the property owners and Engineer.

.2 Replace or repair any pavement, trees, shrubbery, fences, retaining walls, poles or other property and surface structures which have been removed, damaged, or disturbed during the work.

.3 Provide new materials for reconstruction of property and surface structures where original materials are not reconstructible as directed by Engineer.

.4 Restore, unless otherwise stipulated, all pavement, granular base or surfacing materials, side walks, curbing, gutters, shrubbery, poles, sod or other property, and surface structures removed or disturbed as a part of the work to a condition equal to that before the work began, furnishing all labour and materials incidental thereto. No permanent pavement or new gravelling shall be placed unless instructed by the Engineer, and then not until, in the opinion of the Engineer, the condition of the backfill and subgrade is such as to properly support the pavement.

.5 Permanently provide for and maintain the flow, where required, of all sewers, drains, house or inlet connections, and all water courses which may be met with during the progress of the work. Prevent the contents of any sewer, drain, and house or inlet connection from flowing into the trench or sewers to be constructed under the Contract, except where written permission is given by the Engineer.

3.0 FINAL CLEANING OF SITE

.1 Remove all surplus materials, tools and temporary structures from the site.

.2 Remove all surplus usable materials furnished by the Owner from the site and deliver to locations designated by the Engineer.

4.0 MAINTENANCE

.1 Following the issuance of the Engineers Certificate of Substantial Performance, maintain the surface of paved or unpaved trenches, curbs, side walks, gutters, shrubbery, fences, sod, and other surfaces or structures disturbed by the Works for the specified maintenance period.

.2 Maintenance of reinstatement, partial reinstatement, repairs, replacement or restoration until spring start up will be:

.1 at the contractor's expense where the continuance of the contract beyond November 15th is under the contractor's control;

.2 at the Owner's expense where completion of the contract beyond November 15th is under the owner's control. In this case, payment for maintenance shall be in accordance with Section 01610, Force Account.

5.0 REINSTATEMENT OF ROADS

.1 Return all roads to their original or better condition and obtain Department of Works, Services & Transportation acceptance of the roads under their jurisdiction. (Refer also to drawing number 0695).

.2 Comply with and accept responsibility for any requirements that the Department of Works, Services & Transportation imposes on the Owner as a condition of carrying out the Works within the right-of-way of roads under the Departments jurisdiction. These same requirements shall also apply to all other roads and streets affected by the Works. These requirements are, but not necessarily limited to, the following:

.1 The work performed within the right-of-way of the highway will be subject to inspection and approval of authorized Department of Works, Services & Transportation personnel.

.2 All structures placed in a roadway shall be bedded in a firm, well compacted foundation. Backfilling of these structures must be compacted in an approved manner in order to prevent undue settlement. Material for backfilling shall be that excavated or similar to that of which the subgrade is constructed. Compaction specified as:

Subgrade:	95% of the maximum standard proctor dry density (ASTM D698-70)
Subbase:	(granular) 100% (ASTM D698-70)
Asphalt:	100% (ASTM D698-70)

.3 On gravelled surface roads or gravelled shoulders, backfilling with excavated or similar material must be carried on such that a minimum thickness of 150 mm of Class 'A' granular base course or other approved base course material can be placed below the surface grade.

.4 Repair any undue settlement occurring within one year of the completion of the project. Where in the Engineer's opinion permanent repairs to the asphalt pavement or granular surface cannot be undertaken, an asphalt patch or granular surface will be placed by the Contractor and replaced at a convenient time (usually the following year). Both installations shall be at the Owner's expense. Any maintenance of the patch or granular surface required by the Engineer or the Department of Works, Services & Transportation will also be made by the Contractor. (Refer also to Section 02574).

.5 The Contractor is responsible for any damage which may be caused to the road or adjoining property during or as a result of this work.

6.0 METHOD OF PAYMENT

.1 Except as indicated in these Specifications or in the Schedule of Quantities and Prices no separate of direct payment will be made for reinstatement. To ensure reinstatement is carried out as the work progresses a sum equal to 5% of the value of the work completed will be retained in addition to all other specified allowances or holdbacks. This reinstatement allowances will be released progressively each month on the basis of the Engineer's opinion of the percentage of reinstatement completed.

.2 With failure of the Contractor to carry out reinstatement within a reasonable period of time, the Engineer may authorize to have the work carried out by others at the expense of the Contractor. The Engineer will give the Contractor written notice in accordance with GC 9 of the General Conditions, before taking action.

.3 Payment for removal and replacement of existing asphalt pavement shall be to Section 02574.

.4 Fences to be removed, relocated and/or replaced, located within the theoretical trench pay width plus one (1) metre on either side of the trench will be measured by the metre. Fences replaced shall be of a quality equal to or greater than existing conditions.

.5 Culverts and other structures to be removed, relocated and/or replaced, located within the theoretical trench pay width plus a maximum of one (1) metre on either side of the trench will be measured by the unit specified in the Schedule of Quantities and Prices. Structures replaced shall be of a quality equal to or greater than existing conditions.

.6 Ditches or other trenches to be removed, relocated and/or replaced, located within the theoretical trench pay width plus one (1) metre on either side of the trench will be measured by the metre.

.7 Landscaping and topsoil reinstatement will in accordance with Section 02104, with payment based on theoretical trench pay width plus one (1) metre on either side of the trench.

.8 Class "A" (Granular Base) reinstatement for roads and shoulders of paved roads will be measured by the tonne of compacted material incorporated into the work, in accordance with Section 02233. The Contractor shall not be paid more than 110 percent of the calculated quantities based on 100 mm thickness times the width.

.9 Class "A" (Granular Base) and Class "B" (Granular Sub-Base) reinstatement for materials removed during trench excavation along gravel roads will be measured by the tonne of compacted material incorporated in the work in accordance with Section 02233, based on the theoretical trench width and 100 mm thickness.

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This Section is intended to include procedural requirements for submittal of maintenance and record documents, operation data, and warranties and bonds specified in individual Specification Sections.

1.0 QUALITY ASSURANCE

.1 Prepare instructions and data by personnel experienced in maintenance and operation of described products.

2.0 FORMAT

.1 Organize data in the form of an instructional manual. All materials are to be supplied in paper format and in Adobe PDF file format. For paper copies, binders to be commercial quality, 219 x 279 mm maximum ring size. For PDF documents, files are to be provided on Compact Disc(s) (CD-ROM) readable on Windows based microcomputers.

.2 When multiple binders or CD's are used, correlate data into related consistent groupings.

.3 Identify each binder and CD with type or printed title "Project Record Documents"; list title of Project, identify subject matter of contents.

.4 Arrange content by systems, under Section numbers and sequence of Table of Contents.

.5 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.

.6 Manufacturer's printed data, or typewritten data on 20 pound paper.

3.0 CONTENTS OF EACH VOLUME

.1 Table of Contents: provide title of project; names, addresses, and telephone numbers of Consultant and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.

.2 For Each Product or System:
- .1 list names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
- .2 list manufacturer's name, model number, serial number and contractor's purchase order number.

.3 Product Data: mark each sheet to clearly identify specific products and component parts, and data applicable to installation; delete inapplicable information.

.4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.

.5 Type Text: as required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01600.

4.0 SUBMISSION

.1 Submit one copy of completed volumes and CD's in final form 15 days prior to substantial performance.

.2 Copy will be returned after final inspection, with Engineer's comments.

.3 Revise content of documents as required prior to final submittal.

.4 Submit two copies of revised volumes of data and CD's in final form within ten days after final inspection.

5.0 RECORDING AS-BUILT CONDITIONS

.1 For projects where water and sewer systems or roads are the main components, the Contractor's survey crew shall assist in the recording of as-built information in conjunction with the engineer/site representative(s). As-built drawings and related Municipal Information System (MIMS) data must be submitted by the Consultant on CD-ROM in AutoCAD format (Version 2000 or newer) and comply with the current version of the Department's MIMS data standards document.

.2 In projects where a building or buildings is the main component, the Contractor shall provide the architectural, mechanical, electrical and other related as-built information to the Engineer. The information may be provided on marked up contract drawings.

.3 Do not conceal work until required information is recorded.

.4 Shop Drawings: legibly mark each item to record actual construction, including:

.1 Manufacturer, trade name, and catalogue number of each item actually installed, particularly optional items and substitute items.
.2 Changes made by Addenda and change orders.

.5 Other Documents: maintain manufacturer's certifications, inspection certifications, field test records, required by individual specifications sections.

6.0 EQUIPMENT AND SYSTEMS

.1 Each Item of Equipment and Each System: include description of unit or system, and component parts. Give function, normal operation characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.

.2 Panel board Circuit Directories: provide electrical service characteristics, controls, and communications.

.3 Include installed colour coded wiring diagrams.

.4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

.5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

.6 Provide servicing and lubrication schedule, and list of lubricants required.

.7 Include manufacturer's printed operation and maintenance instructions.

.8 Include sequence of operation by controls manufacturer.

.9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

.10 Provide installed control diagrams by controls manufacturer.

.11 Provide Contractor's coordination drawings, with installed colour coded piping diagrams.

.12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

.13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

.14 Include test and balancing reports as specified in Section 01400 and 01660.

.15 Additional Requirements: As specified in individual specification sections.

7.0 MATERIALS AND MATERIALS FINISHES

.1 Building Products, Applied Materials, and Finishes: include product data, with catalog number, size, composition, and colour and texture designations. Provide information for re-ordering custom manufactured products.

.2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

.3 Moisture-protection and Weather-exposed Products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommend schedule for cleaning and maintenance.

.4 Additional Requirements: as specified in individual specifications sections.

8.0 WARRANTIES AND BONDS

.1 Separate each warranty or bond with index tab sheets keyed to the List of Contents listing.

.2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

.3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten days after completion of the applicable item of work.

.4 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial Performance is determined.

.5 Verify that documents are in proper form, contain full information, and are notarized.

.6 Co-execute submittal when required.

.7 Retain warranties and bonds until time specified for submittal.

9.0 METHOD OF PAYMENT

.1 No separate or direct payment will be made for work specified in this section. Costs of all work specified in this section are deemed to be included in the lump sum and unit prices quoted in the Schedule of Quantities and Prices.

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This section specifies requirements for demolishing, salvaging and removing wholly or in part, various items designated to be removed or partially removed and for backfilling resulting trenches, holes and pits and the disposal of resulting materials.

PART 1 - GENERAL

1.1 EXISTING CONDITIONS

.1 Take over structures to be demolished based on their condition on date that tender is accepted.

1.2 MEASUREMENT FOR PAYMENT

.1 Payment at the contract price for the items covered in this Section shall be full compensation for all labour, equipment and materials required including all necessary excavation.

.2 Removal of concrete base to thickness indicated in the contract documents, will be measured in square metres in place. No deductions will be made from computed areas for the spaces occupied by manhole and catch basin castings. The removal of concrete pavement, asphalt covered concrete pavement and concrete base will be measured for payment whether on the roadway surface or within an excavation. The removal of asphalt pavement will be measured in accordance with Section 02574.

.3 The removal of concrete side walks will be measured in square metres in place.

.4 Measurement for removal of curb and gutter will be made horizontally in metres along the faces adjacent to the pavement. Payment will be made for the removal of either concrete curb, concrete curb and gutter or asphalt curb and gutter without further separation into types. No deductions will be made from the measured lengths for the spaces occupied by manholes and catch basin castings.

.5 Where manholes, catch basins and ditch inlets are to be removed in their entirety payment will be made without separation into types for each unit removed.

.6 Removal of fences and/or guide rails where indicated on the contract documents and outside of the trench right-of-way will be measured in metres, unless otherwise specified, the trench right-of-way equals the theoretical trench width plus one (1) metre on either side of the trench.

.7 The removal of water lines, sanitary sewers, storm sewers and culverts where specified or directed by the Engineer will be measured along the surface in metres. There will be no deduction in length for the spaces occupied by intermediate manholes, catch basins, ditch inlets or valve chambers.

.8 The removal of bridges and other items not previously referred to but indicated on the contract documents will be paid by the unit unless otherwise specified.

.9 Imported backfill, when required, will be paid for separately in accordance with the specification for the material required and used.

.10 Removal of mass concrete will be measured in cubic metres in place.

.11 Broken concrete, masonry or asphalt is acceptable for use for rip-rap construction. In accordance with subsection 3.7 "Disposal of Material", the placing of the rip-rap will be paid for separately under the appropriate tender item and will not be part of the work to be carried out under this section of the specification.

.12 Removal of AC pipe will be by the meter in accordance with Occupational Health & Safety Act regulation 111/98 and in accordance with 02070.3.7.5.

PART 2 - PRODUCTS

.1 Not applicable

PART 3 - EXECUTION

3.1 PREPARATION

.1 Inspect site and verify with Engineer items designated for removal and items to be preserved.

.2 Locate and protect utility lines. Preserve in operating condition active utilities traversing site. Notify utility companies before starting demolition.

.3 Disconnect electrical and telephone service lines entering buildings to be demolished in accordance with rules and regulations of Authorities having jurisdiction. Post warning signs on electrical lines and equipment which must remain energized to serve other properties during period of demolition.

.4 Disconnect and cap mechanical services in accordance with requirements of local authority having jurisdiction.

.1 Remove sewer and water lines to main line and cap to prevent leakage.
.2 Remove, cap and dispose of other underground services.

3.2 REMOVAL

.1 Remove items indicated in Contract Documents

.2 In removal of pavements, curbs and gutters.:

.1 Square up adjacent surfaces to remain in place by saw cutting or other approved method.
.2 Protect adjacent joints and load transfer devices.
.3 Protect underlying granular materials.

3.3 DEMOLITION

.1 Demolish structures as indicated in the contract documents. Demolish parts of building to permit construction of addition and remedial work as indicated. Demolish basement foundations walls to minimum of 600 mm below finished grade. Demolish foundation walls and footings, and concrete floors below or on grade within areas of new construction.

.2 Break one 200 mm diameter hole per 500 m^2 area in concrete slabs below grade which are not to be removed, to prevent accumulation of water. Keep floor drains open if permanent drainage still connected.

.3 At end of each day's work, leave work in safe conditions so that no part is in danger of toppling or falling. Protect interiors of parts not to be demolished from exterior elements at all times.

.4 Demolish masonry and concrete walls in small sections. Carefully remove and lower structural framing and other heavy or large objects.

.5 Remove contaminated or dangerous materials from site and dispose of in safe manner in accordance with Regulatory Agencies.

3.4 SALVAGE

.1 Carefully dismantle items containing materials indicated for salvage. Stockpile salvaged materials at locations directed or indicated.

.2 Where manholes, catch basins, and ditch inlets are to be demolished, castings and riveted gratings conforming to this specification shall be removed and stockpiled for use elsewhere on the contract or delivered to the yard designated in the contract, when surplus to the contract requirements.

.3 Other materials when designated in the contract to be salvaged, shall be dismantled, stockpiled or otherwise handled as set out elsewhere within the contract.

3.5 EXCAVATION

.1 Excavation required for the work to be carried out under this section shall be performed in such a manner as, to leave undisturbed adjacent structures or other work to be left in place, and to save where necessary for purposes of backfill, the acceptable excavated materials.

.2 Where payment for the item to be removed is on a volume basis, excavation shall be carried out to such an extent as to permit the measurement by the Engineer of the volume of concrete or masonry to be removed.

.3 Excavation material which is not required for the backfilling of the void resulting from the structure removal, shall be used for embankment construction or disposed of as set out elsewhere in the contract document.

3.6 SEALING

.1 Seal pipe ends and walls of manholes or catch basins where indicated or directed by Engineer. Securely plug to form a watertight seal.

3.7 DISPOSAL OF MATERIAL

.1 Dispose of materials not designated for salvage or re-use in work, off-site, in accordance with Section 01005.13.1.

.2 Trim disposal areas to condition satisfactory to Engineer.

.3 Except as otherwise specified, concrete and masonry may be used for rip-rap or embankment construction within the limits of the contract as directed by the Engineer. It shall be disposed of outside the right-of-way at locations arranged for by the Contractor when unsuitable or surplus to construction requirements.

.4 Timber, steel and materials other than concrete or masonry, which are not designated for salvage, shall become the property of the Contractor and shall be removed from the work.

.5 A.C. pipe removed shall be disposed of in accordance with Department of Environment Waste Material Disposal Act.

3.8 BACKFILL

.1 Backfill in accordance with Section 02223.

3.9 RESTORATION

.1 Upon completion of work, remove debris, trim surfaces and leave work site clean. Reinstate areas and existing works outside areas of demolition to adjacent, undisturbed areas.

3.10 SAFETY REQUIREMENTS

.1 The Contractor shall provide protection by way of barricades, signs, etc. to adequately safeguard the public from injury resulting from demolition activities.

.2 In all cases, the Contractor shall adhere to the requirements of part 8 'Construction Safety Measures" of the National Building Code of Canada.

.3 The Contractor shall not close off or demolish any existing stairs or exit doors until such time as new exit stairs or temporary arrangements have been provided to replace same.

3.11 BASIS OF PAYMENT

.1 When it is necessary to remove a section of pavement, concrete, side walk, curb and gutter or similar item in order to remove a culvert, sewer, or other structure lying beneath, payment will be made for each item removed in accordance with the specification for its removal.

This Section specified fertilizing and preserving root systems of trees and plants affected by changing grades or excavation. This section also covers the requirements for supplying and placing topsoil and appropriate finished grading, and the application of seed and mulch for permanent cover.

PART 1 - GENERAL

1.1 SOURCE QUALITY CONTROL

.1 Inform Engineer of proposed source of topsoil to be supplied and provide access for sampling. Acceptance of topsoil subject to inspection and/or soil analysis test results. Do not commence work until topsail accepted by Engineer.

.2 The Contractor shall notify the Engineer not less than three (3) days before cutting of sod begins. Sod will be approved by the Engineer in its original position before cutting and delivery to the project.

1.2 DELIVERY AND STORAGE

.1 Deliver and store grass seed in original containers showing:

- .1 Analysis of seed mix.
- .2 Percentage of pure seed
- .3 Year of production
- .4 Net mass
- .5 Date when tagged and location.
- .6 Percentage germination.
- .7 Name and address of distributor.

.2 Deliver wood fibre mulch in moisture-proof containers indicating manufacturer, content and net air-dry mass.

.3 Deliver erosion control agent in moisture-proof containers showing manufacturer, content and net mass.

1.3 SCHEDULING OF WORK

.1 Schedule placing of topsoil and finish grading to permit sodding or seeding operations under optimum conditions. Seeds planted or sods and hydroseeding placed in the Fall will not be accepted until the following SPRING.

1.4 MEASUREMENT FOR PAYMENT

.1 Manual seeding and seed protection will be measured in square metres of actual area covered.

.2 Temporary cover measurement shall be in square metres following the contours of the ground of the areas designated for temporary cover.

.3 Measurement for hydraulic seeding and mulching shall be area actually hydroseeded, from within the limits as staked by the Engineer, and measured in square metres, rounded to the nearest whole number.

.4 For shrub and tree preservation the circular measures from the tips of branches in square metres will be used to determine the area for payment.

.5 Preparation of sub-grade for placing of topsoil will not be measured.

.6 Placing of topsoil will be measured in square metres to thickness specified.

.7 Supply and application of agricultural limestone will be measured in square metres of area treated.

.8 Supply and Application of fertilizer will be measured in square metres of area treated.

.9 Measurement for sodding will be by actual area of sod placed by the square metre.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 The topsoil shall be obtained from approved areas off the site. The soil shall be reasonably free from subsoil, clay lumps, brush, objectionable weeds and other litter, and shall be free from stones, stumps and other objects larger than 50 mm in diameter, from roots, toxic substances and from any other material or substances that might harm growth or be a hindrance to grading, planting, or maintenance operation.

.2 Asphalted felt: to CSA A123.3-M1979 (R1992).

.3 Fertilizer shall be 6-12-12 grade, uniform in composition, free flowing and suitable for application with approved equipment delivered to the site in bags or other convenient containers, each fully labelled, conforming to the applicable local government laws, and bearing the name, trademark or tradename and warranty of the producer.

.4 Wound dressing: horticulturally accepted non-toxic, non-hardening emulsion.

.5 Lime shall be ground limestone containing not less than 85% of total carbonates and shall be ground to such fineness that at least 50% will pass through a 100 mesh sieve and at least 90% will pass through a 20 mesh sieve. Coarser materials will be acceptable provided the specified rates of application are increased proportionally on the basis of quantities passing the 100 mesh sieve, but no additional payment will be made for the increased quantity.

.6 Grass seed: Certified Canada No. 1 Grade to Government of Canada, Seeds Regulations and having minimum germination of 75% and minimum purity of 97%.

.7 Turf establishment blanket: uniform, open weave jute matting, wood excelsior covered biodegradable extruded plastic mesh as indicated in contract drawings.

.8 Staples: 25 mm wide by 300 mm deep by 3 mm thick steel wire.

.9 Mulch shall be of natural sun dried plant fibers (straw, cotton and paper specially treated) processed in lengths of 20 mm - 40 mm.

.10 Erosion Control Agent: Asphalt emulsion to CAN2-16.2-M77, Type III (SS-1), Verdol Super.

.11 Water: potable, free of impurities that would inhibit germination.

.12 Binder shall be capable of joining seeds mulch and soil particles together on slopes and erodible surfaces until plant growth has been established. The binder must not form an impervious seal which would prevent the penetration of moisture to the underlying soil.

2.2 GRASS SEED MIXTURE

.1 50% Creeping Red Fescue
30% Kentucky Bluegrass
15% Colonial Bent
5% Dwarf Timothy

.2 The Contractor may provide an alternate mix design provided it is prepared by a qualified agricultural expert.

PART 3 - EXECUTION

3.1 FERTILIZING EXISTING TREES

.1 Apply fertilizer at rate of 50 g/mm of calliper to existing trees to be retained. Take calliper measurement 0.3 m above grade. Apply once early in growing season except where specified or otherwise shown on the drawings.

.2 Distribute fertilizer equally into holes drilled 200-250 mm deep, spaced 600-750 mm apart and located in circular pattern between 2/3 and limit of each tree's branch spread. Water thoroughly after fertilizer applied.

.3 Water retained trees 3 times during summer. Soak area immediately below tree crown sufficiently deep to reach feeder roots.

3.2 RAISING GRADE AROUND EXISTING TREES

.1 Apply fertilizer before revising grade.

.2 Protect bark of buried portion of tree from abrasion by surrounding trunk with water impervious material. Leave minimum 50 mm space between protective material and bark. Fill space with washed stones.

.3 Use approved topsoil to raise grade to required level, making allowance for topsoil specified in Section 02245.

.4 Compact fill without disturbing or damaging roots. Use frost-free materials over frost-free ground conditions. Compact fill to 80% Standard Proctor density to ASTM D698-78.

3.3 LOWERING GRADE AROUND EXISTING TREES

.1 Cut slope from edge of branch spread to new grade level or retaining wall at degree indicated. Build dike of topsail for each tree at periphery of branch spread to hold water where required.

.2 If excavation through roots is required, excavate by hand and cut roots with sharp axe, tree lopper or saw. Seal cut edges 10 mm in diameter and larger with wound dressing.

.3 Apply fertilizer after excavation is backfilled and grading is completed. Do not permit root system to dry out at any time.

3.4 TOPSOIL

.1 The topsoil shall be uniformly distributed on the designated areas and evenly spread to an average thickness of 100 mm with a minimum thickness of 75 mm. The spreading shall be performed in such a manner that planting can proceed requiring little additional soil preparation or tillage. Irregularities in the surface resulting from top soiling or other operations shall be corrected so as to prevent the formation of depressions where water will stand. Topsoil shall not

be placed where the subgrade is frozen, excessively wet, extremely dry or in a condition otherwise detrimental to the proposed planting or to proper grading.

.2 After the topsoil has been spread and graded as required, the surface shall be cleared of stone, stumps or other objects larger than 50 mm in thickness or diameter, and or root, brush, wire or other objects that might be a hindrance to planting or maintenance operations.

3.5 APPLICATION OF FERTILIZER

.1 Fertilizer shall be distributed uniformly at a rate of 1,125 kg/ha over the areas indicated on the drawings to be seeded, and shall be incorporated into the soil to a depth of at least 100 mm by disking, harrowing, or other acceptable methods. The incorporation of fertilizer may be a part of the tillage operation specified in other parts of this section. Distribution by means of an approved seed drill equipped to sow seeds and distribute fertilizer at the same time will be acceptable.

3.6 APPLICATION OF LIME

.1 Immediately following the incorporation of the fertilizer, lime shall be distributed uniformly at a rate of 1125 kg/ha and shall be incorporated into the soil to a depth of at least 25 mm by disking, harrowing, or other acceptable methods.

3.7 PREPARATION OF SURFACES

.1 Undulation or irregularities in the surface resulting from tillage, fertilizing, limning or other operations shall be levelled before seeding operations are begun. The grassed area when completed and settled shall be on such a grade necessary to facilitate drainage.

3.8 APPLICATION OF SEED

.1 Sow during calm weather (winds less than 10 km/h) using equipment suitable for area involved to the approval of the Engineer. Seed shall be applied at the rate of 175 kg/ha.

.2 Sow half of required amount of seeds in one direction and remainder at right angles. Incorporate seed into soil to a minimum depth of 5 mm simultaneously or within one hour after seeding operation. Mix carefully with light chain harrow or wire rakes and roll area immediately afterward with water ballast type lawn or agricultural type roller.

.3 Water with fine spray, avoiding washing out of seed. Apply enough water to ensure penetration of minimum 50 mm.

.4 Add erosion control agent, into seeder and mix thoroughly to complete seeding slurry when indicated in the contract documents.

.5 Complete slurry to be applied per hectare:

- .1 Seed (mixture as specified)
- .2 Mulch 1000 kg
- .3 Erosion Control Agent 300 kg
- .4 Water, minimum 10000 l

3.9 SEED PROTECTION ON SLOPES

.1 Cover seeded slopes (where slope is 3:1 or steeper) with turf establishment blanket. Roll blanket down over slopes without stretching or pulling.

.2 Lay blanket smoothly on soil surface, burying top end of each section in narrow 150 mm trench. Leave 300 mm overlap from top roll over bottom roll. Leave 100 mm overlap adjacent section.

.3 In ditches, unroll blanket in direction of flow. Overlap ends of strips 300 mm with upstream section on top.

.4 Staple outside edges and overlaps at 1000 mm intervals and at intermediate points to ensure close contact between blanket and soil.

3.10 SODDING

.1 Before sodding, the surface is to be raked smooth to provide uniform slopes. Topsoil with a uniform organic content will be placed to a thickness of 75 mm or as directed on site by the Engineer, and raked smooth to conform with the preparation slopes. Lime will be added to the topsoil at the rate of 1,125 kg/ha. The lime may be placed up to three weeks ahead of placing of sod. Fertilizer will be spread evenly over the top 50 mm of the soil.

.2 Fertilizer cannot be added at the same time as the lime. The fertilizer shall be applied at the rate of 1,125 kg/ha, and will have a plant food ratio of 10 nitrogen to 20 phosphorous to 20 potash plus 2% FTE. The fertilizer must be placed not more than one week ahead of sodding. After adding fertilizer, the surface shall be fine graded.

.3 Sod shall be laid on the prepared sod bed within 24 hrs after cutting, except that sod may be stored in stacks or piles, grass to grass and roots to roots for not more than five (5) days. Sod shall be protected against drying from sun or wind and from freezing as necessary. The moving and laying of sod shall, as far as possible, be done when weather conditions and soil moisture are favourable. On slopes, stakes shall be driven flush with the top of the sod, spacing stakes shall not exceed 600 mm across the face of slopes.

.4 If rainfall is insufficient during the period of sodding and initial grass growth, then water shall be applied immediately before and after sodding and subsequently thereafter until the grass is established, as directed by the Engineer. Cost will be included in the unit price for laying sods.

3.11 HYDROSEEDING

.1 Before hydroseeding the surface is to be raked smooth to provide uniform slopes. Topsoil with a uniform organic content will be placed to a thickness of 75 mm, and rated smooth to conform with the prepared slopes.

.2 Lime will be added to the topsoil at a rate of 1,125 kg/ha. The lime may be placed up to three (3) weeks ahead of the placing of hydroseeding.

.3 Areas to be treated with hydroseeding and mulching shall be staked out by the Engineer in the field. Operations will not commence until the Contractor has the approval of the Engineer.

.4 Two operations shall be employed in the hydroseeding of designated areas.

.1 The first operation shall consist of the distribution of a slurry composed of grass seed, fertilizer, lime and binder. The rate of application of these ingredients shall be as follows:

Grass seed mixture	150 kg/ha
Fertilizer	600 kg/ha
Binder	20 kg/ha
(75% straw, 15% cotton, 10% cellulose)	

.2 The second operation shall consist of the distribution of a slurry composed of mulch, plus binder. The rate of application of these ingredients shall be as follows:

Mulch	2,250 kg/ha
Binder	25 kg/ha

(45% straw, 45% cotton, 10% cellulose)

.5 The contractor shall measure the quantities of each of the materials to be charged into the seeder, either by mass or by a system of mass calibrated volume measurements approved by the Engineer. The Contractor shall provide all equipment required for this purpose.

.6 Both operations require that the ingredients be thoroughly mixed with water in a hydroseeding tank. The mix must be continuously agitated during the hydroseeding operation to ensure that a homogenous slurry is produced.

.7 The distribution of the slurry shall be by means of an approved hydroseeder and shall be applied uniformly and in such a manner as to prevent puddling and movement of the soil surface.

.8 Work shall proceed only in calm weather and on ground free of frost, snow, ice or standing water and when, in the opinion of the Engineer, weather and seasonal conditions are suitable. Hydroseeding shall not be carried out during periods of rainfall.

3.12 MAINTENANCE

.1 Ensure maintenance equipment suitable to Engineer.

.2 Keep soil moist during germination period and adequately water grassed areas until accepted by Engineer.

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

3.13 PROTECTION AND REPAIR

.1 The area shall be protected against traffic or other use by erecting barricades immediately after seeding is completed and by placing warning signs of an approved type on the various areas.

.2 If at any time before completion and acceptance of the entire work covered by this contract any portion of the surface becomes gullied or otherwise damaged following seeding, or the seedings have been winter-killed or otherwise destroyed the affected portion shall be repaired to re-establish the condition and grade of the soil prior to seeding and shall then be re-seeded as specified in previous sections.

3.14 ACCEPTANCE

.1 Areas will be accepted by Engineer provided that:

- .1 Seeded areas are properly established.
- .2 Turf is free of eroded, bare or dead spots and 98% free of weeds.
- .3 No surface soil is visible when grass has been cut to height of 40 mm.

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

3.15 BASIS FOR PAYMENT

.1 All costs associated with the work specified in this section shall be deemed to be included in the appropriate unit and lump sum prices quoted in the Schedule of Quantities and Prices.

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This Section covers the requirements for removing and disposing of trees, brush, bushes, stumps, surface litter, boulders and grubbing, as indicated on the drawings or as designated by the Engineer.

PART 1 - GENERAL

1.1 REGULATORY AGENCIES

.1 Obtain necessary burning permits from Regulatory Agencies. Comply with all municipal, provincial and federal laws and regulation.

1.2 MEASUREMENT FOR PAYMENT

.1 Following items will be measured in hectares by plan area within limits indicated or as directed by Engineer.

- .1 Clearing.
- .2 Grubbing.
- .3 Close cut clearing.
- .4 Underbrush clearing.

.2 Clearing and grubbing isolated trees, to a depth of 150 mm, will be measured as area of each tree cleared. The area will be calculated by measuring from tip to tip of the longest branches within the right-of-way; any portion of a tree outside the right-of-way will not be included for payment.

.3 Payment for grubbing shall include the cost of removal, from the area to be grubbed, of boulders which are less than 0.5 m^3.

.4 Earth excavated as part of any of the above operations and within the theoretical paylines for each excavation, will be paid as earth excavation.

.5 Removal of individual boulders 0.5 m^3 and greater in volume will be paid as Rock Removal.

PART 2 - PRODUCTS

.1 Not applicable to this section.

PART 3 - EXECUTION

3.1 CLEARING

.1 Clear trees, shrubs, uprooted stumps and surface debris not designated to remain.

.2 Cut off trees, brush, and scrub as indicated or as directed at a height of not more than 150 mm above ground.

.3 Cut off unsound branches and cut down dangerous trees overhanging area cleared.

3.2 CLOSE OUT CLEARING

.1 Cut off trees, shrubs, stumps and other vegetation to original ground surface.

.2 Perform close cut clearing in such a manner that existing insulation of fibrous material is not damaged.

.3 Cut off unsound branches and cut down dangerous trees overhanging area cleared.

3.3 ISOLATED TREES

.1 Cut off isolated trees indicated or directed by Engineer at a height of 150 mm above ground and grub out isolated tree stumps.

3.4 UNDERBRUSH CLEARING AND GRUBBING

.1 Clear underbrush from areas indicated at ground level and grub out stumps and roots to a depth of 150 mm below original ground surface.

3.5 REMOVAL AND DISPOSAL

.1 Remove cleared and grubbed materials to disposal area indicated and/or as approved by Engineer. Dispose of cleared and grubbed materials by burning and/or burying.

.2 Burn under constant care of competent watchmen, at such times and in such a manner that surrounding vegetation, adjacent property or anything to remain will not be jeopardized. Burning to be performed only when approved by the appropriate Regulatory Agency.

.3 Bury by consolidating to highest degree practicable and covering with a minimum 500 mm of mineral soil. Finish to present a neat levelled appearance.

3.6 FINISHED SURFACE

.1 Leave ground surface in a condition suitable for immediate grading operations and stripping of topsoil.

3.7 BASIS FOR PAYMENT

.1 All costs associated with the work specified in this section shall be deemed to be included in the appropriate unit and lump sum prices quoted in the Schedule of Quantities and Prices.

This section covers the requirements for the removal of rock or boulders classified as rock in grading operations or excavations.

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

.1 Do blasting operations in accordance with requirements of Canadian Construction Safety Code and local and provincial codes, requirements of authority having jurisdiction and Canadian Blasting Association Standards.

1.2 QUALIFICATIONS

.1 Blasting shall only be performed by experienced powder-man licensed in the Province of Newfoundland and Labrador to use explosives.

.2 Prevent damage to persons & property by flying rocks, by covering the site of the blasting with blasting mats or other suitable devices. Post guards, sound warnings and display signs when blasting is to take place.

.3 Carry out trial blasting at the commencement of the blasting work in order to determine the amount of charge required to keep vibrations within safe limits, to the satisfaction of the Engineer. Take seismograph recordings during such trial blasting and at any other time while blasting is continued, as considered necessary by the Contractor for his own protection, or as may be directed by the Engineer. Maximum acceleration during blasting must not exceed 50 mm per sec per sec.

.4 No increase in charges will be permitted without further trial blasting and seismograph recordings, as described above.

.5 Repair any damage caused by blasting. Blasting may not be permitted, or may be limited to such an extent as to ensure the safety of structures, if considered necessary by the Engineer. For his own protection, the Contractor is advised to engage a qualified inspection company to carry out a pre-blasting survey of buildings in the vicinity of his blasting operation in order to record pre-blasting conditions.

1.3 MEASUREMENT FOR PAYMENT

.1 Measurement of rock excavation is by plan quantity of the volumes in cubic metres below the existing rock surface and within theoretical paylines, except that the minimum depth of excavation for measurement purposes shall not be less than 300 mm.

.2 The volume of excavated boulders and rock fragments in excess of 0.5 m^3 will be determined by measuring three maximum mutually perpendicular dimensions.

PART 2 - PRODUCTS

2.1 Not applicable.

PART 3 - EXECUTION

3.1 ROCK REMOVAL

.1 Remove rock to alignments, profiles, and cross sections as indicated.

.2 Correct unauthorized rock removal at no extra cost, in accordance with backfilling requirements specified in Section 02223.

.3 Remove boulders and fragments which may slide or roll into excavated areas.

.4 Excavate trenches to lines and grades to minimum of 150 mm below pipe invert indicated. Provide recesses for bell and spigot pipe to ensure bearing will occur along barrel of pipe.

.5 Cut trenches to widths specified.

3.2 BASIS FOR PAYMENT

.1 All costs associated with the work specified in this section shall be deemed to be included in the appropriate unit and lump sum prices quoted in the Schedule of Quantities and Prices.

This section specifies the requirements for excavation and backfilling for site grading.

PART 1 - GENERAL

1.1 EXAMINATION

.1 Examine all drawings and specifications to ascertain the extent of the work. Visit the site to ascertain special conditions which might affect the work of this Section.

1.2 MEASUREMENT FOR PAYMENT

.1 Mass Rock Excavation

.1 Measured in cubic metres calculated from cross-sections taken in area of excavation.

.2 When depth indicated on the Drawings or directed by the Engineer is less than 300 mm below original rock surface, depth excavated for measurement purposes will be taken as 300 mm.

.3 Volume of excavated boulders and rock fragments in excess of 0.5 m^3 will be determined by measuring three maximum mutually perpendicular dimensions.

.2 Mass Common excavation:

.1 Measured in cubic metres calculated from cross sections taken in areas of excavation.

.2 In areas of excavation provided by Engineer, initial cross sections will be taken prior to clearing and grubbing.

.3 Topsoil and waste material will be measured for payment as common excavation in its original location.

.3 No measurement will be made for:

.1 Unnecessary excavation beyond lines established.

.2 Extra handling of windrowed materials blended on embankment slopes.

.3 Stockpiling of topsoil or protection of stockpiles.

.4 Payment for excavation includes placing of excavated material at another location on site or disposal of waste material off site.

.5 Mass Imported Common Backfill including compaction to be measured in cubic metres in place to specified paylines.

.6 Excavation, trenching and backfilling for all service utilities will be measured in accordance with Section 02223 unless otherwise specified.

.7 When benching is required to key new fill slopes to existing slopes, no measurement or payment shall be made with respect to quantities excavated during this operation.

.8 Clearing and grubbing will be measured in accordance with Section 02111.

.9 Placing and Spreading of on site and/or imported topsoil will be paid by the square metre to the specified depth.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Embankment materials require approval by Engineer.

.2 Material used for embankment not to contain organic matter, frozen lumps, weeds, sod, roots, logs, stumps or any objectionable matter and have not more than 10% passing 0.075 mm sieve nor particles larger than 250 mm or 150 mm within 300 mm of sub-grade.

.3 Common Material to be obtained from sources indicated or approved by Engineer.

2.2 STOCKPILING

.1 Stockpile fill materials on areas designated by Engineer. Stockpile granular material in manner to prevent segregation. Protect stockpiled fill material from freezing.

PART 3 - EXECUTION

3.1 COMPACTION EQUIPMENT

.1 Compaction equipment must be capable of obtaining required densities in materials on project.

3.2 WATER DISTRIBUTORS

.1 Apply water with equipment capable of uniform distribution. Water used for this purpose shall be fresh water.

3.3 EXCAVATION

.1 Excavate areas designated on drawings to design lines, grades and cross-sections. The excavation tolerance in OM shall be ± 30 mm and in rock -150 mm.

.2 Remove materials which are unsuitable to the lines and grades as designated by the Engineer and dispose of as directed.

.3 Suitable material not used immediately in the work shall be stockpiled in areas designated by the Engineer at no additional cost to the Owner for subsequent use in the work.

.4 Maintain crowns and cross slopes to provide good surface drainage.

.5 Excavate to elevations and dimensions indicated or required for construction of work plus space required to erect forms.

.6 Make excavation to clean lines to minimize quantity of fill material required.

.7 Earth bottoms or excavations to be dry undisturbed soil, level, free from loose or organic matter.

.8 Excavation must not interfere with normal 45 degree splay of bearing from bottom of any footing.

.9 When complete, have Engineer inspect excavations to verify soil bearing capacity, depths and dimensions.

.10 Correct unauthorized excavation at no extra cost as follows:

.1 Fill under bearing surfaces and footings with concrete as specified for footings.
.2 Fill under other areas with fill compacted to 95% density.

.11 Do not disturb soil within branch spread of trees or shrubs that are to remain. If excavating through roots, excavate by hand and cut roots with sharp axe or saw. Seal cuts with approved tree wound dressing.

3.4 EXCAVATION REQUIRED BY OTHERS

.1 Excavation for mechanical and electrical work is included in this Section and shall be carried out in accordance with provisions specified herein and indicated.

.2 Excavate trenches to lines and grades shown to a minimum of 75 mm below pipe invert. Provide recesses for bell and spigot pipe to ensure bearing will occur along barrel of pipe.

.3 Cut trenches 300 mm wider than maximum pipe diameter. Trim and shape trench bottoms and leave free of irregularities, lumps or projections.

3.5 BACKFILLING

.1 Do not commence backfilling until areas of work to be backfilled have been inspected and approved by Engineer.

.2 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.

.3 Prior to placing fill under slabs on grade, compact existing sub-grade to obtain same compaction as specified for fill. Remove "soft" material and fill with approved material until specified compaction can be obtained.

.4 Where temporary unbalanced earth pressures are liable to develop on walls or other structures, erect bracing or shoring to counteract unbalance and leave in place until removal is approved by Engineer.

.5 Backfill simultaneously each side of walls and other structures to equalize soil pressures.

.6 Place and compact fill materials in continuous horizontal layers not exceeding 300 mm loose depth. Use methods to prevent disturbing or damaging buried services. Make good any damage.

.7 Maintain optimum moisture content to enable compaction to attain specified density.

.8 In roads, parking lot and under concrete structures place fill materials in 500 mm lifts and compact to 95% corrected maximum dry density.

.9 In other areas of site compact to density of existing soil.

3.6 MAINTENANCE

.1 Maintain roadway surface until next course of material is placed or until project or that portion thereof is accepted.

3.7 PRESERVATION OF TOPSOIL

At the direction of the Engineer:

.1 Remove topsoil before any construction procedures commence to avoid compaction of topsoil.

.2 Handle topsoil only when it is dry and warm.

.3 Remove vegetation from targeted areas by non-chemical means and dispose of stripped vegetation as per Section 02111 - Clearing and Grubbing.

.4 Remove brush from targeted area by non-chemical means and dispose of as per Section 02111 - Clearing and Grubbing.

.5 Strip topsoil to depths as directed by Company's Representative. Avoid mixing topsoil with subsoil.

.6 Pile topsoil by mechanical hoe in berms in locations as directed by Company's Representative. Stockpile height not to exceed 2.0 m.

.7 Protect stockpiles from contamination and compaction.

.8 Topsoil that has been piled for long term storage will be covered with trefoil or grass to maintain agricultural potential of soil.

3.8 INSPECTION AND TESTING

.1 Sieve Analysis: proposed fill materials will be tested to confirm suitability for intended use and conformity with specifications.

.2 Density Test will be conducted on compacted fill to ASTM D698-78 for Standard Proctor Density.

3.9 WASTE MATERIAL

.1 Dispose of waste material not required for backfill, grading or landscaping, at an approved dump site.

3.10 BASIS FOR PAYMENT

.1 All costs associated with work specified in this section shall be deemed to be included in the appropriate unit and lump sum prices quoted in the Schedule of Quantities and Prices. Payment for excavation and borrow material will include placing and compacting in embankments elsewhere on the project, as well as legal disposal of all waste material.

This section specifies requirements for trench excavation and backfill for the installation of pipe lines, conduits and appurtenances.

PART 1 - GENERAL

1.1 MEASUREMENT FOR PAYMENT

.1 Trench excavation to be measured in cubic metres in their original position. Payment for excavation shall include backfill with excavated trench material, compaction, disposal of waste material off site, placing of excavated material at another location on site and all other items as outlined in this section.

.2 Before commencing any excavation, take levels and cross-sections of the original ground surface and agree upon them with the Engineer.

.3 Mass excavation and/or mass backfill will be measured in accordance with Section 02215.

.4 Trench length for measurement purposes will be measured continuously through manholes and other appurtenances except in the case of sewage lift stations and any extra excavation required for their construction outside the specified measurement trench width will be deemed to be included in the contract unit price for these structures and appurtenances.

.5 Excavation and backfill of sewage lift stations will be paid for under this section in accordance with the measurement limits defined under Section 02650.1.1.4.

.6 Excavated quantities measured to be actual volume removed within the following limits unless otherwise detailed in this specification:

.1 Depth: Measured from original ground, less a deduction of 150 mm when grubbing required, to installed grade at bottom of trench as shown on the drawings. In areas of specified mass excavation, trench depth will be measured from the new ground elevation established after mass excavation.

.2 Width: Subject to item 1.6.3, the width of main trench allowed for measuring purposes shall be the sum of the nominal diameters of the pipe in the trench plus pipe insulation plus 600 mm. In the case of service pipes the width of trench allowed shall be 1000 mm. In the case of combined gravity sanitary sewer and storm sewer the width of trench allowed for measuring purposes shall be the sum of the nominal diameters of the pipes plus 1050 mm. When concrete pipe is used the outside diameter of the pipe rather than the nominal diameter shall be used to determine the trench width.

.3 The minimum width of main trench shall be: 1500 mm where the average depth is 0 to 4 m; 2000 mm where the average depth is greater than 4 m to 6 m; 2500 mm where the average depth is greater than 6 m. The average depth shall be calculated between manholes on sewer line or at 100 m intervals along water main only trench. The width of service trench shall increase by 500 mm where the average depth is greater than 4 m and by an additional 500 mm where the average depth is greater than 6 m.

.7 Extra excavation required for manholes and/or the deflection of water mains and/or storm sewer pipes at manholes or other structures will be deemed to be included in the Contract Unit Price for trench excavation and backfill as detailed above. Trench width for measurement purposes will be that required for the number and size of pipes as specified, and assumed as one trench passing continuously through the manhole or other structures. Deflected pipes at or around structures will not be considered as separate trenches for measurement and payment purposes.

.8 When rock is exposed by stripping the common material, the rock surface will be profiled. When rock is to be excavated by drilling from ground level, then rock will be measured by inspection of the sides of the excavation by measuring the height of the over burden on top of the rock.

.9 Imported common backfill including compaction to be measured in cubic metres based on theoretical paylines for trenching.

.10 Excavation and disposal of waste material to be paid under common excavation.

.11 Sheeting and bracing left in place on direction of Engineer will be measured in square metres of surface area of plane surface of sheeting.

.12 Shoring, bracing, trench boxes, cofferdams, underpinning and de-watering of excavation will be incidental to work and will not be measured separately.

.13 When separate payment is specified or indicated in the Schedule of Quantities and Prices for granular materials for pipe bedding and backfill, measurement widths and lengths shall be as specified for trench excavation and backfill. Measurement depth shall be actual depth installed up to limits shown on the contract drawings or as specified in this specification. Bedding volumes shall be adjusted in accordance with Sections 02702.1.2.7 and 02713.1.4.10.

.14 Rock underbedding will be measured compacted in place according to theoretical paylines specified and depth required. Payment includes all additional costs associated with type of materials and greater excavation depths required.

.15 Supply and placement of marking tape will be paid by the metre.

.16 Supply and placement of filter fabric will be measured in accordance with Section 02897.

.17 Trucking, handling, stockpiling, filling and conditioning at the direction of the engineer of otherwise competitent material that is too wet for immediate reuse when removed from the trench shall be measured in accordance with 02223.1.1.6 above.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Marking Tape:
- .1 Heavy gauge polyethylene, 150 mm wide indicating the service buried.
- .2 Detectable metallic underground tape, indicating the service buried, not less than 75 mm wide.

.2 Type 1 bedding: clean, hard durable crushed gravel or stone, free from shale clay, friable materials, organic matter and other deleterious substances and graded within the following limits when tested to ASTM C136-84a and ASTM C117-87 and giving a smooth curve without sharp breaks when plotted on a semi-log chart:

ASTM sieve designation	% passing
25.000 mm	100
19.000 mm	75 - 100
12.500 mm	-
9.500 mm	50 - 100
4.750 mm	30 - 70
2.000 mm	20 - 45
0.425 mm	10 - 25
0.180 mm	-
0.075 mm	3 - 8

.3 Type 2 bedding: clean, hard, durable sand, gravel or crushed stone, free from shale, clay, friable materials, organic matter and other deleterious substances when tested to ASTM C136-84a and ASTM C117-87 and giving a smooth curve without sharp breaks when plotted on a semi-log grading chart:

ASTM sieve designation	% passing
9.5 mm	100
4.75 mm	50 - 100
2.00 mm	30 - 90
0.075 mm	0 - 10

.4 Type 3 bedding: uniformly graded, clean granular material free from mud lumps, cinders, sods, refuse of other deleterious substances. The maximum particle size shall be 25 mm and the gradation and fines content shall be such that the material can be well compacted and will not become unstable and lose its pipe bearing ability upon exposure to water or ground water movement. Type 3 bedding shall be selected, whenever possible, from excavated material at the same point of trench excavation or from other points of trench excavation where suitable material is available. The bedding shall be approved by the Engineer. No payment will be made for the direct reuse of the approved trench material if screening is not required by the Engineer. When the excavated trench material is screened as directed by the Engineer and used for bedding,payment will be made at the unit price bid for Type 3 bedding in the Schedule of Quantities and Prices. Payment for other sources shall be paid at the unit price bid in the Schedule of Quantities and Prices.

.5 Backfill Material: selected material from excavation or other sources, approved by Engineer for use intended, unfrozen and free from rocks larger than 200 mm, cinders, ashes, sods, refuse or other deleterious materials.

.6 Granular bedding shall be the type #1, #2, or #3 material as specified in the Schedule of Quantities and Prices.

.7 Rock underbedding: Crushed stone consisting of durable crushed rock approximately 100 mm maximum size and consisting of angular fragments obtained by breaking and crushing solid or natural rock, reasonably free from thin, flat elongated or other objectionable pieces and fines. Material not to contain any organic soil or objectionable matter with not more than 10% by mass passing the #63 Canadian Metric sieve, including parties adhering to larger stone particles.

PART 3 - EXECUTION

3.1 SITE PREPARATION

.1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.

.2 Strip topsoil from within limits of excavation and stockpile as directed by Engineer, for re-spreading after backfilling or for reinstatement in other parts of the work.

.3 Cut pavement or side walk neatly along limits of proposed excavation or as specified in order that surface may break evenly and cleanly.

3.2 COFFERDAMS, SHORING, BRACING AND UNDERPINNING

.1 Construct temporary works to depths, heights and locations as indicated or directed by Engineer.

.2 During backfill operation:

- .1 Unless otherwise indicated or directed by Engineer, remove sheeting and shoring from excavation.
- .2 Do not remove bracing until backfilling has reached respective levels of such bracing.
- .3 Pull sheeting in increments that will ensure compacted backfill is maintained at an elevation at least 500 mm above toe of sheeting.

.3 When sheeting is required to remain in place, cut off tops at elevations indicated or directed by Engineer.

.4 Upon completion of substructure construction:

- .1 Remove cofferdams, shoring and bracing.
- .2 Remove excess materials from site and restore water courses to conditions indicated or as directed by Engineer.

.5 Obtain permit from authority having jurisdiction for diversion of water course.

3.3 DEWATERING

.1 Keep excavations free of water while work is in progress.

.2 Protect open excavations against flooding and damage due to surface run-off.

.3 Dispose of water in a manner not detrimental to public and private property, or any portion of work completed or under construction. Comply with all requirements of the Department of Environment and other regulatory agencies having jurisdiction regarding disposal of water from excavations.

.4 Submit for Engineer's review, details of proposed dewatering methods, such as dikes or well points.

.5 Provide flocculation tanks, settling basins, or other treatment facilities to remove suspended solids or other materials before discharging to storm sewers, water courses or drainage areas.

.6 Do not dewater during placing of concrete, or for a period of at least 24 hours thereafter, unless from a pump separated from concrete work by a watertight wall or other effective means.

.7 Construct all sub-drains, sump holes, wells or the like required for dewatering the excavations so as not to endanger in any way the stability of the Works, and on completion of the work completely backfill and consolidate these excavations.

3.4 EXCAVATION

.1 Advise Engineer in advance of excavation operations to enable original cross sections to be taken.

.2 Excavate to lines, grades, elevations and dimensions indicated.

.3 Cut pavement or side walk neatly in a line along limits of proposed excavation or as specified in order that surface may break evenly and cleanly. The width removed along the normal trench for the installation of the pipe shall not exceed the width of the trench specified by more than 500 mm on each side of the trench. The width and length of the area removed for the installation of gate valves, specials, manholes, or other structures shall not exceed the maximum linear dimensions of such structures by more than 500 mm on each side. Wherever, in the opinion of the Engineer, existing conditions make it necessary or advisable, remove additional pavement, as directed by the Engineer, and receive extra compensation provided such additional work is not shown in the drawings or specified. Removal or damage to pavement or surfaces beyond these limits, shall be replaced or repaired at the expense of the Contractor.

.4 Remove concrete, masonry, paving, walks, demolished foundations and rubble and other obstructions encountered during excavation.

.5 Do not disturb soil within branch spread of trees or shrubs that are to remain. If excavating through roots, excavate by hand and cut roots with sharp axe or saw. Seal cuts with approved tree wound dressing.

.6 Unless otherwise authorized by Engineer in writing, do not excavate more than 30 m of trench in advance of installation operations and do not leave open more than 15 m at end of day's operation.

.7 Dispose of waste material as indicated in Section 01005. The Engineer shall define waste material.

.8 Do not obstruct flow of surface drainage or natural watercourses.

.9 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.

.10 Obtain Engineer approval of completed excavation.

.11 Remove unsuitable material from trench bottom to extent and depth directed by Engineer.

.12 Where required due to unauthorized over-excavation, correct as follows:

.1 Fill under bearing surfaces and footings with concrete specified for footings.

.2 Fill under other areas with approved fill compacted to minimum of 95% corrected maximum dry density, maximum dry density to ASTM D698-78, method D.

.13 Hand trim, make firm and remove loose material and debris from excavations. Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil.

.14 No extra payment shall be made for measures ordered by the Engineer to correct problems caused by unauthorized over-excavation.

.15 No extra payment shall be made for construction methods required to keep the trench stable, free from disturbance, or dry, nor for crushed stone or other granular material used to facilitate drainage or dewatering during construction of the pipeline or for any extra excavation related thereto.

.16 The use of mechanical excavators will be permitted except where their use in the opinion of the Engineer, will cause damage to property or structures above or below ground which property or structures must be preserved in accordance with the contract. The costs for hand excavation when the proximity of existing structures or other consideration render this necessary are deemed to be included in the Unit Price for trench excavation and backfill in the Unit Price Table.

.17 Keep all surface materials which, in the opinion of the Engineer, are suitable for re-use in restoring the surface separate from the general excavation material.

.18 Stockpile suitable material required for trench backfill in approved location.

3.5 TRENCH BOTTOM PREPARATION

.1 Draw the attention of the Engineer to the nature and condition of the excavated surfaces which are to receive the foundations of the works. If in the opinion of the Engineer, the foundation is unsuitable to receive the structure as shown on the Drawings, the Engineer will issue written instructions for extra excavation, special filling or other extra work required to secure a proper foundation.

.2 Where required due to removal of unsuitable material and/or unauthorized over excavation, bring bottom of excavation to design grade with approved granular material or rock underbedding as directed by the Engineer.

3.6 PRE-INSTALLATION INSPECTION

.1 Excavations require inspection and approval prior to commencement of installation of pipe bedding and operations.

3.7 BACKFILLING

.1 Do not proceed with backfilling operations until Engineer has inspected and approved installations.

.2 Areas to be backfilled and/or backfill material shall be free from debris, snow, ice, water or frozen ground. Do not use backfill material which is frozen or contains ice, snow or debris.

.3 Backfilling around installations:

.1 Place bedding as specified and as detailed on the contract drawings.

.2 Do not backfill around or over cast-in-place concrete within 24 hours after placing.

.3 Place layers simultaneously on both sides of installed work to equalize loading.

.4 Where temporary unbalanced earth pressures are liable to develop on walls or other structures.

.1 Permit concrete to cure for minimum 7 days or until it has sufficient strength to withstand earth and compaction pressure and approval obtained from Engineer or:

.2 If approved by Engineer erect bracing or shoring to counteract unbalance, and leave in place until removal is approved by Engineer.

.5 Place material by hand under, around and over installations until 600 mm of cover is provided. Dumping material directly on installations will not be permitted.

.4 Place backfill material in uniform layers not exceeding 300 mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.

.5 Do not place backfill in freezing weather without written permission of the Engineer.

.6 The foundation or underside of all structures and installations, including pipe bedding for pipes in trench shall bear on undisturbed ground or prepared surfaces as reinstated and approved by the Engineer.

.7 Granular backfill materials:

.1 Beneath paved highways or within 1.5 metres of the edge of pavement and beneath paved areas, curbs, driveways or side walks use granular backfill materials compacted to 95 percent of the maximum density as determined by ASTM D698-78 Method D. Compact using approved mechanical tamping devices.

3.8 RESTORATION

.1 Remove waste materials and debris, trim slopes, and correct defects noted by Engineer.

.2 Replace topsoil as indicated or directed by Engineer.

.3 Reinstate pavement and side walks, lawns to condition and elevation which existed before excavation.

.4 Clean and reinstate areas affected by work as directed by Engineer.

.5 Reinstate areas affected by equipment outside of planned area to condition which existed prior to commencement of work and leave site in rake-clean condition as directed.

3.9 BASIS FOR PAYMENT

.1 All costs associated with work specified in this section shall be deemed to be included in the appropriate unit and lump sum price quoted in the Schedule of Quantities and Prices.

This section specifies requirements for roadway excavation, borrow excavation, embankment construction and disposal of material conforming to lines, grades, dimensions and typical cross-sections shown on plans or established by Engineer.

PART 1 - GENERAL

1.1 MEASUREMENT FOR PAYMENT

.1 Rock Excavation:

- .1 Will be measured in cubic metres calculated from cross-sections taken in areas of excavation.
- .2 Where depth indicated on the Drawings or directed by the Engineer is less than 300 mm below original rock surface, depth excavated for measurement purposes will be taken as 300 mm.
- .3 Volume of excavated boulders and rock fragments in excess of 0.5 m^3 will be determined by measuring three maximum mutually perpendicular dimensions.

.2 Common excavation:

- .1 Measured in cubic metres calculated from cross-sections taken in areas of excavation.
- .2 In areas of excavation provided by Engineer, initial cross-sections will be taken prior to clearing and grubbing and prior to stripping of topsoil.
- .3 Topsoil and Unsuitable material to be paid under common excavation will be measured for payment as common excavation in its original location.

.3 Imported Common Backfill including compaction to be measured in cubic metres in place to specified paylines.

.4 No measurement will be made for:

- .1 Unnecessary excavation beyond lines established.
- .2 Extra handling of windrowed materials blended on embankment slopes.
- .3 Placing of excavated material at another location on site or disposal of waste material off site.

.5 Imported Rock Backfill including compaction to be measured in cubic metres in place to specified paylines unless otherwise specified by the Engineer.

.6 Placing and spreading of topsoil on site and/or imported topsoil will be paid by the square metre to the specified depth.

.7 Supply and Placement of filter fabric will be paid in accordance with Section 02897.

1.2 TRAFFIC PROVISIONS

.1 Provide and maintain roadways, walkways and detours, for vehicular and pedestrian traffic and access to fire hydrants.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Embankment materials require approval by Engineer.

.2 Material used for embankment not to contain organic matter, frozen lumps, weeds, sod, roots, logs, stumps or any other objectionable matter and have not more than 10% passing 0.075 mm sieve nor particles larger than 250 mm. Within 300 mm of sub-grade the maximum particle size shall be 150 mm.

.3 Common Material shall be obtained from sources indicated or approved by Engineer.

PART 3 - EXECUTION

3.1 COMPACTION EQUIPMENT

.1 Compaction equipment must be capable of obtaining required densities in materials on project.

3.2 WATER DISTRIBUTORS

.1 Apply water with equipment capable of uniform distribution.

.2 Water used for this purpose shall be fresh water.

3.3 EXCAVATING

.1 General:

- .1 Advise Engineer sufficiently in advance of excavation operations for initial cross-sections to be taken.
- .2 Maintain crowns and cross slopes to provide good surface drainage.
- .3 Notify Engineer whenever unsuitable materials are encountered in cut sections and remove unsuitable materials to depth and extent directed.
- .4 Where subgrade is on transition from excavation to embankment treat ground slopes at grade points as indicated or as directed by Engineer.

.2 Stripping:

- .1 Strip topsoil from areas and to depths indicated or directed by Engineer prior to beginning of excavation and embankment work. Avoid contamination to topsoil and underlying soil.
- .2 Remove materials unsuitable for embankments to lateral limits and depths directed and dispose of as directed.

.3 Rock Excavation:

- .1 If during excavation, material appearing to conform to classification for rock is encountered, notify Engineer in sufficient time to enable measurements to be made to determine volume of rock.
- .2 Remove rock to 300 mm below sub-grade elevation indicated.
- .3 Provide effective drainage to ditches, leaving no undrained pockets in foundation.
- .4 Scale down rock slopes and remove rock fragments which are liable to slide or roll down slopes.

.4 Borrow:

.1 Completely use in embankments, suitable materials removed from excavations before taking material from borrow areas.

.2 Obtain from borrow areas additional suitable embankment material.

.1 Engineer to approve location and extent of borrow areas, and allowable depth of cutting.

.2 Shape edges of borrow areas on slopes of 2:1 and provide drainage as directed by Engineer.

.3 Trim and leave borrow pits in a condition to permit accurate measurement of material removed.

.4 Leave borrow pits in safe condition suitable for rehabilitation.

.5 Side Ditches:

.1 Construct side ditches to depths and widths indicated or directed by Engineer, to permit ready flow of surface water.

.2 Maintain and keep ditches open and free from debris until final acceptance of work.

3.4 DEWATERING

.1 Keep excavations and embankments dry while work is in progress by draining and pumping as required.

.2 Dispose of water in a manner not detrimental to public health, environment, public and private property, or any portion of the work completed or under construction. Comply with all requirements of the Department of Environment & Lands and other regulatory agencies having jurisdiction regarding disposal of water from excavation.

3.5 EMBANKMENTS

.1 When directed by Engineer, scarify or bench existing slopes in side hill or sloping sections to ensure a proper bond between new materials and existing surfaces. Obtain prior approval of method to be used.

.2 Do not place material which is frozen or place material on frozen surfaces.

.3 Maintain a crowned surface during construction to ensure ready run-off of surface water. Do not place material in free standing water. Drain low areas before placing.

.4 With material containing less than 25% by volume of stone or rock fragments larger than 100 mm:

.1 Place and compact to full width in uniform layers not exceeding 500 mm loose thickness. Engineer may authorize thicker lifts if specified compaction can be achieved.

.2 Compact to a density of not less than 95% corrected maximum dry density, maximum dry density in accordance with ASTM D698-78 except last 150 mm up to sub-grade elevation. Compact last 150 mm to 100% corrected maximum dry density, maximum dry density in accordance with ASTM D698-78.

.5 Where material consists principally of rock:

.1 Place to full width in layers of sufficient depth to contain maximum sized rocks but in no case is layer thickness to exceed 500 mm.

.2 Carefully distribute rock material to fill voids with smaller fragments to form a compact mass.

.3 Fill surface voids at subgrade level with rock spalls or selected material to form an earth-tight surface.

.4 Do not place boulders and rock fragments with dimensions exceeding 150 mm within 300 mm of subgrade elevation.

.6 Upon completion of embankment construction, if so directed, place stock piled and windrowed topsoil and unsuitable material against embankment and trim to maintain embankment slope.

.7 Place topsoil taken from stockpile or other sources, at locations and to depths directed. Remove surface stones, roots and other debris and leave surface in uniform condition.

3.6 FINISHING

.1 Remove soft or other material that will not compact properly and fill resulting depressions with approved material.

.2 Shape and compact entire roadbed to within 30 mm of design elevations but not uniformly high or low.

.3 Do scarifying, blading, compacting or other methods of work as necessary to provide a thoroughly compacted roadbed shaped to grades and cross sections indicated or directed.

.4 Finish back and side slopes of common material to a neat condition, suitable for seeding, true to line and grade.

.1 Remove boulders encountered in cut slopes and fill resulting cavities.
.2 Hand finish slopes that cannot be finished satisfactorily by machine.

.5 Finish back and side slopes of rock material to a neat and safe condition, true to line and grade. For rock slopes greater than 1:1, scale slope by removing loose fragments.

.6 Grade and leave all disposal areas or dump sites in a condition acceptable to the Engineer and do not obstruct flow of surface drainage or natural watercourses. Ensure that approved disposal sites are available so that the Work shall not be delayed.

3.7 MAINTENANCE

.1 Maintain finished surfaces in a condition conforming to this section until acceptable.

3.8 BASIS FOR PAYMENT

.1 All costs associated with work specified in this section shall be deemed to be included in the appropriate unit and lump sum prices quoted in the Schedule of Quantities and Prices. Payment for excavation and borrow material will include placing and compacting in embankments elsewhere on the project, as well as disposal of all waste material at approved dump sites.

This section specifies general requirements for supplying and processing of aggregates to be stockpiled or incorporated into work. Specific requirements for physical properties of aggregate properties are given in the related work sections.

PART 1 - GENERAL

1.1 SOURCE APPROVAL

.1 Source of materials to be incorporated into work or stockpiled requires approval of Engineer prior to commencing work. Provide gradation analysis and other laboratory testing results as directed by Engineer.

.2 If, in opinion of Engineer, materials from the proposed source do not meet, or cannot reasonably be processed to meet specified requirements, procure an alternative source or demonstrate that material from source in question can be processed to meet specified requirements.

.3 Should a change of material source be proposed during work, advise Engineer sufficiently in advance of such change to allow sampling and testing.

.4 Acceptance of a material at source does not preclude future rejection if it is subsequently found to lack uniformity, or if it fails to conform to requirements specified, or if its field performance is found to be unsatisfactory.

1.2 PRODUCTION SAMPLING

.1 Aggregate will be subject to continual sampling during production. Provide Engineer with ready access to source and processed material for purpose of sampling and testing.

1.4 MEASUREMENT FOR PAYMENT

.1 No separate or direct payment will be made for work specified in this section. Costs of all work specified in this section are deemed to be included in lump sum or unit prices quoted in Unit Price Table.

PART 2 - PRODUCTION

2.1 MATERIALS

.1 Aggregate quality: sound, hard, durable material free from soft, thin, elongated or laminated particles, organic material or other deleterious substances.

.2 Flat and elongated particles are those whose greatest dimension exceeds five times their least dimension.

.3 Particles having at least one freshly fractured face are considered as crushed material.

.4 Fine aggregates satisfying requirements of applicable section shall be one, or a blend of following:

- .1 Natural sand.
- .2 Manufactured sand.
- .3S creenings produced in crushing of quarried rock, boulders, gravel or slag.

.5 Coarse aggregates satisfying requirements of applicable section shall be one of following:

- .1 Crushed rock or slag.
- .2 Gravel composed of naturally formed particles of stone.

PART 3 - EXECUTION

3.1 DEVELOPMENT OF AGGREGATE SOURCE

.1 Prior to excavating materials for aggregate production, clear and grub area to be worked, and strip unsuitable surface materials. Dispose of cleared, grubbed and unsuitable materials as directed by Engineer.

.2 Where clearing is required, leave a screen of trees between area and roadways as directed.

.3 Clear, grub and strip an area ahead of quarrying or excavating operation sufficient to prevent contamination of aggregate by deleterious materials.

.4 When excavation is completed dress sides of excavation to a nominal 1.5:1 slope, and provide drains or ditches as required to prevent surface standing water.

.5 Trim off and dress slopes of waste material piles and leave site in a neat condition.

3.2 PROCESSING

.1 Process aggregate uniformly using methods that prevent contamination, segregation and degradation.

.2 Blend aggregates, if required, to obtain gradation requirements specified. Use methods and equipment approved by Engineer.

.3 Blending to increase percentage of crushed particles or decrease percentage of flat and elongated particles is permitted.

.4 Wash aggregates, if required to meet specifications. Use only equipment approved by Engineer.

3.3 HANDLING

.1 Handle and transport aggregates to avoid segregation, contamination and degradation.

3.4 STOCKPILING

.1 Unless otherwise authorized in writing by Engineer, stockpile aggregate on site in locations shown on drawings or designated by Engineer.

.2 Stockpile aggregates in sufficient quantities to meet project schedules.

.3 Stockpiling sites shall be level, well drained, and of adequate bearing capacity and stability to support stockpiled materials.

.4 Except where stockpiled on acceptably stabilized areas, provide a compacted sand base not less than 300 mm in depth to prevent contamination of the aggregate or, if permitted, stockpile aggregate on ground but do not incorporate bottom 300 mm of pile into work.

.5 Separate aggregates by substantial dividers or stockpile far enough apart to prevent intermixing.

.6 Reject intermixed or contaminated materials. Remove and dispose of rejected materials as directed by Engineer within 48 hours of rejection.

.7 Stockpile materials in uniform layers of thickness as follows:

.1 Max 1 m for coarse aggregate and base course materials.
.2 Max 2 m for fine aggregate and sub-base materials.
.3 Max 1.5 m for other materials.

.8 Complete each layer over entire stockpile area before beginning next layer.

.9 Uniformly spot-dump aggregates delivered to stockpile in trucks and build up stockpile as specified.

.10 Coning of piles or spilling of material over edges of pile will not be permitted.

.11 During winter operations, prevent ice and snow from becoming mixed into stockpile or in material being removed from stockpile.

3.5 STOCKPILE CLEANUP

.1 Leave stockpile site in a tidy, well drained condition, free of standing surface water.

.2 Leave any unused aggregates in neat compact stockpiles as directed by Engineer.

3.6 BASIS FOR PAYMENT

.1 All costs associated with work specified in this section shall be deemed to be included in the appropriate unit and lump sum price quoted in the Schedule of Quantities and Prices.

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This section specifies requirements for scarifying and reshaping of a road surface prior to the application of Selected Granular Base Course or asphaltic pavement.

PART 1 - GENERAL

1.1 MEASUREMENT FOR PAYMENT

.1 Scarifying and reshaping existing roadbed including compaction will be measured in square metres.

.2 Repair of soft areas will be measured in accordance with Section 02224.

PART 2 - PRODUCTS

Not applicable

PART 3 - EXECUTION

3.1 SCARIFYING AND RESHAPING

.1 Where directed by the Engineer the Contractor shall scarify and reshape a road surface prior to the application of Selected Granular Base Course or Asphaltic Pavement. The scarifying and reshaping shall be carried out within the lengths designated by the Engineer, and within the width to be covered by the proposed pavement plus 0.3 m on each side, or to such other widths as the Engineer may designate.

.2 Where the road surface consists of Selected Granular Base Course of a particular type, then the scarifying shall be to the full depth of the base course of that type, or to a depth of 300 mm, whichever is less.

.3 Where the road surface consists of subgrade then the scarifying shall be to a depth of not less than 300 mm.

.4 Unsuitable roadbed materials as determined by the Engineer, which are encountered during the scarifying operation shall be excavated to the lateral limits and depth directed by the Engineer and shall be disposed of as directed.

.5 No boulders greater than 150 mm in diameter shall be left within 300 mm of the top of the subgrade composed of Other Material. Such boulders over 150 mm in diameter which cannot be removed by the scarifying operation shall be removed by hand excavation, blasting or any other suitable method. All excavated boulders shall be removed from the subgrade and ditches and then disposed of.

.6 Excavations resulting from removal of boulders or Unsuitable Material shall be backfilled with approval material to the specified grades.

.7 Whenever the materials incorporated in the existing subgrade are insufficient to provide the required profile and cross-section, the Contractor shall add additional approved material as directed by the Engineer.

.8 The maximum variation from the specified profile and cross-section of the compacted scarified and reshaped road surface shall be 30 mm, except in those instances where paving is to take place directly on top of the scarified and reshaped material, in which case the finished surface shall not deviate at any place on a 3 metre straight edge by more than 10 mm.

.9 Where due to traffic use, or for whatever other reason, the scarified and reshaped road surface no longer lies within the required tolerance, then, before placing the next materials, the Contractor shall scarify and reshape the affected area again, at his own expense.

3.2 COMPACTING

.1 Road material disturbed by the scarifying and reshaping shall be compacted.

.2 Where subgrade is scarified and reshaped, the disturbed materials shall be compacted to not less than 95% maximum Standard Proctor Dry Density in accordance with ASTM D698-78 Method D.

.3 Where select granular base course is scarified and reshaped the disturbed materials shall be compacted to not less than 100% of the Maximum Standard Proctor Dry Density.

3.3 MAINTENANCE

.1 Maintain finished surfaces to degree of compaction and within tolerance specified until surfaces are covered with required granular or pavement course or until project is accepted by Engineer.

3.4 BASIS FOR PAYMENT

.1 All costs associated with work specified in this section shall be deemed to be included in the appropriate unit and lump sum price quoted in the Schedule of Quantities and Prices.

This section specifies requirements for the supply and the placing of Selected Granular Base Course Class "A", and granular sub-base Class "B".

PART 1 - GENERAL

1.1 MEASUREMENT FOR PAYMENT

.1 Measurement for Payment will only be made for those materials accepted for use under this specification and then only when incorporated into the work at the required locations and thicknesses as indicated on the plans. The contractor shall not be paid more than 110% of the calculated quantities based on theoretical limits.

.2 Selected Granular Base Course materials will be measured in tonnes of compacted material incorporated into the work within the areas and to the thicknesses indicated on the Contract Drawings unless otherwise specified.

.3 Weigh Scales shall be provided by the Contractor and shall conform with the requirements of Section 01155 - Weigh Scales. The Contractor will supply scale tickets, and the Engineer will issue tickets. Only loads certified by the Engineer as being placed in the works at the required locations shall be included in measurement for payment. The weight shall be computed in tonnes, rounded to one decimal place.

.4 Excavation of base, sub-base and sub-grade materials to correct deficiencies in sub-grade discovered during placing of base or sub base will be measured for payment as common excavation under Section 02224. Backfill of sub-grade with suitable materials will be measured for payment as imported backfill under Section 02224. Replacement of base and sub-base material will be measured for payment under this section.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 The granular materials shall be composed of clean, hard, uncoated particles and shall be free from organic matter, clay lumps and deleterious materials such as shale, slate, ochre and schists.

.2 Materials from deposits acceptable as to the quality of the particles, but deficient in sizes to provide the required gradation, may be accepted if the Contractor furnishes and satisfactorily incorporates into the product supplementary sizes from other sources to produce the required grading. If the deficiencies occur in Class "A" or Class "B" materials, corrections may be attempted by crushing to a smaller maximum particle size. In that event, the Engineer will furnish special grading limits on the actual maximum particle size.

.3 Materials shall be considered unsuitable even though particle sizes are within the specified gradation limits if particle shape or any other characteristic precludes satisfactory compaction or fails to provide a roadway suitable for traffic. If, in the opinion of the Engineer, an improved particle shape can be achieved by using a different crushing unit fro that proposed by the Contractor, then the Contractor shall supply and use a crushing unit of the type directed by the Engineer.

.4 Class "A" and Class "B" shall be processed by crushing and, when necessary, to eliminate surplus fines passing the 4.76 mm sieve, shall be screened and washed.

.5 Granular base material (Class "A") to following requirements:

.1 Gradation to be within following limits when tested to ASTM C136-84a and ASTM C117-87. The gradings shall not show marked fluctuations from opposite extremes of the limiting sizes, and giving a smooth curve without sharp breaks when plotted on a semi-log grading chart to ASTM E11-87.

ASTM Sieve Designation	% Passing
19.0 mm	100
9.51 mm	55 - 80
4.76 mm	35 - 60
1.20 mm	17 - 35
0.300 mm	7 - 20
0.075 mm	3 - 6 (Pit Source)
	3 - 8 (Rock Source)

.2 Liquid Limit ASTM D423-66 (1972) Maximum 25
.3 Plasticity Index ASTM D424-59 (1971) Maximum 0
.4 Los Angeles Abrasion ASTM C131-81 Max. % loss by weight: 35
.5 Crushed Fragments: 50%. The percent of crushed particles will be determined by examining the fraction retained on the 4.76 mm sieve and dividing the weight of the crushed particles by the total weight retained on the 4.76 mm sieve.
.6 CBR:AASHTO T193-72 Min 100 when compacted to 100% of AASHTO T180-74 Method D

.6 Granular sub-base material (CLASS "B") to following requirements:

.1 Gradation to be within following limits when tested to ASTM C136-82 and ASTM C117-80. The gradings shall not show marked fluctuations from opposite extremes of the limiting sizes, having a smooth curve without sharp breaks when plotted on a semi-log grading chart to ASTM E11-87.

ASTM Sieve Designation	% Passing
50.8 mm	75 - 100
15.9 mm	45 - 80
4.76 mm	25 - 55
1.20 mm	12 - 35
0.300 mm	7 - 20
0.075 mm	3 - 6 (Pit Source)
	3 - 8 (Rock Source)

.2 Other Properties as follows:

.1 Liquid Limit ASTM D423-66 (1972) Maximum 25
.2 Plasticity Index ASTM D424-59 (1971) Maximum 0
.3 Los Angeles Abrasion ASTM C131-81 Max % Loss by Weight 35.
.4 Crushed fragments: 50% The percent of crushed particles will be determined by examining the fraction retained on the 4.76 mm sieve and dividing the weight of the crushed particles by the total weight retained on the 4.76 mm sieve.
.5 CBR: AASHTO T193-72 Minimum 100 when compacted to 100% of AASHTO T180-74 Method D.

PART 3 - EXECUTION

3.1 INSPECTION OF UNDERLYING SUB-BASE OR SUB-GRADE

.1 The Contractor shall prepare the road surface in accordance with Section 02231 to the satisfaction of the Engineer before commencing placement of any selected granular base course materials.

3.2 PLACING

.1 The Contractor shall place all granular bases in such a manner as to prevent contamination by other materials and to prevent segregation. If, in the opinion of the Engineer, the methods and techniques used by the Contractor cannot overcome contamination or segregation, then the Engineer may direct a modification in these methods which may require the use of an approved spreader box or other acceptable device.

.2 All granular bases shall be placed in uniform layers such that the thickness of the compacted layer does not exceed 150 mm.

.3 Prior to closing down operations for each working day, all granular materials shall be bladed and compacted to the specified density.

.4 The materials shall be sprayed with water when and as directed by the Engineer, either to aid compaction or reduce dust nuisance or both. When water is added to aid compaction, it shall be applied immediately ahead of the compacting unit.

.5 Each layer of granular base shall be bladed shaped and compacted as necessary to produce the required profile and cross-section. The finished surface shall not deviate at any place on a 3 m straight edge by more than 20 mm for Class "B" and 10 mm for Class "A". The upper layer shall be maintained to these tolerances and to the specified density until completion of the contract, or until the surface is paved. This may require keeping the moisture content at the appropriate value during periods of dry weather in addition to regrading and recompacting as frequently as may be deemed necessary by the Engineer.

.6 Calcium chloride shall be applied uniformly by mechanical means when, and as directed by the Engineer under Section 02242.

3.3 SHOULDERING

.1 Unless otherwise directed by the Engineer the placing of granular materials for shoulder construction shall be carried out by means of an approved spreader. Spreader shall consist of a box to hold shouldering material and a suitable mechanism to control the width and rate of application and to prevent material getting onto the pavement.

.2 Granular materials for shoulder construction shall be placed directly on the shoulder and any spillage and materials dragged onto the pavement surface shall be immediately removed, without damage to the pavement, and the area so affected shall be thoroughly cleaned by the use of a power broom or other suitable method.

.3 The shoulders shall be sloped to the specified lines, grades and cross-section.

.4 Shouldering operations shall not commence along any section of pavement until 24 hours have elapsed from the time of completion of the final pavement course in that section, but the shouldering operations shall be completed within the next 24 hours on sections which are open to traffic.

3.4 COMPACTION

.1 All Class "A" and Class "B" materials placed on the roadway, or placed on shoulders, shall be compacted to not less than 100% of the maximum Standard Proctor Dry Density ASTM D698-78 Method D.

.2 Compaction operations shall be carried out as closely as possible behind the placing and spreading operation. At the end of each working day, all materials placed shall have been compacted to the specified density.

.3 Each layer of material shall be graded and compacted as specified before the next layer is placed.

.4 Where necessary to obtain the required compaction, the Contractor shall apply sufficient water by means of an approved distributor.

3.5 MAINTENANCE

.1 Maintain finished base in a condition conforming to this section until succeeding material is applied or until acceptance.

3.6 BASIS FOR PAYMENT

.1 All costs associated with work specified in this Section shall be deemed to be included in the unit price per tonne for Granular Base (CLASS "A") and Granular Sub Base (CLASS "B") in the Schedule of Quantities and Prices.

This section specifies the requirements for the placing of rip-rap for erosion protection at locations and to details indicated or directed by the Engineer.

PART 1 - GENERAL

1.1 MEASUREMENT FOR PAYMENT

.1 Rip-rap will be measured in cubic metres to measurement specified or directed by the Engineer.

.2 Transportation of material to placement site, access to placement site, and preparation of foundation base not to be measured for payment but considered incidental to work and included in the Schedule of Quantities and Prices.

.3 Filter Fabric will be paid in accordance with Section 02897.

PART 2 - PRODUCTS

2.1 STONE

.1 Rip-rap shall consist of clean, hard, durable rock, having a density not less than 2.6 tonnes/m^3. The rock material, if subjected to the Los Angeles Abrasion Test (ASTM C131-81), shall have a loss not greater than 35%. When tested for soundness, five cycles of magnesium sulphate (ASTM C88-83), the rock material shall have a loss of not greater than 15%.

.2 Stones for use in rip-rap shall consist of clean, hard, durable rock, free of cracks. Rock subject to marked deterioration by water or weather will not be accepted. Only those stones approved by the Engineer shall be used.

.3 The largest rocks procurable shall be supplied and in no case shall any fragment measure less than 0.0035 cubic metres in volume. In hand laid dry wall rip-rap, spalls shall be supplied to fill open joints. Field stones or boulders or other materials may be used when approved by the Engineer.

2.2 SOD

.1 Sod shall consist of a dense well rooted growth of permanent and desirable grasses. When sod is lifted it shall be covered with grass recently mowed to a length not more than 75 mm. Sod shall be in widths not less than 300 mm nor more than 450 mm, in thickness not less than the depth of the fibrous roots and in no case less than 25 mm.

.2 All sod shall be taken from good loamy soil. It shall be well permeated with roots; be uniform in texture and free from weeds; be in good healthy condition with no sign of decay, and contain sufficient moisture to maintain its vitality during transportation and placing.

2.3 GROUT

.1 Grout shall consist of a cement mortar composed of one part Portland Cement and three parts fine aggregate.

PART 3 - EXECUTION

3.1 EXCAVATION

.1 Should the Engineer require that excavation be carried out to prepare a foundation for the rip-rap, then the work shall be carried out in accordance with Section 02224.

.2 Rip-rap - Hand Laid Dry Wall; Hand Laid with Sod; Grouted;

.1 On slopes to be rip-rapped the slopes shall be fine graded to a uniform surface. Depressions shall be filled and thoroughly compacted.

.3 Rip-rap Random;

.1 Where directed by the Engineer, excavation for foundation shall be performed to provide a shelf or ledge to retain the rock so dumped.

3.2 PLACING

.1 Rip-rap - Hand Laid Dry Wall;

.1 Unless laid to form a flat apron, the rip-rap shall commence in a trench below the toe of the slope. Stones shall be placed by derrick or by hand. Stones shall be set normal to the slope, and placed so that the largest dimension is perpendicular to the face of the wall, unless such dimensions is greater than specified thickness of the wall.

.2 The largest stones shall be placed in the bottom courses and for use as headers through subsequent course. No shaping of stones will be required; but the Contractor shall build to reasonable semblance of courses with stones laid closely and voids chinked with spalls.

.3 Stones shall be placed in the wall in such a way that the rear of each stone shall be embedded into the slope of the embankment.

.4 On the completion of laying of rip-rap operations any open foundation trenches bordering the rip-rap shall be backfilled and tamped.

.2 Rip-rap Hand Laid With Sod;

.1 The placing of stones and the backfilling and tamping of trenches shall be as required under Section 02270.3.3.1.

.2 However, as the placing of stones proceeds sod shall be placed so that sod separates the stones from each other, both horizontally and vertically. The sod shall be placed so that there are no voids between stones.

.3 Sod shall not be placed upside-down.

.4 The sodding shall be trimmed so that the exposed edges of sods are flush with the exposed face of the rip-rap.

.3 Rip-rap - Grouted;

.1 The placing of stones shall be as required under Section 02270.3.3.1. Before applying mortar the surfaces of the stones shall be amply wetted. The spaces between the stones shall be filled with mortar, starting from the bottom and working to the top. The mortar shall be worked with suitable tools to completely fill all voids except that the outer faces of the stones shall be exposed. Excess mortar shall be removed with a stiff brush. Grouted rip-rap shall be cured in accordance with the requirements for curing concrete side walk.

.2 After mortar has set any foundation trenches bordering the rip-rap shall be backfilled and tamped.

.4 Rip-rap - Random;

.1 Rock material may be placed by dumping it into position over the surface to be rip-rapped.

.2 The Engineer will indicate whether the larger stones should be placed near the bottom of the slope, or near the top of the treated area to protect against scour. The Contractor shall make a reasonable endeavour to dump the larger stones where required. Placing shall be done in such a manner that the surface of the finished rip-rap shall have a uniform appearance.

3.3 BASIS FOR PAYMENT

.1 Payment for the Contract Unit price for rip-rap shall be full compensation for all labour, materials and equipment-use to supply stones, haul the materials to the site, trim and tamp ground that is to receive rip-rap treatment, and construct the required rip-rap treatment as specified.

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This section specifies the requirements for the placing of armour stone for erosion protection at locations and to details indicated or directed by the Engineer.

PART 1 - GENERAL

1.1 MEASUREMENT FOR PAYMENT

.1 Payment for supply and installation of armour stone will be measured in cubic metres unless otherwise specified.

.2 Transportation of material to placement site, access to placement site, and excavation for and preparation of foundation base not to be measured for payment but considered incidental to work and included in the Schedule of Quantities and Prices.

.3 Filter Fabric will be paid in accordance with Section 02897.

PART 2 - PRODUCTS

2.1 STONE

.1 Armour stone shall consist of clean, hard durable rock having a density not less than 2.6 tonne/m^3. The rock material is subject to the Los Angeles Abrasion Test (ASTM C131-81) shall have a loss not greater than 35%. When tested for soundness, five cycles of magnesium sulphate, ASTM C88-83, the rock material shall have a loss not greater than 15%.

.2 Armour stones shall be of an angular shape, and be of a uniform gradation. The least dimension of any stone shall not be less than one quarter of the greatest dimension.

.3 Individual armour stones shall be of a weight, or of a volume that is not less than that specified in the contract item in the Schedule of Quantities and Prices.

PART 3 - EXECUTION

3.1 PLACING

.1 Armour stones shall be placed within the limits required by the Engineer.

.2 The Contractor shall prepare a foundation for the armour stone by excavating a seat in the existing ground.

.3 Excavation shall be by means of a backhoe, or a clam a required, to carry out the excavation for the seat at the required location and to sufficient depth to provide a proper footing for the armour stone.

.4 Stones shall be placed by a crane, or similar equipment, starting at the bottom of the slope and working upwards.

.5 No pushing or dumping of the stones by bulldozers or other equipment will be allowed.

.6 The Contractor shall choose the stones and place them in such a way that the whole structure will be bound and consolidated to as great an extent as the nature of the rock will allow. Placing shall be done in such a manner that the surface of the armour stone treated slope shall have a uniform appearance. The thickness of the treated slope shall not be less than that specified in the item in the Schedule of Quantities and Prices.

.7 Care shall be taken by the Contractor to ensure that no stones are placed outside of the specified limits.

.8 If any armour stones are placed outside of the area to be treated or are washed out of place during construction, then they shall be removed or replaced by the Contractor at his own expense.

3.2 BASIS FOR PAYMENT

.1 Payment at the Contract Unit Price for armour stone shall be compensation in full for all labour, materials and equipment-use to supply the required armour stones, to transport the armour stones from the source to the place where the stones are to be placed, and to place the armour stones.

This section specifies requirements for supply and installation of baskets fabricated from wire mesh and filled with stone. A gabion structure consists of a number of baskets placed and wired together so that joints between baskets are as strong as the wire mesh, making a monolithic structure.

PART 1 - GENERAL

1.1 MEASUREMENT FOR PAYMENT

.1 Gabions of the size and type specified will be measured in cubic metres of stone filled wire mesh baskets incorporated into the work based on the nominal dimensions of the gabion units used.

.2 Measurement for volume of the gabion structure shall be the sum of the volumes of the individual rows of gabions. The volume of a row of gabions shall be calculated as the product of: the mean length of a row, times the mean height of the row measured along the face of the row, times the mean depth of the row measured perpendicularly to the exposed face.

.3 Only gabions placed within specified lines and grades will be measured for payment.

.4 Where excavation required for gabions overlaps excavation required for other work, then payment for excavation will be made in accordance with the specification for the other work as though no excavation were required for gabions.

.5 Mass excavation and backfill, if required, shall be paid in accordance with Section 02224.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Gabion baskets:

- .1 Fabricated so that sides, ends, lid and internal diaphragms readily assemble at site into rectangular baskets of sizes indicated.
- .2 Single unit construction or with joints having strength and flexibility equal to that of mesh.
- .3 When the length exceeds horizontal width, provide diaphragms of same mesh as gabion walls to divide basket into equal cells of a length not in excess of horizontal width.
- 4. Wire mesh to be uniform pattern wire woven in a triple twist pattern or welded wire with openings of approximately not greater than 80 x 100 mm and fabricated to be non-ravelling. Perimeter edges of mesh to be securely selvedged so that joints formed by tying selvedges are as strong as body of mesh.
- .5 Wire to have following mechanical properties:
  Wire for mesh: 3.0 mm diameter
  Wire for selvedges: 3.8 mm diameter
  Wire for binding: 2.2 mm diameter
  Minimum tensile: 400 mPa strength:
  Minimum elongation: 10%
- .6 Wire: hot dipped galvanized with a minimum of 250 g/m^2 and/or covered with a 0.5 mm thick polyvinyl chloride coating as specified in the unit price table.

.2 Stone fill:

- .1 Stone to be hard, durable and abrasion resistant and such that it will not disintegrate from action of wetting and drying, wave action, freezing and thawing cycles.
- .2 Stone to be minimum 100 mm to maximum 200 mm dimension unless otherwise specified.

2.2 PRODUCTION

.1 Gabions shall be so fabricated that the sides, ends, lid, base and diaphragms can be readily assembled at the construction site into rectangular baskets of the specified sizes. Gabions shall have all components interconnected in such a manner that the strength and flexibility at the point of connection is at least equal to that of the mesh.

.2 Where the length of the gabion exceeds its horizontal width, the gabion shall be divided by diaphragms, of the same mesh and thickness of steel wire as the body of the gabion, into equal cells whose length does not exceed the horizontal width. Diaphragms shall be secured in the proper position on the base section such that no additional tying will be required at this juncture.

.3 Gabions and gabion mats shall be supplied in the sizes and to dimensions indicated in the contract documents.

2.3 CERTIFICATION

.1 Gabions shall be accompanied by a certified report of tests showing that the products to be supplied meet the requirements of this specification, and by a statement of the system to be used in identifying the various sizes of gabions to be supplied.

.2 These requirements may be waived for subsequent supply, provided the supplier certifies that the gabions to be furnished are of the same specific material and manufactured as that covered by a certified report of the tests previously submitted and approved.

2.4 INSPECTION AND TESTING

.1 Notwithstanding the acceptance of certification, the authority reserves the right to make inspections and tests, and at such times as the Engineer may consider necessary to ensure that the materials supplied are in accordance with this specification.

.2 All materials failing to comply with the requirements of this specification shall be rejected.

.3 Rejection shall constitute automatic withdrawal of the Engineer's approval. Applications for re-approval shall be substantiated by an up-to-date test report as required for certification.

2.5 SHIPPING AND MARKING

.1 Gabions shall be shipped folded flat in bundles each containing a uniform number of one size only, except as necessary to complete an order, and weighing not more than 230 kg.

.2 Bundles shall be clearly marked to show the size and number of gabions. In addition, each gabion shall be clearly coloured coded, or otherwise suitably identified, to indicate the size.

.3 Gabion mats shall be shipped in rolls of 30 m long, 2 or 3 m wide with ends, sides and dividers attached to base.

PART 3 - EXECUTION

3.1 SITE PREPARATION

.1 All stumps, roots, debris, and loose boulders in excess of 100 mm in maximum dimension shall be removed and disposed off the right-of-way prior to placing of gabions. The necessary grading and excavation for gabion structure shall be carried out to such lines and grades as indicated in the contract and as required to provide a smooth uniform

gradient.

3.2 INSTALLATION

.1 Install gabions to lines and grades indicated or as directed by Engineer.

.2 The foundation shall be excavated to an even finish and to the required grade.

.3 The contractor shall assemble gabions according to the manufacturer recommendations.

.4 The contractor shall unfold each gabion to the open position. The four corner edges shall be wired to secure the gabion shape. The edges of the diaphragms shall be wired to the gabions walls in the correct position.

.5 Each assembled gabion shall be securely wired to the adjacent gabions along the top and the vertical edges prior to placing of stone.

.6 In assembling individual units, the selvedges at the corners shall be bound together and the selvedges of diaphragms shall be bound directly to the fabric with binding wire. The binding wire, throughout the length of the selvedged, shall be tightly looped around every other mesh opening in such a manner that single and double loops are alternated. Loops shall be separated by a distance not greater than 100 mm.

.7 To achieve better alignment and finish, the contractor shall stretch gabions before filling.

.8 Where gabion units are grouped together in whatever configuration is called for in the contract, each unit shall be secured to adjoining units by binding along and throughout the length of each contacting selvedged edge, in a manner similar to that described for assembling individual units.

.9 Gabions shall be assembled so as to leave no wire ends projecting outside the basket on any exposed surface.

3.3 FILLING BASKETS

.1 On exposed faces of gabions, place stones by hand with flattest surfaces bearing against face mesh to produce a satisfactory alignment and appearance. The remaining rock may be randomly placed.

.2 After the first gabion in a row has been filled to provide the necessary wight, the remaining rock shall be placed only after the baskets have been stretched taut by means of a standard fence stretcher or by other means approved by the Engineer and adjusted to proper alignment. Four or five gabions in a row may be stretched simultaneously.

.3 In order to prevent local deformation, when 0.91 m gabions or 0.46 m gabions are placed in rows, they shall be filled in stages. When the first basket has been filled, the second shall have been filled two-thirds of its depth and the third basket shall have been filled tone one-third of its depth.

.4 Fill basket cells in lifts of 300 mm and connect opposite walls with 2 tie wires after each lift.

3.4 PLACING OF CONNECTING WIRES

.1 When a gabion has been filled to a depth of 0.23 m in the case of 0.46 m gabions or to a depth of 0.30 m in the case of 0.91 m gabions, 2 horizontal connecting wires, one in each direction, shall be placed. In the case of 0.91 m gabions, an additional horizontal connecting wire shall be placed in each direction at the end 0.60 m mark when the basket has been two-thirds filled. Connecting wires shall be looped around 2 adjoining mesh openings and shall be pulled hand tight.

.2 Where 0.46 m depth gabions are used for channelling or revetment, connecting wires are not necessary.

3.5 PLACING GABIONS

.1 Place baskets in position prior to filling with stones.

.2 Wire adjacent baskets together at corners so that joints are as strong as mesh.

.3 For underwater placement, gabions may be prefilled. Provide special devices to handle filled baskets without distortion and to place gabions in position. Connect adjacent basket together when in place using a diver.

3.6 SECURING LIDS

.1 When the basket has been filled, the lid shall be bent over by hand and with the use of a pinch bar, if necessary, inserted at intervals between the selvedges of the lid and the selvedges of the top and sides. The lid shall be pulled until the selvedges coincide and shall be secured to the front and ends by binding wire in a manner as described under 3.1.

3.7 BASIS FOR PAYMENT

.1 Payment at the contract price for gabions shall be compensation for all labour and equipment used to supply, load and haul gabion baskets and tie wire to the installation site, assemble and place the gabion baskets, tie together the gabion baskets, place connecting wires, together with the supply and placing of stones and also the supply of anchors.

This specification covers the requirements for the supply and installation of various guide rail installation types together with the accompanying posts. Unless the type of guide rail installation is specified otherwise in the Schedule of Prices and Quantities, the type of guide rail shall be the standard type shown on Drawings 1220 to 1250.

PART 1 - GENERAL

1.1 MEASUREMENT FOR PAYMENT

.1 Measurement for payment for the supply and installation of Standard Type Guide Rail, Guide Rail with Additional Posts, or Type "A" Guide Rail, as the case may be, shall be the length of that type of guide rail placed within the limits specified or designated by the Engineer, measured in metres, rounded to one decimal place, measured end to end along the face of the railing and terminal sections.

.2 Measurement for payment for the supply and installation of Type "B" Guide Rail shall be the length of rail and terminal sections placed within the limits specified or designated by the Engineer, measured in metres, rounded to one decimal place, measured end to end along one side only.

.3 Where the guide rail structure is a composite of more than one type of guide rail installation, then measurement for payment shall be by the metre of each type of guide rail installation making up the composite.

.4 Payment by the metre shall include excavation of post holes, supply and install all posts, anchors, rail sections, angled rail sections, rail terminal sections, bolts, nuts, washers, spikes and nails, the backfill of post holes, compaction of backfill, the disposal of waste material, the trimming of posts, the supply and application of wood preservative, the installation of reflectors, the cleaning, pre-treatment and coating of steel rail with cold galvanizing compound where so required, all in accordance with this specification.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Guide rail parts furnished under these specifications shall be interchangeable with similar parts, regardless of their source of manufacture.

.1 The rail elements shall consist of a corrugated steel W-beam with corrugations symmetrical about the horizontal axis and such that the edges and centre of the rail element may contact each post.

.2 The individual rail elements shall be of the Standard Type (W-beam) consisting of 2.75 mm thick (12 gauge) rail of length not less than 4125 mm, having post bolt slots 3810 mm apart centre to centre; unless indicated elsewhere on a drawing or supplementary general condition in which case one additional post bolt slot will be placed at mid-span.

.3 The rail metal shall be open hearth oxygen furnace or electric furnace steel having an elongation of not less than 12 per cent in 50 mm and shall withstand a cold bend, without cracking, or 180^{o} around a mandrel of a diameter equal to 2 1/2 times the thickness of the plate.

.4 The rail elements shall be hot-dip galvanized before or after fabrication. In accordance with the specifications of ASTM Designation A-525 (Class 2 1/2 oz) or A123.

.5 Rail element joints shall be capable of withstanding a tensile load of not less than 350 kN without failure. The rail element shall not deflect more than 140 mm when tested as a simple beam with the traffic face up and with a 8.9 kN load applied at the centre of a 3650 mm span through a 76 mm wide flat bearing.

.6 Workmanship shall be equivalent to good commercial practice and all edges, bolt holes and surfaces shall be free of torn metal, burns, sharp edges and protrusions.

.7 Rail sections shall be supplied by the Contractor.

.8 Two certified copies of mill test reports of each batch from which the rail element is formed, shall be furnished to the Engineer, if so required.

.2 Angled rail sections shall be manufactured to meet the dimensions as shown on drawings 1220 to 1250. The sections shall be shop fabricated from rail sections conforming to the requirements. No punching, cutting or welding will be permitted in the field.

.1 The weld shall be cleaned, pre-treated and coated with cold galvanizing compound as outlined.

.2 Where corrugated steel beam is cut with a saw, drilled, or welded, the beam shall be thoroughly cleaned with a wire brush to remove scale, rust, slag residue, weld splatter, etc. and wiped clean. The cleaned surface shall receive at least one application of metal conditioner to de-oxidize, de-grease and phosphatize the metal surface to be treated if the surface is oily. Pre-mixed, ready-to-apply, liquid-zinc compound should be applied to the prepared, clean, dry metal surface. The cold-galvanizing compound must be of a type that imparts cathodic action against corrosion. The cold-galvanizing compound should have a minimum 50 mm overlap of the surrounding undamaged galvanized metal.

.3 Both metal conditioner and cold-galvanized compound must be approved by Underwriters Laboratories Inc. for component coatings - organic and meet or exceed Canadian Government Specifications 1-GP-181A. All materials must be applied in accordance with the manufacturer's instructions.

.4 The Contractor shall supply the angled sections.

.5 Contractors are advised that on request, angled sections may be obtained from the district depots. Each angled section may be obtained in exchange for a standard guide rail section, without additional charge to the Contractor.

.3 Rail terminal sections shall be of the standard type, as illustrated on the drawings 1220 to 1250. The metal and galvanizing shall be of the same thickness and quality as is stipulated for the rail sections. The Contractor shall supply the terminal sections.

.4 All bolts, nuts and washers shall conform to the specifications of ASTM Designation A-307 or A-325, except that rail splice bolts shall be button headed.

.1 Post bolts and splice bolts shall have shoulders of such shape and size that they fit into the bolt slot in the rails and thus prevent the bolt from turning.

.2 Post bolts shall be 16 mm diameter and 200 mm long for use with standard 150 mm x 150 mm posts, or 16 mm diameter and 250 mm long for use with 200 mm x 200 mm posts.

.3 Post bolt washers for the back of posts shall be 45 mm in diameter and 4 mm thick.

.4 Bolts for anchors shall be 16 mm diameter and 350 mm long for use with standard 150 mm x 150 mm posts and anchors, or 16 mm diameter and 450 mm long for use with 200 mm x 200 mm posts and anchors. Washers shall be 45 mm round and 4 mm thick.

.5 Spikes for anchors shall be 125 mm galvanized spikes.

.6 Bolts, nuts, washers and other fittings shall be hot-dip galvanized in accordance with the specification of ASTM Designation A-153.

.7 The Contractor shall supply the bolts, nuts, washers and spikes.

.5 Silver signal reflectors and yellow signal reflectors shall be of size 75 mm x 100 mm. The contractor shall supply both types of signal reflector.

.6 Nails for securing signal reflectors, shall be supplied by the Contractor and shall consist of 30 mm galvanized flat head nails.

.7 Timber for posts and anchors shall be sound, well seasoned structural grade lumber.

.1 Posts shall have minimum dimensions of 150 mm x 150 mm x 2000 mm, except in the particular case of posts to be used in tender items worded "Guide Rail with Additional Posts", as shown in the drawings, in which case posts shall have minimum dimensions of 200 mm x 200 mm x 2000 mm.

.2 Anchors shall consist of either one piece of guide rail post cut 450 mm long, or two pieces of 38 mm x 140 mm x 450 mm lumber.

.3 After cutting to size, posts and anchors shall be pressure treated with wood preservation in accordance with the requirements for Wood Preservation. The minimum weight of preservative retained per cubic metre of timber shall be 130 kg with empty cells.

.4 The Contractor shall supply all the required wood preservative treated posts and anchors.

.8 Wood Preservative for use in treating field cut ends of posts shall be of the same type and chemical composition as that used in the original treatment.

.1 The Contractor shall supply the wood preservative.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Galvanized materials shall be loaded, hauled and handled in such manner that galvanizing will not be damaged. All bare, abraded, and damaged surfaces shall be cleaned, pre-treated if required and coated with cold galvanizing compound as outlined above.

.2 Guide rail shall be placed to the lengths, lines and grades set by the Engineer. Except where directed otherwise by the Engineer, the guide rail shall be installed in accordance with the requirement of the drawings 1220 to 1250, as the case may be.

.3 An angled rail section shall be placed at the approaching traffic end of a run of guide rail, and a terminal section shall be placed at the other end, unless directed otherwise by the Engineer.

.4 The end post at an angled rail section shall have an anchor secured to the bottom of the post.

.5 Where a 150 mm x 150 mm x 450 mm timber anchor is used it shall be secured to the post by means of a galvanized nut and 16 mm diameter bolt 350 mm long together with two 45 mm round 4 mm thick galvanized washers.

.6 Where a double 38 mm x 140 mm x 450 mm lumber anchor is used it shall be secured to the post by means of four 125 mm galvanized spikes.

.7 Field boring and cutting to length of anchors will be permitted, provided that the hole is treated with two coats of wood preservative before driving the bolts and provided that the cut end is treated with two coats of wood preservative before burying.

.8 The Contractor shall excavate holes for the posts such that when placed in the holes the bottom of the posts are at lest 1000 mm below the ground surface.

.9 Posts shall be set plumb and to the established lines and grades and shall be placed at 3810 mm intervals, unless directed otherwise by the Engineer.

.10 The posts shall be firmly backfilled with selected material, free of large rock, placed in layers of thickness not greater than 100 mm. Each layer shall be thoroughly compacted before the next layer is placed. Should the backfill be dry then each layer shall be moistened before tamping.

.11 All backfill shall be compacted to 95% of Standard Proctor Density (ASTM D698-78).

.12 All excavated waste material shall be disposed of along the sides of fill, or in other locations as directed by the Engineer.

.13 The rails shall be secured to even lines such that the centre of the rail is 500 mm above the edge of pavement.

.14 The Contractor shall bore holes in the posts for the post bolts and treat the holes with two coats of wood preservative before driving the bolts.

.15 Rail elements and terminal sections shall be lapped so that the exposed ends will not face approaching traffic.

.16 The bolted connections of the rail element to the post shall be capable of withstanding a 22.5 kN pull at right angles to the lines of the railing.

.17 When the attachment of the rail elements to the posts has been completed, the tops of the posts shall be cut to a point 75 mm above the top of the rail as shown by Drawings 1220 to 1250. The tops of the posts shall be treated with two coats of wood preservative after cutting.

.18 Signal reflectors shall be attached to posts at terminal sections, posts at the welded angled sections, and to every fourth post in a length of guide rail. Silver reflectors shall be placed facing oncoming traffic and yellow reflectors shall be placed on the opposite side except for divided highway where the yellow reflectors will be omitted.

.19 The Contractor shall drill nail holes in the reflectors, bend the reflectors to the required shape and secure the reflectors with 30 mm galvanized flat head nails as shown on drawings 1220 to 1250.

3.2 BASIS OF PAYMENT

Payment at the contract price for the Supply and Installation of Guide Rail of a particular type shall be compensation in full for all labour, materials and equipment used.

This specification covers the requirements for the salvage of an existing guide rail and posts from one location, and the reinstallation of the guide rail at another location using either the salvaged rail sections and posts, or the salvaged rail sections and new posts.

PART 1 - GENERAL

1.1 MEASUREMENT FOR PAYMENT

.1 Measurement for payment for the Salvage and Reinstallation of Guide Rail shall be the length of the reinstalled guide rail placed within the limits designated by the Engineer, measured in metres, rounded to one decimal place, measured end to end along the face of the railing and terminal sections.

.2 No separate payment shall be made to the Contractor for the cost to:

- .1 Dismantle and salvage the rail sections.
- .2 Transport the rail sections and terminal sections to a secure storage site provided by the Contractor at his own expense.
- .3 Excavate and salvage the guide rail posts.
- .4 Transport the guide rail posts to a secure storage site provided by the Contractor at his own expense if required to be re-used or to a site designated by the Engineer if new posts are to be provided.
- .5 Store the rail sections and guide rail posts as required.
- .6 Backfill and compact the excavation.
- .7 Excavate holes for posts at the required new location.
- .8 Supply new preserved wood posts and anchors.
- .9 Transport the stored rail sections and rail terminal sections from the storage site to the place of installation.
- .10 Supply the bolts, nuts, washers and spikes.
- .11 Assemble and secure the anchors to the posts as required.
- .12 Assemble the guide rail to the required lines and grade.
- .13 Backfill post holes, compact backfill, dispose of excavated waste material, trim posts, supply and apply wood preservative to cut ends and drill holes, and install reflectors.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Rail Sections and Rail Terminal Sections

- .1 Only salvaged rail sections, angled rail sections and rail terminal sections deemed acceptable by the Engineer shall be used in the re-assembly.

.2 Bolts, Nuts, Washers and Spikes

- .1 All bolts, nuts and washers shall conform to the specifications of ASTM Designation A-307 or A-325, except that rail splice bolts shall be button headed.

- .2 Post bolts and splice bolts shall have shoulders of such shape and size that they fit into the bolt slots in the rails and thus prevent the bolt from turning.

- .3 Post bolts shall be 16 mm diameter and 200 mm long unless otherwise required. Post bolt washers for the back of the post shall be 45 mm round and 4 mm thick.

.4 Bolts for anchors shall be 16 mm diameter and 350 mm long unless otherwise required and washers shall be 45 mm round and 4 mm thick.

.5 Spikes for anchors shall be 125 mm galvanized spikes.

.6 Bolts, nuts, washers and other fittings shall be hot-dip galvanized in accordance with the specification of ASTM Designation A-153.

.7 The Contractor shall supply the bolts, nuts, washers and spikes.

.8 Should any of the salvaged bolts, nuts and washers be suitable for re-use, then the Contractor may use these.

.3 Signal Reflectors

.1 Silver signal reflectors and yellow signal reflectors shall be of size 75 mm x 100 mm. Reflectors to supplied by the Contractor.

.4 Nails for Reflectors

.1 Nails for securing signal reflectors, shall be supplied by the Contractor and shall consist of 30 mm galvanized flat head nails.

.5 New Posts and Anchors

.1 Timber for new posts and anchors shall be sound, well seasoned structural grade lumber.

.2 Posts shall have minimum dimensions of 150 mm x 150 mm x 2000 mm, unless otherwise specified on a drawing or supplementary general condition.

.3 Anchors shall consist of either one piece of 150 mm x 150 mm x 450 mm timber, or two pieces of 38 mm x 140 mm x 450 mm lumber.

.4 After cutting to size, posts and anchors shall be pressure treated with wood preservative. The minimum weight of preservative retained per cubic metre of timber shall be 130 kg with empty cells.

.5 Where the contract item is given as "Salvage and Reinstallation of Guide Rail with New Posts" then, the Contractor shall supply all the required wood preservative treated new posts and anchors.

.6 Re-usable Posts and Anchors

.1 Only salvaged posts and anchors deemed acceptable by the Engineer shall be used in the re-assembly, and then only if the contract item is given as, "Salvage and Reinstallation of Guide Rail with Salvaged Posts". Where the contract item is given as, "Salvage and Reinstallation of Guide Rail with New Posts" then, salvaged posts shall not be used.

.7 Wood Preservative

.1 Wood preservative for use in treating field cut ends of posts shall be of the same type and chemical composition as that used in the original treatment.

.2 The Contractor shall supply the wood preservative.

PART 3 - EXECUTION

3.1 DISMANTLING OF EXISTING GUIDE RAIL

.1 The Contractor shall exercise care in dismantling and removing rails and terminal sections so that they are not damaged and remain suitable for re-use. The rails and terminal sections shall be transported to, and stored at, a secure storage site provided by the Contractor at his own expense, pending their re-assembly at a new location.

.2 Should any material, designated for reinstallation, be damaged or lost by the Contractor, then the Contractor shall be charged with the costs of replacement with equivalent new material. Damaged material shall become the property of the Contractor.

3.2 REMOVAL AND SALVAGE OF EXISTING POSTS

.1 The Contractor shall exercise care in excavating posts so that they are not damaged and remain suitable for re-use.

.2 Where the contract item is given as, "Salvage and Reinstallation of Guide Rail with Salvaged Posts" then, the posts shall be transported to, and stored at a location designated by the Engineer.

.3 Where the contract item is given as, "Salvage and Reinstallation of Guide Rail with Salvaged Posts" then, the posts shall be transported to and stored at, a secure storage site provided by the Contractor at his own expense pending their re-use at a new location.

.4 Should any post designated for salvage, be damaged or lost by the Contractor, then the Contractor shall be charged with the cost of replacement. Damaged posts shall become the property of the Contractor.

3.3 BACKFILLING POST HOLES

.1 The Contractor shall backfill to the required grade using the excavated materials if suitable. Should the excavated material be unsuitable, or should there be insufficient suitable backfill material from the excavation, then the Engineer will direct that material from a cut of from a borrow area will be used to complete the backfilling.

.2 Backfill shall be placed in layers not exceeding 200 mm in thickness loose measurement. Each layer shall then be compacted to the required compaction before a further layer is placed.

.3 Backfill consisting of other material or other material borrow shall be compacted to not less than 95% of the Standard Proctor Density (ASTM D698-78).

.4 In rock backfill material where Standard Proctor test cannot be carried out, compaction shall be continued until a compaction is achieved that is equivalent to that obtained in a fill when there is no visible movement of fill under a vibrating vibratory compactor roller of length not less than one decimal five metres.

.5 The backfilled hole or trench shall be levelled and trimmed to provide sightly contours and adequate drainage.

3.4 INSTALLATION

.1 The rail sections, terminal sections and posts shall be transported to the location where they are required.

.2 Guide rail shall be placed to the lengths, lines and grades set by the Engineer. The guide rail shall be installed in accordance with the requirements of Drawings 1210 to 1250, except where directed otherwise by the Engineer.

.3 An angled rail section shall be placed at the approaching traffic end of a run of guide rail, and a terminal section shall be placed at the other end, unless directed otherwise by the Engineer.

.4 The end post at an angled rail section shall have an anchor secured to the bottom of the post.

.5 Where a 150 mm x 150 mm x 450 mm timber anchor is used it shall be secured to the post by means of a galvanized nut and 16 mm diameter bolt 350 mm long together with two 45 mm round 4 mm thick galvanized washers.

.6 Where a double 38 mm x 140 mm x 450 mm lumber anchor is used it shall be secured to the post by means of four 125 mm galvanized spikes.

.7 Field boring and cutting to length of anchors will be permitted, provided that the hole is treated with two coats of wood preservative before driving the bolts and provided that the cut end is treated with two coats of wood preservative before burying.

.8 Where the contract item is given as, "Salvage and Reinstallation of Guide Rail with Salvaged Posts" then, posts with the original anchors may be used provided that the anchor is sound. Should the anchor have been damaged during salvage then the Contractor shall replace the anchor on the post using new materials at his own expense.

.9 The Contractor shall excavate holes for the posts such that when placed in the holes the bottom of the posts are at least 1000 mm below the ground surface.

.10 Posts shall be set plumb and to the established lines and grades and shall be placed at 3810 mm intervals, unless directed otherwise by the Engineer.

.11 The posts shall be firmly backfilled with selected material, free of large rock, placed in layers of thickness not greater than 100 mm. Each layer shall be thoroughly compacted before the next layer is placed. Should the backfill be dry then each layer shall be moistened before tamping.

.12 All backfill shall be compacted to 95% of Standard Proctor Density (ASTM D698-78).

.13 All excavated waste material shall be disposed of along the sides of fill, or in other locations as directed by the Engineer.

.14 The rails shall be secured to even lines such that the centre of the rail is 500 mm above the edge of pavement or road surface.

.15 The Contractor shall bore holes in the posts for the post bolts and treat the holes with two coats of wood preservative before driving the bolts.

.16 Rail elements and terminal sections shall be lapped so that the exposed ends will not face approaching traffic.

.17 The bolted connections of the rail, element to the post shall be capable of withstanding a 22.5 kN pull at right angles to the lines of the railing.

.18 When the attachment of the rail elements to the posts has been completed, the tops of the posts shall be cut to a point 75 mm above the top of the rail as shown in Drawings 1210 to 1250. The tops of the posts shall be treated with two costs of wood preservative after cutting.

.19 Signal reflectors shall be attached to posts at terminal sections, posts at the welded angled sections, and to every fourth post in a length of guide rail. Silver reflectors shall be placed facing oncoming traffic and yellow reflectors shall be placed on the opposite side except for a divided highway where the yellow reflectors will be omitted.

.20 The Contractor shall drill nail holes in the reflectors, bend the reflectors to the required shape and secure the reflectors with 30 mm galvanized flat head nails as shown on Drawings 1210 to 1250.

.21 When reinstalling salvaged posts, the original reflectors shall be removed and new reflectors shall be attached.

3.5 BASIS OF PAYMENT

.1 Payment at the contract price for Salvage and Reinstallation of Guide Rail with New Posts, shall be compensation in full for all labour, materials and use of equipment.

.2 Payment at the contract price for Salvage and Reinstallation of Guide Rail with Salvaged Posts, shall be compensation in full for all labour, materials and use of equipment.

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This section covers the requirements for the supply and installation of pedestrian hand railing constructed of steel pipe complete with steel pipe posts. Locations shall be as shown on the drawings or as directed by the Engineer.

PART 1 – GENERAL

1.1 MEASUREMENT FOR PAYMENT

.1 The unit of measurement shall be the lineal metre as measured along the top rail between the centres of the posts and shall include installation and painting.

.2 The form and dimensions of the handrail shall conform to those given in the drawings. The length shall be as required to suit the particular site conditions. The contractor shall vary the spacing of the posts such that the spacing is uniform throughout the length of the rail.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Posts and rails shall consist of 50 mm inside diameter galvanized schedule 40 steel pipe conforming to ASTM standard A53.

.2 The railing shall be pre-fabricated before erection. Joints between rails and posts shall be made by cutting and fitting to ensure complete contact.

.3 Joints shall be welded.

.4 Welds and surrounding heat-damaged areas shall be galvanized after fabrication or otherwise protected from corrosion through the use of a zinc base coating.

.5 Railing shall be delivered to the site complete and ready for erection.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Holes for posts shall be drilled or preformed in concrete walls, walks, steps, sidewalks or headwalls as required.

.2 Posts shall be embedded in cement grouts in accordance with the bedding detail in the drawings.

.3 After installation, posts and rails shall be prepared and painted as follows:

.1 Clean galvanize steel with a metal conditioner as specified.

.2 Prime steel with one coat of zinc oxide primer as specified.

.3 Paint steel with two coats of exterior enamel in colour specified by the Engineer.

3.2 PAYMENT

.1 Payment at the contract unit price for the supply and installation of Handrail shall be compensation in full for all labour, materials and equipment used.

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This section specifies requirements for constructing sub-drains with granular filter material to lines and grades indicated or directed.

PART 1 - GENERAL

1.1 MEASUREMENT FOR PAYMENT

.1 Excavation and backfill will be measured under Section 02223.

.2 Bedding gravel and filter material will be measured in cubic metres of material incorporated into work to specified paylines indicated in the Contract Documents. No deduction to be made for volume occupied by drain.

.3 Supply and installation of sub-drains will be measured horizontally from center to center of manholes or catch basins over surface after work has been completed, in metres, for each type and size installed. In cases where drain is not connected to manholes or catch basins, measurement will be actual length in place.

.4 Filter Fabric will be paid in accordance with Section 02897.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Perforated corrugated steel pipe to meet following requirements:

.1 CSPI 501M.
.2 Asphalt coated, type AC or galvanized corrugated steel pipe.
.3 Metal thickness unless otherwise indicated:

Diameter	Thickness of Metal
150 to 200 mm	1.2 mm
250 to 300 mm	1.6 mm

.2 Plastic pipe and fittings: to CGSB 41-GP-29M+Amdt-Dec-76, nominal inside diameter 100 mm.

.3 Perforated plastic pipe and fittings to CSA B 182.1-M92 or CSA B 182.2-M92.

.4 Bedding gravel or crushed stone; hard, durable particles, graded evenly in size from 16 mm to 18 mm.

.5 Granular filter material to meet following requirements:

ASTM Sieve	% Passing
10.00 mm	100
5.00 mm	95 - 100
2.50 mm	80 - 100
1.25 mm	50 - 90
0.630 mm	25 - 65
0.315 mm	10 - 35
0.160 mm	1 - 10

PART 3 - EXECUTION

3.1 TRENCHING

.1 Do excavating, trenching and backfilling in accordance with Section 02223.

.2 Do not place bedding, filter material prior to approval of excavation.

3.2 BEDDING

.1 Place 100 mm layer of bedding material as indicated and compact to minimum 95% of corrected maximum dry density.

3.3 INSTALLATION

.1 Lay drains on prepared bed, true to line and grade with inverts smooth and free of sags or high points. Ensure barrel of each pipe is in contact with bed throughout full length.

.2 Commence laying at outlet and proceed in upstream direction. Lay perforated pipes with perforations downwards at angels indicated on the drawings. Make joints tight in accordance with manufacturer's instructions. Do not allow water to flow through pipes during construction except as approved. Make watertight connections to existing drains, new or existing manholes and catch basins where indicated or as directed. Surround and cover drain with filter material in uniform 150 mm layers to an elevation of at least 150 mm above top of drain and compact to at least 95% of corrected maximum dry density.

.3 Backfill remainder of trench to Section 02223.

3.5 BASIS FOR PAYMENT

.1 All costs associated with work specified in this section shall be deemed to be included in the appropriate unit and lump sum price quoted in the Schedule of Quantities and Prices.

This specification covers the requirements for constructing pipe culverts and culvert extensions and includes the requirements for excavation, bedding and placing of the pipe, and backfilling operations. This section does not include the specification for the supply and installation of structural plate pipe or pipe arch.

PART 1 - GENERAL

1.1 MEASUREMENT FOR PAYMENT

.1 Supply and installation of pipe culvert including couplings, will be measured in metres in place for each size, type and class of pipe. Measurement to be made over surface after work has been completed.

.2 Excavating, backfill and bedding for road culverts will be measured and paid in accordance with Section 02223.

.3 Excavation and backfill for driveway culverts will be included in the price for the culverts. Bedding for driveway culverts will be paid in accordance with Section 02223.

.4 Where Rip-Rap is required for driveway culverts, measurement for payment shall be made in accordance with Section 02270.

.5 Measurement for payment for water tight cut-off collars, prefabricated end sections, and debris racks where indicated on the contract drawings, shall be paid by the each. Cast in place concrete headwalls shall be measured and paid by the cubic meter. Handrails shall be measured and paid in accordance with section 02284.

PART 2 - PRODUCTS

2.1 ALUMINIZED STEEL PIPE MATERIALS

.1 Aluminized corrugated steel pipe, couplers, wyes, tees, bends, adapters, nuts and bolts shall conform to the requirements of the most recent revisions of the following specifications: AASHTO M274 and M36, ASTM A819 and A760 and CSA G401. Wall thickness as specified by the Engineer in the Schedule of Quantities and Prices, but not less than:

PIPE DIAMETER	**WALL THICKNESS**
100 mm to 500 mm	1.6 mm for any corrugation
600 mm to 1200 mm	2.0 mm for any corrugation
1400 mm to 1800 mm	2.0 mm for 76 mm x 25 mm helical corrugation
2000 mm to 2400 mm	2.8 mm for 76 mm x 25 mm helical corrugation & 125 mm x 25 mm annular corrugation

.2 Provide water-tight cut-off collars as indicated on the contract drawings.

.3 Prefabricated end sections, wing walls as indicated on the contract drawings.

2.2 CONCRETE PIPE MATERIALS

.1 Non-reinforced concrete pipe: to CSA A257.M92 for Class II strength.

.2 Reinforced concrete pipe: to CSA A257.M92 Class II strength.

.3 Rubber gaskets for joints: to CSA A257.M92.

.4 Bituminous joint filler: to CGSB 56-GP-4a, CGSB 56-GP-9a.

.5 Cement mortar joint filler:

.1 Portland cement: to CAN3-A5-M90 type 10.
.2 Sand: to CSA A82.56-M1976.
.3 Mortar to be one part by volume of cement to two parts of clean, sharp sand mixed dry. Add sufficient water after mixing to give optimum consistency for hand application.

2.3 PLASTIC PIPE MATERIALS

Couplers and plastic pipe, consisting of corrugated polyethylene pipe, shall be of a type, size and strength acceptable to the Engineer and in compliance with AASHTO M294-07-UL, Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm Diameter, ASTM D 3350, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials, and CSA-B182.8-06, Profile Polyethylene (PE) Storm Sewer and Drainage Pipe and Fittings. The Contractor shall provide the plastic pipe and couplers.

2.4 GRANULAR BEDDING AND BACKFILL

.1 Granular bedding and backfill material: Bedding and gravel or sand containing no particles larger than 50 mm and not more than 10% passing 0.075 mm sieve, unless otherwise specified. Material to be free of snow and frozen lumps. Bedding material shall not be placed on a frozen earth grade.

PART 3 - EXECUTION

3.1 TRENCHING AND BACKFILL

.1 Do trenching and backfill work to Section 02223.

.2 Trench line and depth requires Engineer's approval prior to placing bedding material or pipe.

.3 Do not backfill until pipe grade and alignment checked and accepted by Engineer.

3.2 DEWATERING

.1 The Contractor shall provide, at his own expense, all means of keeping the excavations free from water which affects the satisfactory placing of the pipe.

3.3 BEDDING

.1 Place minimum thickness of 150 mm of approved granular material on bottom of excavation and compact to minimum 95% of corrected maximum dry density.

.2 Shape bedding to fit lower segment of pipe exterior so that a width of at least 50% of pipe diameter is in close contact with bedding and to camber indicated or directed, free from sags or high points.

3.4 LAYING ALUMINIZED STEEL PIPE

.1 Commence pipe placing at downstream end. Ensure bottom of pipe is in contact with shaped bed or compacted fill throughout its length. Lay pipe with the inside circumferential laps facing downstream and longitudinal laps shall be located in the upper half of the pipe. Do not allow water to flow through pipes during construction except as permitted by Engineer.

3.5 JOINING ALUMINIZED STEEL CULVERTS

.1 Match corrugations or indentations of coupler with pipe sections before tightening. Tap couplers firmly as they are being tightened, to take up slack and ensure a snug fit. Insert and tighten bolts.

3.6 LAYING CONCRETE PIPE CULVERTS

.1 Begin at downstream end of culvert with female end of first pipe section facing upstream. Ensure barrel of each pipe is in contact with shaped bed throughout its length. Do not allow water to flow through pipes during construction except as permitted by Engineer.

3.7 JOINING CONCRETE PIPE CULVERTS

.1 Joints may be made with rubber gaskets, Concrete Pipe bituminous jointing compound or Portland cement mortar where a specific joint type is not otherwise specified.

.1 Rubber gasket joints:

.1 Install to manufacturers recommendations.
.2 Ensure that male ends are fully entered into female ends.

.2 Bituminous filled joint.

.1 Make joint with an excess of filler to form a continuous bead around outside of pipe and finish smooth on inside.

.3 Mortar joints.

.1 Prepare mortar as specified herein.
.2 Clean pipe ends and wet with water before joint is made.
.3 Place mortar in lower half of female end of pipe section in place.
.4 Apply mortar to upper half of male end of pipe section being installed.
.5 Join pipe ends and force joint up tight, taking care to ensure inner surfaces of abutting pipe sections are flush and even.
.6 Clean inside of pipe and annular space between ends of pipes after each joint is made.
.7 Fill joint with mortar and finish smooth and even.
.8 For pipes 800 mm or less in diameter fill joints before mortar in joints has set.
.9 For pipes over 800 mm in diameter postpone filling joint until backfilling has been completed. Re-clean joints before applying mortar.

3.8 LAYING PLASTIC PIPE CULVERTS

.1 Commence pipe placing at downstream end. Ensure bottom of pipe is in contact with shaped bed or compacted fill throughout its length. Do not allow water to flow through pipes during construction except as permitted by Engineer.

.2 Plastic pipe shall be laid on a bed of 150mm granular bedding material. Where excavation for foundation is required, the excavation shall be to 150mm below the proposed invert elevations so that granular bedding material may be placed to provide a bed for the culvert. The granular bedding material shall be placed and shaped to conform to the underside of the culvert, and graded so as to provide a uniformly firm bed throughout the length of the culvert.

.3 The cover shall not be less than the manufacturer's recommended minimum cover.

3.9 JOINING PLASTIC PIPE CULVERTS

.1 Plastic pipe culverts shall be joined with couplers recommended by the manufacturer of the pipe being installed.

3.10 BACKFILLING

.1 Backfill around and over culverts as indicated or as directed.

.2 Place approved backfill material in 150 mm layers to full width, alternately on each side of culvert so as not to displace it.

.3 Compact each layer to 95% of Corrected Maximum Dry Density, taking special care to obtain required density under haunches.

.4 Protect installed culvert with minimum 600 mm cover of compacted fill before heavy equipment is permitted to cross during construction of project. Width of fill, at its top, to be at least twice the diameter or span of pipe and with slopes not steeper than 1:2.

.5 For driveway culverts minimum cover shall be as directed by the Engineer.

.6 Frozen materials are not acceptable as backfill or cover material.

3.11 PROTECTION FROM TRAFFIC

.1 Prior to allowing the movement of construction equipment or any vehicular traffic over the completed structure the depth of backfill over the culvert shall be at least equal to the minimum required for protection as specified in the contract.

3.12 BASIS FOR PAYMENT

.1 Payment at the contract price for corrugated steel pipe products shall be full compensation for all labour, equipment, and materials of the size, thickness, shape, and length specified; for any hardware required for proper installation; and for the handling and delivery.

This section specifies requirements for constructing, cleaning, deepening, widening and relocating water channels, other than those ditches which are contiguous with main grading operations, to design lines, grades, dimensions and typical cross sections shown on plans or established by Engineer.

PART 1 - GENERAL

1.1 MEASUREMENT FOR PAYMENT

.1 Channel excavation for new channels will be measured in cubic metres in the original location.

- .1 Channel Excavation (Common): will be measured in cubic metres to theoretical paylines.
- .2 Channel Excavation (Rock): Volume of rock excavated will be calculated from cross-sections of original rock surfaces, design grade and typical cross-sections as shown on the Contract Drawings.

.2 Where depth indicated on the Drawings or directed by the Engineer is less than 300 mm below original rock surface, depth excavated for measurement purposes will be taken as 300 mm.

.3 Cleaning and deepening of existing channels will be measured in metres of channel.

PART 2 - PRODUCTS

.1 Not applicable.

PART 3 - EXCAVATION

3.1 EXCAVATION

.1 Excavate to design lines, grades and cross-sections indicated.

.2 Deepen existing channels to design lines, grades and cross-sections indicated and clean channel bottom of debris and roots.

.3 Do not place excavated materials adjacent to channel in a manner that will impede flow of surface water from adjacent land.

.4 Upon completion of excavation, clean and trim site.

.5 Dispose of excavated materials as directed by Engineer.

3.2 BASIS FOR PAYMENT

.1 All costs associated with work specified in this section shall be deemed to be included in the appropriate unit and lump sum price quoted in the Schedule of Quantities and Prices.

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This section specifies requirements for supply of timber and necessary fastenings, fabrication, placing and ballasting of timber cribwork as specified.

PART 1 - GENERAL

1.1 MEASUREMENT FOR PAYMENT

.1 Timber cribwork will be measured in cubic metres of completed work including rock ballast as specified in the Contract Documents.

.2 Cubic measure of cribs will be determined by product of following dimensions measured in place:

- .1 Height: average of measurements taken at each vertical from bottom of lowest timber to top side of uppermost course of timber.
- .2 Width: average of measurements between outside faces of exterior longitudinal timbers, each width measured on top ties of each row of cross ties.
- .3 Length: measured horizontally along centre-line of crib between outside faces of exterior cross ties.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Timber: use timber graded and stamped in accordance with applicable grading rules and standards of associations or agencies approved to grade lumber by Canadian Lumber Standards Administration Board of CSA.

.2 Species: Douglas Fir Group A.

.3 Grade: No. 1 Structural

.4 Grading authority: NLGA

.5 Preservative treatment: to CSA 080-M1989, Commodity Standard Pressure Treated.

- .1 For fresh water cribwork no wood preservative shall be used.
- .2 For salt water cribwork treat to CSA 080 M1989, commodity standard 080.18, Table 1 and its referenced standard, with the following minimum assay retentions: Waterborne preservatives 24 kg/m^3, oil-borne preservatives 30 kg/m^3.

.6 Miscellaneous steel:

- .1 Wire nails, spikes, staples: to CSA B111-1974.
- .2 Bolts, nuts, washers: to ASTM. A307-80.
- .3 Ogee washers: to Timber Design Manual 1974 issued by Laminated Timber Institute of Canada and as follows: ogee washers to be of cast iron free from injurious defects or impurities.
- .4 Steel straps and plates: to CAN3-G40.21-M92 Grade 350W.
- .5 Drift Bolts: to G40-21-M92 from round stock, button head and diamond or wedge point.

.7 Ballast stone for filling cribs: minimum dry bulk density in place of 2600 kg per cubic metre. Supply hard durable quarry stone containing no organic material, silt, clay or foreign substances. Ballast stone to be well graded with maximum sizes not exceeding 200 mm and not more than 10% of material by mass passing 25 mm sieve.

PART 3 - EXECUTION

3.1 PREPARATION

.1 Dredge area of crib base to elevations shown on the contract drawings.

.2 Before construction provide sufficient ballast to completely fill cribs.

.3 Take closely spaced accurate soundings precisely located by template to determine actual slope of base area of crib and construct crib bottom to match base slope.

3.2 CRIB CONSTRUCTION

.1 Precut timber prior to preservative treatment. There will be no field application of preservative treatment when pressure treated timbers are to be used for a water intake cribwork structure.

.2 Bore holes for drift bolts 1.5 mm smaller diameter than bolt and for full length of bolt. Bore holes for machine bolts to same diameter as bolts.

.3 Construct timber cribwork to full height prior to sinking in final position in work.

.4 Levelling pieces: place levelling pieces beneath bottom timbers in such a manner that they will conform to shape of base area. Place levelling pieces horizontally so that succeeding pieces will be solidly secured at intersections of bottom timbers and vertical posts and other levelling pieces with machine bolts of proper length.

.5 Bottom timbers: place bottom timbers lengthwise, and crosswise to form bottom three courses of cribs. Crosswise bottom timbers to be of one piece. Lengthwise bottom timbers to be minimum 6 m long. Splice timbers in lengthwise direction at centre of a 1.5 m long splice block. Stagger butt joints in bottom timbers so that no joint is further than 0.5 m from a crosswise timber and joint will not be located in same bay as a joint in course below. Secure three courses of bottom timbers together with machine bolts at every intersection with each other and vertical posts.

.6 Ballast floor: place ballast floor on pockets on bottom or middle course of bottom timbers. Secure each ballast floor timber to bottom timbers with drift bolts so that adjacent ballast floor timbers are not secured to same bottom timber.

.7 Longitudinals: butt join exterior and interior longitudinals in centre of a 1.5 m block. Secure block to lower timber with drift bolt at centre and secure longitudinals to be spliced to block with drift bolts at ends. Longitudinals to be as indicated on the contract drawings. Stagger joints in longitudinal timbers so that adjacent longitudinals, directly above or below, will not be joined in same bay or on same vertical post. Secure longitudinals to intersection of cross ties with drift bolt and to intersection of vertical posts with machine bolt every third course of longitudinals. Countersink machine bolts on exterior face above LNT.

.8 Cross ties: to be in one length across cribs. Secure cross ties to intersection of longitudinals with drift bolt and to intersection of vertical posts with machine bolt every third course of cross tie.

.9 Vertical posts: to be in one length from bottom of cribwork to top of cribwork. Extend front posts to elevation LNT.

.10 Fillers: place filler timber as indicated. Secure fillers with drift bolts to timbers immediately below.

.11 Drift Bolts: will have length equal to thickness of timbers to be fastened less 50 mm.

.12 Machine Bolts: will have length equal to thickness of timbers being fastened plus thickness of washers plus 40 mm less depth of countersinking, if countersinking is indicated on the contract drawings.

3.3 HANDLING TREATED TIMBER

.1 Handle treated material to avoid damage causing alteration in original treatment.

.2 Treat in field, cuts and damage to surface of treated material with an appropriate preservative as described in CSA 080-M89. Ensure that damaged areas such as abrasions nail and spike holes, are thoroughly saturated with field treatment solutions as per CSA 080-M89.

.3 Do NOT field treat any timbers when being used for a water intake structure.

3.4 BALLAST

.1 Place ballast stone in a manner which will not damage timber cribwork. Engineer to approve placing method.

.2 Place ballast so that differential height of fill between adjacent cells will be less than 600 mm.

3.5 TOLERANCES

.1 Construct crib overall dimensions to tolerance of 1 in 300.

3.6 BASIS FOR PAYMENT

.1 All costs associated with work specified in this section shall be deemed to be included in the appropriate unit and lump sum price quoted in the Schedule of Quantities and Prices.

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PART 1 - GENERAL

1.1 MAXIMUM DRY DENSITY

.1 Maximum dry density to be determined to ASTM. D698-78 Method D with particles exceeding 16 mm removed from sample.

1.2 CORRECTED MAXIMUM DRY DENSITY

.1 Where the in-situ material being tested for compaction contains particles exceeding #4000 sieve, maximum dry density will be corrected using the following equation:

.1 $$D = \frac{D1 \times D2}{(F1)(D2)+(F2)(D1)}$$

Where:

D = corrected maximum dry density kg/m^3 for in-situ material being tested.

F1 = fraction (expressed as a decimal) of total field sample passing ASTM. 4.75 mm sieve

F2 = fraction (expressed as a decimal) of total field sample retained on ASTM. 4.75 mm sieve (equal to 1.00 - F1)

D1 = maximum dry density, kg/m^3 of material passing ASTM. 4.75 mm sieve

D2 = bulk density, kg/m^3, of material retained on passing 4.75 mm sieve, equal to 1000 G where G is bulk specific gravity (dry basis) of material when tested to ASTM. C127-84.

.2 For free draining soils and soil-aggregate mixtures, determine D1 (maximum dry density) to ASTM. D2049-69 dry method.

PART 2 - PRODUCTS

.1 Not applicable to this section.

PART 3 - EXECUTION

3.1 BASIS FOR PAYMENT

.1 No separate or direct payment will be made for work specified in this Section. Costs of all work specified is deemed to be included in the lump sum and unit prices quoted in the Schedule of Quantities and Prices.

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This method covers measurement of loss of Marshall Stability resulting from action of water on compacted asphalt paving mixtures containing penetration grade asphalt cement. Numerical index of reduced stability is obtained by comparing stability of specimens determined in accordance with usual Marshall procedures with stability of specimens that have been immersed in water for prescribed period.

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

.1 Do testing in accordance with ASTM D1559-82 except where specified otherwise.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Representative samples of each asphalt paving mixture proposed for use on project.

2.2 APPARATUS

.1 One or more water baths with automatic controls for immersing specimens. Baths normally used for Marshall test are suitable for test herein described.

.2 Scale and water bath with suitable accessory equipment for weighing test specimens in air and in water to determine their densities.

.3 Supply of flat transfer plates of glass or metal. One of these plates to be kept under each specimen during immersion period and during subsequent handling, except when weighing and testing, to prevent breakage or distortion of specimens.

.4 Apparatus required to conduct Marshall test.

PART 3 - EXECUTION

3.1 PREPARATION OF TEST SPECIMENS

.1 Prepare at least 8 specimens for each test.

.2 Compact test specimens using 50 blows on each face.

3.2 TEST PROCEDURE

.1 Weigh each specimen in air and in water. Latter should be done as rapidly as possible to minimize absorption.

.2 Calculate specific gravity of each specimen as follows:

$$\text{Specific Gravity} = \frac{A}{B}$$

Where A = weight of specimen in air in grams
B = weight of specimen in water in grams

.3 Sort each set of 8 specimens into 2 groups of 4 specimens each so that average specific gravity of specimens in group 1 is essentially the same as that of group 2.

.4 Test group 1 specimens for Marshall stability.

.5 Immerse group 2 specimens in water for 24 h at 60 deg C then test immediately for Marshall stability.

3.3 TEST REPORT

.1 Report numerical index of resistance of asphaltic paving mixtures to detrimental effect of water, expressed as percentage of original stability retained after immersion period.

.2 Calculate index as follows:

$$\text{Index of Retained Stability} = \frac{S2}{S1} \times 100$$

Where: S1 = Marshall stability of group 1 (average)
S2 = Marshall stability of group 2 (average)

3.4 BASIS FOR PAYMENT

.1 No separate or direct payment will be made for work specified in this Section. Costs of all work specified is deemed to be included in the lump sum and unit prices quoted in the Schedule of Quantities and Prices.

This method of test is intended for measuring wearing qualities of thin, fine aggregate asphalt surfacing mixtures, such as slurry seals, under wet abrasion conditions. It may also be used for design purposes to establish optimum quantity and type of binder consistent with wear resistance of surfacing mixture.

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

.1 Do Wet Track Abrasion Test (WTAT) in accordance with procedure outlined by W. J. Kari and L. D. Coyne published in Proceedings of Association of Asphalt Paving Technologists Vol. 33, 1964 except where specified otherwise.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Aggregate: representative samples of aggregate proposed for use in paving mixture and meeting specified gradation requirements for mixture.

.2 Emulsified asphalt: SS-type specified for project.

.3 Portland cement or hydrated lime: as required.

2.2 APPARATUS

.1 Scale: capable of weighing 500 grams to within plus or minus 1.0 grams.

.2 Planetary type mechanical mixer (such as Hobart C-100 made by Hobart Mfg. Co): equipped with 2,265 g weighted rubber hose holding device (abrasion head) which has approximately 12 mm free up-and-down movements in shaft sleeve.

.3 Heavy 3 mm flat bottom metal pan: approximately 325 mm diameter with 50 mm vertical side walls (1 mm thick or heavier) having 4 equi-spaced screw clamps capable of securing 285 mm diameter specimen to bottom of pan.

.4 Heavy thickness round bottom bowl (such as type obtainable with Hobart C-100): to contain sample during mixing.

.5 Long-handled serving spoon: of sufficient length to project approximately 100 mm or more out of round bottom bowl during stirring.

.6 150 to 175 mm diameter metal funnel: with tubular opening tapering from 20 to 12 mm at bottom.

.7 285 mm diameter discs: cut from smooth roofing felt.

.8 Equipment used in specimen preparation: circular Lucite template 6 mm thick with 280 mm diameter circular opening and 305 to 355 mm short handled window squeegee.

.9 Forced draft constant temperature oven: thermostatically controlled at 60 deg C plus or minus 3 deg C to ASTM E145-68 (1981 Type IIB).

.10 Constant temperature water bath controlled at 25 deg C plus or minus 1 deg C.

.11 Reinforced rubber hose (equivalent to Gages Rubber Company 35-B-a 3 ply contractor's water hose): 20 mm inside diameter and approximately 6 mm wall thickness. Hose to have natural rubber/Dane3 core (ASTM Designation "R") and a Neoprene cover (ASTM Designation "SC"). Hose shall be cut into 125 mm lengths and drilled with two paired 10 mm holes aligned on 100 mm centres. Avoid drilling holes on convex or concave side of hose.

.12 Wooden prop block: for supporting Hobart platform assembly in position during testing.

PART 3 - EXECUTION

3.1 PREPARATION OF TEST SPECIMEN

.1 Quarter air-dried aggregate meeting specified gradation requirements to obtain sufficient material for required number of 600 gram batches. Make three tests for each level of binder treatment.

.2 Weigh 600 grams of aggregate into mixing bowl. Using spoon, stir in sufficient water to completely change colour of sample from light to dark.

.3 Incorporate weighed amount of SS-type emulsion (usual range is 15, 20 and 25% of emulsion based on mass of aggregate) by mixing with spoon. Use a circular motion combined with back and forth motion.

.4 Adjust to funnel flow mix consistency by adding water in increments, stirring after each addition, followed by testing ability of slurry to flow through 12 mm opening funnel. Lowest water content at which mixture will flow through funnel is then selected as slurry pouring consistency. Note: Mixtures which segregate will not be acceptable. They are unsuitable for slurry work unless this segregation can be overcome by additions of Portland Cement or hydrated lime or by a change of gradation (blending). If free flowing consistency is unattainable without segregation discard batch. Repeat steps 1, 2 and 3 with addition of Portland Cement or hydrated lime to aggregate (suggest 0.5% to 1.0% based on mass of aggregate). Subsequent mixtures would include amount of Portland Cement of hydrated lime necessary to overcome segregation.

.5 Place opening in Lucite template over 285 mm diameter disc of roofing felt. Pour slurry onto felt.

.6 Squeegee slurry level with top of template with a minimum of manipulation (excessive squeegeeing contributes to segregation). Scrape off excess material and discard.

.7 Remove Lucite Template, place moulded specimen in 60 deg C oven and dry to constant mass for a minimum of 24 h.

3.2 TEST PROCEDURE

.1 Remove dried specimen from 60 deg C oven, allow it to cool to room temperature and weigh.

.2 After weighing, place specimen in 25 deg C water bath for 60 to 75 min.

.3 Remove specimen from water bath and place in 330 mm diameter flat bottom pan. Secure specimen to pan bottom by tightening four wing-nut washers.

.4 Completely cover specimen with at least 6 mm depth of distilled water at 25 deg C.

.5 Secure pan containing specimen on platform of Hobart C-100 machine. Lock rubber hose abrasion head on shaft of Hobart machine. Elevate platform of Hobart machine until rubber hose bears on surface of specimen. Use prop block to support platform assembly during testing.

.6 Operate Hobart machine on low speed (144 shaft r/min at 42.6 turn of planetary). Operate machine for 5 min plus or minus 1 s running time. Use a suitable laboratory timer. Note: Install fresh section of hose after completion of each test. It is permissible to rotate hose one-half turn after each test run and obtain fresh section for next specimen.

.7 Remove specimen from pan after abrasion cycle and wash off debris. Place washed test specimen in 60 deg C oven and dry to constant mass.

.8 Remove dried specimen from oven, allow to reach room temperature and weigh. Difference between this mass and mass obtained in Step 1 is multiplied by 33.3 to express loss in grams per square metre (wear value). Note: Factor 33.3 is used to convert loss for actual abraded area, 0.03 m^2, to a 1 m^2 basis. (33.3 value only applies to Hobart C-100 machine with a 380 mm rubber hose).

3.3 TEST REPORT

.1 Report following:

- .1 Average wear value (WTAT loss) in grams per square metre for each quantity of emulsified asphalt.
- .2 Total water added (per cent based on aggregate mass) to arrive at pouring consistency.
- .3 Tendencies observed towards mix segregation during preparation of test specimens.
- .4 Observations as to texture, signs of surface skinning, or tackiness in specimen at start of test procedure.
- .5 Percent of Portland cement added to overcome mix segregation at free-flowing consistency.

3.4 BASIS FOR PAYMENT

.1 No separate or direct payment will be made for works specified in this Section. Costs of all work specified is deemed to be included in the lump sum and unit prices quoted in the Schedule of Quantities and Prices.

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This method test is intended for measuring coating ability of fine aggregate used for thin asphalt surfacing mixtures containing emulsified asphalt, such as slurry seals.

PART 1 - GENERAL

.1 Not applicable

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Aggregate: representative sample of aggregate proposed for use in surfacing mixture. Test to be performed on portion of aggregate passing 2.80 mm sieve and regained on 1.18 mm sieve.

.2 Emulsified asphalt: SS-1 or SS-1h as specified for project.

2.2 APPARATUS

.1 Drying oven, scale, standard sieves, porcelain dish, spatula, 250 ml graduated cylinder with stopper.

PART 3 EXECUTION

3.1 PREPARATION OF TEST SPECIMEN

.1 Thoroughly wash aggregate with tap water and rinse in distilled water.

.2 Oven dry aggregate for 24 h at 140 deg C.

.3 Separate oven dried aggregate into 100 g specimens. One specimen required for each test. Prepare sufficient aggregate for duplicate testing.

3.2 TEST PROCEDURE

.1 Place 100 g specimen of aggregate into porcelain dish, add 2 ml. of freshly boiled distilled water and thoroughly mix by spatula until aggregate is completely wetted.

.2 Place 100 g of emulsified asphalt into 250 ml graduated cylinder, add wetted aggregate specimen, cap and invert cylinder 4 times.

.3 Pour contents of cylinder over a 0.85 mm sieve and allow to drain for 5 min.

.4 Transfer material retained on 0.85 mm sieve to porcelain dish and place in 100 deg. C oven for 2 h.

.5 Observe initial coating of aggregate when removed from oven. Thin brownish translucent areas are to be considered fully coated.

.6 Water immersion: completely cover test specimen in porcelain dish with freshly boiled distilled water and allow to stand at room temperature for 18 to 20 h.

.7 Visual estimation after water immersion period:

.1 Carefully remove floating film on water surface in dish without disturbing test specimen.
.2 With aid of a shaded lamp, estimate percentage of aggregate surface remaining coated and record results.

.8 Visual estimation after boiling period:

.1 Add freshly boiled distilled water to test specimen in dish and boil gently for 8 min.
.2 Allow dish and contents to cool to room temperature.
.3 Pour fluid from test specimen and add freshly boiled distilled water to cover specimen.
.4 Estimate percentage of aggregate surface remaining coated and record results.

3.3 TEST REPORT

.1 Report coating ability of aggregate expressed as percentage of aggregate surface of test specimens remaining coated;

.1 When removed from oven after initial coating stage.
.2 After water immersion period.
.3 After boiling period.

3.4 BASIS FOR PAYMENT

.1 No separate or direct payment will be made for work specified in this Section. Costs of all work specified is deemed to be included in the lump sum and unit prices quoted in the Schedule of Quantities and Prices.

This section specifies requirements for constructing Portland cement concrete walks, curbs and gutters, along with the installation of catch basin frames and grates which lie within the flow lines of the curb and gutter system, to lines, grades, dimensions and typical cross-sections or directed.

PART 1 - GENERAL

1.1 MEASUREMENT FOR PAYMENT

.1 Excavation: will be measured in accordance with Section 02224. Limit for excavation shall be 300 mm each side of the concrete structure.

.2 Granular base (CLASS "A") and sub base (CLASS "B"): will be measured in cubic metres within the areas and to the thicknesses indicated on the contract drawings, unless otherwise specified. Limit for bedding will be 300 mm each side of the concrete structure.

.3 Concrete walks, combined curb and sidewalk, curb and gutter, and concrete curb will be measured in metres to dimensions specified and shown on the contract drawings. The unit of measurement includes lowbacks, pedestrian ramps, bull noses and any other modifications inherent in the system. Driveway ramps will be measured separately in metres along the sidewalk to the dimensions specified and as shown on the contract drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Concrete: to Section 03300.

.2 Concrete mix design to produce 32 MPa minimum compressive strength at 28 days and containing 20 mm maximum size coarse aggregate with water/cement ratio and Air Category to CAN3-A23.1M90, Table 8 for Class "C2" exposure and 80 mm slump at time and point of deposit. Air Entrainment to CAN3-A23.1-M90, Table 10.

.3 Joint filler: Sikaflex La, 1 component, polyurethane base, elastomeric sealant conforming to Federal Specification TT-S-00230C, Type II, Class "A" and CGSB-16M, Type 2, or equivalent.

.4 Granular sub base (CLASS "B") to Section 02233.

.5 Curing compound to ASTM C309-74(1981) Type 2 Class.

.6 Boiled linseed oil to CGSB 1-GP-2M.

.7 Non-staining mineral type form release agent: chemically active release agents containing compounds that react with free lime to provide water soluble soap.

.1 Acceptable product: Noxcrete by Bird-Goodco, Formshield by W.R. Grace.

.8 Fiber expansion joint filler: Meadows Sealtight Fiber Expansion Joint Filler conforming to ASTM D1751-83, or equivalent.

.9 Wire mesh: To CSA G30.5-M1983 (R1991).

.10 Reinforcing steel: To Section 03200.

PART 3 - EXECUTION

3.1 GRADE PREPARATION

.1 Excavate to lines, depths and widths indicated or directed.

.2 Construct embankments using excavated material free from organic matter or other objectionable materials. Provide for minimum 0.5 m shoulders, where applicable, outside of neat lines of concrete.

.3 Provide borrow material for fill when a deficiency of excavated material exists. Place fill in 150 mm layers and compact to at least 100% of maximum density ASTM D698-78 method D.

3.2 GRANULAR BASE

.1 Obtain Engineer's approval of sub-grade before placing granular base.

.2 Place granular base material to lines, widths, and depths indicated or directed. Compact to at least 100% of maximum density ASTM D698-78 method D.

3.3 CONCRETE

.1 Obtain Engineer's approval of granular base and reinforcing steel prior to placing concrete.

.2 Do concrete work in accordance with Section 03300 and as specified herein.

.3 Round edges, including edges of joints, with 10 mm radius edging tool. Finish surfaces to within 3 mm in 3 m from line, level or grade as measured with a straightedge placed on surface. Finish exposed surfaces to a smooth uniform finish, free of open texturing and exposed aggregate. Do not work more mortar to surface than required. Do not use neat cement as a drier to facilitate finishing. Broom finish surface to provide non-skid texture.

.4 Cure and protect concrete in accordance with CAN3-A23.1-M90. Alternatively, apply curing compound to finished surface within one hour of placing at a rate recommended by manufacturer.

.5 If corrosion protection for de-icing salts is specified use water cure method.

3.4 FORMING

.1 Form vertical surfaces to full depth using forming material that will not deform under loading by plastic concrete. Securely position forms to required lines and grades. Coat forms with form release agent.

.2 Obtain approval of forms before placing concrete.

.3 Install transitions from full curb to drop curb, 450 mm long where indicated or directed.

.4 Slip forming may be approved subject to evaluation of mechanical equipment proposed for use. For evaluation by Engineer place 50 metre trial section for Engineers approval.

3.5 EXPANSION AND CONTRACTION JOINTS

.1 Install joints in concrete walk as indicated or directed at intervals of:

.1 Expansion joints, a maximum of 6 m or as required under 3.5.3.
.2 Transverse contraction joints at approximately the width of the sidewalk but not more than 1.5 times sidewalk width or 3 metres (30 times slab thickness).

.2 When sidewalk is adjacent to curb, make joints of curb, gutters and sidewalk coincide. When concrete curb and gutter is constructed adjacent to concrete pavement, the contraction joint spacing of the curb and gutter shall coincide with that of the concrete pavement. When concrete curb and gutter is constructed adjacent to asphalt pavement, transverse joints shall have a uniform spacing not exceeding 4.5 m.

.3 Install expansion (isolation) joints around manholes and catch basins and along length adjacent to concrete curbs, catch basins, buildings, or permanent structure, and also before and after curve sections and at intersections of sidewalk and/or curb, to full depth of concrete. Seal joints with approved sealant.

.4 Install transverse contraction joints 25 mm deep either by oiled steel separators which are removed after concrete has set sufficiently or by sawing the set concrete.

.5 Combined curb and sidewalk to be provided with a continuous dummy joint 150 mm from the face of the curb. This joint to be similar to the transverse contraction joint and to be 25 mm deep.

.6 Contraction joint spacing shall vary to coincide with the centreline of manholes, hydrants, poles or other box outs.

3.6 BACKFILL

.1 Allow concrete to cure for 7 days prior to backfilling.

.2 Backfill to designated elevations with suitable material, compact and shape to required contours as indicated or directed by Engineer.

3.7 CORROSION PREVENTION

.1 Apply when specified or directed by the Engineer for protection against de-icing salts. Apply with spray method only, two coats of one to one mixture of boiled linseed oil and kerosene.

.2 Insure concrete surfaces are dry, free of dirt or dust, and at least two weeks old before applying coating. Apply each coat at a rate of 0.1 litres per square metre.

.3 Dry first coat thoroughly before further application.

.4 Protect adjacent surfaces from spray.

3.8 BASIS FOR PAYMENT

.1 All costs associated with work specified in this section shall be deemed to be included in the appropriate unit and lump sum price quoted in the Schedule of Quantities and Prices.

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This section specifies requirements for the supply and application of an asphalt tack coat to an existing asphalt or concrete surface prior to asphaltic concrete paving.

PART 1 - GENERAL

1.1 MEASUREMENT FOR PAYMENT

.1 Measurement for payment shall be the horizontal area actually treated with tack coat lying within the area designated by the Engineer for treatment. The area shall be computed in square metres, rounded to one decimal point.

1.2 ENVIRONMENTAL PROVISIONS

.1 Should any tack coat spill larger than 70 L occur, then the spill shall be immediately reported to the Department of Environment & Lands. Contractors should verbally report the spill via the Canadian Coast Guard (telephone collect 737-2083).

.2 The Contractor shall take such steps as are necessary to abate the discharge, clean up the area affected, dispose of waste materials in an approved waste disposal site, and restore the environment to the satisfaction of the Department of Environment & Lands, all at the Contractor's expense.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 The Contractor has the option of using type RC-70 cut back asphalt, a solution of type RS-1k emulsified asphalt or a solution of type SS-1h emulsified asphalt, as the tack coat material, or other materials approved by the Engineer. The Engineer shall be notified in advance as to which type the Contractor intends to use and the tack coat shall meet the following standards:

.1 Type RC-70 cut back asphalt shall conform to ASTM D2028-76.

.2 Type RS-1k emulsified asphalt shall conform to ASTM D977-85.

.3 Type SS-1h emulsified asphalt shall conform to ASTM D977-86. Water for forming the solution with the SS-1h shall be clean water free from impurities.

PART 3 - EXECUTION

3.1 EQUIPMENT

.1 Tack coat shall be applied by means of an approved pressure distributor equipped with thermometer, pressure gauge, fifth wheel tachometer and suitable spray nozzles which shall all be of the same orifice and manufacturer and capable of producing a fog-type spray. The slot of each nozzle shall be set at 30 degrees to the axis of the spray bar and the spray bar shall be set at a height above the existing pavement that will permit the fan from each nozzle to overlap its neighbouring fan by exactly half.

3.2 APPLICATION

.1 Obtain Engineer's approval of existing surface before applying asphalt tack coat. Clean surface as required.

.2 Tack coat shall only be placed on surfaces that are clean and dry and then only when the atmospheric temperature is at least $10^{o}C$.

.3 Should the surface to be treated be dirty, then the Contractor shall thoroughly clean the surface by means of a power broom, or equivalent.

.4 Tack Coat shall be placed on surfaces that have been approved by the Engineer.

.5 The Contractor shall plan his work so that no more tack coat than is necessary for the days paving operation is applied at one time.

.6 To avoid nuisance and possible property damage to the travelling public, the Contractor shall install portable traffic lights or other means of directing one-way traffic while working on the adjacent part of the road.

.7 The type RC-70 tack coat shall be applied at a temperature between $38^{o}C$ and $80^{o}C$ and at a rate of 0.25 l/m^2 on old pavement. Care must be exercised not to exceed the recommended application rate. However, on pavement which was placed during the previous construction season the rate of application shall be as directed by the Engineer. The rate will not exceed the rate for old pavement.

.8 The type RS-1k tack coat shall be applied at a temperature between $38^{o}C$ and $80^{o}C$ and at a rate of 0.15 l/m^2 on old pavement. Care must be exercised not to exceed the recommended application rate. However, on pavement which was placed during the previous construction season the rate of application shall be as directed by the Engineer. The rate will not exceed the rate for old pavement.

.9 The type SS-1h emulsion shall be diluted with an equal volume of water prior to the application. The diluted Ss-1h emulsion shall be applied at a rate of 0.5 l/m^2 of diluted emulsion on old pavement. Both the mixing temperature and the application temperature shall be between $20^{o}C$ and $50^{o}C$. Care must be exercised not to exceed the recommended application rate. However, on pavement which was placed during the previous construction season the rate of application shall be as directed by the Engineer. The rate will not exceed the rate for old pavement.

3.3 CURING

.1 No hot mix shall be placed upon the tack coat until it has dried to a proper condition of tackiness, as determined by the Engineer. The Contractor is advised that the period required for such drying will depend upon weather conditions; it will normally be about 24 hours for Type RC-70 tack coat and 1 to 2 hours for Types RS-1k and SS-1h emulsion tack coats.

3.4 BASIS FOR PAYMENT

.1 Payment at the contract price for Tack Coat shall be compensation in full for all labour, materials and equipment used to; clean the existing surface, supply and apply the tack coat, together with the provision of portable traffic lights, if required.

This section covers the requirements for the production, placing and compaction of hot mix, hot laid asphaltic concrete. Also covered are the requirements for asphaltic levelling course to fill pavement depressions.

PART 1.0 GENERAL

1.1 SCOPE

.1 The base and surface course asphaltic concrete pavement shall consist of asphaltic cement, coarse and fine mineral aggregate plus mineral filler if required, placed and compacted on a prepared base in conformity with the lines, grades, dimensions and cross-sections as detailed in the Contract Drawings.

1.2 MEASUREMENT FOR PAYMENT

.1 Measurement for payment will only be made for those materials accepted for use under this specification and then only when incorporated into the work at the required locations and thickness as indicated in the Schedule of Quantities and Prices. The Contractor shall not be paid more than 110% of the calculated quantities based on theoretical limits.

.2 Measurement for payment for the particular type of asphaltic course shall be by the weight of that material in tonnes, rounded to one decimal place.

.3 The material shall be weighed by means of weigh scales. Only loads certified by the Engineer as being placed in the works at the required locations shall be included in measurement for payment.

.4 Measurement for payment of asphalt patching and asphalt removal shall be in square metres to Section 02574.

.5 Asphalt walkways, where required, will be measured in square metres to the thickness specified in the Contract Documents.

.6 The preparation and cutting of joints required as a result of a break in paving operations, will not be measured for payment.

.7 Asphalt paved ditch will be paid in tonnes of asphalt delivered to the site in accordance with Section 02552.1.2.2. An extra and over payment will be made by the lineal metre for the additional work as detailed on the standard drawings.

PART 2.0 PRODUCTS

2.1 ASPHALT CEMENT

.1 Unless otherwise specified, asphalt cement shall conform to the requirements of the Canadian General Standards Board Specification Can/CGSB-16.3 M 89 entitled “Asphalt Cement For Road Purposes”. The penetration grade of the asphalt cement shall be 150/200, Group B. Asphalt cement conforming to the current version of the Department of Transportation & Works Specification Book Section 330 is also acceptable.

.2 The Contractor shall obtain from the manufacturer and furnish to the Engineer/Architect, in tabular or graphic form, the temperature - viscosity relationship of the asphalt cement to be used.

.3 The Contractor shall supply the asphalt cement.

2.2 COARSE AGGREGATES

.1 Coarse Aggregate shall consist of hard, durable crushed stone particles of crushed gravel particles reasonably uniform in quality throughout and free from soft or disintegrated pieces. The portion of the material retained on the 4.76 mm sieve

shall be known as coarse aggregate.

.2 Gravel shall be washed if necessary to have clean surfaces free from coatings of foreign matter.

.3 Coarse Aggregates shall conform to the physical requirements shown in Table 1.

TABLE 1: Physical Requirements for Coarse Aggregates

Los Angeles Abrasion* (Loss % Maximum)	ASTM C131-81	35
Absorption (% Maximum)	ASTM C127-84	2
Bulk Specific Gravity (Minimum)	ASTM C127-84	2.20
Soundness-Magnesium Sulphate – (5 cycles Max)	ASTM C88- 83	15
Crushed Particles (% Minimum)		70
Flat and Elongated** Pieces (% Maximum)		10
Loss by Washing (% Maximum Passing 0.075 mm sieve)	ASTM C117-87	2

* Material with an abrasion ratio higher than 0.265, for 100-500 revolutions shall not be used without the written permission of the Engineer.

** Flat and elongated pieces are those whose greatest dimension exceeds four times their least dimension.

.4 In addition to the requirements of Table 1, coarse aggregate proposed for use in surface course pavement will not be acceptable if more than 1% of the particles (expressed as a percentage of the weight of material retained on the 4.786 sieve), absorbs more than 5% by weight of water.

.5 The aggregates shall be of such nature that a thorough coating of asphalt cement will not strip off upon contact with water as determined by the Standard Method of Test for Coating and Stripping of Bitumen-Aggregate Mixtures (ASTM D 1664-85).

.6 Irrespective of compliance with the physical requirements of Table 1, any aggregate may be accepted or rejected on the basis of past field performance.

.7 Coarse aggregates shall be supplied by the Contractor.

2.3 FINE AGGREGATES

.1 Fine aggregate shall consist of clean, tough, rough-surfaced grains, free from clay, loam and other foreign matter. As delivered to the mixer it shall be free from clayey lumps or loosely bonded aggregations, and the individual particles shall be free from adhering dust. The portion of the material passing the 4.76 mm sieve shall be known as fine aggregate.

.2 The aggregates shall be of such nature that a thorough coating of asphalt cement will not strip off upon contact with water as determined by the Standard Method of Test for Coating and Stripping of Bitumen-Aggregate Mixtures (ASTM D 1664-85).

.3 The physical requirements in Table 1 for Coarse Aggregates shall also apply to fine aggregates for abrasion, absorption, bulk specify gravity and soundness.

.4 Any aggregate may be accepted or rejected on the basis of past field performance.

.5 Fine aggregates shall be supplied by the Contractor.

2.4 BLENDING SAND

.1 Blending sand shall consist of clean, tough, rough surfaced grains, free from clay, loam, or any other foreign matter.

.2 The gradation of the blending sand shall be such that when used in the asphalt mix, the resulting mix shall meet the requirements of Tables 2 and 3 of this section. In any case, the blending sand shall have 100% (by dry weight) passing the 12.5 mm sieve and at least 50% (by dry weight) passing the 4.25 mm sieve. Blending sand shall be supplied by the Contractor.

2.5 MINERAL FILLER

.1 Where sufficient material passing the 0.075 mm sieve is not available in the aggregate the Contractor shall supply mineral filler approved by the Engineer at no extra cost.

.2 Mineral filler shall consist of thoroughly dry stone dust, portland cement, or other artificially or naturally powdered material dust, 65% to 100% of which will pass a 0.075 mm sieve.

2.6 COMPOSITION OF MIXTURE

.1 The mixture shall consist of uniformly graded fine and coarse aggregate and thoroughly mixed with asphalt cement as specified. Blending sand, mineral filler and chemical additives shall be added when required.

.2 Unless otherwise specified, the aggregates shall be combined in such proportions as to produce a mixture conforming to the grading and asphalt content requirements of Table 2.

TABLE 2: Asphalt Aggregate Mixtures

	Percent Passing by Dry Weight		
Sieve Size	Base Course	Surface Course	Levelling Course
19.0 mm	100	100	100
12.5 mm	80-100	97-100	100
4.76 mm	35-75	55-75	55-75
2.00 mm	20-60	35-55	35-55
0.425 mm	10-35	18-30	18-30
0.075 mm	0-8	0-8	0-8
Asphalt Content (% by weight of total mixture)	5.0-7.0	5.5-7.5	5.5-7.5

.3 Once an acceptable aggregate gradation is achieved in the crushing operation, the tolerances for subsequent production are as follows:

Tolerance for Production of Asphalt Aggregate

Aggregate Passing 4.76 mm sieve	5%
Aggregate Passing 2.00 mm sieve & 4.25 mm sieve	4%
Aggregate Passing 0.075 mm sieve	2%

.4 Aggregate gradation and asphalt cement content of the mixture shall be as specified in the approved mix design. Asphalt cement contents varying from that specified in the mix design by more than 0.25% shall be unacceptable.

.5 Asphaltic Levelling Course shall consist of asphaltic surface course asphaltic concrete, except on those projects where there is no item for Asphaltic Surface Course, in which case Asphaltic Base Course may be used instead.

2.7 PHYSICAL REQUIREMENTS FOR MIXTURE

.1 The aggregates and the asphalt cement shall be mixed in such proportions as to satisfy the criteria contained in Table 3. These criteria are based on the Standard Marshall Test Procedures and using a compactive effort of 75 blows on each face of the specimen, or other compactive effort found necessary during the mix design.

TABLE 3: Physical Requirements
Base and Surface Course Paving Mixtures

	Min.	Max.
Marshall Stability kg. at 60°C	550	-
Marshall Flow Index units of 0.25 mm	10	17
% Air Voids	3	5
% Voids in Compacted Mineral Aggregate	15	-

2.8 UNAUTHORIZED TAMPERING WITH PLANT SETTINGS & MATERIALS

.1 Any person employed by the Contractor, who, in the opinion of the Engineer, alters or causes to be altered, any settings or screens of an asphalt plant after it has been calibrated, or who adds or causes to be added, any unapproved material to a stockpile or aggregate, or in any way hampers the production of the mix as designed, shall at the written request of the Engineer, be forthwith removed from the project and such persons shall not again be employed in the work.

PART 3 - EXECUTION

3.1 USE OF PITS, QUARRIES AND STOCKPILES

.1 The use of pits and quarries for the production of the aggregates, together with the requirements for the stockpiling of the aggregates shall be in compliance with the provisions of Department of Works, Services & Transportation Specification Section 310 "Use of Pits, Quarries and Stockpiles For Production of Materials Supplied by Contractor".

.2 Should the Contractor intend to use a Drum Mixer Asphalt Mixing Plant, then the designated aggregates shall be split on the 6.35 mm screen and each material shall be stockpiled separately such that intermixing of each size and type does not occur.

.3 The course aggregate stockpile shall contain no more than 15% passing the 6.35 mm screen.

3.2 EQUIPMENT - Mixing Plants

.1 Equipment for Preparation of Asphalt Cement

.1 Tanks for storage of asphalt shall be quipped for heating the material, under effective and positive control at all times, and maintaining it in a range between 120°C and 160°C. The actual working temperature shall not vary by more than +/-5°C when the amount of asphalt cement added to the mixture is measured volumetrically. Heating shall be by steam or oil coils, electricity, or other means such that no flame shall contact the heating tank.

.2 A circulating system for the asphalt cement shall be of adequate capacity to provide proper and continuous circulation between storage tank and proportioning units during the entire operation period. All pipe lines and fittings shall be steam or oil jacketed or otherwise properly insulated to prevent heat loss.

.3 Storage tank capacity shall be such as to ensure continuous operation of the plant and uniform temperature of the asphalt cement when it is introduced into the mixer.

.4 A sampling outlet shall be provided in the asphalt cement feed lines connecting the plant storage tanks to the weighing system or spray bar. The outlet shall consists of a valve installed in such a manner that samples may be withdrawn from the line slowly at any time during plant operation. The sampling outlet shall be installed between the pump and the return line discharge in a location that is readily accessible and free from obstruction. A drainage receptacle shall be provided for flushing the outlet prior to sampling.

.2 Cold Bins

.1 Cold bins shall be divided into not less than three compartments, each to be equipments, with individual gate controls, so as to enable accurate and positive proportioning of each size of col aggregate. Partitions of sufficient height to eliminate intermingling of the aggregate shall be provided between adjoining bins, if the bins are being fed with a front-end loader the width of each bin must be at least 500 mm wider than the width of the loader bucket.

.3 Drier

.1 A rotary drier, of satisfactory design, for drying and heating the aggregate shall be provided.

.4 Screens

.1 Plant screens on batch and continuous mix plants shall have adequate capacity and size range to properly separate all of the aggregate into the sizes required for proportioning so that they may be recombined consistently within the specification limits.

.2 All screens shall have square openings.

.5 Hot Aggregate Storage Bins

.1 Batch and continuous mix plant shall have a hot bin storage of sufficient capacity to ensure uniform and continuous operation. Bins shall be divided into compartments arranged to ensure separate and adequate storage of appropriate fractions of the aggregate. Each compartment shall be provided with an overflow pipe of such size and at such a location to prevent any backing up of material into other bins or into contact with the screen. Adequate and convenient facilities shall be provided for obtaining aggregate samples from each bin.

.6 Asphalt Cement Control Unit

.1 Satisfactory means, either by weight, metering or volumetric measurements, shall be provided to obtain the proper amount of asphalt cement. All measuring devices shall prove accurate to within +/-2.0% when tested for accuracy.

.7 Thermometric Equipment

.1 An armoured thermometer of suitable range shall be fixed in the asphalt cement feed line at a convenient location near the discharge of the mixer unit.

.2 The plant shall be further equipped with approved recording thermometers, pyrometers, or other approved recording thermometric instruments at the discharge chute of the drier and in the hot fines bin to register and record automatically the temperature of the heated aggregate.

.8 Dust Collectors

.1 Dust collectors shall be provided where required under the provisions of Section 01560. Provision shall be made to waste the material so collect ed, or to return all or any part uniformly to the aggregate mixture.

.9 Safety Requirements

.1 Adequate and safe stairways to the mixer platform shall be provided and guarded ladders to other plant units shall be located where requested. All gears, pulleys, chains, sprockets, and other dangerous moving parts shall be thoroughly protected.

.2 Ample unobstructed passage shall be maintained at all times in and around the truck-loading space. This space shall be kept free of drippings from the mixing platform. A ladder or platform shall be located at the truck-loading space to permit easy and safe inspection of the mixture as it is delivered into the trucks.

.3 Overhead protection shall be provided where necessary.

3.3 SPECIAL REQUIREMENTS FOR BATCHING PLANTS

.1 Weigh Box or Hopper

.1 The equipment shall include a means for weighing each bin size of aggregate into a weigh box or hopper, suspended on scales, and ample in size to hold a full batch without running over. The weigh box or hopper shall be supported on fulcrums and knife edges that will not easily be thrown out of alignment or adjustment. Gates both on the bins and the hopper shall be constructed to prevent leakage when closed.

.2 Plant Scales

.1 Scales shall be of the dial or digital type and of a standard make and design. Scales for weighing aggregates shall be accurate and sensitive to 0.5% of the maximum loading required. All scales shall provide a positive means of balancing the tare weight of the hopper or asphalt bucket. After each plant set-up and prior to batching any materials, and whenever deemed necessary by the Engineer, the Contractor shall, at his own expense, have the plant scales tested to the satisfaction of the Engineer.

.3 Mixer Unit

.1 The plant shall include a batch mixer of an approved twin shaft pugmill type capable of producing a uniform mixture within the permissible job mix tolerances. The clearance between the mixer blades and liner plates shall not exceed 20 mm. The mixer shall be constructed to prevent leakage of the contents. Mixer discharge shall not cause appreciable segregation. The mixer shall be fitted with separate dry and wet mixing cycle timers and locking devices so that asphalt cement cannot be discharged and the pugmill gate cannot be opened until the desired mixing times have elapsed.

3.4 SPECIAL REQUIREMENTS FOR CONTINUOUS MIXING PLANTS

.1 Gradation Control Unit

.1 The plant shall include means for accurately proportioning by volumetric measurement the aggregate discharged from each hot bin. The unit shall include a feeder, mounted under the compartment bins. Each bin shall have an accurately controlled individual gate to form an orifice for volumetrically measuring the material drawn from each respective bin compartment. The orifice shall be rectangular with dimension adjustable by positive mechanical means. Indicators shall be provided on each gate to show the opening in millimetres. Each gate will be provided with a lock.

.2 Weight Calibration of Material Feed

.1 The plant shall include a means for calibration of gate openings by weighted test samples. The equipment shall include a method of obtaining hot aggregates from the binds fully representative of the flow from the specific gate openings. It shall also include platform scales capable of accurately weighing test samples of aggregates and asphalt cement.

.2 All calibration equipment, including revolution counters, shall be kept in good operating order at all times and shall be available whenever required.

.3 Synchronization of Aggregate and Asphalt Feed

.1 Satisfactory means shall be provided to afford positive interlocking control between the flow of aggregate from the bins and the flow of asphalt from the metre or other proportioning sources, in order to ensure the correct flow of aggregate from the bins and the flow of asphalt from the metre or other proportioning sources, in order to ensure the correct flow of asphalt cement to the mixer at all times, the plant shall be equipped with means of maintaining a constant head of asphalt cement to the metering device. A satisfactory pressure gauge shall be installed on the asphalt line between the metering device and the spray bar.

.4 Mixer Unit

.1 The plant shall include a continuous mixer of an approved twin shaft pugmill type that shall be capable of producing a uniform mixture within the specified tolerances.

.2 The clearance of the blades from the inner surfaces of the pugmill liners shall not exceed 20 mm. The paddles shall be of a type adjustable for angular position on the shafts and reversible to retard the flow of the mixture. The mixer shall be equipped with an adjustable dam gate at the discharge end to control the level of the material. The mixer shall carry a manufacturer's plate giving the net volumetric contents of the mixer at several heights.

.3 Unless otherwise required, determination of mixing time shall be by weight method under the following formula.

$$\text{Mixing time in seconds} = \frac{\text{Pugmill Capacity in kg}}{\text{Pugmill Output in kg/s}}$$

.5 Discharge Hopper

.1 All continuous mix plants shall be equipped with a controlled discharge storage hopper. The minimum capacity of the hopper in tonnes shall be equal to 1-1/2 % of the hourly production rate of the plant but shall not be less than one tonne. This hopper shall be kept in satisfactory operating condition at all times and operated to prevent segregation of the mixture.

.6 Material Level Indicators

.1 Material level indicators shall be installed in each hot aggregate bin at the one-third full level and at the two-thirds full level and they shall be connected to remote high-low indicator lights mounted at the operator's station. Operation of the mixer shall not be permitted when the low-level indicator shows any bin to be less than one-third full.

3.5 SPECIAL REQUIREMENTS FOR DRUM MIXER PLANTS

.1 Additional to all other requirements, the designated aggregates shall be split on the 6.35 mm screen and each material shall be stockpiled separately such that intermixing of each size and type does not occur. The coarse aggregate stockpile shall contain no more than 15% passing the 6.35 mm screen.

.1 Aggregate Feed

.1 Aggregates shall be fed to the drier drum by means of a multibin (minimum 3 or 4 bins) cold feed unit and shall be blended to meet job-mix requirements by adjustment of variable speed feed belts and gates on each bin. There shall be no overflow from one bin to another.

.2 A reliable moisture probe shall be installed in the fine aggregate cold feed with a metre mounted in the plant control panel.

.3 The total flow of aggregate shall be metered by an electronic weight belt system with an indicator that can be monitored by the plant operator and which is interlocked with a variable speed asphalt pump so that the proportions of aggregate and asphalt entering the mixer remain constant.

.4 A positive interlocked automatic shut off shall be provided so that the plant shuts down automatically if there is any disruption in the flow of aggregate or asphalt cement.

.5 A vibrating screen of adequate capacity shall be provided to remove oversize from the combined cold feed.

.6 An aggregate sampling device shall be provided which will divert a representative combined aggregate sample of adequate size into a container or hopper for the purposes of gradation testing. The sampling device shall be located after the cold feed aggregates have passed through the vibrating screen and prior to mixing with asphalt cement.

.2 Asphalt Cement Feed

.1 The asphalt cement feed system shall be equipped with a calibration system which will enable approximately 200 L of asphalt cement to be bypassed into a container which can be weighed. Adequate scales shall be provided by the Contractor.

.2 A temperature gauge, showing the temperature of the asphalt cement at the metering pump, shall be provided in the control trailer. The gauge shall be graduated to cover at least the range 100°C to 200°C with increments of not less than 2.5°C.

.3 A temperature compensating system shall be installed in the asphalt cement metering system designed to provide a volume of asphalt cement which will be constant when referenced to 15°C regardless of variations in the temperature of the asphalt cement from the storage tank.

.3 Asphalt Cement Mixing

.1 The heating, coating and mixing of the asphalt mix shall be accomplished in an approved parallel flow drier-mixer. The aggregate and asphalt shall enter the drum at the burner end and travel parallel to the flame and exhaust gas stream. Heating shall be controlled to prevent fracture of the aggregate or excessive oxidization of the asphalt. The system shall be equipped with automatic burner controls and shall provide for continuous temperature sensing of the bituminous mixture of discharge, with a printing recorder that can be monitored by the plant operator. The printed record of mix temperatures shall be available to the Engineer for inspection.

.2 The mixing period and temperature shall be such as to produce a uniform mixture in which all the particles are thoroughly coated, and the moisture content of the material as it leaves the mixer shall be reduced to 1% or less. Facilities for sampling and observing the mix at this point shall be provided.

.3 The temperature of the mix immediately after mixing shall not exceed 165°C.

.4 The method used to transfer the mixture from the drum mixer to the haulage units shall be designed, constructed and operated so that there shall be no segregation of, or damage to, the mix.

.5 A system for wasting unacceptable asphalt aggregate mixture shall be provided between the drum mixer discharge and holding bin.

.6 The plant shall not be operated below 50% of the rated capacity of the belt scale.

3.6 TRUCK WEIGH SCALES

.1 The scales shall be in accordance with Section 1155.

3.7 HAULAGE EQUIPMENT

.1 Trucks for hauling asphaltic mix shall be of the metal box type. The metal box shall be oiled, be in good condition, be smooth, and be free of rust scales and foreign materials. Each vehicle shall be equipped with a tarpaulin of sufficient size to completely cover the load.

3.8 SPREADING EQUIPMENT

.1 Mechanical self-powered pavers shall be used which are capable of spreading the mixture true to line, grade and crown as specified and as directed by the Engineer.

.2 Pavers shall be equipped with hoppers and distributing screws to place the mixture evenly in front of the screeds.

.3 Pavers shall be equipped with screeds and shall be capable of spreading the mixture, without segregation, in thickness of from 10 mm to 200 mm and in widths of from 2500 mm to 4000 mm in increments of 150 mm.

.4 The Contractor shall provide on each paver a 3 m straight edge with a level recessed in its upper surface parallel to the lower face and capable of detecting a variation from the horizontal of 3 mm in 1000 mm.

.5 The term "screed" shall mean any strike-off device operated by cutting, crowding, or other practical action which is effective on the mixture and which produces a finished surface of the evenness and texture required. The screed shall be adjustable as to level and crown and shall be heated in an approved manner.

.6 Pavers shall be equipped with automatic screed controls, as recommended by the paver manufacturer, for the control of longitudinal grade and transverse slope. The longitudinal grade control shall be equipped to operate from a joint matching shoe when required. The transverse slope control shall be capable of operating from either side of the paver.

.7 When required, a paver shall be equipped with an approved 12 m ski. Where such a ski is a flexible unit, it shall be equipped with a spring-tensioned wire extending between brackets fitted on and slightly above each end of the ski. The sensing grid shall ride on the wire, not on the ski.

3.9 ROLLERS

.1 All rollers shall be of the types specifically designed for asphalt compaction and shall be in good condition and capable of reversing without backlash. They should be operated at all times by competent and experienced operators.

.2 All rollers shall be weighed in the presence of the Engineer and ballasted, if required, immediately before commencing work and whenever subsequently required by the Engineer.

.3 Steel tired rollers shall be equipped with satisfactory means to supply sufficient water to the rolls to prevent adhesion of asphalt mixture. The rear rolls of three-wheel rollers shall each be not less than 450 mm in width, rolls of the tandem rollers shall each be not less than 1250 mm in width. Steel wheeled rollers shall weigh at least 9 tonnes and shall exert a load on the compression roll of at least 4.5 tonnes per metre of wheel width.

.4 All pneumatic tired rollers shall be self-propelled and shall have not less than nine wheels revolving on two axles. The tires on the front and rear axles shall be staggered to cover the entire area over which the roller travels with a minimum overlap of 15 mm. Under working conditions, the roller shall exert a load of not less than 5 tonnes per metre of tire width on the asphalt surface. The tires shall be inflated to an air pressure of not less than 400 kPa. The roller shall be equipped with an adequate scrapping or cleaning device on each tire to prevent the bituminous mixture from accumulating on the tires. The roller shall be equipped with a water system which will keep all tires uniformly wet, and which will have a capacity that will provide not less than two hours continuous operation without refilling.

3.10 CONSTRUCTION

.1 Preparation of Gravel Road Surface

.1 Where paving is to take place directly on top of a gravel surface, then the Contractor shall prepare the road to the satisfaction of the Engineer before paving. Not less than 300 m of prepared grade shall be maintained in front of the paver at all times, except at the end of the paving operation for that day.

.2 Where the top layer of Granular Base Course Class "A" was placed under the same contract as the paving, then the preparation of the Class "A" prior to paving shall be carried out in accordance with Section 02233 "Selected Granular Base Course".

.3 However, where the paving is to take place directly on top of materials that were not placed in the paving contract, then such preparation prior to paving as the Engineer may require shall be carried out in accordance with Section 02231 "Scarifying and Reshaping".

.2 Preparation of Old Paved Surface

.1 When required by the Engineer, old paved surfaces shall be treated with Tack Coat prior to repaving with asphaltic concrete.

.2 Such treatment with Tack Coat as may be required shall be carried out in accordance with Section 02547 "Tack Coat".

.3 Placing of Asphaltic Courses

.1 The base on which paving is to take place shall be cleaned of all loose or foreign material before paving may take place.

.2 The asphaltic mixture shall be laid only upon a base which is dry or at least free from standing water, and when weather conditions are suitable. No paving shall take place during rain.

.3 No course shall be placed upon a previously laid course less than 12 hours after final compaction of the latter, except with the permission of the Engineer in circumstances where in his opinion this requirement would be impractical.

.4 No hot mix shall be placed unless the air temperature at the surface of the road is 7°C or above without the written permission of the Engineer.

.5 The temperature of the mixture immediately after spreading and prior to initial rolling shall not be less than 125°C.

.6 The width of succeeding courses shall be adjusted by an offset of width of from 150 mm to 300 mm so that longitudinal joints do not coincide.

.7 The longitudinal joints in the surface course shall correspond to the demarcation between driving lanes, speed change lanes, tapers, etc. indicated in the contract or as directed by the Engineer.

.8 Immediately after any course is laid and before roller compaction is started the surface and edges shall be checked and any irregularities adjusted by the addition or removal of mixture.

.9 All pavers which are equipped with a tamping device or other mechanical apparatus designed to aid compaction of the mixture shall have such devices operating continuously when the mixture is being placed unless otherwise directed. Where screed extensions are used, such extensions shall be designed so that the tamping or vibratory action of the screed is effectively transferred to the extensions in such manner as to provide a uniform degree of initial compaction across the full width of the freshly laid mat.

.10 To ensure continuous operation of the pavers they shall operate at whatever speed necessary to match the output of the plant provided that a consistent and satisfactory mat is being laid. However, in no case shall the speed of the paver exceed 0.7 km/h.

.11 When two or more pavers are in echelon, pavers following the lead paver shall use the joint shoes, designed for the purpose, which shall ride on the previously placed undisturbed mat. Pavers are considered to be paving in echelon when the lead paver is not more than 60 m in advance of an adjacent succeeding paver.

.12 Mixtures may be spread by hand only in places inaccessible to the paver. Hand placing shall be from a steel dump board by means of hot shovels. Hand spreading shall be with rakes of suitable design. The mixture shall be spread to the depth required to give the compacted design thickness after rolling.

.13 No loads of mixture shall leave the plant so late in the day as to preclude the spreading and compacting of the mixture during daylight.

.4 End of Paving Season for Asphaltic Concrete

.1 The season for laying asphaltic base course shall end on the 15th of November each year, unless extended by the Engineer.

.2 The season for laying asphaltic surface course shall end on the 15th of October, unless extended by the Engineer.

.5 Joints

.1 All joints shall be made in such a manner as to ensure a thorough and continuous bond and to provide a smooth riding surface.

.2 All foreign material and all loose material, shall be removed from all faces against which joints are to be made. All cold faces against which joints are to be made shall be cut back to full depth to expose a fresh vertical face, and painted with a continuous thin coating of hot asphalt cement.

.3 Longitudinal joints shall be rolled immediately upon placement of the fresh mixture and before the adjacent strip has completely cooled. The joint shall be set-up with the back of a rake or lute at proper height and grade to receive the required compression under rolling.

.4 The depth of the newly laid mat shall be adjusted to allow for compaction.

.5 The paver shall overlap the existing mat by at least 50 mm.

.6 On surface courses the method of making joints shall be such that the excess material is not scattered on the surface of the freshly laid mat. Such excess material shall be carefully removed and disposed of as directed.

.7 Transverse joint shall be checked with a straight edge immediately after initial rolling. Any irregularity in the pavement surface at the joint shall immediately be corrected by the addition of or removal of mixture. When possible, the transverse joints shall be initially rolled in a direction perpendicular to the direction of paving.

.6 General Requirements for Compaction

.1 The mixture shall be compacted to a density of 97% of the density of the laboratory compacted mixture based on the criteria given in Section 02552.2.4 Physical Requirements for Mixture.

.2 It is an express condition of this specification that all mixtures be compacted to the specified density immediately following placement. If, during the course of the paving operation, measured insitu densities fall below the specified minimum, the Contractor shall revise his operation by slowing the rate of progress of the pavers, by using additional rollers or by any other means necessary to achieve the specified degree of compaction.

.3 Rollers should normally operate with the drive wheel forward in the direction of paving. In all cases, the production and placing of mixture shall be controlled so that all rolling shall be completed before sunset.

.7 Compacting Asphaltic Base and Surface Courses with Static Wheel Rollers

.1 Where the Contractor elects to compact the mixture using static wheel rollers, a minimum of 2 steel wheel and 1 pneumatic tire roller will be required to operate with each paver used.

.2 The initial breakdown rolling by a steel wheel roller shall commence as soon after placing as the mixture will bear the roller without checking or undue displacement.

.3 Rolling shall start longitudinally at the lower edge and proceed towards the higher edge of the course, overlapping on successive passes. Alternate passes of the roller shall be staggered.

.4 Intermediate rolling, using a pneumatic tire roller, shall follow the breakdown roller as closely as possible. Passes shall be so arranged as to ensure overlapping successive tire paths. The Contractor shall be responsible for ensuring that the tiers are in proper condition at all times to prevent pick-up of the mixture.

.5 Finishing rolling, using a steel wheel roller, shall be accomplished with the minimum number of passes required to produce a satisfactory surface. Rolling shall start longitudinally at the higher edge and proceed towards the lower edge.

.6 The operating speed of static sheet rollers shall not exceed 5 km/h and shall be slow enough to avoid displacement of the mix.

.8 Compacting Asphaltic Base and Surface Courses with Vibratory Rollers

.1 Where the Contractor elects to compact the mixture using vibratory rollers, a minimum of one vibratory roller and one pneumatic tired roller will be required to operate with each paver used.

.2 The required compaction shall be obtained by the vibratory roller followed by the pneumatic tire roller. Rolling shall commence as soon after placing as the mixture will bear the roller without checking or undue displacement.

.3 In areas where a vibratory roller proves ineffective (ie. intersections and bridge decks) compaction shall be obtained using a suitable static steel wheel roller.

.9 Compacting Asphaltic Levelling Course

.1 Where the Contractor elects to compact Levelling course using a static wheel roller, or a double steel wheel vibratory roller, then a pneumatic tire roller shall be used following the steel wheel roller.

.2 However, where the Contractor elects to compact Levelling course using a vibratory roller of the type consisting of two or more pneumatic tires and a vibratory steel drum, then a separate pneumatic tire roller will not be required.

.10 Requirement for Asphaltic Levelling Course

.1 Asphaltic Levelling Course shall be used to fill surface depressions on old pavement, to restore the surface to the original profile and cross section.

.2 Patching and Levelling shall not be carried out simultaneously at the same place.

.3 The patch, consisting of asphaltic base course, shall be placed and fully compacted before Levelling operations may proceed over the patch.

.11 Requirements for Completed Asphaltic Base and Surface Courses

.1 Each course after final compaction shall be smooth and true to the established crown and grade, shall have the average thickness specified, and shall at no point vary more than 6 mm from the specified thickness. The surface of each course shall be free from deviations exceeding 3 mm as measured with a 3 m straight edge paralleling the center line of the roadway.

.2 Any low or defective places shall immediately be remedied by cutting out the course as required and replacing it with fresh hot mixture which shall be immediately compacted to conform with the surrounding area and shall be thoroughly bonded to it.

3.11 BASIS OF PAYMENT

.1 Basis of Payment for Asphaltic Surface, Asphaltic Base and Asphaltic Levelling Courses

.1 Payment at the contract price for asphaltic base course, asphaltic surface course or asphaltic Levelling course, as appropriate, shall be full compensation for:

.1 The supply of all materials, including the supply of asphalt cement.

.2 The handling, storing, crushing, stockpiling and preparation of all materials, together with all haulage of the materials.

.3 The preparation of all joints with hot asphalt cement, together with the cutting and removal of pavement where a joint is required as the result of a break in the paving operations.

.4 The mixing, placing and compacting of the asphaltic mixture, together with all haulage of the mixture to places within the Contract.

.5 The cutting and installation of channel cuts to blend with existing asphalt.

.6 All other costs arising from the requirements of the section for which payment is not otherwise specifically provided.

This section specifies requirements for the supply and placement of materials to repair the asphaltic concrete removed in the carrying out of the works.

PART 1 - GENERAL

1.1 MEASUREMENT FOR PAYMENT

.1 Measurement for removal and replacement of existing asphalt pavement removed during trench excavation shall depend on the width of trench as specified in Section 02223 for the installation of the pipe. The width of pavement removed along the trench for the installation of the pipe shall not exceed 500 mm each side of the specified trench width for main lines 0 to 4 m deep, not exceed 1000 mm each side of the specified trench width for main lines greater than 4 m to 6 m deep and not exceed 1500 mm each side of the specified trench width for main lines greater than 6 m deep. The width of pavement removed along the trench for the installation of pipe in service laterals shall not exceed 300 mm each side of the specified trench width for service lines 0 to 4 m deep, and not exceed 600 mm each side of the specified trench width for service lines greater than 4 to 6 m deep, and not exceed 900 mm each side of the specified trench width for service lines greater than 6 m deep.

.2 If the Contractor removes or damages pavement or surfaces beyond the limits specified above, such pavement and surfaces shall be replaced or repaired at the expense of the Contractor.

.3 Asphalt removal designated in the contract documents or as directed by the Engineer for thicknesses up to 100 mm shall be paid by the square metre to the lines established by the Engineer. Thicknesses over 100 mm shall be paid by the square meter unit price prorated on the basis of price per 100 mm.

.4 Asphalt patching of approved asphalt removed, as designated in the contract documents or as directed by the Engineer, shall be paid by the square metre including placing and compaction of granular base.

.5 The minimum width for asphalt removal and replacement adjacent to concrete will be 0.5 meter.

.6 Recapping of asphalt patching when directed by the Engineer will be paid for by the tonne in accordance with Section 02552.

.7 Temporary asphalt patching, as designed in the contract documents or as directed by the Engineer, shall be paid by the square metre including placing and compaction of granular base. Temporary asphalt shall be 38 mm thick.

.8 For pothole patching only, cutting shall be paid by the lineal meter.

.9 Asphalt work under 2.5 meter wide shall be a patch and asphalt work less than 100 square meters shall be a patch. Asphalt work 100 square meters and greater shall be paid by the tonne.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Granular base: material to Section 02233:

.2 Asphaltic concrete shall be as specified in Section 02552. Recycled asphalt may be used only if it is included in the Schedule of Quantities & Prices and only in areas indicated in the drawings.

.3 Tack Coat:
Asphaltic Materials: emulsified asphalt to CAN2-16.2-M77 + Amdt-Mar-81, Grade SS-1h, RC-70 or RS-1k as specified in Section 02547.

PART 3 - EXECUTION

3.1 CONSTRUCTION

.1 Weather Limitation:

.1 Permanent patching shall be carried out only when the temperature of the air is 7°C and rising and when not raining.

.2 Temporary patching may be specified by the Engineer, when the ambient air temperature is less than 7°C, for one winter use and may be replaced with permanent patching the following summer.

.2 Time Limitation:

Asphalt patching after October 15 shall be temporary patching and may be replaced with permanent patching the following summer at the discretion of the Engineer.

.3 Cutting Out:

The areas to be patched shall be agreed upon by the Engineer. The Contractor shall cut out the sections marked true and square with a power buster or other means acceptable to the Engineer to expose a fresh vertical face clear of any broken or loose material.

.4 Application of Asphaltic Material:

In all areas where new asphalt is to meet existing asphalt a tack coat of asphaltic cement is to be applied to the face of the existing asphalt prior to placing the asphaltic concrete.

.5 Placing Asphalt:

Before any placing of asphalt, the Contractor shall compact all backfilled materials and place and compact to 95% Modified Proctor Density, of granular base A to the thickness of original bedding and to a maximum of 150 mm as specified by Section 02233. The Contractor shall also ensure that all asphaltic patching shall be equal in thickness to the original pavement but in no case shall be less than 50 mm or more than 100 mm.

.6 Spreading and Finishing:

Spreading and finishing shall be carried out as specified. A mechanical spreader shall be used on areas which are deemed by the Engineer to be large enough for such application.

.7 Rolling:

Rolling shall be carried out as specified in Section 02552.

.8 Clean Up:

The Contractor shall dispose of all cut out asphaltic concrete or waste materials at a dumping site approved by the Engineer.

3.2 BASIS FOR PAYMENT

.1 Payment for removal, replacement, removal and replacement or removal only, of existing asphalt pavement shall be compensation in full for all labour, plant and materials required to cut out and replace asphalt pavement including all requirements of any permit issued by the Provincial Department of Works, Services & Transportation for the project.

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This section is intended for use when preparing pavement surfaces prior to surface treatments or thin overlays.

PART 1 - GENERAL

1.1 MEASUREMENT FOR PAYMENT

.1 Crack cleaning and filling will be measured in metres.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Anionic emulsified asphalt: to CAN 2-16.2-M77+Amdt-Mar-81, grade SS-1.

.2 Liquid asphalt: to CAN 2-16.1-M77 grade RC-250.

.3 Aggregate for crack filling: material to following requirements:

.1 Screened sand or screening consisting of hard, durable particles, free from clay lumps, cementation, organic material, frozen material and other deleterious materials.

.2 Gradations to be within limits specified when tested to ASTM C136-84a and ASTM C117-87 and to have a smooth curve without sharp breaks when plotted on semi-log grading chart.

ASTM Sieve Designation	% Passing	
	Sand-asphalt slurry using emulsion	Sand-asphalt mix using liquid asphalt
2.00 mm	100	100
0.425 mm	30-55	-
0.180 mm	12-30	-
0.075 mm	3-12	0-8

.3 Sand Equivalent not less than 45% when tested to ASTM D2419-74(1979).

.4 Mixing water: potable.

2.2 MIXES

.1 Determine exact proportions for preparing filling mixes by site conditions and subject to approval of Engineer.

.2 Prepare sand asphalt slurry or mix with approximate following proportions:

.1 50 kg of aggregate.

.2 10 to 16 litres of asphalt.

.3 Water to produce uniform mix of consistency to achieve full penetration into cracks.

PART 3 - EXECUTION

3.1 APPLICATION EQUIPMENT

.1 Pressure applicator capable of applying sealant to 100 kPa.

.2 Pouring pots.

.3 Small diameter diamond bladed pavement saws. Mechanical rotary routers specifically designed for following random irregular cracks without tearing, chipping or spalling edge and capable of producing clean, vertical side walls. Open "V" type grooves not permitted.

3.2 PREPARATION

.1 Clean cracks designated by Engineer. Remove by use of hooks or other suitable tools, existing sealer and loose material from spalled edges, from surface and to a minimum depth of 50 mm.

.2 Saw or Rout designated cracks using approved rotary routers with maximum cutting width of 12 mm, to depth of 20 mm minimum and 32 mm maximum. Clean loose material from cracks with oil free compressed air applied at pressure not less than 550 kPa, or by other approved means. Dispose of material removed from cracks as directed. Do not contaminate drainage system.

3.3 CRACK FILLING

.1 Fill cracks designated and approved by Engineer. Cracks to be clean and dry before filling.

.2 Fill cracks when air temperature is above $10^{o}C$ and daily low temperature does not fall below $5^{o}C$, and no rain is forecast. Tamp cracks to minimum 50 mm depth and level with pavement surface. Due to shrinkage of mixture, two or more separate applications may be required for tight sealing.

.3 Remove and dispose of excess filler material as directed by Engineer.

3.4 BASIS FOR PAYMENT

.1 All costs associated with work specified in this Section shall be deemed to be included in the appropriate unit price quoted in the Schedule of Quantities and Prices.

This section specifies requirements for supply and application of materials for pavement markings.

PART 1 - GENERAL

1.1 MEASUREMENT FOR PAYMENT

.1 Pavement marking including symbols and letters will be measured by lump sum measure.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Paint:

- .1 To CGSB 1-GP-74M+Amdt-May-81, alkyd traffic paint.
- .2 To CGSB 1-GP-149M, alkyd reflectorized traffic paint.
- .3 Colour: to CGSB 1-GP-12C+(Amdt Dec 84) yellow 505-308, black 512-301, white 513-301, as indicated.

.2 Thinner: to CGSB 1-GP-5M.

PART 3 - EXECUTION

3.1 EQUIPMENT REQUIREMENTS

.1 Paint applicator to be an approved pressure type distributor capable of applying paint in single or double and dashed lines and that will ensure uniform application and having a positive shut-off.

3.2 CONDITION OF SURFACES

.1 Pavement surface to be free from surface water, frost, ice, dust, oil, grease and other foreign materials.

3.3 APPLICATION

.1 Lay out pavement markings.

.2 Unless otherwise approved by Engineer apply paint only when air temperature is above $10^{o}C$ and no rain is forecast. Apply point evenly at a rate of 3 m^2/l and do not thin unless approved by Engineer.

.3 Symbols and letters to conform to dimensions specified in the contract documents.

.4 Paint lines to be of uniform colour and density with sharp edges. Thoroughly clean distributor tank before refilling with paint of different colour.

.5 Apply paint using specified equipment only.

3.4 TOLERANCE

.1 Paint markings to be within plus or minus 12 mm of dimensions specified.

3.5 PROTECTION OF COMPLETED WORK

.1 Protect pavement markings until dry.

3.6 BASIS FOR PAYMENT

.1 All costs associated with work specified in this section shall be deemed to be included in the appropriate lump sum price quoted in the Schedule of Quantities and Prices.

This section specifies requirements for constructing new, adjusting and sealing over existing, manholes, catch basins and ditch inlets as indicated or as directed.

PART 1 - GENERAL

1.1 MEASUREMENT FOR PAYMENT

.1 Excavation and backfill will be measured in accordance with Section 02223.

.2 Manholes will be measured in units within depth classification as follows, measured from top of cover or grating to the lowest invert:

- .1 2 m or less.
- .2 Greater than 2 m but not more than 2.5 m.
- .3 Greater than 2.5 m but not more than 3 m.
- .4 Greater than 3 m but not more than 3.5 m.
- .5 Further depths in increments of 0.5 m.

.3 Outfall structures, cast-in-place manholes, drop manholes, special manholes and catch basins will be measured in units.

.4 Adjusting tops of existing manholes or catch basins will be measured in units.

.5 Sealing over existing manholes or catch basins will be measured in units.

.6 Manhole inflow protectors shall be paid by the each

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Concrete
- .1 To Section 03300.
- .2 Cement: to CAN3-A5-M88, type 10.
- .3 Concrete mix design to produce 30 MPa for pre-cast manholes, catchbasins and ditch inlets and 25 MPa for cast-in place manholes. Maximum size aggregate shall be 40 mm except 28 mm for pre-cast units. The water/cement ratio and air category shall be to CAN 3-A23.1-M90, table 7. The exposure condition F1 shall be used for catchbasins and ditch inlets and F2 for manholes. Air entrainment to CAN3-A23.1-M90 table 10.

.2 Concrete reinforcement: to Section 03200.

.3 Precast manhole sections: to ASTM C478-79, circular or oval. Top sections shall be flat slab top type with opening offset for vertical ladder installation. All sections shall be cured by the manufacturer not less than 7 days before shipping and date stamped with the casting date.

.4 Precast catch basin sections: to ASTM C139-73(1979), ASTM C478-79.

.5 Ribbed waterstops: Extruded PVC of sizes indicated to following properties:
- .1 Tensile strength: To ASTM D412-80, Die 'C' method, minimum 11.4 MPa.
- .2 Elongation: To ASTM D4412-80, Die 'C' method, minimum 275%.
- .3 Tear resistance: To ASTM D624-73, Die 'B' method, minimum 48 kN/m.

.6 Precast Joints: to be made watertight using rubber ring gaskets.

.7 Non-shrink grout to Section 03300.2.1.9.

.8 Mortar:
- .1 Aggregate: to CSA A82.56-M1976.
- .2 Cement: to CAN3-A8-M88.

.9 Ladder rungs: to CSA G30.12-M1977, No 25M billet steel deformed bars, hot dipped galvanized to CSA G164-M92 (R1972). Rungs to be safety pattern (drop step type). Alternate aluminum ladder rungs as detailed on the contract drawings.

.10 Safety landings: shall be placed in all manholes having a depth greater than 5 metres as measured from the top of cover to the invert of outlet pipe. They shall be constructed and located as specified by the Engineer and in accordance with drawing 0785.

.11 Adjusting rings: to ASTM C478-79.

.12 Drop manhole pipe:
- .1 outside drop pipe to be same as sewer pipe.
- .2 inside drop including force line hood to be as manufactured by Reliner/Duran Inc. or approved equal.

.13 Steel gratings, I-beams and fasteners: as indicated.

.14 Frames, gratings, covers to plan dimensions and following requirements:

- .1 Metal gratings and covers to bear evenly on frames. A frame with grating or cover to constitute one unit. Assemble and mark unit components before shipment.
- .2 Grey iron castings to ASTM A48-76, strength class 30B.
- .3 Castings to be coated with two applications of asphalt varnish, sand blasted or cleaned and ground to eliminate surface imperfections.
- .4 Manholes frames and covers: Heavy duty municipal type for road service. Cover cast without perforations and complete with two 25 mm lifting holes. Clear opening to be 580 minimum, or such larger size as indicated on the Drawing. 170 kg per set.
- .5 Catch basin frames and covers: Heavy duty municipal type for road service. Standard catch basin 190 kg per set. Curb and gutter type, 250 kg per set.

.15 Manhole inflow protection covers:

- .1 The manhole inflow protection cover and its associated valve body and components shall be manufactured from corrosion proof material suitable for atmospheres containing hydrogen sulphide and dilute sulphuric acid as well as gases associated with wastewater collection systems.

- .2 The cover body shall be made from an acetate, Butyrate, Styrene material that meets ASTM test requirements D256, D538, D790, D792, D646.

- .3 The thickness shall not be less than 2.38 mm nor greater than 3.96 mm. The cover body shall be manufactured to the dimensions as shown on the contact documents to allow for easy installation in the manhole frame.

- .4 The gasket shall be made of closed cell neoprene. The gasket shall have a pressure sensitive adhesive on one side and be placed under the cover rim by the manufacturer. The adhesive shall be compatible with the cover material so as to form a long lasting bond in either wet or dry conditions of use.

.5 The gas relief valve shall be designed to relieve at a pressure of 0.45 kg. The valve body shall be made of medium density polyethylene. The venting tube shall be capable of sealing on dirt and small debris. The valve shall have a leak down rate not exceeding 45 l/24 hr. to eliminate the ponding of water over the manhole cover after a rain storm.

.6 The valve shall be designed so that it is flexible and will not be broken by any movement of the cover over the valve proper. This valve configuration will allow the shallowest practical cover design eliminating unnecessary water retention or weight accumulation. The valve shall be easily removed for water drainage, should inspection be required immediately after or during a rain storm.

.7 The inflow protection cover shall be manufactured to fit the manhole frame rim upon which the manhole cover rests.

PART 3 - EXECUTION

3.1 EXCAVATING AND BACKFILL

.1 Excavate and backfill in accordance with Section 02223.

.2 Obtain approval of Engineer before installing outfall structures, manholes, catch basins, valve chambers or ditch inlets.

.3 Do not backfill any manhole or other structure for which a leakage test is required, prior to completion of testing and acceptance of test by Engineer.

3.2 CONCRETE WORK

.1 Do concrete work in accordance with Section 03300.

.2 Place concrete reinforcement in accordance with Section 03200.

.3 Position metal inserts in accordance with dimensions and details indicated.

3.3 INSTALLATION

.1 Construct units in accordance with details indicated, plumb and true to alignment and grade.

.2 Complete units as pipe laying progresses. Maximum of three units behind point of pipe laying will be allowed.

3. Pump excavation free of standing water and remove soft and foreign material before placing base. Fill any excavation below level of bottom of specified bedding as outlined in Section 02223.

.4 Cast base directly on undisturbed ground or when permitted by Engineer, set a precast concrete base on 150 mm minimum of compacted granular material compacted to ASTM D698-78 Method D.

.5 For precast units:
- .1 Make each successive joint watertight with approved rubber ring gaskets. Each lifting ring hole shall be grouted with non-shrink grout.
- .2 Clean surplus grout and joint compounds from interior surface of unit as work progresses.

.6 For cast-in-place units:
- .1 Place stub outlets and bulkheads at elevations and in positions indicated.

.2 Bench to provide a smooth U-shaped channel. Side height of channel to be full diameter of sewer. Slope adjacent floor at 1 on 5. Curve channels smoothly. Slope invert to establish sewer grade.

.3 Apply two coats of cement rendering to manhole benching. Cement rendering shall consist of one part cement and two parts sand with sufficient mixing water. Surface to be rendered shall be roughened before concrete has fully set, and immediately before rendering is applied, cleaned of all oil, grease, laitance or foreign matter. Keep surface moist. Roughen between coats. Work into surface and give last coat smooth, steel trowel finish.

.7 Installing units in existing systems:

.1 Where a new unit is to be installed in an existing run of pipe, ensure full support of existing pipe during installation, and carefully remove that portion of existing pipe to dimensions required and install new unit as specified.
.2 Make joints watertight between new unit and existing pipe.
.3 Where deemed expedient to maintain service around existing pipes and when systems constructed are ready to be put in operation, complete installation with appropriate break-outs, removals, redirection of flows, blocking unused pipes or other necessary work.

.8 Place frame and cover on top section to required elevation. If adjustment required use concrete, concrete ring, HDPE adjustment rings in accordance with 02601.3.4.4, or rubber risers in accordance with 02601.3.4.4.

.9 Clean units of debris and foreign materials. Remove fins and sharp projections. Prevent debris from entering system.

3.4 ADJUSTING TOPS OF EXISTING UNITS

.1 Remove existing gratings, frames and store for re-use at locations designated by Engineer.

.2 Sectional units:

.1 Raise or lower straight walled sectional units by adding or removing precast sections as required.
.2 Raise or lower tapered units by removing cone section, adding, removing, or substituting riser sections to obtain required elevation, then replace cone section. When the amount of raise is less than 300 mm use grade rings or cast-in-place concrete .

.3 Cast-in-place:

.1 Raise cast-in-place units by roughening existing top to ensure proper bond and extend to required elevation with cast-in-place concrete.
.2 Lower cast-in-place units with straight wall by removing concrete to elevation indicated for rebuilding.
.3 When monolithic units with tapered upper section are to be lowered more than 1500 mm, remove concrete for entire depth of taper plus as much straight wall as necessary, then rebuild upper section to required elevation with cast-in-place concrete.
.4 Install additional manhole ladder rungs in adjusted portion of units as required.
.5 Bring manholes to required elevation using cast-in-place concrete.
.6 Re-set gratings and frames to required elevation on full bed of cement mortar, parge and trowel smooth.

.4 Frame and cover adjustments:

.1 High Density Polyethylene frame adjustment rings injection molded to ASTM D1248 designed and tested to withstand loading in excess of ASSHTO HS25 and sealed with a sealant approved by the manufacturer and installed in accordance with the manufacturers instructions.

.2 Rubber Adjustment Frame Risers density 1.098 ± 0.05 gm/cm^3, compression deformation under 1 MPa $6 \pm 2\%$, and tested to withstand loading in excess of ASSHTO HS25, and sealed with a sealant approved by the manufacturer and installed in accordance with the manufacturers instructions.

.3 Cover adjustment rings must be cast iron.

3.5 MANHOLE INFLOW PROTECTION COVER

.1 The manhole frame shall be cleaned of all dirt or debris before placing the inflow protection cover upon the rim.

.2 The inflow protection cover shall be fully seated around the manhole frame rim to retard water from seeping between the cover and the manhole frame rim.

.3 After installation the inflow protection cover shall not infiltrate more than 45 1/24 hr.

3.6 INFILTRATION AND EXFILTRATION TEST

.1 Install watertight plugs or seals on inlets and outlets of each new sanitary sewer manhole and fill manhole with water. Keep manhole full for 24 hours to allow maximum absorption. Leakage not to exceed 0.3% per hour of volume of manhole.

.2 If permissible leakage is exceeded:

a) by up to 0.03% per hour of the volume of the manhole defects may be corrected on site by the manufacturer's representative using injected polyurethane.. **Concrete mortar grouting is not acceptable.** Repeat testing until acceptable.

b) by more than 0.03% per hour of the volume of the manhole, the manhole must be replaced at the Contractor's expense at the discretion of the engineer.

.3 In areas of high ground water the allowable infiltration shall not exceed 0.3% per hour of the volume of the manhole.

.4 Test any water retaining structure or special manhole in accordance with this section, as directed by the Engineer.

.5 Engineer will issue a Test Certificate for manholes passing test.

3.7 BASIS FOR PAYMENT

.1 All costs associated with work specified in this Section including bases and benching shall be deemed to be included in the appropriate unit and lump sum prices quoted in the Schedule of Quantities and Prices.

.2 Prices quoted in the Schedule of Quantities and Prices for manholes, drop manholes, catch basins, or other structures will be deemed to include benching, miscellaneous metals, ladder rungs, frames and covers, sewer backdrop (dwg. 0810), and any extra excavation and backfill required for construction space over and above that measured and paid for in accordance with Section 02223.

.3 Payment for manholes and catch basins will be at the quoted price after construction, pouring, stripping, and cement finishing and the frame and cover is installed and the manhole is tested and ready for use in the system.

.4 For all manholes or structures requiring an infiltration/exfiltration test, payment will be made to the maximum of 95% of the value of the structure until the leakage testing is completed and accepted by the Engineer.

This section specifies the requirements for the supply and installation or retrofit of a pre-fabricated or cast-in-place sewage pumping station consisting of tank, submersible or horizontal self-priming centrifugal pumps, piping including valves and all other components and accessories necessary for reliable operation.

PART 1 - GENERAL

1.1 MEASUREMENT FOR PAYMENT

.1 Payment for all work and materials specified in this section will be by the lump sum unit as quoted in the Schedule of Quantities and Prices. Unless specifically marked optional and not specified elsewhere all items must be supplied and installed.

.1 For each sewage pumping station specified under Supplementary Conditions using the format outlined in this Section.

.2 For each portable diesel generator specified under Supplementary Conditions using the format outlined in this Section.

.3 Overflows from sewage lift stations shall be paid in accordance with Sanitary Sewer Outfall Pipe as per Section 02704.

.4 Excavation and backfilling for lift stations shall be paid for in accordance with Section 02223. Measurement limits shall be the plan outside dimensions plus 2 metres and shall be to the full depth of the structure from original ground to the bottom of the structure.

PART 2 - PRODUCTS

2.1 WET WELL CHAMBER

.1 The chamber shall be of inside dimensions with size and height as detailed on the drawings to be able to contain all associated equipment. The station shall be cast-in-place concrete, pre-cast concrete, steel, fibreglass reinforced plastic or approved equal. Benching is to be included with the chamber so that accumulation of sewage and solids is diminished.

.2 The unit shall be designed to prevent flotation under all conditions.

.3 Cast-in-place concrete shall be designed to produce 25 MPa minimum compressive strength at 28 days and shall contain 40 mm maximum size coarse aggregate. The water cement ratio and air category shall be according to CAN3-A23.1-M90, table 7 or class F-2 exposure. The slump at time and point of deposit shall be 80 mm. Air entrainment shall be according to CAN3-A23.1-M90, table 10.

.4 Cast-in-place concrete exposed to deicing chemicals or sea water shall be designed to meet the appropriate exposure condition of Table 8, CAN3-A23.1-M90. Air entrainment according to CAN3-A23.1-M9, table 10.

.5 Pre-cast concrete chambers shall be designed to meet ASTM C478-79. Concrete shall be designed to produce 30 MPa minimum compressive strength at 28 days and shall be designed to meet the appropriate exposure conditions of clauses 2.1.3 and 2.1.4. Top sections shall be flat slab top type with the opening offset for vertical ladder installation.

.6 The design of pre-cast chambers for pumping stations to be constructed of steel, concrete, fibreglass reinforced plastic or other material shall be as specified and approved by the Engineer. Steel tanks require corrosion protection.

.7 Pre-cast stations shall be pre-assembled to the extent that safe and economic shipping permits, to minimize installation and start-up costs.

.8 The chamber shall be tested for infiltration and exfiltration according to Section 02601 Clause 3.6 and shall meet the test requirements of that Clause 3.6.

.9 All electrical equipment installed in wet wells and/or areas not isolated from wet wells shall be approved for installation in Class I, Division 2, Group D, hazardous locations in accordance with Section 18 of the Canadian Electrical Code, Part I (CSA C22.1).

2.2 PUMPS

.1 Submersible

.1 General

.1 Supply ..... submersible, non-clog or grinder pump(s). Each pump shall be equipped with ..... kW(hp) submersible, electric motor connected for operation on ..... volt, ... phase, 60 Hz, with ..... m of neoprene-jacketed type SOW, composite cable, ... AWG, for both power supply and monitoring functions. The pump unit shall be capable of delivering ..... l/s at ..... m TDH, with a shut-off head of ..... m (minimum). Each unit shall be supplied complete with a mating, cast iron ..... mm discharge connection and be fitted with ..... m of galvanized lifting chain, Grade A8, approved for overhead lifting and of adequate strength to permit raising and lowering of the pump.

.2 Pump and motor shall be of the close-coupled, integral design. Preference will be given to units employing motor and hydraulic units from the same manufacturer. The pump(s) shall be capable of handling raw, unscreened sewage. The discharge connection elbow shall be permanently installed in the wet well, together with the discharge piping.

.3 The pump(s) shall be automatically connected to the discharge connection elbow when lowered into place, and shall be easily removed for inspection and service.

.4 There will be no requirement for personnel to enter the chamber. Sealing of the pumping unit to the discharge connection shall be accomplished by a simple linear downward motion of the pump. A sliding guide bracket shall be attached to the pump unit. Guide devices which are integral with the pump casing will be unacceptable. The entire weight of the pumping unit shall be guided by no less than two (2) guide bars or cables and pressed tightly against the discharge connection elbow, providing a tight seal through either metal-to-metal contact or through an elastomer gasket.

.5 No portion of the pump shall bear directly on the floor of the chamber. The pump, with its appurtenances and cable, shall be capable of continuous submergence under water, without loss of watertight integrity, to a depth of 20 m.

.6 Major pump components shall be grey cast iron, Class 30, with smooth surfaces, devoid of blowholes and other irregularities.

.7 All exposed nuts and bolts shall be 300 series SS construction. All surfaces coming into contact with

sewage, other than SS or brass, shall be protected by an approved, sewage-resistant coating. The impeller shall be coated with an alkyd-resin primer. The pump exterior shall be finished with a non-toxic top coat. Chlorinated-rubber paint or other special epoxy primers and top coats shall be available when required to meet special or abnormal liquid considerations.

.8 All mating surfaces where watertight sealing is required shall be machined and fitted with nitrile rubber o-rings. Fittings shall be such that sealing is accomplished by metal-to-metal contact between machined surfaces.

.9 Controlled compression of nitrile rubber o-rings without the requirement of a specific torque limit is necessary. No secondary sealing components, rectangular gaskets, elliptical o-rings, grease or other devices or materials shall be used.

.10 The volute shall be of a single part, non-concentric design and shall have smooth fluid passages, large enough at all points on the volute to pass any size solids which can pass through the impeller.

.11 The impeller shall be of grey cast iron, Class 30 or better, dynamically balanced, enclosed, non-clog or recessed design having a long throughlet without acute turns. The impeller shall be capable of handling solids, fibrous material, heavy sludge, and other matter found in normal sewage applications. The impeller shall be a ..... vane design, and shall be capable of passing a minimum ..... mm sphere.

.12 The pump manufacturer shall, upon request, furnish mass moment of inertia data for the proposed impeller and/or impeller and motor shaft combination.

.13 A wear ring system shall be installed to provide efficient sealing between the volute and impeller, and shall consist of a stationary ring of brass or cast iron, which is drive-fitted to the volute inlet.

.14 Grinder Pumps shall have hardened stainless shredding ring and grinder to reduce sewage to a small size for discharge through small diameter piping.

.2 Cable

.1 The power and/or control cable(s) shall be SOW type sized to handle electrical code requirements. The cable must be neoprene-jacketed and approved by CSA.

.3 Cable Entry

.1 The cable entry, water-seal design shall preclude specific torque requirements to ensure an impermeable seal.

.2 The cable entry(s) shall be comprised of a cylindrical elastomer grommet, flanked by SS washers, all having a close tolerance fit against the cable's outside diameter and the entry's inside diameter, and compressed by the entry body, until it bottoms out on a shoulder, assuring controlled compression. Cable sealing systems which utilize mastic, adhesive, epoxy resin, or sealing compounds as a primary seal shall be capable of preventing entry of moisture even through a damaged cable to a submerged depth of 20 meters.

.3 The cable entry body contains a strain relief function, separate from the function of sealing the cable. The strain relief will be applied from the outer side of the cable entry assembly.

.4 Guide Bars

.1 Two vertical guide bars shall be provided with each pump to ensure correct alignment of the pump with

the automatic discharge connection. For each pump, the guide bars shall consist of Schedule 40 galvanized pipe, securely fixed at the lower end to the discharge connection by means of special bosses, provided. The guide bars shall extend from the discharge connection toward ground level and shall be securely fixed by a galvanized or equivalent bracket (upper guide bar holder), anchored to the station roof. The bracket shall also be provided with special inserts to position the guide bars rigidly. Or

.2 A guide system consisting of stainless steel cables fastened to a mounting bracket located at the pump access frame, & looped around the discharge elbow, shall be acceptable. No wall or pipe brackets will be required with this system.

.5 Automated Flush Valves (Optional)

.1 The station is to be provided with a fully automatic system to flush the lift station or pump sump to keep the chamber free of sludge build-up and prevent the formation of related poisonous, corrosive and malodorous hydrogen-sulphide gas.

.2 The mix-flush system is to consist of a motorized or hydraulic valve able to provide a jet-flushing stream from the pump discharge when the pump is running. The mix-flush system must be removable with the pump.

.3 The mix-flush valve is to be closed after an adjustable time (0-60 seconds), initially set for 30 seconds. After the mix-flush valve closes, the full capacity of the pump is to be delivered to the force main.

.4 The valving and piping configuration of the mix-flush system shall not allow return of effluent upon completion of the pumping cycle.

.5 The mix-flush system is to have a capacity sufficient to provide adequate mixing and flushing of the sump.

.6 Discharge Connections

.1 A cast iron, automatic discharge connection shall be provided for each pump to connect the pump to the discharge piping. The discharge connection shall be permanently fixed in position by four (4) anchor bolts attached to the bottom of the pump chamber. Discharge connections shall permit rapid and precise installation or removal of the pumps without entering the pump chamber.

.7 Shaft and Seals

.1 The pump shaft shall be of AISI 400 series SS. This is a nickel-bearing chromium steel, heat-treated, designed to superior mechanical properties providing greater corrosion and abrasion-resistant characteristics. Each pump shall be provided with a tandem mechanical shaft seal system.

.2 The upper of the tandem set of seals shall operate in an oil chamber. This set shall contain one stationary tungsten-carbide or silicon-carbide ring and one positively-driven rotating carbon ring. It shall function as an independent secondary barrier between the pumped liquid and the stator housing.

.3 The lower of the tandem set of seals shall function as the primary barrier between the pumpage and the stator housing. This set shall consist of a stationary ring and a positively-driven rotating ring, both of which shall be solid tungsten-carbide or silicon-carbide.

.4 Each interface shall be held in place by its own spring system. The seals shall require neither maintenance nor adjustment, but shall be easily inspected and replaced. Shaft seals without positively driven rotating members or conventional double mechanical seals containing either a common single or double spring, acting between the upper and lower units, shall not be considered acceptable or equal to the dual,

independent seal specified. Each pump shall be provided with an oil chamber for the shaft sealing system. The oil chamber shall be designed to assure that air is left in the oil chamber to absorb the expansion of the oil due to temperature variations.

.8 Bearings

.1 The pump shaft shall rotate on two independent bearings either permanently lubricated or run in oil. The support (upper) bearing shall be a single-row ball bearing and the main (lower) bearing shall be a two-row angular contact ball bearing, sized to take all radial and shock loads.

.9 Lifting Davit

.1 A galvanized lifting davit will be attached to the air vent and control mounting assembly. It shall swing in such a manner that it allows removal of either pump.

.2 A chain hoist shall be attached to the davit. The chain hoist will not have a load chain, but the sprocket will be suitable for acceptance of the pump lifting chain. This pump lifting arrangement will allow the pump to be lifted by its chain, in a single lift, thus providing a simple method of removing pump(s) for inspection and service. The chain hoist shall have a minimum one (1) ton lifting capacity.

.2 Self-Priming

.1 Pumps must be designed to handle raw, unscreened, domestic sanitary sewage. Pumps shall have ____ mm suction connection, and ____ mm discharge connection. Each pump shall be selected to perform under following operating conditions:

Capacity (lps)	_____
Total Dynamic Head (m)	_____
Total Dynamic Suction Lift (m)	_____
Maximum Repriming Lift (m)	_____
Maximum Static Suction Lift (m)	_____
Total Discharge Static Head (m)	_____
Minimum Submergence Depth (m)	_____

.2 Pumps shall be horizontal, self-priming centrifugal type. All internal passages, impeller vanes, and recirculation ports shall pass a 63 mm spherical solid for 75 mm pumps and 75 mm spherical solid for 100 mm pumps and larger. Smaller internal passages that create a maintenance nuisance or interfere with priming and pump performance shall not be permitted. Upon request from the engineer, manufacturer's certified drawings showing size and location of the recirculation port(s) shall be submitted for approval.

.3 The manufacturer of the pumps shall have a quality management system in place and shall be ISO 9001 certified.

.4 Materials and Construction Features

.1 Pump casing: Casing shall be cast iron Class 30 with integral volute scroll. Casing shall incorporate following features:

.1 Mounting feet sized to prevent tipping or binding when pump is completely disassembled for maintenance.

.2 Fill port coverplate, 89 mm diameter, shall be opened after loosening a hand nut/clamp bar

assembly. In consideration for safety, hand nut threads must provide slow release of pressure, and the clamp bar shall be retained by detente lugs. A Teflon gasket shall prevent adhesion of the fill port cover to the casing.

.3 Casing drain plug shall be at least 32 mm NPT to insure complete and rapid draining.

.2 Coverplate: Coverplate shall be cast iron Class 30. Design must incorporate following maintenance features:

.1 Retained by hand nuts for complete access to pump interior. Coverplate removal must provide ample clearance for removal of stoppages, and allow service to the impeller, seal, wearplate or check valve without removing suction or discharge piping.

.2 A replaceable wearplate secured to the coverplate by weld studs and nuts shall be AISI 1015 HRS.

.3 In consideration for safety, a pressure relief valve shall be supplied in the coverplate. Relief valve shall open at 517-1379 kpa.

.4 Two O-rings of Buna-N material shall seal coverplate to pump casing.

.5 Pusher bolt capability to assist in removal of coverplate. Pusher bolt threaded holes shall be sized to accept same retaining capscrews as used in rotating assembly.

.6 Easy-grip handle shall be mounted to face of coverplate.

.3 Rotating Assembly: A rotating assembly, which includes impeller, shaft, mechanical shaft seal, lip seals, bearings, sealplate and bearing housing, must be removable as a single unit without disturbing the pump casing or piping. Design shall incorporate following features:

.1 Sealplate and bearing housing shall be cast iron Class 30. Separate oil filled cavities, vented to atmosphere, shall be provided for shaft seal and bearings. The same oil shall not be used to lubricate both bearings and seal. Cavities must be cooled by the liquid pumped. Three lip seals will prevent leakage of oil.

.1 The bearing cavity shall have an oil level sight gauge and fill plug check valve. The clear sight gauge shall provide easy monitoring of the bearing cavity oil level and condition of oil without removal of the fill plug check valve. The check valve shall vent the cavity but prevent introduction of moist air to the bearings.

.2 The seal cavity shall have an oil level sight gauge and fill/vent plug. The clear sight gauge shall provide easy monitoring of the seal cavity oil level and condition of oil without removal of the fill/vent plug.

.3 Double lip seal shall provide an atmospheric path providing positive protection of bearings, with capability for external drainage monitoring.

.2 Impeller shall be ductile iron, two-vane, semi-open, non-clog, with integral pump out vanes on the back shroud. Impeller shall thread onto the pump shaft and be secured with a lockscrew and conical washer.

.3 Shaft shall be AISI 4140 alloy steel unless otherwise specified by the engineer, in which case

AISI 17-4 pH stainless steel shall be supplied.

.4 Bearings shall be anti-friction ball type of proper size and design to withstand all radial and thrust loads expected during normal operation. Bearings shall be oil lubricated from a dedicated reservoir. Pump designs which use the same oil to lubricate the bearings and shaft seal shall not be acceptable.

.5 Shaft seal shall be oil lubricated mechanical type. The stationary and rotating seal faces shall be tungsten titanium carbide alloy. Each mating surface shall be lapped to within three light bands flatness (35 millionths of an inch), as measured by an optical flat under monochromatic light. The stationary seal seat shall be double floating by virtue of a dual O-ring design; an external O-ring shall secure the stationary seat to the sealplate, and an internal O-ring shall hold the faces in alignment during periods of mechanical or hydraulic shock (loads which cause shaft deflection, vibration, and axial/radial movement). Elastomers shall be viton. Cage and spring to be AISI 316 stainless steel. Seal shall be oil lubricated from a dedicated reservoir. The same oil shall not lubricate both shaft seal and shaft bearings. Seal shall be warranted for a minimum of four years.

.4 Adjustment of the impeller face clearance (distance between impeller and wearplate) shall be accomplished by external means.

.1 Clearances shall be maintained by external shimless coverplate adjustment, utilizing collar and adjusting screw design for incremental adjustment of clearances by hand. Requirement of realignment of belts, couplings, etc., shall not be acceptable. Coverplate shall be capable of being removed without disturbing clearance settings.

.2 There shall be provisions for additional clearance adjustment in the event that adjustment tolerances have been depleted from the coverplate side of the pump. The removal of stainless steel shims from the rotating assembly side of the pump shall allow for further adjustment as described above.

.3 Clearance adjustment which requires movement of the shaft only, thereby adversely affecting seal working length or impeller back clearance, shall not be acceptable.

2.3 PIPING

.1 Pipe: All station piping to be ASTM A-53, electric resistance weld steel pipe, schedule 40, and/or ductile iron to ANSI/AWWA A21.51/C115, Class 53.

.2 Fittings: Forged welding fittings to ASTM A-181; grooved standard rigid couplings to CSA B242; ductile iron grooved fittings to ASTM A536.

.3 Flanges: To ANSI B-16.1, Class 125. Ductile iron grooved end flanges to ASTM AS36.

.4 Wall Pieces: All wall pieces to have slip-on flanges, welded to the pipe and located in the center of the wall. Exterior wall pieces to be cement-lined ductile iron, flanged inside and plain end outside. Exterior connections to forcemain to be by suitable dresser style coupling. Ductile iron conforming to AWWA C151 with flexible cut grooves to ANSI/AWWA C-606 may be used.

.5 .1 Valves within the wet well:

.1 Non-clog ball check valves and ballcentric plug valves shall be installed in each pump discharge

line. Each valve shall have a throughway size equal to the pump discharge pipe size to ensure full, free-flow operation. Grooved end Plug Valves & Check Valves to AWWA C606, laying length to AWWA C509.

.2 Valves external to wet well:

.1 Check Valve: Each pump shall be equipped with a full flow type check valve, capable of passing a 75 mm spherical solid, with flanged ends and be fitted with an external lever and spring. The valve seat shall be constructed of stainless steel and shall be replaceable. The valve body shall be cast iron and incorporate a 75 mm clean-out port. Valve clapper shall have a molded neoprene seating surface incorporating low pressure sealing rings. Valve hinge pin and internal hinge arm shall be stainless steel supported on each end in brass bushings, sealing busing shall have double o-rings. O-rings shall be easily replaceable without requiring access to interior of valve body. Valve shall be rated at 1200 kpa water working pressure, 2400 kpa PSI hydrostatic test pressure. Valves other than full flow type or valves mounted in such a manner that prevents the passage of a 75 mm spherical solid shall not be acceptable.

.2 Plug Valve: A 3-way plug valve must allow either or both pumps to be isolated from the force main. The plug valve shall be non-lubricated, tapered type. Valve body shall be semi-steel with flanged end connections drilled to 125 pound standard. The drip-tight shutoff plug shall be mounted in stainless steel bearings, and shall have a resilient facing bonded to the sealing surface. Valve shall be operated with a single lever actuator providing lift, turn, and reseat action. The lever shall have a locking device to hold the plug in the desired position.

.6 All internal piping will be prefabricated and galvanized (hot-dip method) prior to installation. Stainless steel bolts and fasteners will be used to assemble all internal piping and valves. All grooved pipe & fittings to be galvanized prior to installation.

.7 Influent and discharge lines shall terminate in a standard 150 lb. flange connection, or a standard grooved cap & rigid coupling to CSA B242, inside the lift station chamber.

.8 Wet well vent piping and control mounting assembly shall be mounted as shown on the drawings. A mounting plate with four (4) 50 mm conduit nipples shall be set in the concrete at the time of pour. Both conduit and vent pipe base will be open at the bottom. The wet well vent pipes will be of 100 mm piping, and this assembly will be hot-dip galvanized.

2.4 MISCELLANEOUS ITEMS

.1 Steel Splash Plate. Fabricated from Steel ASTM A36, as detailed. To be painted with one coat of zinc based paint. Inter-zinc by International Paints, Carbo-zinc by Standard Manufacturing, or approved equal.

.2 Valve Chamber Drain: Floor drain from valve chamber into wet well to be 50 millimetre diameter.

.3 Flushing Valve Connection: A 64 diameter flushing valve connection to be installed on pump header pipe in the valve chamber as indicated. Valve to be Crane No. 429, or approved equal. Stub & cap, threaded to Owner's fire hydrant standard, to be installed as detailed.

.4 Brickwork: Bricks to CSA A82.1-M87, type 1 standard metric, by Trinity Brick Products Ltd. or approved equal. Colour as approved by Engineer. Mortar and grout to CSA A179-M1976.

.5 Insulation: Expanded polystyrene to CSGB 51-GP-20M, 50mm. Styrofoam, or approved equal.

.6 Ladders shall be: Heavy duty portable extension non-conductive ladders, extendable to sump depth plus 2 metres. Details to be submitted as per Section 01340 for Engineer's review and approval.

.7 Padlock: Two padlocks, Master Lock No. 2081 or equal, c/w four master keys to match the existing master key.

2.5 PORTABLE DIESEL GENERATOR

.1 Supply and commission a ..... KW, ... phase ..... volt portable diesel generator, CSA approved, complete with 120 volt, GFCI convenience receptacle, rated at 15 amp; a receptacle for connection of power cord to the lift station emergency receptacle. All receptacles to have weather protectors. Engine to be diesel, alternator to be brushless type rated for full load, continuous duty; 95 litre fuel tank with bottom tapered to a collection sump with drain cock, control panel with main breaker, 12 volt electric start with battery charging circuit, residential muffler. Engine and alternator to be close coupled and mounted on a 3000 lb spring axel trailer with fenders, fender lights, wheels, toe eye extension, extension cable and mating plug for transfer switch.

2.6 MOTOR

.1 Submersible

.1 The pump motor shall be of the squirrel-cage induction type design, housed in a watertight chamber of maximum efficiency and durability. The motor shall be designed for continuous duty capable of sustaining a maximum of fifteen (15) starts per hour. At the design condition, the motor shall not draw more than .....KW at nominal voltage of utility supply quality at a maximum speed of ..... rpm.

.2 The motor stator shall be directly shrink fitted into the stator housing. Preference will be given to pumps with cast iron stator housings. The use of bolts, pins or other fastening devices requiring penetration of the stator housing shall be rejected. The stator winding and leads shall be insulated with moisture-resistant varnish capable of withstanding a temperature of 155^{o}C or the motors maximum temperature rise, whichever is greater. The stator shall be dipped and baked three (3) times in Class F varnish.

.3 The rotor bars and short-circuit rings shall be made of aluminum. Thermal sensors shall be used to monitor stator temperatures on all pumps. The stator shall be equipped with not less than two (2) thermal switches embedded in the end coils of the stator windings (one switch per phase to protect the motor against surcharges and high temperature). These shall be used in conjunction with, and supplemental to, external motor overload protection, and wired to the control panel.

.4 The junction box chamber containing the terminal board shall be sealed from the motor by an elastomer compression grommet for pumps of 3 kW (4 hp) or more.

.5 The motor housing shall be equipped with a moisture detector to detect any leakage of water or pumpage, into the stator housing. The signals from the thermal switches and the moisture detector will be wired to the control panel.

.6 The control of the moisture detector and the winding thermal switches shall be accomplished by using a control/indicator relay(s) which will be installed and wired inside the control panel to stop the pump unit upon a fault signal.

.7 Cooling (Air Cooled Motors)

.1 (up to 10 kW)
Each unit shall be provided with an adequately designed cooling system consisting of thermal radiators

(cooling fins) integral to the stator housing, and shall provide adequate cooling of the motor.

.2 (over 10 kW)
Each unit shall be provided with an adequately designed cooling system consisting of a water jacket completely surrounding the stator housing. The water jacket shall provide a separate circulation of the pumped liquid. Cooling media channels and ports shall be non-clogging by virtue of their dimensions and design of the circulation vanes.

.3 Alternate designs of pumps without cooling jackets will be acceptable.

.2 Self-Priming

.1 Motors:

.1 Pump motors shall be ___ kw, horizontal ODP, 1,800 RPM, NEMA design B with cast iron frame with copper windings, induction type, with class F insulation and 1.15 Service Factor for normal starting torque and low starting current characteristics, suitable for continuous service. The motors shall not overload at the design condition or at any head in the operating range as specified. Motors shall be suitable for operation using the utility power available specified in part 1 of this section.

.2 Motors shall be tested in accordance with provisions of ANSI/IEEEE Std. 112, Method B.

.2 Drive Transmission:

.1 Power to pumps transmitted V-belt drive assemblies. The sheave/belt combination shall provide the speed ratio needed to achieve the specified pump operating conditions.

.2 Each drive assembly shall utilize at least two V-belts providing a minimum combined safety factor of 1.5. Single belt drives or systems with a safety factor of less than 1.5 are not acceptable. Computation of safety factors shall be based on performance data published by the drive manufacturer.

.3 Pump drives to be enclosed on all sides by a guard constructed of fabricated steel or combination of materials included expanded, perforated, or solid sheet metal. No opening to a rotating member shall exceed ½ inch.

2.7 ACCESS FRAME AND COVER

.1 The aluminum access frame shall be fabricated using an extrusion of 6351 aluminum. The cover shall be fabricated using a plate of 5086 aluminum designed to withstand shear and deflect not more than 1/79 of the maximum span for minimum specified loads of 7.2 kPa uniform load or 1100 kg point load. The cover shall rest on a rubber gasket and shall be hinged along one side with a continuous aluminum hinge.

.2 The top of the access frame shall be flush, the handle recessed. A padlock shall be installed within the recess to lock the cover in the closed position.

.3 A cover stay shall be provided which allows the cover to be locked in the open position.

.4 Where applicable, each access frame shall be capable of supporting the full weight of any equipment which can be installed through its opening.

.5 The access frames shall be designed for embedding into the concrete top of a sewer station, the extrusion shall be shaped such as to provide good anchoring to the concrete. All surfaces in contact with the concrete shall be bitumastic coated.

.6 The frames shall be capable of being installed side-by-side by bolting them together using standardized bolting kits.

.7 Where applicable, aluminum rail nuts shall be provided within the extrusions, permitting an upper guide bar holder, a level regulator hanger and a chain hook to be attached without any modifications required to the frame.

.8 A bilingual confined space warning label shall be clearly displayed on the underside of the cover.

2.8 LIQUID LEVEL CONTROL

.1 Liquid level regulators shall be provided to control the operation of the pumps in accordance with variations of sewage levels in the pump chamber.

.2 Float type level regulators shall consist of a switch enclosed in a watertight polypropylene casing, and shall be suspended from the top of the pump chamber by means of a three conductor, PVC-jacketed cable and pre-determined elevations within the pump chamber.

.1 The centre of gravity of the float type level regulator being in a different position from the centre of buoyancy, results in the regulator tilting whenever the liquid level reaches it, thus activating the switch to energize or de-energize the 24-volt control circuit.

.2 The float type level regulator shall be installed on a galvanized hanger fitted with squeeze connectors. Level regulator cables shall run directly to the control panel. Cable lengths shall be selected to suit site conditions.

.3 The air bubbler level control system shall utilize an electronic pressure switch which shall continuously monitor the wet well level, permitting the operator to read wet well level at any time. Upon operator selection of automatic operation, the electronic pressure switch shall start the motor for one pump when the liquid level in the wet well rises to the "lead pump start level". When the liquid is lowered to the "lead pump stop level", the electronic pressure switch shall stop this pump. These actions shall constitute one pumping cycle. Should the wet well level continue to rise, the electronic pressure switch shall start the second pump when the liquid reaches the "lag pump start level" so that both pumps are operating. These levels shall be full adjustable with a local LED status indicator

.1 The electronic pressure switch shall include a DC power supply to convert 120VAC control power to 12VDC EPS power. The power supply shall be 500 mA (6W) minimum and be UL listed Class II power limited power supply.

.2 The electronic pressure switch shall be equipped with an electronic comparator and solid state output relay to alert maintenance personnel to a high liquid level in the wet well. An indicator, visible on the front of the control panel, shall indicate that a high wet well level exists. The alarm signal shall be maintained until the wet well level has been lowered and the circuit has been manually reset. High water alarm shall be furnished with a dry contact wired to terminal blocks.

.4 Ultrasonic level transmitters shall use non-contacting ultrasonic technology to provide effective monitoring for a range up to 15 meters. The unit shall be programmed using an integral keypad and shall be panel mounted. The unit shall have a universal power supply, multi-field backlit LCD, two alarm/pump relays, high level switch operation, lead/lag pump operation, isolated mA output and a bi-polar communications loop. The accuracy shall be .25% of range or 6 mm, whichever is greater and the resolution 0.1% of program range or 2 mm, whichever is greater. The

memory shall be non-volatile FLASH for programs and non-volatile EEPROM for parameters. The display shall be a minimum of 75 x 20 mm multi-field backlit and the unit shall be CSA approved for panel mounting.

2.9 PUMP CONTROL PANEL

.1 Submersible Pump Control Panel

.1 General

.1 All parts shall be of the best industrial quality, designed for extended, reliable and maintenance-free operation under extreme weather conditions. Electro-mechanical components shall normally be limited to a strict minimum.

.2 The enclosure shall be of heavy industrial quality, SS, and shall be weatherproof to EEMAC 3, in order to provide reliable outdoor operation. The box shall be fitted with a heavy steel inner door. The exterior door shall be hinge-mounted with a 135-degree angle opening to allow easy access to the components.

.3 The control panel shall be equipped with a main disconnect switch, automatically interlocked with the inner door to electrically isolate the components of the control panel when the inner door is open.

For ratings up to 100 A, the main disconnect switch shall be of the fusible type, with fuses rated at 100,000 A short-circuit capacity. For capacities above 100 A, the main disconnect switch shall be a thermal-magnetic circuit breaker having a fast response, with a high interrupting capacity approved by the Engineer, and sealed contact chambers with clear covers for inspection.

.4 Each pump circuit shall be fitted with an adjustable 3-pole, thermal magnetic-circuit breaker or current-limiting motor protector and overload relay. The response time under short-circuit conditions shall be less than one-quarter of a cycle; the action shall open all poles, thus avoiding single-phase operation of three-phase pumps.

.5 The circuit breaker and overload relay shall exhibit stable operation under varying temperature conditions (from -25^{o}C up to 50^{o}C). The circuit breaker shall have a high interrupting capacity independent of the thermal setting.

.6 Each pump circuit shall be fitted with a 3-pole, fast-acting magnetic contactor, designed for a minimum of 20 years service under normal operating conditions of sewage pumping stations. Under overload conditions, the circuit shall be designed to open the overload relay first and then the contactors.

.7 The control shall be equipped with not less than a 50-watt heating element integral with a thermostat and a protective shield around the heating element to prevent injuries.

.8 A manual line transfer switch, complete with a weatherproof, exterior-mounted receptacle, shall be installed in the microprocessor control in those locations as specified by the engineer.

.9 Phase failure and phase reversal protection shall be installed in three phase stations only.

.2 Micro Processor Controller Based:

.1 The pump manufacturer shall supply a completely assembled control panel based on a solid-state microprocessor controller with a fault diagnostic system and pump running time recorder, specially designed and programmed for the operation of two or more submersible pumps, ... kW, ... volts, ... phase, as specified. Where specified by the engineer an electro-mechanical panel may be provided. This panel shall provide basically the same functions as the PLC based, except for the float fault function.

.2 Isolated rotary handles for each motor protector shall be mounted on the inner door.

.3 A state-of-the-art, microprocessor-based control with fault diagnostics and display shall be used to provide failsafe operation of the sewage pumping station and shall fulfil, but not be limited to the following functions:

.1 The microprocessor shall control the starting, stopping and alternation of the pumps and shall include a 15-second time delay between the consecutive start of either pump to prevent high inrush currents which would result if both pumps were started at the same time.

.2 The microprocessor shall be equipped with four (4) LED indicators showing which level regulator is activated. The control shall monitor any failure in any of the level regulator circuits. If any of the level regulators are out of service, the next higher level regulator shall assume automatically the duties of the faulty regulator. At the same time, an LED will identify the faulty level regulator.

For example: if float is faulty, float 2 will assume the duties of float 1; float 3; the duties of float 2, and float 4, the duties of float 3 and 4. Even in the event of fault occurrences in all of the level regulator circuits the control shall at least send an alarm.

.3 The control shall have LED indicators showing the pump(s) in operation and/or a demand for a pump to operate.

.4 The control shall monitor the pump heat sensor output(s) and shall shut off the overheating pump before high temperature damage to the insulation.

.5 The control shall monitor any leakage of water into the stator housing and shall shut off the faulty pump and initiate the alarm.

.6 The microprocessor starts up the back-up pump whenever a faulty condition stops the service pump.

.7 The microprocessor identifies the degree of urgency of all fault conditions and classifies them as "malfunction", and can transmit these conditions to a remote location through a telemetry, remote monitoring system (optional).

.8 High priority faults, identified as "emergency", which require immediate intervention are only alarmed when a definite risk of flooding exists.

.9 Low priority faults are identified as "malfunctions" and their correction may be scheduled during the regular maintenance activities of the following day.

.10 Upon inspection, the diagnostic display will identify any fault which has occurred since the last visit, even if the fault has self-corrected or no longer exists.

.11 An alarm silencing push button shall be included to stop the alarm from unnecessary operation, once the station operator has taken notice of the fault.

.12 MANUAL/OFF/AUTO switches shall be incorporated to allow manual pump operation.

.13 An alarm test button shall be incorporated for testing the alarm circuits.

.4 A duplex receptacle with ground-fault circuit interrupter at 120 V shall be installed for connection of a convenience lamp. An exterior-mounted, vandal-proof, shatter proof alarm light, two running-time recorders, and a two-pump, running-time recorder shall be installed.

.5 The control panel and microprocessor shall operate the pumps as per the following sequence:

.a Float 1: stop both pumps and alternate pumps
.b Float 2: run duty pump
.c Float 3: run standby pump
.d Float 4: emergency alarm

.3 PLC/RTU Based:

.1 The pump manufacturer shall supply a completely assembled control panel based on a PLC/RTU controller complete with graphics touch screen operator interface and remote communications using modbus protocol or option modbus TCP/IP protocol via high-speed Internet access. The panel shall be designed and programmed for the operation of two or more submersible pumps, ___ kw, ___ volts, ___ phase as specified. The panel shall provide space for a UHF or 900 MHz data radio.

.2 A state-of-art PLC/RTU shall be used to provide fail safe operation of the sewage pumping station. All control system parameters required to implement the pumping station operation shall be entered using the touch screen. The system shall be designed to be 100% user configurable to allow the operator to perform the initial start-up and any future adjustments to the parameters, set points, alarms set points, etc. The PLC/RTU shall fulfill, but not be limited to the following functions:

.1 The PLC/RTU shall control the starting, stopping and alternation of the pumps and shall include a user selectable time delay between the consecutive start of either pump to prevent high inrush currents which would result if both pumps were started at the same time.

.2 The PLC/RTU shall be interfaced to a 125 mm, 256 color graphics touch screen for data entry and monitoring. The screen shall display 320 trend points on the X-axis to permit on screen plotting of all data points. The range between points shall be user selectable, in seconds.

.1 The screen shall display active and current alarms and alarm history of the last 25 alarms.

.2 The following alarms shall be displayed:
- pump under current
- pump over load
- pump high temperature
- pump leakage
- transmitter fault
- high well level
- low well level
- voltage fault

.3 The screen shall have a graphical representation of the pumping station showing the following:
- pump hours

- pump starts
- pump amps
- pump status
- well level
- station inflow
- pump flow
- combined pump flow

.3 The PLC/RTU shall be programmed to log well level, pump starts, pump amps, pump hours and station inflow. The data logger shall have a minimum storage capacity of 10,000 records with user selectable logging rate. The software package to retrieve the data from the logger shall be provided with the pump station.

.4 All operating parameters are to be entered from the touch screen through a series of configuration screens and include but is not limited to the following:

- Well Level Transmitter Span
- Well Level Transmitter Zero
- Float or Level Transmitter operation selection
- Float normally open or normally closed selection
- Hi and Lo alarm Set points
- Lead, Follow, and Standby pump start and stop set points
- Leak and thermal fault enabling and selection for each pump
- Pump 1, 2 & 3 Start delay time
- Pumps Maintenance selection/interval
- Wet well surface area
- Riser Area
- Bench Level
- Auto clean settings
- Data log settings
- External alarm light settings
- Pump auto status

.5 The PLC/RTU shall be equipped with flash type non-volatile type memory.

.6 The PLC/RTU shall have three RS232 serial parts.

.3 A duplex receptacle with ground-fault, interrupter at 120 V, 3 amps shall be installed for connection of a convenience lamp, and an exterior-mounted, vandal-proof, shatter proof alarm light.

.4 The control panel and PLC/RTU shall operate the pumps as per the following sequence:

.1 Pump stop level set point
.2 Stop both pumps and alternate pumps
.3 Lead pump run set point
.4 Run duty pump
.5 Standby pump run set point
.6 Run standby pump

.2 Self- Priming Pump Control Panel

.1 The pump station control panel will be tested as an integral unit by the pump station manufacturer. The control

panel shall also be tested with the pump station as a complete working system at the pump station manufacturer's facility.

.2 Panel Enclosure

.1 Electrical control equipment shall be mounted within a common NEMA 1 stainless steel, dead front type control enclosures. Doors shall be hinged and sealed with a neoprene gasket and equipped with captive closing hardware. Control components shall be mounted on removable steel back panels secured to enclosure with collar studs.

.2 All control devices and instruments shall be mounted using threaded fasteners, and shall be clearly labeled to indicate function.

.3 Branch Components

.1 Motor branch components to be of highest industrial quality, secured to the sub-plate with machine screws and lockwashers. Mounting holes shall be drilled and tapped; Self-tapping screws shall not be used to mount any component.

.2 Circuit Breakers and Operating Mechanism

.1 A properly sized heavy duty circuit breaker, with RMS interrupting rating of_____ amperes at ____ volts, shall be furnished for each pump motor. The circuit breakers must be sealed by the manufacturer after calibration to prevent tampering.

.2 An operating mechanism installed on each motor circuit breaker shall penetrate the control panel door. A padlockable operator handle shall be secured on the exterior surface. Interlocks must prevent opening the door until circuit breakers are in "OFF" position.

.3 Motor Starters

.1 An open frame, across-the-line, NEMA rated magnetic starter with under-voltage release, and overload protection on all three phases, shall be furnished for each pump motor. Starters of NEMA size 1 and above shall allow addition of at least two auxiliary contacts. Starters rated "O", "OO", or fractional size are not acceptable. Power contacts to be double-break type made of cadmium oxide silver. Coils to be epoxy molded for protection from moisture and corrosive atmospheres. Contacts and coils shall be easily replaceable without removing the starter from its mounted position. Each starter shall have a metal mounting plate for durability.

.4 Overload Relays

.1 Overload relays shall be solid-state block type, having visual trip indication with trip-free operation. Electrically resetting the overload will cause one (1) normally open and one (1) normally closed isolated alarm/control contact to reset, thus re-establishing a control circuit. Trip setting shall be governed by solid-state circuitry and adjustable current setting. Trip classes shall be 10, 15 and 20. Additional features to include phase loss protection, selectable jam/stall protection and selectable ground fault protection.

.2 A reset pushbutton, mounted through the control panel door, shall permit resetting the overload relays without opening the door.

.4 Control Circuit

.1 A normal duty thermal-magnetic circuit breaker shall protect all control circuits by interrupting control power.

.2 Pump mode selector switches shall permit manual start or stop of each pump individually, or permit automatic operation under control of the liquid level control system. Manual operation shall override all shutdown systems, except the motor overload relays. Selector switches to be oil-tight design with contacts rated NEMA A300 minimum.

.3 Pump alternator relay to be electro-mechanical industrial design. Relay contacts to be rated 10 amperes minimum at 120 volts non-inductive. A switch shall permit the station operator to select automatic alternation of pumps, to select pump number one to be "lead" for each pumping cycle, or to select pump number two to be "lead" pump for each pumping cycle.

.4 Six digit elapsed time meter (non-reset type) shall be connected to each motor starter to indicate total running time of each pump in "hours" and "tenths of hours". An integral pilot light shall be wired in parallel to indicate that the motor is energized and should be running.

.5 A high pump temperature protection circuit shall override the level control and shut down the pump motor(s) when required to protect the pump from excessive temperature. A thermostat shall be mounted on each pump casing and connected to a pump shutdown circuit. If casing temperature rises to a level sufficient to cause damage, the thermostat causes the shutdown circuit to interrupt power to the motor. A visible indicator, mounted through the control panel door shall indicate motor stopped due to high pump temperature. The motor shall remain locked out until the pump has cooled and circuit has been manually reset. Automatic reset of this circuit is not acceptable.

.6 A duplex ground fault receptacle providing 115 VAC, 60 Hz, single phase current, will be mounted on the side of the control enclosure. Receptacle circuit shall be protected by a 15 ampere thermal-magnetic circuit breaker.

.7 Wiring

.1 The pump station, as furnished by the manufacturer, shall be completely wired, except for power feed lines to the branch circuit breakers and final connections to remote alarm devices.

.2 All wiring, workmanship, and schematic wiring diagrams shall comply with applicable standards and specifications of the National Electric Code (NEC).

.3 All user serviceable wiring shall be type MTW or THW, 600 volts, color coded as follows:

1. Line and Load Circuits, AC or DC power.....Black
2. AC Control Circuit Less Than Line Voltage.....Red
3. DC Control Circuit.....Blue
4. Interlock Control Circuit, from External Source.....Yellow
5. Equipment Grounding Conductor.....Green
6. Current Carrying Ground.....White
7. Hot With Circuit Breaker Open.....Orange

.4 Control circuit wiring inside the panel, with exception of internal wiring of individual components, shall be 16 gauge minimum, type MTW or THW, 600 volts. Power wiring to be 14 gauge minimum. Motor branch wiring shall be 10 gauge minimum.

.5 Motor branch and other power conductors shall not be loaded above 60 degree C temperature rating, on circuits of 100 amperes or less, nor above 75 degrees C on circuits over 100 amperes. Wires must be clearly numbered at each end in conformance with applicable standards. All wire connectors in the control panel shall be ring tongue type with nylon insulated shanks. All wires on the sub-plate shall be bundled and tied. All wires extending from components mounted on door shall terminate at a terminal block mounted on the back panel. All wiring outside the panel shall be routed through conduit.

.6 Control wires connected to door mounted components must be tied and bundled in accordance with good commercial practice. Bundles shall be made flexible at the hinged side of the enclosure. Adequate length and flex shall allow the door to swing full open without undue stress or abrasion. Bundles shall be held on each side of hinge by mechanical fastening devices.

.8 Conduit

.1 Factory installed conduit shall conform to following requirements:
.2 All conduit and fittings to be UL listed.
.3 Liquid tight flexible metal conduit to be constructed of smooth, flexible galvanized steel core with smooth abrasion resistant, liquid tight polyvinyl chloride cover.
.4 Conduit to be supported in accordance with articles 346, 347, and 350 of the National Electric Code.
.5 Conduit shall be sized according to the National Electric Code.

.9 Grounding

.1 Station manufacturer shall ground all electrical equipment inside the pump station to the control panel back plate. All paint must be removed from the grounding mounting surface before making final connection.

.2 The contractor shall provide an earth driven ground connection to the pump station at the main grounding lug in accordance with the National Electric Code (NEC).

.10 Equipment Marking

.1 Permanent corrosion resistant name plate(s) shall be attached to the control and include following information:

1. Equipment serial number
2. Supply voltage, phase and frequency
3. Current rating of the minimum main conductor
4. Electrical wiring diagram number
5. Motor horsepower and full load current
6. Motor overload heater element
7. Motor circuit breaker trip current rating
8. Name and location of equipment manufacturer

.2 Control components shall be permanently marked using the same identification keys shown on the electrical diagram. Labels shall be mounted adjacent to device being identified.

.3 Switches, indicators, and instruments mounted through the control panel door shall be labeled to indicate function, position, etc. Labels shall be mounted adjacent to, or above the device.

2.10 ELECTRICAL WIRING

.1 Only equipment essential for the operation of the pump station shall be installed inside. Where possible, all fans, heaters, switches and junction boxes etc. shall be located outside to avoid corrosion or flood damage. All electrical wiring of the pump station shall be designed and supplied by the manufacturer in accordance with the Canadian Electrical Code and CSA draft bulletin S 2619. Pump power and level regulator cables shall be provided in sufficient length to run directly to the control panel via an external conduit. Conduit fittings and strain relief connectors shall be provided in sufficient number and size to permit installation of the conduit to the pumping station. All external conduits shall enter the control panel enclosure only through the bottom. Conduits shall be sealed with a permanently flexible sealant, preventing entry or vapour or gas from the wet well. The seal shall be so located to enable motor removal c/w electrical disconnect without disturbing the seal. Conduits shall be sealed with "O" rings at entrances to control panels or junction boxes.

.2 All wiring in the pump station shall be coded either by colour or a numbering system. Pump power and level regulator (and automatic flush valve-optional) cables shall be provided with sufficient length to run directly to the control panel (except where otherwise specified), and shall be pulled through external conduits.

.3 All conductors in power wiring shall be no less than No. 14 AWG. Control wiring conductors may be smaller in size, in accordance with the current requirements of the circuit involved and all applicable standards.

2.11 INSPECTION, TESTING AND SHIPMENT

.1 Inspection and Testing

.1 The pump shall be tested for proper operation at rated power supply values and for electrical and mechanical integrity prior to shipment. The pump supplier must have adequate test facilities, at its Newfoundland Service Depot, to at least provide a single-point performance test or a complete performance curve at an accuracy of +/- 1%. The level regulators should also be checked for correct operation.

.2 The pump/motor assembly shall be CSA approved as one, integral unit, as per CSA standard CAN/CSA-C22.2.108-M89, LIQUID PUMPS. Proof of this approval shall be submitted by the pump manufacturer together with the approval drawings. An approval of the motor unit only shall not be acceptable. The cable shall be CSA approved, SOW type, neoprene-jacketed, with a 90 degree Celsius rating.

.3 The supplier grants the right of inspection of the pumping station to any authorized representative of the purchaser before shipment from factory. If inspection is requested give 48 hours notice in advance of the time when the equipment will by ready for inspection at the factory.

.4 Any equipment in the pumping station that may have been provided by another supplier shall have been tested by the original supplier.

.5 The pump manufacturer shall perform the following inspections and tests on each pump before shipment from its Newfoundland Service depot:

.1 Impeller, motor rating, and electrical connections shall be checked for compliance to the customer's purchase order.

.2 A motor and cable insulation test for moisture content and/or insulation defects.

.3 Prior to submergence, the pump shall be run dry to establish mechanical integrity and free rotation.

.4 The pump shall be run for 30 minutes, submerged 2 m minimum depth.

.5 After operational test number 4, the insulation test, number 2, shall be repeated.

.6 The oil housing will be checked for any leakage of water by the lower seal.

.7 The motor housing and junction box shall be inspected for any water leakage.

.6 Upon request, a written report stating that the above tests have been performed will be supplied with each pump at the time of shipment.

.7 The pump cable end will be sealed with a high-quality protective covering to make it impervious to moisture and/or water seepage, prior to shipping to job site and electrical installation.

2. Shipment

.1 The station will be shipped assembled to the greatest extent possible to reduce installation and start-up costs. Shipped separately from the tank will be the pumps, the controls including the regulators, and a container of miscellaneous connecting hardware, etc.

2.12 LABELS

1. Suitable nameplates shall be permanently affixed onto the pumps, control enclosure components, and other operating components to indicate the purpose of the component or operating routine and parameters applying to the component. The lift station pumps and control equipment are CSA approved and the CSA logo appears on the nameplates of these components.

2.13 DRAWINGS AND DATA

.1 As soon as possible after receipt of an order, the contractor shall furnish the following, according to Section 01340:

1. General assembly drawings (plans, elevations, sections). These drawings shall reflect the necessary location and excavation required for the pumping station.

2. Outline dimension drawings, including, but not limited to:

.1 Pumping station
.2 Discharge connections
.3 Liquid level regulator
.4 Pumps
.5 Station equipment
.6 Access frames
.7 Automatic flush valve (optional)

3. Layouts and wiring diagrams for the complete station, including all power and control circuits.

3 - MAINTENANCE AND OPERATIONS MANUALS

.1 Two copies of a maintenance and operations manual shall be provided with each pumping station, according to Section 01720. These manuals shall contain the following information:

.1 The general assembly drawing(s) of the station confirming locations, sizes, elevations and equipment to be supplied.
.2 An outline drawing of the pumps and discharge connections.
.3 A performance curve for the pumps.
.4 Information on the level regulation system and components.
.5 A schematic diagram of the control system.
.6 Start-up, operating and safety instructions for the system.
.7 Operating and maintenance information for optional equipment.
.8 Outline dimension drawings of the installed sewage pumping station as installed.
.9 Layout and wiring diagrams for the complete station, including all power and control circuits.
.10 Operators' and complete parts manual to provide complete maintenance and operation information on the station.

4 - INSTALLATION SUPERVISION

.1 An authorized representative of the manufacturer must be made available to:

.1 Supervise the installation of the pumps.
.2 Install and adjust the level regulators.
.3 Test the controls.
.4 Start, test and adjust the equipment for complete and satisfactory operation after installation.
.5 Explain and brief thoroughly, owners representative on station functioning.

5 - PROVISION FOR POWER

.1 Arrange with the electric power utility for temporary power as required to the site during construction.

6 - BASIS FOR PAYMENT

.1 Unless otherwise specified, all work under this section will be deemed included in the lump sum prices included in the Schedule of Quantities and Prices.

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This section covers the requirements for constructing storm sewers, sanitary sewers and service connections with bedding material to lines, grades and dimensions indicated or directed by the Engineer.

PART 1 - GENERAL

1.1 AS-BUILT DRAWINGS

.1 Provide data necessary to produce As-Built Drawings, including details of pipe material, invert elevations at manholes and connections, location of tees, bends, clean-outs, manholes, saddles, laterals and caps.

1.2 MEASUREMENT FOR PAYMENT

.1 Excavation and backfill will be measured under Section 02223.

.2 Sanitary sewer and storm sewer will be measured through fittings and manholes after the work is completed. Measurement will be horizontally in metres over the center line of the pipe when the grade of the pipe is less than 10% and in metres along the slope length of the pipe when the grade of the pipe is 10% or greater, for each size pipe and depth class supplied and installed. Measurement will be made from center to center of manholes, catch basins, ditch inlets or from center of manholes, catch basins, ditch inlets to the end of the pipe where no manhole, catch basin or ditch inlet is installed under this contract.

.3 Concrete bedding, head walls, and encasement of pipes will be measured in accordance with Section 03300.

.4 For service connections, measurement will be made in metres horizontally, where the grade is less than 10% and along the slope length of the pipe when the grade is 10% or greater, from the center line of the main sewer to a point vertically above the end of the service connections of each size and class of pipe supplied and installed. The length of long radius bends will not be included as service pipe.

.5 Tees, caps, plugs and other fittings will be measured by unit.

.6 Measurement for TV camera inspection will be by the metre of pipe inspected and accepted.

.7 Granular bedding material will be measured in cubic metres of material incorporated into the work to Section 02223. No deduction for pipe up to and including nominal diameters of 300 mm will be made. Calculation of deduction will be made for pipe end area, based on the nominal diameter, for pipes in excess of 300 mm nominal diameter.

.8 Breaking into and connecting to existing manhole will be measured by each such connection.

.9 Locating and connecting to existing sewer stubs will be measured by each such connection.

.10 Measurement of long radius bends on service connections shall be by the each

PART 2 - PRODUCTS

2.1 CONCRETE PIPE

.1 Non-reinforced circular concrete pipe and fittings: to CSA A257.1-M92, designed for flexible rubber gasket joints, mortar joints to CSA A257.3-M92.

.2 Reinforced circular concrete pipe and fittings: to CSA 257.2-M92, designed for flexible rubber gasket joints, mortar joints to CSA A257.3-M92 and to ASTM C655M

2.2 HYPRESCON PIPE

.1 Pipe and Fittings:
- .1 Prestressed concrete pressure pipe, steel cylinder type, lined-cylinder type to A.W.W.A. C-301(L).
- .2 Prestressed concrete pressure pipe, steel cylinder type, embedded-cylinder type to A.W.W.A. C301(E).
- .3 Reinforced concrete pressure pipe, non-cylinder type to A.W.W.A. C302.
- .4 Reinforced concrete pressure pipe, steel cylinder type, pre-tensioned to A.W.W.A. C303.

2.3 STEEL PIPE

.1 Corrugated steel pipe, fasteners and coatings: to CAN3-G401-93 and to CSPI No. 501-78M.

.2 Corrugated steel pipe, fasteners and coatings: to CAN3-G401-93 except that the zinc coating mass (total on both sides) shall not be less than 1220 gm/m^2 may be used as an alternative to bituminous coated corrugated steel pipe.

.3 Spiral rib steel pipe to AWWA A760 and AWWA A796.

2.4 PLASTIC PIPE

.1 Smooth wall polyvinyl pipe and fittings to ASTM D3034-80 and ASTM F679. Plastic pipe and fittings: to CAN/CSA B182.1-M92 for 100/125/150 mm sizes, CAN/CSA B-182.2-M90 for 200 mm to 675 mm sizes. Standard Dimensional Ratio (SDR): 35 for mains and SDR 28 for service pipe, unless otherwise indicated on the contract drawings, with locked-in gasket and integral bell system. Nominal lengths: 4 and 6 m.

.2 Profile wall polyvinyl chloride pipe with locked-in gasket and integral bell system. Pipe and fittings to be certified to CAN/CSA B-182.4-M92 and ASTM F794. Pipe stiffness to be 320 kPa for sanitary sewer mains, this pipe not to be used for diameters less than 300 mm. Pipe stiffness to be minimum 210 kPa for storm sewer drains. Nominal length 4 m.

2.5 HIGH DENSITY POLYETHYLENE PIPE

.1 Pressure pipe to CSA B137.1 to be supplied in 12.2 metre lengths, iron pipe size. All polyethylene pressure pipe to be joined by means of thermal butt fusion or socket fusion, in accordance with the recommendations of the manufacturer. Approved butt fusion equipment to be used and all work to be carried out by workers skilled in the use of such equipment.

.2 Corregated, double wall pipe to CSA B182.6-M92 for storm sewers. Pipes to have a smooth inner wall. Pipes may be bell and spigot style or plain end fastened with a coupling recommended by the manufacturer. Pipe stiffness to be minimum 210 kPa.

2.6 CEMENT MORTAR

.1 Portland cement to CAN3-A5-M88 normal type 10. Mix mortar one part by volume of cement to two parts of clean, sharp sand mixed dry. Add only sufficient water after mixing to give optimum consistency for placement. Do not use additives.

2.7 CORRUGATED ALUMINUM PIPE

.1 Corrugated Aluminum Pipe and Couplers, manufactured to AASHTO M-196, WW-P-402, ASTM B209 Alloy Alcad 3004 II34.

PART 3 - EXECUTION

3.1 PREPARATION

.1 Clean pipes and fittings of debris and water before installation. Inspect materials for defects before installing. Remove defective materials from site.

3.2 TRENCHING AND BACKFILLING

.1 Do trenching and backfill work in accordance with Section 02223.

.2 Trench line and depth as well as condition of trench bottom require approval prior to placing bedding material and pipe.

.3 Do not backfill trenches until pipe grade and alignment have been checked and accepted and infiltration and exfiltration test results are within the limits specified. If the pipe is backfilled for any reason prior to testing, accept responsibility to meet the tests or to re-excavate and repair the line and pay all costs.

3.3 CONCRETE BEDDING AND ENCASEMENT

.1 Do concrete work in accordance with Section 03300. Place concrete to details indicated or directed.

.2 Pipe may be positioned on concrete blocks to facilitate placing of concrete. Rigidly anchor or weight pipe to prevent flotation when concrete is placed if necessary.

.3 Do not backfill over concrete within 24 hours after placing.

3.4 GRANULAR BEDDING

.1 Place granular bedding materials in accordance with details specified or directed.

.2 Shape bed true to grade and to provide continuous, uniform bearing surface for barrel of pipe. Do not use blocks when bedding pipe.

.3 Shape transverse depressions as required to within bell if bell and spigot pipe is used.

.4 Compact full width of bed to at least 95% of corrected maximum dry density. ASTM D698-78 Method D.

.5 Fill excavation below bottom of manholes or structures with specified bedding material or common backfill as directed by the Engineer.

3.5 INSTALLATION

.1 Lay and join pipes in accordance with manufacturer's recommendations.

.2 Handle pipe with approved equipment. Do not use chains or cables passed through pipe bore so that weight of pipe bears upon pipe ends.

.3 Use laser-type instrument to control line and grade for sewers unless otherwise approved by the Engineer.

.4 Lay pipes on prepared bed, true to line and grade, with pipe invert smooth and free of sags or high points. Ensure barrel of each pipe is in contact with shaped bed throughout its full length.

.5 Commence laying at outlet and proceed in upstream direction with bell ends of pipe facing upgrade.

.6 Check alignment between manholes as each portion is laid by means of a strong light shone through the pipe from manhole to manhole. If less than half the full pipe cross-section at the light source is visible at the other end, realign pipes at no additional cost to the Contract, if so directed by the Engineer.

.7 Do not allow water to flow through pipe during construction, except as may be permitted by Engineer.

.8 Whenever work is suspended, install a removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.

.9 Position and join pipes by approved methods. Do not use excavating equipment to force pipe sections together.

.10 Install PVC pipe and fittings in accordance with CSA B182.11-1967 and Uni-Bell.

.11 Lay corrugated steel pipe:

.1 With outside circumferential laps facing upgrade and longitudinal laps or seams at side or quarter points.
.2 With longitudinal center line of paved invert coinciding with flow line.

.12 Joints:

.1 Corrugated steel pipe:

.1 Install flexible sealing rings where called for.
.2 Match corrugations or indentations of coupler band with pipe sections before tightening.
.3 Tap coupler firmly while tightening, to take up slack and ensure a snug fit.
.4 Ensure bolts are inserted and tightened.

.2 Pipe Joining:

.1 Install gaskets as recommended by manufacturer.
.2 Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
.3 Align pipes carefully before joining.
.4 Maintain pipe joints free from mud, silt, gravel and other foreign material.
.5 Avoid displacing gasket or contaminating with dirt or other foreign material. Remove disturbed or dirty gaskets; clean, lubricate and replace before joining is attempted. Use only manufacturers recommended lubricant.
.6 Complete each joint before laying next length of pipe.
.7 Minimize joint deflection after joint has been made to avoid joint damage.
.8 Apply sufficient pressure in making joints to ensure that joint is complete as outlined in manufacturer's recommendations.
.9 At rigid structures, install pipe joints not more than 600 mm from side of structure.

.3 Concrete pipe joints:

.1 Pipe Interior: Circular pipes 700 mm in diameter and larger, and arch or elliptical pipe equivalent to 900 mm diameter or larger shall have interior gap between ends of adjacent pipes filled with mortar. Apply mortar a minimum 7 days after backfilling has been completed to allow pipe settlement to occur. Finish interior surface of joints smooth.

.2 Pipe Exterior: For bell and spigot pipe, mortar to be used for caulking outside of joints. Press and caulk mortar into place. Allow mortar to set minimum of one hour before backfilling.

.4 Hyprescon pipe joints:

.1 Joints:

.1 Bell and Spigot steel joint rings with confined o-rings, mortar protected.

.13 Block pipes as directed when any stoppage of work occurs to prevent creep during down time.

.14 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes as directed by the Engineer. Backfill to prevent flotation as required or as directed by the Engineer.

.15 Cut pipes as required for special inserts, fittings or closure pieces in a neat manner, as recommended by pipe manufacturer, without damaging pipe or its coating and to leave a smooth end at right angles to axis of pipe.

.16 Make watertight connections to manholes or other structures. Provide details of proposed method of installing pipe stubs in structure walls to ensure a watertight joint. In the case of precast manhole bases an integral joint gasket may be cast in the manhole wall to receive the pipe stub. In the case of cast-in-place manhole bases the exterior pipe surface in contact with the structure wall shall be roughened or treated to provide a bond with the concrete. Any grout used to be non-shrink type.

.17 Use prefabricated saddles or approved field connections for connecting pipes to existing sewer pipes. Joint of saddle to pipe shall be structurally sound and watertight.

.18 Leave joints and fittings exposed for ex-filtration testing. Provide protection when required. If it is necessary to backfill sections of the sewer prior to testing, take full responsibility and bear all costs for any additional excavation and backfill to expose pipe, fittings or joints that may be necessary.

.19 When infiltration and ex-filtration test results are acceptable to Engineer, backfill remainder of trench in accordance with Section 02223.

.20 Hand place granular material in uniform layers not exceeding 150 mm thick to minimum 300 mm over top of pipe. dumping of material directly on top of pipe is not permitted.

.21 Place layers uniformly and simultaneously on each side of pipe to prevent lateral displacement of pipe.

.22 Compact each layer to at least 95% maximum density ASTM D698-78, Method D.

3.6 SERVICE CONNECTIONS

.1 Install pipe to CSA B182.11-1967 and manufacturer's standard instructions and specifications.

.2 Maintain grade for 100 and 125 mm diameter sewers at 1 vertical to 50 horizontal unless directed otherwise.

.3 Service connections to main sewer shall be approved tees including bends. "Inserta Tee" system, or approved equal, may be used. Do not use break-in and mortar patch-type joints.

.4 Service connections for Type PSM Poly (PVC) pipe to be certified to Can/CSA B-182.1-M92, B-182.2-M90 and B-182.4-M92, depending on wall type and diameter.

.5 Service connection pipe shall not extend into interior of main sewer.

.6 Make up required horizontal and vertical bends from 45 degree bends or less, separated by a straight section of pipe with a minimum length of four pipe diameters. Use long radius bends where applicable. 100 mm long radius bends shall have a minimum radius of curvature of 600 mm. 150 mm long radius bends shall have a minimum radius of curvature of 900 mm.

.7 Plug service laterals with water tight caps or plugs as approved.

.8 Place location marker at ends of plugged or capped unconnected sewer lines. Each marker shall consists of a 38 x 89 mm stake extending from pipe end at pipe level to 0.6 m above grade. Paint exposed portion of stake red with designation SAN SWR LINE in black.

.9 Install service connections before carrying out infiltration and ex-filtration tests.

3.7 FIELD TESTING

.1 Repair or replace pipe, pipe joint or bedding found defective.

.2 Prior to TV inspection remove foreign material from sewers and related appurtenances by flushing with water.

.3 Perform infiltration or ex-filtration testing as soon as practicable after jointing and bedding are complete, and service connections have been installed.

.4 Do infiltration and/or ex-filtration testing as directed. Perform tests in presence of Engineer. Notify Engineer 24 hrs. in advance of proposed tests.

.5 Carry out tests on each section of sewer between successive manholes including service connections.

.6 Install watertight bulkheads in suitable manner to isolate test section from rest of pipeline.

.7 Ex-filtration test:

- .1 Fill test section with water in such a manner as to allow displacement of air in line.
- .2 Immediately prior to test period add water to pipeline until there is a head of 1 metre over interior crown of pipe measured at highest point of test section or water in manhole is 1500 mm above static ground water level, whichever is greater.
- .3 Duration of ex-filtration test shall be one hour.
- .4 Water loss at end of test period shall not exceed maximum allowable ex-filtration over any section of pipe between manholes.

.8 Infiltration test:

- .1 Conduct infiltration test in addition to ex-filtration test.
- .2 Install a watertight plug at upstream end of pipeline test section.
- .3 Discontinue pumping operations for at least 3 days before test measurements are to commence and during this time keep thoroughly wet at least one third of pipe invert perimeter.
- .4 Prevent damage to pipe an bedding material due to flotation and erosion.

.5 Place a 90° V-notch weir, or other measuring device approved by Engineer in invert of sewer at each manhole.

.6 Measure rate of flow over a minimum of 1 hour, with recorded flows for each 5 min interval.

.9 Infiltration/ex-filtration shall not exceed 4.63 litres per millimetre of internal pipe diameter per kilometre per 24 hours which are the following limits in litres per hour per 100 m of pipe, including service connections.

Internal Pipe Diameter(mm)	Maximum Amount(l/hr)
100	1.93
150	2.89
200	3.86
250	4.83
300	5.79
350	6.75
400	7.72
450	8.68
500	9.65
550	10.61
600	11.58
700	13.51
800	15.44
900	17.37

.10 Repair and retest sewer line as required, until test results are within limits specified at no additional cost to the Contract.

.11 Repair visible leaks regardless of test results.

.12 Carry out any retesting of sewer sections which have previously passed ex-filtration and/or infiltration tests, as directed by the Engineer. If any sewer section passes this initial retest, additional payment will be made for such retest of that section. If any sewer section does not pass this initial retest, repair and retest such sewer as required until test results are again within limits specified, at no additional cost to the Contract.

.13 Television inspections:

.1 Television equipment shall consist of a self-contained color camera and a monitoring unit connected by a 3 wire coaxial cable. The camera shall be small enough to ensure passage through a 150 mm sewer, shall be waterproof, and shall have a self-contained remotely controlled lighting system of varying the illumination of the interior of the sewer line for inspection and photographic purposes. Picture quality shall be such as to produce a continuous 600-line resolution picture showing the entire periphery of the pipe. All video tapes must be VHS format, SP mode. An audio description of the inspection must also be provided. The monitor shall be not less than a 13 inch color monitor.

.2 Carry out inspection of installed sewers by television camera.

.3 If defective work is found by such inspections, repair sewer line and repeat television inspections as required until all defective work has been corrected, at no additional cost to the Owner.

.4 All tapes of television inspections are to be retained by the Engineer as a permanent record. V.H.S. Format only. Tape references shall be in hours and minutes (not counter number).

.5 Carry out television inspections of sewer sections previously not showing defective work as directed by

the Engineer. Additional payment will be allowed for such television inspections for sewer sections still free of defects. If defective work is found by such re-inspections repair sewer line and repeat inspection as required until all defective work has been corrected, at no additional cost to the Contract.

.14 A sewer section is defined as the length of pipe between successive manholes.

.15 Deflection Test for PVC Pipe

.1 Carry out a deflection test on all sections of the sewer. The maximum allowable deflection under fully backfilled and compacted trench conditions shall not exceed 5% before 30 days and 7.5% after 30 days.

.2 Locations with excessive deflection shall be repaired and/or the pipe replaced at the Contractor's expense. The equipment used for the deflection test shall be that as recommended by the manufacturer, and may include an Electronic Deflectometer or a Rigid "Go-No-Go" Device. For the purpose of deflection measurement, the base inside diameters and the deflection mandrel dimensions are provided in the following table. To ensure accurate testing the lines shall be thoroughly cleaned.

Table for Base Inside Diameters and Deflection Mandrel Dimensions
PVC SDR-35 (ASTM D3034)

Nominal Size	Base Inside Diameter (mm)	5% Deflection Mandrel (mm)	7.5% Deflection Mandrel (mm)
200	194.69	185.0	180.0
250	242.90	230.8	224.6
300	288.57	274.0	266.9
375	353.01	335.4	326.6

.3 For nominal sewer sizes not shown in above table the Mandrel dimensions shall be calculated as follows:

$$\text{Mandrel O.D.} = \frac{(100-Y)}{100} \times \text{Base I.D.}$$

where Y = Deflection Limit in %

3.8 BASIS OF PAYMENT

.1 All costs associated with work specified in the Section shall be deemed to be included in the appropriate unit and lump sum prices quoted in the Schedule of Quantities and Prices.

.2 Payment will be made to the maximum of 90% of the value of sewers, fittings and appurtenances until the system (or sections of the system, if payment approved by the Engineer) has passed all tests. The 10% retained shall be called the sewer test allowance.

.3 Infiltration and/or ex-filtration tests do not apply to corrugated storm sewer pipe unless otherwise specified.

PART 1 – GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

.1	Excavation, Trenching and Backfill:	Section 02223
.2	Manholes, Catch Basins, Ditch Inlets and Valve Chambers:	Section 02601
.3	General Concrete:	Section 03300
.4	Aggregates, General:	Section 02226
.5	Underwater Photos and Videos:	

1.2 SAMPLES

.1 At least 4 weeks prior to commencing work, inform Engineer of proposed source of bedding materials and provide gradation analysis and other labratory tests as directed by the Engineer.

1.3 MATERIAL CERTIFICATION

.1 At least 4 weeks prior to commencing work, submit manufacturer's test data and certification that pipe materials meet requirements of these specifications.

1.4 AS-BUILT DRAWINGS

.1 Provide data necessary to produce As-Built Drawings, including details of pipe material, invert elevations, and location of manholes all in accordance with Section 01720.

1.5 SCHEDULING OF WORK

.1 Schedule Work to minimize interruptions to existing services.

.2 Maintain existing sewage flows during construction.

.3 Submit schedule of expected interruptions to Engineer for approval and adhere to approved schedule.

1.6 MANUFACTURER'S INSTRUCTIONS

.1 Make available six (6) copies of manufacturer's installation instructions, if requested by the Engineer.

1.7 MEASUREMENT FOR PAYMENT

.1 Excavation and backfill will be measured under Section 02223.

.2 Outfall sewer will be measured horizontally from manhole to discharge invert in metres. Horizontal measurement will be made over the surface, through fittings and manholes after the work has been completed.

.3 Tees, caps, plugs and other fittings will be measured by the each for each unit installed unless measurement is indicated to be included in the measurement of manholes or other structures.

.4 Concrete bedding and encasement of pipes will be measured in cubic metres to the measurement limits shown or specified, unless noted otherwise in the Schedule of Quantities and Prices.

.5 Concrete head blocks, cradles and supports will be measured by the each for each unit installed.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

.1 Ductile Iron Pipe

.1 To AWWA C151/ANS1 A21.50-86 Pressure Class 350 for 2400 kPa for 100 to 300 mm diameter and as by design according to AWWA C150/ANS1 A21.50 for 350 mm diameter and larger (as indicated in the Schedule of Quantities & Prices Table). Cement mortar lined to AWWA C104/ANS1 A21.4.

.2 Joints

.1 Mechanical, rubber gaskets with plain tip, high strength heat treated cast-iron or alloy steel tie head bolts with hex nuts.
.2 Push-on joint with continuous rubber molded ring gasket.
.3 All other pipes and fittings to be as specified under Section 02702.

.2 Polyvinyl Chlorine Pressure Pipe:

.1 To AWWA C900-89, AWWA C905-88, DR 18, pressure class 150 or to CSA B137.3-M90, series 160; (unless otherwise specified in the Schedule of Quantities and Prices), 1MPa gasket bell end, cast iron outside diameter.

.3 Polyethylene Pressure Pipe:

.1 To AWWA C906-90, AWWA C901-88, CSA B137.1 M89, ASTM 3035-88 & ASTM F714-88 Type P.E. CSA series 160 or AWWA Pressure Class 350 (unless otherwise specified in the Schedule of Quantities and Prices).

.2 HDPE to HDPE joints to be thermal butt fusion welded to C207-86, AWWA C906-90 or flanges with backing flanges when necessary.

2.2 PIPE BEDDING MATERIALS

.1 Concrete required for cradles, encasement, supports, to Section 3300, strength 25 MPa.
.2 Other bedding types to be as specified.

PART 3 - EXECUTION

3.1 PREPARATION

.1 Clean pipes and fittings of debris and water before installation. Inspect materials for defects before installation. Remove defective material from site.

.2 Check profiles and confirm grades and depths with Engineer, prior to excavation.

3.2 TRENCHING AND BACKFILLING

.1 Do trenching and backfilling in accordance with Section 02223.

.2 Trench line and depth, as well as condition of trench bottom, require approval of the Engineer prior to placing pipe.

.3 Do not backfill trenches until pipe grade and alignment have been checked and accepted.

3.3 CONCRETE BEDDING AND ENCASEMENT

.1 Do concrete work in accordance with Section 03300. Place concrete to details indicated or directed by the Engineer.

.2 Pipe may be positioned on concrete blocks to facilitate placing of concrete. Rigidly anchor or weight pipe to prevent flotation when concrete is placed if necessary.

.3 Do not backfill over concrete within 24 hours after placing.

3.4 PIPE INSTALLATION

.1 Lay pipes to AWWA C600-87.

.2 Join pipes in accordance with AWWA C600-87 and the Manufacturer's Instructions. Torque wrench to be used for all machanical joint bolts.

.3 Handle pipe by approved methods. Do not use chains or cables passed through pipe bore so that weight of pipe bears on pipe ends. Inspect pipes for defects whole suspended above grade. If required by Engineer, place heavy, tightly woven canvas bag over each pipe end before lowering into trench and leave in place until ready to make joint.

.4 Lay pipes on prepared bed, true to line and grade. Ensure barrel of each pipe is in contact with shaped bed throughout its full length. Take up and replace defective pipe. correct pipe which is not in true alignment or grade or pipe which shows undue settlement after installation. Remove all rejected pipe from site of the Works.

.5 Face bell ends of pipe in direction of laying. For mains on a grade of 2 percent or greater, face bell ends upgrade.

.6 Do not exceed permissible deflection at joints as recommended by pipe manufacturer.

.7 Keep jointing materials and installed pipe free of dirt and water and other foreign materials. Whenever work is stopped, install a removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials. Bulkhead to remain in place until all water is removed from trench.

.8 Position and join pipes with approved equipment. Do not use excavation equipment to force pipe sections together.

.9 Cut pipes as required for special fittings or closure pieces, in a neat manner as recommended by pipe manufacturer, without damaging pipe or its coating and to leave a smooth end at right angles to axis of pipe. Flame cutting or burning of pipe not permitted.

.10 Align pipes carefully before jointing.

.11 Install gaskets to manufacturer's recommendations. Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.

.12 Avoid displacing gasket or contaminating with dirt or other foreign material. Gaskets so disturbed or contaminated shall be removed, cleaned, lubricated and replaced before jointing is attempted again. Use only manufacturer's gasket lubricant.

.13 Complete each joint before laying next length of pipe.

.14 Minimize deflection after joint has been made.

.15 Apply sufficient pressure in making joints to ensure that joint is completed to manufacturer's recommendations.

.16 When stoppage of work occurs, block pipes in an approved manner to prevent creep during down time.

.17 Do not lay pipe on frozen bedding.

3.5 PAYMENT

.1 All costs associated with work specified in this section shall be deemed to be included in the appropriate unit and lump sum prices quoted in the Schedule of Quantities and Prices.

PART 1 - GENERAL

1.1 MEASUREMENT FOR PAYMENT

.1 All work associated with the installation of foundation and underslab drainage will be measured as a lump item within a 1.5 metre perimeter outside the foundation or slab.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Coarse filter aggregate: to CAN3-A23.1-M90, Table 2, Group 1, 20 to 5 mm.

.2 Fine filter aggregate: to CAN3-A23.1-M90, Table 1.

.3 Plastic pipe and fittings: to CSA B182.1 and B182.2, M-1990.

.4 Perforated Corrugated steel pipe, couplers and fittings: to CSPI 501-78M with asphalt coating, inside diameter as indicated on the drawings.

PART 3 - EXECUTION

3.1 INSPECTION

.1 Ensure graded subgrade conforms with required drainage pattern before placing filter bed material.

.2 Report to Engineer improper slopes, unstable areas, areas requiring additional compaction or other unsatisfactory conditions.

.3 Begin installation of foundation drainage after deficiencies have been corrected.

.4 Ensure foundation wall, damp proofing and water proofing have been inspected and accepted.

3.2 INSTALLATION

.1 Pipe bedding: cut trenches in compacted sub-base and place 100 mm thickness minimum of coarse filter aggregate and tamp to grade.

.2 Pipe laying:

- .1 Ensure pipe interior and coupling surfaces are clean before laying.
- .2 Lay perforated pipe to grade as indicated. Face perforations and coupling slots downward.
- .3 Lay non-perforated pipe to grade as specified, from perforated pipe to disposal source. Make joints watertight.
- .4 Do not use shims to establish pipe slope.
- .5 Use fittings recommended by manufacturer except where indicated otherwise.
- .6 Install end plugs at ends of collector drains.
- .7 Protect pipe ends from damage and ingress of foreign material.
- .8 Connect pipe to storm drain or sump pit by appropriate adapters manufactured for this purpose.

.3 Filter bed backfill:

.1 Place filter bed backfill after pipe installation is approved.

.2 Place minimum of 150 mm thickness coarse filter aggregate on each side of perforated pipe and minimum of 300 mm thickness coarse filter aggregate over perforated pipe.

.3 Extend coarse filter aggregate to and along foundation wall minimum 300 mm above top of pipe. Place 150 mm thickness of fine filter aggregate over coarse filter aggregate.

.4 Place minimum of 150 mm thickness clean sand on each side and over non-perforated pipe.

.5 Place filter bed in 150 mm lifts. Consolidate tamping lightly. Prevent displacement of pipe.

.6 Place top seal of polyethylene or building paper to prevent surface infiltration of fine materials into coarse filter material, thereby blocking ground water infiltration.

.4 Provide flush clean-outs for systems where nature of filter material or ingress of deleterious material warrants maintenance.

3.3 BASIS FOR PAYMENT

.1 All costs associated with work specified in this section shall be deemed to be included in the appropriate unit and lump sum price quoted in the Schedule of Quantities and Prices.

This section cover the requirements for constructing watermains, service connections and appurtenances in open cut.

PART 1 - GENERAL

1.1 LOCATION OF CURB STOPS

.1 Unless otherwise designated by the Engineer, curb stops will be installed by the Contractor within 1.5 m of the road right-of-way off the property line. Curb stops may be located on private property where special conditions exist upon approval of the Engineer.

1.2 AS-BUILT DRAWINGS

.1 Provide data necessary to produce As-Built Drawings, including details of pipe materials, invert elevations, location of tees, bends, laterals and caps, valves, hydrants and end caps.

1.3 SCHEDULING OF WORK

.1 Schedule work to minimize interruptions to existing services.

.2 Submit schedule of expected interruptions for approval by Engineer and adhere to interruption schedule as approved by Engineer.

.3 Notify building occupants a minimum of 24 hrs. in advance of any interruption in service.

.4 Do not interrupt water service for more than 3 hrs. and confine this period between 10:00 and 16:00 hrs. local time unless otherwise authorized.

.5 Notify fire department of any planned or accidental interruption of water supply to hydrants.

1.4 MEASUREMENT FOR PAYMENT

.1 Trenching and backfilling will be measured under Section 02223.

.2 Watermains will be measured in metres of each size of pipe installed through valves and fittings, including hydrant leads, after the work has been completed. Measurement will be horizontally in metres over the center line of the pipe when the grade of the pipe is less than 10% and in metres along the slope length of the pipe when the grade of the pipe is 10% or greater.

.3 For service connections, measurement will be made horizontally from the point of connection to the watermain through curb valve and adjustable valve box to a point vertically above the end of the service connections.

.4 Hydrants, to the specified depth of bury in the Schedule of Quantities and Prices, will be measured in units installed including the hydrant marker post and concrete support base as detailed.

.5 All fittings, sounding points/markers and appurtenances will be measured by units installed.

.6 Hydrant extensions will be measured by the units installed and shall include all fitting and bolting required to make the extension a functional part of the hydrant.

.7 If colour coded painting of hydrants is required, payment shall be made by the each as specified in the Schedule of Quantities & Prices.

.8 Valves not in chambers will be measured in units installed including valves and valve boxes.

.9 Valve chambers will be measured in units installed complete including frames and covers, valves, piping, clamps and appurtenances.

.10 Granular bedding material will be measured in cubic metres to Section 02223. No deduction for pipe volume up to and including nominal diameter of 300 mm will be made. Calculation of pipe volume deduction will be made based on the nominal diameter for pipes in excess of 300 mm nominal diameter.

.11 Concrete for bedding, thrust blocks, encasement of pipes , supports and cut-off walls will be measured in cubic metres.

.12 Swabbing of watermain shall be measured by metre of line swabbed, and accepted by the Engineer, for each size of pipe cleaned.

.13 Locating and tie-in to existing watermain to be measured by the each.

.14 Plugging of hydrant drains when directed by the engineer after installation has been completed and backfilled shall be paid in accordance with Section 01610.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

.1 Ductile Iron Pipe shall be as designed by AWWA C150/ANSI A21.50 and manufactured to AWWA C151/ANSI A21.51. Pipe shall be supplied in minimum pressure class 350 for 100 mm through 300 mm, pressure class 250 for 350 mm through 500 mm, pressure class 200 for 600 mm, and pressure class 150 for 900 mm and larger, or to the pressure classes shown on the drawings. All pipe shall be cement mortar lined and asphaltic seal coated in accordance with AWWA C104/ANSI A21.4.

.1 Joints:

.1 Mechanical, rubber gaskets with plain tip, high strength heat treated cast-iron or alloy steel tie head bolts with hex nuts.

.2 Push-on joint with continuous rubber molded ring gasket - AWWA C111/ANSI A21.11.

.2 Fittings: to AWWA C110/ANS1 21.10-87 or AWWA C153/ANS1 A21.53-88 for pipe diameters larger than NPS 4. Restrained joint fittings must be rated to the same pressure rating as the pipe. Thrust blocks are not required on restrained joint fittings.

.2 Concrete steel cylinder pipe: to AWWA C303 AWWA C301.

.1 Pipe and fittings joints

.1 Bell and spigot steel joints with confined rubber gaskets.
.2 Flanged joints to conform to AWWA C-207.

.3 Polyvinyl chloride pressure pipe:

.1 To CSA B137.3 M90, series 160 unless otherwise specified in the Schedule of Quantities and Prices or to AWWA C900-89 for pipe sizes 100 mm to 300 mm, Dr 18 (pressure class 150 psi) unless otherwise specified in the Schedule of Quantities and Prices or to AWWA C905-88 for pipe sizes 350 mm to 900 mm, DR 18 (pressure class 235 psi) unless otherwise specified in the Schedule of Quantities and Prices. All pipe shall be certified to CSA B173.3 M90, shall be U.L. and F.M. approved, and shall be 1 MPa gasket bell end, cast iron outside diameter.

.2 Composite epoxy impregnated fibreglass PVC pipe to ASTM D2996-71(1977), class H. Unplasticized PVC core overwrapped with bonded fibreglass reinforced epoxy resin. Pressure class 300, 2.4 MPa with cast iron outside diameter and integral bell gasketed joints to ASTM D2992-71(1977). Material to ASTM D2310-80 classification RTRP-11HZ-5001-PVC-13223.

.3 PVC Fittings: to CSA B 137.2 M89 or AWWA C907-91 for pipe sizes 100 mm to 300 mm and shall be U.L. and F.M. approved.

.4 .1 Polyethylene pressure pipe: to AWWA C906-90, AWWA C901-88, CSA B137.1-M89, ASTM D3035-88 & ASTM F714-88 Type P.E. CSA series 160 or AWWA Pressure Class 151 (unless otherwise specified in the Schedule of Quantities and Prices).

.2 HDPE to HDPE joints: to be thermal butt fusion welded to C207-86, AWWA C906-90 or flanged with backing flanges when necessary.

.3 Polyethylene fittings: to CSA B137.1-M89 or AWWA C906-90.

.5 Bolted, sleeve-type couplings to AWWA C219-91.

2.2 VALVES AND VALVE BOXES

.1 Gate valves: to AWWA C500, standard iron body, bronze mounted, wedge double disc valves with non-rising stems, suitable for 1 mPa with mechanical joints or resilient seat to AWWA C-509.

.2 Resilient wedge valves greater than 400 mm in diameter shall be gear operated. All other valves 400 mm in diameter and greater shall be gear operated.

.3 Valves to open counter clockwise and to be supplied with a square-sided operating nut, 51 mm to the side, unless otherwise specified.

.4 Cast iron valve boxes: bituminous coated three piece, 125 mm diameter sliding type, adjustable over a minimum of 450 mm. Valve to have circular guide plate which fits over operating nut and prevents lateral movement of valve box. Guide plate not to interfere with operation of valve or key. Base to be large round type with minimum inside diameter of 234 mm. Top of box to be marked "WATER".

.5 PVC valve boxes to be as per manufacturer's recommendations.

.6 Air and vacuum release valves: to CSA B64-M88, heavy duty combination air release valves employing direct acting kinetic principle. Valves to be constructed of cast iron body and cover, with bronze trim, stainless steel floats with shock-proof synthetic seat suitable for 2 MPa working pressure. Valves to expel air at a high rate during filling, at a low rate during operation, and to admit air while line is being drained. Valve to be complete with a surge check unit. Ends to be flanged to ANSI B 16.1.

.7 Butterfly valves shall conform to the requirements of AWWA C504.

2.3 VALVE CHAMBERS

.1 Concrete and reinforcing steel: to Sections 03305 and 03201 03300 and 03200.

.2 Precast concrete sections to ASTM C478M-80a. Ladder rungs be cast integral with unit; field installation not permitted.

.3 Jointing materials:
- .1 Manufacturer's rubber ring gaskets,
- .2 Mastic joint filler,
- .3 Cement mortar or,
- .4 Combination of above types.

.4 Mortar: aggregate to CSA A82.56-M1976, masonry cement to CAN3-A8-M88

.5 Ladder rungs for valve chambers: 20 mm diameter deformed rail steel bars to CSA G30.18-M92, hot-dipped galvanized after fabrication to CSA G164-M92. Rungs to be safety pattern.

.6 Valve chamber frames and covers: grey iron castings, minimum tensile strength 200 MPa to AASHTO M105-76 with two coats, shop applied, approved asphalt coating with a mass of approximately 215 kg per set. Design and dimensions to be as indicated. Cover to be marked WATER.

2.4 SERVICE CONNECTIONS

.1 The minimum size of a water service connection shall be 19 mm diameter.

.2 Copper tubing: to ASTM B68-80, type K, annealed for service laterals up to 50 mm in diameter.

.3 Ductile iron pipe: to AWWA C151/ANSI A21.51-86, pressure class 150, for service laterals 100 mm diameter or greater.

.4 Polyvinyl chloride pressure pipe: to CSA B137.3-M90, type 1120 series 160 unless otherwise specified in the Schedule of Quantities & Prices.

.5 Polyethylene pipe: to AWWA C901-88 pressure class 160 or to CSA B137.1-90 type PE series 160, unless otherwise specified in the Schedule of Quantities and Prices.

.6 Cross linked polyethylene pipe to CSA B137.5, ASTM F877, PP1 TR-4, NSF 14 and NSF 61, with co-extruded UV shield to allow exposure to natural sunlight for up to 1 year. The minimum degree of cross linking shall be 80%.

.7 Polyethylene/Aluminum/Polyethylene composite pipe to CSA B137.9 and ASTM F1282. Compression fittings to be as per manufacturers specifications and suitable for underground service (red brass).

.8 Copper pipe joints: to be flared or compression type suitable for 1 MPa working pressure.

.9 PVC joints: to be bell and spigot to manufacturer's specifications.

.10 Polyethylene pipe joints: to be thermal butt fusion welded or socket fusion welded.

.11 Joints for ductile iron pipe: to be push-on joints to ANSI A21.11-85. Rubber gaskets to ANSI A21.11-85.

.12 Brass corporation stops: red brass to ASTM B62-80 flared or compression type having threads to AWWA C800-89, pressure rated for 1050 kilopascals.

.13 Brass inverted key-type curb stops: to ASTM B62-80 flared or compression type with drain (Unless indicated otherwise in contract documents). Curb stops to have 1.5 to 1.8 m adjustable bituminous coated, cast iron service box with stem to suit depth of bury. Top of cast iron box marked "WATER". The stop boss on curb stops must be capable of withstanding a 75 foot-pound torque test.

.14 Tappings of ductile iron may be threaded without service clamps. Double strap service connections with galvanized malleable iron body and neoprene gasket cemented in place may be used. Tappings to conform to following:

Pipe Diameter (mm)	Maximum Tap Without Clamp (mm)	Maximum Tap With Clamp (mm)
100	20	25
150	20	40
200	25	50
250	25	50
300	40	75

.15 PE tapping tees or multi-saddle tees: for PE pipe. Tees to be socket fused to pipe up to 150 mm NPS

.16 Service clamps for PE or PVC service connections to be of double strap-type, with confined "O" ring seal cemented in place. Clamps to be tapped with threads to AWWA C800-89.

.17 Tee connections: for services above 25 mm. Tee connections to be fabricated of same material and to same standards as specified pipe fittings and to have ends matching pipe to which they are joined.

.18 Copper couplings to be AWWA C800-89.

2.5 HYDRANTS

.1 Hydrants shall conform to the requirements of AWWA C502, and shall be ULC and FM approved.

.2 Post type hydrants: to ULC-S-520; designed for maximum working pressure of system with two 65 mm threaded hose outlets, one 100 mm steamer port, 150 mm riser barrel, 125 mm bottom valve and 150 mm connection for main. Hydrants to open counter clockwise, threads, outlets and operating nut to St. John's standard unless otherwise specified in the Unit Price Table. Depth of bury 2.1 m unless otherwise specified in the Unit Price Table.

.1 Provide key operated gate valve located 1 m from hydrant unless otherwise specified in the Schedule of Quantities and Prices.

.2 Paint hydrants in accordance with the following colour code:

FLOW RATE	REFLECTIVE COLOUR	CGSB COLOUR CHART 1-GP-12c
Under 38 l/s	RED	509-102
38 to 75 l/s	ORANGE	508-103
Over 75 l/s	GREEN	503-107

2.6 PIPE BEDDING MATERIALS

.1 Granular material as specified in Section 02223, for granular bedding.

.2 Concrete required for cradles, encasement, supports, thrust blocks and cut-off walls all to Section 03300, strength 25 MPa.

2.7 PIPE DISINFECTION

.1 Sodium hypochlorite, Calcium hypochlorite or Liquid chlorine to AWWA B300-87 and AWWA B301-87 to disinfect water mains.

.2 Swab all lines before disinfecting.

2.8 TOOLS AND EQUIPMENT

Supply as directed by the Engineer:

.1 One service post wrench for curb stops.

.2 One tee-handle operating keys for valves.

.3 One wrench for operating fire hydrant operating nut.

PART 3 - EXECUTION

3.1 PREPARATION

.1 Clean pipes, fittings, valves, hydrants and appurtenances of accumulated debris and water before installation. Carefully inspect materials for defects. Remove defective materials from site.

3.2 TRENCHING AND BACKFILL

.1 Do trenching and backfill work to Section 02223.

.2 Trench depth to provide minimum cover over pipe of 1.8 m from finished grade or as indicated.

.3 Trench alignment and depth require Engineer's approval prior to placing bedding material or pipe.

.4 Do not backfill trenches until installed work has been checked and accepted by Engineer.

3.3 CONCRETE BEDDING, CUT-OFF WALLS AND/OR ENCASEMENT

.1 Do concrete work to Section 3300. Place concrete to details indicated or directed.

.2 Pipe may be positioned on concrete blocks to facilitate placing of concrete. When necessary, rigidly anchor or weight pipe to prevent flotation when concrete is placed.

.3 Do not backfill over concrete within 24 hrs. after placing concrete.

3.4 GRANULAR BEDDING

.1 Place granular bedding materials to details indicated or directed.

.2 Shape bed true to grade to provide continuous uniform bearing surface for pipe exterior. Do not use blocks when bedding pipe.

.3 Shape transverse depressions in bedding as required to make joints.

.4 Compact full width of bed to at least 95% maximum density ASTM D698-78, Method D.

.5 Fill any excavation below level of bottom of specified bedding as specified in Section 02223.

3.5 PIPE INSTALLATION

.1 Water service laterals shall terminate at the Right-of-Way or when specified to 1.5 metres outside the building wall. Cap or seal end of pipe and place temporary marker to locate pipe end.

.2 Lay and join ductile iron pipe to AWWA C600-87, manufacturer's standard instructions and specifications. Do not use blocks except as permitted in 3.3.2. Torque wrench to be used for all mechanical joint bolts.

.3 Handle pipe by approved methods. Do not use chains or cables passed through pipe bore so that weight of pipe bears on pipe ends.

.4 Lay pipes on prepared bed, true to line and grade. Ensure barrel of each pipe is in contact with shaped bed throughout its full length. Take up and replace defective pipe. Correct pipe which is not in true alignment or grade or pipe which shows undue settlement after installation.

.5 Face bell ends of pipe in direction of laying and for mains on a grade of 2% or greater, face bell ends upgrade.

.6 Do not exceed permissible deflection at joints as recommended by pipe manufacturer. Any deflection should be taken after the joint is assembled.

.7 Keep jointing materials and installed pipe free of dirt and water and other foreign materials. Whenever work is stopped, install a removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials. Bulkhead to remain in place until all water removed from trench.

.8 Position and join pipes with approved equipment.

.9 Remove all defective pipe from the site of the works.

.10 Cut pipes, as required, for special fittings or closure pieces, in a neat manner as recommended by pipe manufacturer, without damaging pipe or its coating and to leave a smooth end at right angles to axis of pipe. Flame cutting and burning of pipe not permitted. File smooth any sharp edges which might damage the gasket.

.11 Align pipes carefully before jointing.

.12 Install gaskets to manufacturer's recommendations. Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.

.13 Avoid displacing gasket or contaminating with dirt or other foreign material. Gaskets so disturbed or contaminated shall be removed, cleaned, lubricated and replaced before joining is attempted again. Use only manufacturers recommended lubricant.

.14 Complete each joint before laying next length of pipe.

.15 Minimize deflection after joint has been made.

.16 Apply sufficient pressure in making joints to ensure that joint is completed to manufacturer's recommendations. Carefully follow all assembly instructions of manufacturer. Provide the Engineer with a copy of these instructions.

.17 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes or as otherwise approved by Engineer. Backfill to prevent flotation or as directed by the Engineer.

.18 When stoppage of work occurs, block pipes in an approved manner to prevent creep during down time.

.19 Recheck plastic pipe joints assembled above ground after placing in trench to ensure that no movement of joint has taken place.

.20 Do not lay pipe on frozen bedding.

.21 Protect hydrants, valves and appurtenances from freezing.

.22 Upon completion of pipe laying and after Engineer has inspected work in place, surround and cover pipes between joints with approved granular material placed to dimensions indicated or directed.

.23 Hand place granular material in uniform layers not exceeding 150 mm thick to minimum 300 mm over top of pipe. Dumping of material directly on top of pipe is not permitted.

.24 Place layers uniformly and simultaneously on each side of pipe to prevent lateral displacement of pipe.

.25 Compact each layer to at least 95% maximum density. ASTM D698-78, Method D.

.26 Surround and cover joints and fittings with granular material placed and compacted as specified herein. Backfill remainder of trench to Section 02223.

.27 Install HDPE pipe to manufacturer's recommendations.

3.6 VALVE INSTALLATION

.1 Install valves to manufacturer's recommendations at locations indicated.

.2 Support valves located in valve boxes or valve chambers by means of concrete blocks, located between valve and solid ground. Bedding same as adjacent pipe. Minimum length of pipe on each end of valve shall be one full pipe length or 1 m at stub connection at Tee. Valves shall not be supported by pipe.

3.7 VALVE CHAMBERS

.1 Use cast-in-place or precast units as indicated and approved by Engineer.

.2 Construct units as indicated, plumb and centred over valve nut, true to alignment and grade. Valve chambers shall not rest on pipe.

.3 Place reinforcing steel and miscellaneous metals required to be embedded in concrete to details indicated and to Section 03200.

.4 Cast base directly on undisturbed ground or when permitted by Engineer, set a precast concrete base on 150 mm minimum granular material compacted to 95% maximum density ASTM D698-78 Method D.

.5 Clean surplus mortar and joint compounds from interior surface of valve chamber as work progresses.

.6 Plug lifting holes with precast concrete plugs set in cement mortar, mastic compound or mortar as indicated or approved by the Engineer.

.7 Set frame and cover to required elevation to frame with cement mortar, parge and trowel smooth and use concrete slab for setting frame and cover only if authorized in writing by the Engineer. Water proof chambers as specified in Section 02601.

.8 Place frame and cover on top section to elevation indicated. If adjustment is required use concrete ring.

.9 Clean valve chambers of debris and foreign materials; remove fins and sharp projections.

.10 Test chambers for infiltration and exfiltration according to Section 02601.3.6 and shall meet the test requirements of that clause.

3.8 SERVICE CONNECTIONS

.1 Install service connections before carrying out hydrostatic and leakage test of water main.

.2 Water service lines shall be installed to the right of sewer service lines when viewed from the position of the watermain and facing the building.

.3 Employ only competent workmen equipped with suitable tools to carry out tapping of mains, cutting and flaring of pipes.

.4 Tap main at 2:00 o'clock or 10:00 o'clock position for services up to 32 mm. Do not tap pipe closer to a joint nor adjacent service connections than recommended by manufacturer, or 1 m, whichever is greater. Tap 40 and 50 mm services at 9:00 o'clock or 3:00 o'clock position to keep gooseneck below frost.

.5 Leave corporation stop valves fully open.

.6 Install rigid stainless steel liners in small diameter plastic pipes with compression fittings or use fittings with built in liner.

.7 Install curb stop with corporation box on services 50 mm or less in diameter. Equip larger services with a gate valve and cast iron box. Set box plumb over stop and adjust top flush with final grade elevation. Leave curb stop valves fully closed.

.8 Place temporary location marker at ends of plugged or capped unconnected water lines. Each marker to consist of a 38 x 89 mm stake extending from pipe end at pipe level to 600 mm above grade. Paint exposed portion of stake red with designation "WATER SERVICE LINE" in black.

3.9 HYDRANTS

.1 Install hydrants at locations specified or directed in accordance with AWWA Manual of Practice M-17-1970.

.2 Install gate valve and cast iron valve box on hydrant service leads as specified.

.3 Set hydrants plumb, with hose outlets parallel with edge of payment or curb line, with pumper connection facing roadway and with body flange set at elevation of 50 mm above final grade. When placed behind the curb no part of the hydrant shall be closer than 150 mm or farther than 300 mm from the gutter face of the curb or future curb. When between curb and sidewalk or on lawn behind sidewalk no part of the hydrant shall be closer than 150 mm, to the sidewalk.

.4 Place concrete thrust blocks as specified ensuring that drain holes remain unobstructed unless specified in the contract that drain holes should be plugged.

.5 Install drain plug in areas of high groundwater when directed by the Engineer. After testing and prior to turn over to the owner, pump down water in barrels of plugged hydrants. To provide proper draining for each hydrant, excavate a pit measuring not less than 1 x 1 x 0.5 m deep and backfill with coarse gravel or crushed stone to a level 150 mm above drain holes.

.6 Place appropriate sign on installed hydrants indicating whether or not they are in service during construction. Install hydrant marker post as detailed on the contract drawings.

.7 Disassembly or reassembly of hydrants may only be carried out by properly trained personnel. Hydrants that have been disassembled after leaving the manufacturer's facilities must be pressure tested after reassembly according to AWWA Manual of Practice M-17-1970.

3.10 THRUST BLOCKS

.1 Do concrete work to Section 03300.

.2 Place concrete thrust blocks between valves, tees, plugs, caps, bends, changes in pipe diameter, reducers, hydrants and fittings and undisturbed ground as specified or as directed by Engineer.

.3 Keep joints and couplings free of concrete.

.4 Do not backfill over concrete within 24 hours after placing.

.5 Install joint restraints with or without thrust blocks where indicated on the plans and specifications or where required by the Engineer. Joint restraints shall be of the same pressure rating as the pipes to be joined and restrained. Installation of joint restraints shall be in accordance with the manufacturer's instructions for the types of pipes to be joined and restrained. All components of joint restraints shall be corrosion resistant or suitably protected from corrosion and be approved by the Engineer.

3.11 PRESSURE TEST

.1 After the pipe has been laid and backfilled and following the installation of service pipes and fittings, all newly laid pipe, or valved section thereof, shall be subjected to a hydrostatic pressure of 150% of normal operating pressure based on the elevation of the lowest point in the main and corrected to elevation at the test gauge location or a minimum of 1000 kPa, whichever is greater, for a period of 1 hour. Where hydrants are in the test section, the test shall be made against the closed hydrant valve.

.2 Each valved section of pipe shall be slowly filled with water and the test pressure shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Engineer. The pump, pipe connection and all necessary apparatus shall be furnished by the Contractor.

.3 Before applying the test pressure, all air shall be expelled from the pipe. If permanent air vents are not located at all high points the Contractor shall install corporation cocks at such points so the air can be expelled, the corporation cocks shall be closed and the test pressure applied.

.4 The pressure test shall be of a duration of at least 1 hours and the pressure shall not vary by more than +/- 35 kPa.

.5 Pressure testing of PE pipe to be carried out as per Manufacture's recommendations.

.6 Pressure testing of HDPE pipe.

.1 Water is to be used as the pressure medium. Testing can be done before or after the pipe is placed in the trench. If the pipe must be backfilled before it is tested, the mechanical joints may be exposed for visual inspection during testing.

.2 Pipe should be tested at a pressure of 1.5 times the rated pressure of the pipe (1.5 times series number) at the lowest point in the system. To compensate for initial pipe stretch, a period of 3 hours is required to pressurize the pipe plus 1 hour during which time the required pressure is maintained before the test period is started. Unless a high-volume high-pressure pump is used, it is sometimes difficult to raise the pressure within the allowable time.

.3 After the completion of the initial expansion stage, i.e. a total of four hours, the pressure should be at the required level and the test period should commence. This period should not exceed 3 hours. After the test period, a measured amount of make-up water should be added to return the pipe to the test pressure. the amount of make-up water should not exceed the allowance given in the following table:

ALLOWANCE FOR EXPANSION TABLE

Nominal Pipe Size mm	(in.)	Allowance for Expansion (Litres/100 meters of pipe) 1-hour Test	2-hour Test	3-hour Test
75	(3)	1	2	4
100	(4)	2	4	5
150	(6)	4	7	11
200	(8)	6	12	19
250	(10)	10	16	26
275	(11)	12	25	37
300	(12)	14	29	42
350	(14)	17	35	52
400	(16)	21	41	62
450	(18)	27	53	81
500	(20)	35	68	99
550	(22)	43	87	130
600	(24)	56	111	168
700	(28)	68	138	209
800	(32)	87	178	267
900	(36)	112	224	335
1000	(40)	137	273	410
1200	(48)	186	335	534

.4 Under no circumstances should the total time under test exceed 8 hours at 1 ½ times the pressure rating. If the test is not completed because of leakage or equipment failure, the test section should be permitted to "relax" for 8 hours prior to the next testing sequence.

.5 Testing for leakage can be done by developing the test pressure (described above) for a period of 4 hours and then dropping the pressure by 69 kPa (10 psi). If the pressure remains steady for one hour this indicates that there is no leakage in the system.

.7 All faulty or leaking connections shall be corrected at the Contractor's expense.

3.12 LEAKAGE TEST

.1 A leakage test shall be conducted concurrently with the pressure test. The Contractor shall supply all equipment necessary for the conducting of this test.

.2 "Leakage" shall be defined as the quantity of water that must be supplied into the newly laid pipe or any valved section thereof, to maintain pressure within +/- 35 kPa of the test pressure after the air in the pipeline has been expelled.

.3 No pipe installation will be accepted if the leakage is greater than the allowable leakage for joints plus the allowable leakage for closed metal seated valves.

.4 Allowable leakage for joints is calculated as follows:

$$L = \frac{N\,D\,(P)^{0.5}}{128}$$

where:

L = the allowable leakage in l/h
N = the number of joints in the length of pipeline tested
D = the nominal diameter of the pipe in metres
P = the average test pressure during the leakage test in kilopascals

.5 Allowable leakage for closed metal seated valves shall be 0.00121 l/h/mm of nominal valve size.

.6 If any test of pipe discloses leakage greater than the allowable, the Contractor shall, at his own expense, locate and repair the defective joints until the leakage is within the specified allowance. All joints until the leakage is within the specified allowance. All visible leaks are to be repaired regardless of the amount of leakage.

3.13 FLUSHING AND DISINFECTING

.1 Flushing and disinfecting operations shall be witnessed by Engineer. Notify Engineer at least 4 days in advance of proposed date when disinfecting operations will commence.

.2 Disinfection of watermains shall be done in accordance with AWWA C651 **(latest version).**

.3 Prior to being chlorinated the mains shall be filled to eliminate air pockets and shall be flushed to remove particles. Flush with a sufficient flow to produce a velocity of 1.5 m/s, unless the Engineer determines that conditions do not permit the required flow to be discharged, or until foreign materials have been removed and flushed water is clear.

.4 Flushing flows shall be as follows:

Pipe Size mm	Flow (l/s) Minimum
150 and below	38
200	75
250	115
300	150
350	200
400	250

.5 Water from existing distribution system, or other approved source of supply, shall be made to flow at a constant measured rate into the newly laid water mains and hydrant leads.

.6 At a point not more than 3 m downstream from the beginning of the new main, water entering the new main shall receive a dose of chlorine fed at a constant rate, such that the water will have not less than 25 mg/l free chlorine. To assure that this concentration if provided, measure the chlorine concentration at regular intervals.

.7 During the application of chlorine, valves shall be positioned so that the strong chlorine solution in the main being treated, will not flow into water mains in active service. Chlorine application shall not cease until the entire main is filled with heavily chlorinated water. The chlorinated water shall remain in the main for at least 24 hours, during which time all valves and hydrants in the section treated shall be operated in order to disinfect the appurtenances. At the end of this 24 hours period, the treated water in all portions of the main shall have a

residual of not less than 10 mg/l free chlorine.

.8 After the final flushing and before the water main is placed in service, water samples shall be collected from the line and tested for bacteriological quality and shall show the absence of coliform organisms, disinfection shall be repeated until satisfactory samples have been obtained.

.9 The Contractor shall get approval of the governing agency or agencies before the heavily chlorinated water can be discharged into storm, sanitary or other receiving systems. If the heavily chlorinated water cannot be accepted by nearby storm, sanitary or other receiving systems, the water shall be discharged into tanks and disposed of at an approved site. The cost associated with disposing of heavily chlorinated water shall be borne by the Contractor.

3.14 SWABBING

.1 Appropriately sized and designed watermain swabs shall be inserted into the main at as many locations as need be to ensure every section of watermain is swept by a swab when the water is first charged into the system. After main lines have been swabbed, hydrant leads will be thoroughly flushed, but not swabbed. Flushing shall be accomplished by opening and closing valves and hydrants several times using water, under expected line pressure, with flow velocities adequate to flush foreign material out of the valves and hydrants.

3.15 BASIS OF PAYMENT

.1 All costs associated with work specified in this Section shall be deemed to be included in the appropriate unit and lump sum prices quoted in the Schedule of Quantities and Prices.

.2 Payment will be made to the maximum of 90% of the value of watermains, hydrants, valves, fittings and appurtenances until the system, or sections of the system if payment approved by the Engineer, has passed all hydrostatic leakage tests. The 10% retained shall be called the water testing allowances.

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This section covers the requirements for the construction of storm water and sanitary sewage forcemains and associated appurtenances.

PART 1 - GENERAL

1.1 MEASUREMENT FOR PAYMENT

.1 Trenching will be measured under Section 02223.

.2 Sewage force main will be measured through fittings and chambers after the work is completed. Measurement will be horizontally in metres over the center line of the pipe when the grade of the pipe is less than 10% and in metres along the slope length of the pipe when the grade of the pipe is 10% or greater, for each size pipe and depth class supplied and installed.

.3 Granular bedding material will be measured in cubic metres of material incorporated into work as per Section 02223.

.4 Concrete for bedding, encasement of pipes, supports and thrust blocks will be measured in accordance with Section 03300.

.5 Combination air release valve and vacuum valve and chamber to be measured in units for each installed, including all labour and materials including the connection to the force main.

.6 Fittings will be measured in units of each size installed.

.7 Force main connection to manholes, including grouting flange and bends, will be measured by the unit.

.8 Swabbing of force main will be measured in metres of pipe swabbed for each size of pipe cleaned.

.9 Breaking into and connecting to existing manhole to be measured by the each.

PART 2 – PRODUCTS

2.1 MATERIALS

.1 Ductile iron: AWWA C151/ANS1 A21.51-86 Pressure Class 350 for 2400 kPa for 100 mm to 300 mm diameter (unless otherwise specified in the Schedule of Quantities and Prices) and by design according to AWWA C150/ANS1 21.50-86 for 350 mm diameter and larger (unless otherwise specified in the Schedule of Quantities and Prices), cement mortar lined to AWWA C104/ANS1 A21.4-90.

.1 Joints:

.1 Mechanical, rubber gaskets with plain tip, high strength heat treated cast-iron or alloy steel tie head bolts with hex nuts.

.2 Push-on joint with continuous rubber moulded ring gasket.

.2 Fittings: to CSA B70-M91, AWWA C110-87 cement mortar lined to A.N.S.I. A21.4-90.

.2 Polyvinyl chloride pressure pipe:

.1 To AWWA C900-89 for pipe size 100 mm to 300 mm and AWWA C905-88 for pipe size 350 mm to 900 mm, DR 18 (pressure class 150), (unless otherwise specified in the Schedule of Quantities and Prices) 1 MPa gasket bell end, cast iron outside diameter.

.2 To CSA B137.3-M90, PVC series 160, 1.1 MPa elastomeric gasket coupling.

.3 Composite epoxy impregnated fibreglass PVC pipe to ASTM D2996-71(1977), class H. Unplasticized PVC core over wrapped with bonded fibreglass reinforced epoxy resin. Pressure class 300, 2.4 MPa with cast iron outside diameter and integral bell gasketed joints to ASTM D2992-71(1977). Material to ASTM D2310-80 classification RTRP-11HZ-5001-PVC-13223.

.4 Cast iron fittings: to AWWA C110/ANSI A21.10 and for pipe diameters larger than NPS 4 cement mortar lined to A.N.S.I. A21.4-90.

.5 PVC fittings: to CSA B137.2 M89 or AWWA C-907-91.

.3 Polyethylene pressure pipe: to AWWA C906-90, AWWA C901-88, CSA B137.1-M89, ASTM D3035-88 & ASTM F714-88 Type P.E. CSA series 160 or AWWA Pressure Class 151 (unless otherwise specified in the Schedule of Quantities and Prices).

.1 Polyethylene to polyethylene joints: to be thermal butt fusion welded to AWWA C207-86 or flanged with steel backing flanges.

.2 Polyethylene fittings: to CSA B137.1-M89 for pipe sizes NPS 4 and less.

.4 Pipe insulation to be rigid polyethylene foam factory applied, core density 32 to 48 kg/m^3, closed cell content 90% minimum, water absorption p.024 gm/cm^3 per surface immersed 45 hours, 2.44 metre head of water, thermal conductivity 0.019 to 0.028 W/M.^oC, compressive strength 210 to 281 kg/m^2, tensile strength 527.3 kg/m^2, shear 2109 kg/m^2, maximum service temperature 121^oC.

.5 Pipe metal jacket to be 0.889 mm galvanized steel formed from a continuous strip which is shaped and jointed in a spiral pattern using a pressure grooved, single lock, waterproof seam.

.6 Adjustable steel yoke pipe roll shall be as manufactured by I.T.T. Grinnell Figure 181 size to match outside diameter of insulated pipe systems.

.7 Insulation protection shield shall be as manufactured by I.T.T. Grinnell Figure 167 size to match outside diameter of insulated pipe system.

2.2 PIPE BEDDING MATERIALS

.1 Granular bedding and backfill materials as specified in Section 02223.

.2 Concrete for cradles, encasement, supports, thrust blocks to Section 03300, strength 25 MPa.

PART 3 - EXECUTION

3.1 PREPARATION

.1 Clean pipes and fittings of debris and water before installation. Carefully inspect materials for defects before installing. Remove defective materials from site.

3.2 TRENCHING AND BACKFILL

.1 Do trenching and backfill in accordance with Section 02223.

.2 Trench alignment and depth require approval prior to placing bedding material or pipe.

.3 Do not backfill trenches between joints until pipe slope and alignment have been checked and accepted. Do not backfill at joints and valves until pressure and leakage test results are within limits specified. Provide a minimum 1.8 m cover unless otherwise specified.

3.3 BEDDING

.1 Place bedding material to details indicated and compact to minimum of 95% of corrected maximum dry density.

3.4 CONCRETE BEDDING AND ENCASEMENT

.1 Pipe may be positioned on concrete blocks to facilitate placing of concrete. When necessary, rigidly anchor or weight pipe to prevent flotation when concrete is placed.

.2 Do not backfill over concrete within 24 hrs. after placing concrete.

3.5 INSTALLATION

.1 Lay and join pipes in accordance with AWWA C600-87 for ductile iron pipe and manufacturer's recommendations. Torque wrench to be used for mechanical joint assembly. Avoid damage to machined ends of pipes in handling and moving pipe.

.2 Maintain grade and alignment of pipes. Align pipes carefully before jointing.

.3 Do not exceed maximum joint deflection recommended by pipe manufacturer unless directed in writing by Engineer. Use special bends where necessary to avoid joint deflection. Support pipe firmly over entire length, except for clearance necessary at couplings.

.4 Keep pipe and pipe joints free from foreign material. Avoid bumping gasket and knocking it out of position, or contaminating with dirt or other foreign material. Gaskets so disturbed to be removed, cleaned, lubricated and replaced before jointing is attempted. Use gasket lubricant as recommended by manufacturer.

.5 Support pipes by means of hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.

.6 Apply sufficient pressure in making joint to ensure that joint is complete to manufacturer's recommendations.

.7 Apply restraint to force main to ensure that joints when completed are held in place, by tamping fill material under and alongside pipe, or otherwise as approved by Engineer.

.8 Block pipe as directed when any stoppage of work occurs to prevent creep during down time.

.9 Do not lay pipe on frozen bedding. Insulated above ground high density polyethylene pipe to be installed in accordance with manufacturer's recommendations.

.10 Upon completion of pipe laying and after Engineer has inspected work in place, surround and cover pipes between joints with approved granular material placed to dimensions indicated or directed.

.11 Leave joints and fittings exposed for hydrostatic testing. If it is necessary to backfill sections of the force main prior to testing, take full responsibility and bear all costs for any additional excavation and backfill to expose pipe, fittings or joints that may be necessary.

.12 Hand place granular material in uniform layers not exceeding 150 mm thick to minimum 300 mm over top of pipe. Dumping material directly on top of pipe is not permitted.

.13 Compact each layer to at least 95% maximum density ASTM D698-78, method D.

.14 When HDPE pipe is used, butt fusion to be carried out by a qualified technician.

3.6 THRUST BLOCKS

.1 Place concrete thrust blocks between bends, tees and fittings and undisturbed ground. Keep pipe couplings free of concrete.

.2 Bearing area of thrust blocks to be as indicated or specified by the Engineer.

.3 Do not backfill over concrete within 24 hrs.

3.7 FIELD TESTING OF FORCE MAIN

.1 Provide labour, equipment and materials required to perform hydrostatic and leakage tests. Testing of force main to be carried out under supervision of Engineer.

.2 Before testing, bed and cover pipe between joints to prevent movement of force main when test pressure is applied.

.3 Strut and brace caps, bends and tees, to prevent movement when test pressure is applied.

.4 Expel air from force main, by slowly filling main with water. High pints to be drilled and tapped and suitable cocks installed to vent air and to be shut when pressure is applied. Remove cocks after satisfactory completion of test and seal holes with tight fitting plugs.

.5 Apply a hydrostatic test pressure of 150% of the normal working pressure based on the elevation of the lowest point in the main and corrected to elevation at the test gauge location or a minimum of 1000 kPa, whichever is greater, for a period of one hour.

.6 Apply pressure for 1 hr. for pressure test and 2 hrs. for leakage test.

.7 Examine exposed pipe, joints and fittings while system is under pressure. Remove defective joints, pipe and fittings and replace with new sound material. Make leaking joints watertight.

.8 Test force main in sections not exceeding 300 m in length, unless otherwise authorized by the Engineer.

.9 Define leakage as amount of water supplied from water storage tank in order to maintain test pressure for 2 hrs. The allowable leakage is 0.03 l/mm pipe diameter per 300 metres, per hour for a working pressure of 1000 kPa. For other working pressures test in accordance with AWWA C600-87.

.10 Locate and repair defects if leakage is greater than amount specified. Repeat test until leakage is within specified allowance for full length of force main.

3.8 SWABBING

.1 Appropriately sized and designed sewer swabs shall be inserted into the main at as many locations as need be to insure every section of sewer main is swept by a swab when the system is first charged into the system.

3.9 BASIS FOR PAYMENT

.1 All costs associated with the work specified in this section shall be deemed to be included in the appropriate unit and lump sum prices quoted in the Schedule of Quantities and Prices.

.2 Payment will be made to the maximum of 90% of the value of force mains, fittings and appurtenances until the system (or sections of the system, if payment approved by the Engineer) has passed all hydrostatic and leakage tests. The 10% retained shall be called the force main testing allowance.

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PART 1 - GENERAL

1.1 MEASUREMENT FOR PAYMENT

.1 Trenching and backfilling will be measured under Section 02223 - Excavation, Trenching and Backfilling.

.2 Watermain, hydrants, service connections, valves and valve chambers will be measured in accordance with Section 02713 - Water Mains. Specified insulation, heat tracing, and appurtenances will not be measured but considered incidental to work.

.3 Sanitary sewer will be measured in accordance with Section 02702 - Sewer Mains. Specified insulation, heat tracing, and appurtenances will not be measured but considered incidental to work.

.4 Sewage forcemain will be measured in accordance with Section 02724 - Sewage Forcemains. Specified insulation, heat tracing, and appurtenances will not be measured but considered incidental to work.

.5 Concrete for bedding, encasement of pipes, supports and thrust blocks will be measured in cubic metres in place.

.6 Granular bedding and surround material will be measured in cubic metres in accordance with Section 02713 - Water Mains, Section 02702 - Sewer Mains or Section 02724 - Sewage Forcemains, as applicable.

.7 Testing will not be measured for payment.

1.2 SHOP DRAWINGS

.1 Submit shop drawings in accordance with GC 41.

.2 Submit shop drawings for pre-insulated piping, insulation kits, heat tracing cables, controllers and appurtenances.

PART 2 - PRODUCTS

2.1 CARRIER CORE PIPE AND FITTINGS

.1 Water Mains and Sewage Forcemains:
- .1 Polyethylene pressure pipes to ASTM F714:
  - .1 Type PE 3408.
  - .2 Dimension Ratio: as indicated on contract drawings.
- .2 Class 125 Cast Iron Flanged Fittings to ANSI/ASME B 16.1.
- .3 Plain End Polyethylene Fittings: to CSA B137.1.

.2 Sewer Mains:
- .1 PVC Sewer Pipe and Fittings: to ASTM D3034, CAN/CSA-B182.2.
  - .1 Standard Dimension Ratio: as indicated on contract drawings.
- .2 PVC pressure pipe: to CAN/CSA B137.3, ASTM D1785.
  - .1 Dimension Ratio: as indicated on contract drawings.

2.2 FACTORY APPLIED INSULATION

.1 Pipes to be cleaned of surface dust or dirt and treated if necessary to assure positive bond of foam to entire pipe surface.

.2 Material: rigid polyurethane foam factory applied or factory applied rigid expanded polystyrene.

.3 Insulation thickness: 50 mm minimum.

.4 Density: to ASTM D1622, 0.032 to 0.048 gm/cm^3.

.5 Closed cell content: to ASTM D2856, 90% minimum.

.6 Water absorption: to ASTM D2842, 4.0 gm/1000 cm^3, maximum 4.0 % by volume.

.7 System compressive strength: to Modified ASTM D1621 with 50 mil Jacket, 150 kPa minimum.

.8 Thermal conductivity: to ASTM C518, 0.020 to 0.026 W/m.C^o maximum.

.9 Service temperature: minus 45^{o}C to plus 85^{o}C.

2.3 OUTER JACKET FOR BURIED APPLICATIONS

.1 Material: factory applied polyethylene tape jacket with enhanced cold weather properties, black in colour (UV inhibited) or factory applied polyurethane/urethane jacket, black in colour.

.2 P.E. tape.

.3 Sealant: Butyl rubber & resin.

.4 Jacket thickness: 1.27 mm minimum.

.5 Elongation: to ASTM D1000, 300% maximum 6 month test.

.6 Service temperature: minus 45^{o}C to plus 85^{o}C maximum.

.7 Water vapour transmission rate: 3 gm/m^2/24 h average.

.8 Tensile strength: 6.8 kg/cm width minimum.

2.4 OUTER JACKET FOR ABOVE GROUND APPLICATIONS

.1 Material: factory applied galvanized lock seam, spiral steel outer jacket, 18 to 22 mm gauge minimum thickness spirally applied from continuous steel strip using lock seam, or;

.2 Factory applied polyethylene case, 0.38 mm thickness, black in colour.

2.5 INSULATED PIPE JOINTS FOR BURIED APPLICATIONS

.1 Material: rigid polyurethane half shells or rigid expanded polystyrene half shells, with properties as described in paragraph 2.2.

.2 A moisture proof seal shall be provided with mastic sealants as described in 2.9 and with heat shrink sleeves or spray on polyurethane/urethane coating.

.3 Heat shrink sleeves: adhesive coated cross linked polyethylene sleeve. Sleeves: to cover entire exposed joint length plus overlap of 76 mm of pipe coating on either side.

.4 Spray on polyurethane/urethane coating, meeting the requirements of paragraph 2.3 above, shall be applied by factory trained workers.

2.6 INSULATED PIPE JOINTS FOR ABOVE GROUND APPLICATIONS

.1 Material: rigid polyurethane half shells or rigid expanded pollystyrene half shells, with properties as described in paragraph 2.2.

.2 A moisture proof seal shall be provided with silicone caulking circumferentially beaded around outer jacket of pipe 50 mm from pipe as described in paragraph 2.9 and either:

.1 Adhesive coated cross linked pollyethylene heat shrink sleeves to cover the entire exposed joint length plus overlap of 76 mm of pipe coating on either side and protected with rolled sheet steel 0.85 mm thick wrapped around and strapped into place to complete joint; or

.2 Spray on polyurethane/urethane coating to a minimum thickness of 3.25 mm with properties as described in paragraph 2.3 above.

2.7 INSULATION KITS FOR FITTINGS

.1 Material: rigid polyisocyanurate foam with polymer protective coating on all exterior surfaces including ends. Kits to be supplied complete with silicone caulking for seams, stainless steel attachment straps and clips, and heat shrink sleeves to seal between pipe and insulation cover.

.2 Rigid polyisocyanurate foam insulation:
- .1 Density: to ASTM D1622, 0.027 gm/cm^3.
- .2 Compressive strength: ASTM D1621, 131 kPa minimum.
- .3 Closed cell content: 90% minimum.
- .4 Water absorption: to ASTM C272, less than 0.7 % by volume.
- .5 K Factor: to ASTM C518, 0.027 W/m.^oC.

.3 Polymer coating to ASTM D3574:
- .1 Two component high density polyurethane coating, black in colour.
- .2 Density: 1170 kg/m^2.
- .3 Abrasion: durometer D scale: 60.
- .4 Tensile strength: 11,000 kPa minimum.
- .5 Tear strength: 26.5 N/mm minimum.
- .6 Thickness: 1.9 mm outside surfaces, 0.51 mm inside surfaces.

2.8 INSULATION FOAMED IN PLACE

.1 Material: two component polyurethane Class 1 foam, supplied in portable, disposable, pressurized container.

.2 Density: to ASTM 1622, 0.035 to 0.039 gm/cm^3.

.3 Closed cell content: to ASTM D2856, 90% minimum.

.4 Thermal conductivity: to ASTM C518, 0.022 to 0.024 W/m.^{o}C.

.5 Compressive strength: to ASTM D1621, 103 to 172 kPa at 10% deflection, minimum.

.6 Water absorption: to ASTM D2842, 4.25% maximum by volume.

2.9 INSULATION ACCESSORIES

.1 Heat shrink tape for sealing insulation half shells against moisture adaptable to flexible installations:
- .1 Crosslinked polyolefin backing with a hot melt adhesive coating.
- .2 Backing thickness: 0.35 mm minimum.
- .3 Adhesive thickness: 0.51 mm minimum.
- .4 Service temperature: minus 40 to plus 60^{o}C maximum.
- .5 Tensile strength: 20 MPA minimum.

.2 Low density polyethylene tape for minor repair of the outer jacket or completion of straight insulation joints in field where irregular surfaces are not involved:
- .1 Adhesive backed tape protected by easily removed release liner.
- .2 Backing thickness: 0.178 mm mm average.
- .3 Adhesive thickness: 0.711 mm.
- .4 Service temperature: minus 34 to plus 85 ^{o}C.
- .5 Tensile strength: 3.6 kg/cm width.
- .6 Colour: black.

.3 Asphalt mastic vapour barrier coating to waterproof exterior surfaces of half shells or sprayed in place foam:
- .1 Colour: black.
- .2 Coverage: 3 – 5 l/m^{2}.
- .3 Drying time to touch: 4 h maximum.
- .4 Drying time firm: 48 h maximum.
- .5 Service temperature: minus 40 to plus 125 ^{o}C.
- .6 Application temperature: 4 ^{o}C minimum.
- .7 Water vapour permeability: 0.018 perms at 3 cm.

.4 Silicone caulking for joining faces of rigid urethane insulation:
- .1 Colour: black.
- .2 Specific gravity: 1.02.
- .3 Tensile strength: 8 kg/cm^{2}.
- .4 Elongation: 400 %.
- .5 Service temperature: 205^{o}C maximum.

2.10 ELECTRIC HEAT TRACING

.1 Heat tracing conduits:
- .1 To consist of extruded plastic moulding and to be applied to pipe prior to application of insulation.
- .2 To be securely fastened to pipe and sealed to prevent ingress of foam during insulation.
- .3 Each conduit to be checked after insulating to ensure it is not plugged.
- .4 Ends to be sealed prior to shipping to prevent foreign material from entering conduit while in transit or during installation.

.2 Parallel circuit type electric tracing cable:
- .1 Resistive parallel circuit type: to CSA C22.2 No. 130, constant watt, power rating and voltage as indicated on contract drawings.
- .2 Fluoropolymer inner and outer insulation jackets, and suitable for cutting to length in field.
- .3 Manufacturer to ensure that specified electric tracing cable and heat tracing conduit size are compatible, so that cable may be pulled in with relative ease.
- .4 Standard of Acceptance: Urecon Thermocable, or approved equal.

.3 Series type electric tracing cable:
- .1 Resistive series circuit type: CSA approved, constant watt, power rating and voltage as indicated on contract drawings.
- .2 Fluoropolymer inner and outer insulation jackets.
- .3 Cable manufacturer to engineer cable for specific circuit length.
- .4 Manufacturer to ensure that specified electric tracing cable and heat tracing conduit size are compatible, so that cable may be pulled in with relative ease.
- .5 Standard of acceptance: Urecon SC Heatrace Series Type Heating Cables For Long Line Electric Tracing, or approved equal.

.4 Solid state controller:
- .1 On-off control with 1°C temperature differential for accurate control.
- .2 Load switch:
  - .1 30A, 120/240V controllers - mechanical relay switch.
  - .2 15-60A, 575V controller – mechanical contactor.
- .3 Low temperature sensor control to be factory preset at 3°C for water or sewer, and 10°C for fire protection water.
- .4 High temperature sensor control to be attached to active zone of heat tracing cable and to serve as high temperature cut-out, factory preset at 65 °C.
- .5 Rating: as indicated on contract drawings.
- .6 Resistance temperature detectors (RTD): as indicated on contract drawings.
- .7 Indicator lamps to be mounted on front of controller to indicate status of system.
- .8 Alarms: controllers on main lines to be equipped with remote alarm contacts to activate an audible alarm and flashing red light for the following alarm conditions:
  - .1 Low temperature.
  - .2 High temperature.

  Alarm system to shut down once system conditions return to normal.
- .9 Standard of Acceptance: Urecon Temperature Controllers or approved equal.

.5 Terminal end seal kits to be certified for installation in damp conditions to CSA C22.2 No. 130.2 and to consist of:
- .1 Constant watt:
  - .1 90 cm of Teflon tape.
  - .2 Adhesive-lined heat shrink end cap.
  - .3 Adhesive-lined heat shrink tubing.

.6 Power connection kits to connect to pipe and to CSA C22.2 No. 130.5 as indicated.
- .1 Constant watt:
  - .1 Flexible conduit.
  - .2 Adhesive-lined heat shrink end cap.
  - .3 Adhesive-lined heat shrink tubing.
  - .4 Power Splice.

PART 3 - EXECUTION

3.1 UNLOADING AND HANDLING OF PRE-INSULATED PIPE

.1 Unload from trucks or containers by hand or by lifting apparatus with fabric slings. Do not use cables or chains.

.2 Once removed, store on smooth surface. Lay pipes flat. Where sleepers are desired use several lengths of wide planks to provide broad bearing surface.

.3 Lift, do not drag, insulated pipes from storage area to job site.

3.2 REPAIRING DAMAGED PRE-INSULATED PIPE

.1 Repair any damage to outer jacket by applying heat shrink sleeve to approval of Company's Representative or cover using heated HDPE UV resistant adhesive backed tape or cover with spray on polyurethane/urethane as described in 2.3 or 2.4 above.

3.3 TRENCHING AND BACKFILLING

.1 Do trenching and backfilling work in accordance with Section 02223 - Excavating, Trenching and Backfilling.

3.4 GRANULAR BEDDING AND SURROUND

.1 Place bedding and surround material as indicated on contract drawings and as specified in Section 02713 - Water Mains, Section 02702 - Sewer Mains, or Section 02724 - Sewage Forcemains.

3.5 PIPE INSTALLATION

.1 Install pipe in accordance to Section 02713 - Water Mains, Section 02702 - Sewer Mains, or Section 02724 - Sewage Forcemains.

3.6 INSULATION OF PIPE JOINTS

.1 Complete installation of rigid polyurethane, or rigid expanded polystyrene, halves on joints after laying pipe in trench and after successful pressure testing of pipe.
  .1 Trim half shells to required length with handsaw to provide tight-fit in insulation gap between ends of factory insulation.
  .2 No seam to exceed 3 mm in width at any joint. Match outer surface of shell with outer surface of insulation on pipe with tolerance of plus or minus 6 mm. Shave off any sharp edge with rasp or sharp knife.
  .3 Hold half shells in place with masking tape while installing heat shrink sleeve.

.2 Install heat shrink sleeves using large broad flame propane torch to produce 600 mm flame.
  .1 Peel back release liner 12 cm from end, centre sleeve over joint and press firmly down. Wrap sleeve around pipe, removing release liner as it is wrapped. If corner on underlap is not precut, then cutoff

about 25 mm from each corner.

.2 Before completing overlap wrapping, warm underlap area approximately 12 cm until adhesive starts to appear at edge. Smooth out any wrinkles with gloved hand.

.3 Remove remaining release liner and complete wrapping.

.4 Remove release paper from closure seal, prewarm adhesive slightly, centre seal cover overlap and press down until well bonded. Heat closure seal, and press down with gloved hand to remove any bubbles and wrinkles.

.5 With torch, start at centre of sleeve and shrink it all around joint. Keep torch moving using broad circumferential strokes to avoid burning. Continue shrinking sleeve toward one end until about 50 mm is left. Then aim torch inward towards centre and shrink edges. Repeat this operation on other end of sleeve. Finish off by applying long horizontal strokes of torch all around sleeve.

.6 Pay special attention to sleeve overlap area, ensuring no void remains along underlap edge. Use roller, or gloved hand to firmly and thoroughly press down along underlap edge. Start in centre and work outwards.

.7 Allow joint and sleeve to cool for at least 30 min before lowering pipe into trench.

3.7 INSULATION OF FITTINGS

.1 Cut pipes as required to accommodate fittings and fitting insulation kits without damaging pipe insulation or its jacket. Leave smooth end at right angles to pipe axis.

.2 Cracks larger than 6.4 mm to be filled with insulation foamed-in-place in following manner:

.1 Use strip of thin galvanized sheet metal wide enough to overlap both insulation kit and pipe by at least 8 cm and long enough to wrap around pipe leaving 2.5 cm opening on top.

.2 Hold metal in place with two tension metal or nylon straps, one at either end.

.3 Spray foam through opening on top into cavity.

.4 Spray until cavity is almost half-filled on both sides of pipe. Foam will rise to complete filling.

.5 Allow curing for 10 to 15 min.

.6 Trim top and apply waterproofing sealant asphalt mastic, HDPE tape or heat shrink tape or sprayed on polyurethane/urethane to the appropriate thickness.

3.8 ELECTRIC TRACING

.1 Install electric heat tracing, controllers, and appurtenances in accordance with manufacturer's recommendations.

.2 At fittings and flanged joints seal heat trace channel with silicone caulking.

3.9 TESTING

.1 Flush, disinfect, and test water mains for leakage in accordance with Section 02713 - Water Mains.

.2 Leakage test sewage forcemains in accordance with Section 02724 - Sewage Forcemains.

.3 Field test sanitary sewers for infiltration and exfiltration in accordance with Section 02702 - Sewer Mains.

.4 After completion of repair work, redo leakage, infiltration and exfiltration tests.

.5 Electric heat tracing to be tested in accordance with cable suppliers instructions.

.6 Protect piping from freezing if testing at temperatures lower than 0 ^{o}C.

3.10 BASIS OF PAYMENT

.1 All costs associated with work specified in this Section shall be deemed to be included in the appropriate unit and lump sum prices quoted in the Schedule of Quantities and Prices in accordance with clause 1.1 above.

.2 Payment will be made to the maximum of 90% of the value of watermains, sewermains, forcemains, hydrants, valves, fittings and appurtenances until the system, or sections of the system if payment approved by the Engineer, has passed all specified tests. The 10% retained shall be the specified testing allowances.

Work under this section includes the drilling, development and pump testing of drilled wells to a depth authorized by the Engineer in accordance with the Well Drilling Regulations under the Water Resources Act.

PART 1 - GENERAL

1.1 REPORTS

.1 On completion of work, submit to Engineer a report containing documents in accordance with the Well Drilling Regulations. These will generally include, but not be limited to:
- .1 Well maintenance instructions
- .2 Log of well drilling
- .3 As-built drawing of well including:
  - .1 Elevations
  - .2 Size and length of each casing section installed
  - .3 Grouting details
  - .4 Description of screen
  - .5 Gravel packing details
- .4 Final pumping test results.
- .5 Results of chemical and bacteriological tests on water samples.
- .6 Recommendations on water treatment or tests required to determine treatment necessary.
- .7 Type and size of permanent well pump recommended.

1.2 MEASUREMENT FOR PAYMENT

.1 Drilling in unconsolidated and consolidated formations will be measured in metres of each size hole drilled.

.2 Supply and installation of casing will be measured in metres of each type and size of casing permanently installed.

.3 Supply and installation of screen will be lump sum if size listed in Schedule of Quantities or to be negotiated after screen selection if size not specified.

.4 Gravel packing will be measured in kilograms of gravel installed in well.

.5 Grouting will be measured as number of 40 kg bags of Portland cement used in grouting.

.6 Well development will be measured in hours during which contractor is actually engaged in well development.

.7 Disinfection of well will be lump sum.

.8 Test pumping will be measured in hours during which pump is in operation to successfully complete a test.

.9 Well seals and caps by the number of each size supplied and installed.

.10 Water quality testing will be lump sum.

PART 2 - PRODUCTS

2.1 PERMANENT WELL CASING

.1 Use new material only.

.2 Casing to A.W.W.A. A100. 150 mm diameter casing unless otherwise specified in the Schedule of Quantities and Prices, internal diameter 150 mm and wall thickness 9 mm.

.3 Use pipe fittings of same standard as pipe casing.

.4 Joints shall be welded or threaded couplings as shown on drawings.

.5 A Drive Shoe shall be welded to the bottom of the well casing.

2.2 SCREEN

.1 To Engineer's approval after analysis of the aquifer.

.2 Pipe size well screen to following requirements:

.1 Material; Stainless steel ASTM B124-81, Alloy 7.
.2 Type; as indicated on drawings or as directed by Engineer.
.3 Openings; as indicated or directed by Engineer and free of jagged edges or other irregularity.

.3 The screen shall be provided with such fittings as are necessary to seal tightly the top to the casing and to close the bottom. If the screen is installed inside the casing, figure K packer seal shall be used as the top which shall be so located that there is a 12 inch overlap of the well casing and screen. If the screen is attached to the casing, a suitable coupling shall be provided, or the screen shall be welded to the casing. All fittings, except plugs and seals, but including couplings, where required for joining sections of the screen, shall be constructed of the same material as the screen sections of casing over 5 ft. in length used to connect sections of screen shall not be considered as fittings.

.4 The screen shall have adequate strength to resist external forces applied to it after installation and to minimize the likelihood of damage during installation. The screen must have no change of alignment at any joint after installation. If required by the engineer, the contractor shall submit for approval drawings and other information showing the design and method of construction of the screen.

2.3 WELL SEAL

The well shall be sealed with a vermin proof sanitary seal sized to fit the well casing with a 32 mm hole or a well cap sized to fit the casing as directed by the engineer.

PART 3 - EXECUTION

3.1 DRILLING

.1 Notify the engineer 48 hours before commencement of drilling.

.2 Use drilling equipment and methods approved by Engineer.

.3 Drill in locations and to depths indicated or directed. Drill holes round, plumb and true to line. Dispose of drill cuttings as directed. Ensure drilling methods do not impair production for aquifers encountered.

.4 Prevent foreign matter from entering bore hole and prevent contaminated water or other objectionable fluids from reaching aquifer through bore hole.

.5 Take measures as necessary to prevent tampering with bore hole and to eliminate dangerous conditions for persons or animals in area.

.6 Maintain log of all bore holes including following information:

.1 Depth of changes in formation.
.2 Description of formations encountered.
.3 Elevations at which aquifers are encountered, sudden changes in water level, loss of drilling mud or other indications of permeable strata.

.7 In unconsolidated formations, obtain duplicate soil samples from each 3 m of depth drilled and at least one set of duplicate samples from each formation encountered. Submit samples to Engineer with identification data on drill hole and depth.

.8 In consolidated formation, obtain one rock sample from each 6 m of depth drilled.

.9 Conduct pumping tests and obtain water samples as directed. Be prepared to shut off and seal a hole should flowing artesian water or gas be encountered.

.10 Seal abandoned holes in accordance with 02729.3.10.

.11 At no cost to Engineer, redrill holes lost due to caving or abandoned due to loss of drilling equipment.

3.2 SCREEN INSTALLATION

.1 When aquifer material has been sampled and analyzed, Engineer will advise on type and size of screen required.

.2 Install screen by approved methods and to manufacturers recommendations.

3.3 PERMANENT CASING INSTALLATION

.1 Clean casing pipe and fittings prior to installation.

.2 Install permanent well casing to sizes and depths as indicated or directed.

.3 Center casing by use of centering brackets spaced not more than 15 m apart and install so that variance from vertical does not exceed two thirds internal diameter of casing per 30 m of depth.

.4 Prove alignment by lowering into casing a straight section of pipe 12 m long with outside diameter not more than 12 mm smaller than internal diameter of casing being tested. If plumb fails to move freely through casing to lowest anticipated pumping level, correct alignment to satisfaction of and at no cost to Engineer.

.5 After grouting is completed, cut off casing squarely and neatly 450 mm above ground level and cover with screwed or flanged cap satisfactory to Engineer.

.6 Maintain accurate records of casing lengths and sizes installed.

3.4 GRAVEL PACKING

.1 Gravel used for gravel packing shall be clean, rounded, water washed quartz or granite gravel free of silt, clay, and other deleterious materials. Gradation will be decided by Engineer after analysis of aquifer samples.

.2 Place gravel packing by approved methods to details indicated or as directed

3.5 GROUTING

.1 Grout shall be a mixture of type 10 Portland cement to CAN3-A5-M88 with 3% by volume bentonite clay added and not more than 880 l of water per cubic metre of cement.

.2 Grout annular space around casing to details indicated or as directed.

.3 Place grout from bottom up by approved methods. Place grout in one continuous operation with entire amount placed before initial set occurs.

.4 Use retainer, packer or plug at bottom as necessary to ensure grout does not leak into wall.

.5 When further drilling is required after grouting, do not drill until 72 h after complete placement of grout.

3.6 DISINFECTION

.1 Thoroughly clean the well to remove foreign substances, including tools, timbers, rope, cement, oil, grease, joint dope and scum. Thoroughly swab casing pipe using alkalis if necessary to remove oil, grease or joint dope.

.2 Disinfect well in accordance with AWWA standard C654, Disinfection of Wells.

.3 During final test pumping, obtain two samples of water for bacteriological analysis and a sample for chemical analysis one-half hour after start of test pumping and again during last 15 min of test pumping. Total of 6 samples. Submit samples to Engineer designated laboratory.

3.7 TEST PUMPING

.1 Test pumping equipment requirements:

- .1 Pump with variable pumping rate up to capacity as indicated or directed and capable of operating a minimum of 54 hours or more without interruption. Equipped with tachometer to measure pump motor speed.
- .2 Discharge piping of sufficient size and length to conduct water being pumped during test to an approved point of discharge where it will not recharge aquifer, damage property or create nuisance and equipped with valve close to pump.
- .3 Apparatus to measure rate of pump discharge shall be an orifice plate with transparent tube to measure water head upstream of plate, or a suitable water meter.
- .4 Apparatus to measure pumping level shall be an electric sounder (or calibrated air line).

.2 Conduct interim test pumping during construction as directed by Engineer.

.3 Final test pumping shall be as follows:

- .1 Pumping rate as directed.
- .2 Testing time of 72 hours or as directed.
- .3 After pumping commences record water level in well at following intervals: every minute for first 10 min, every 2 min for next 10 min, every 5 min for next 40 min, every 10 min for next 1 hour, every 30 min for next 3 hours, every hour for next 5 hours and every 2 h to end of test.
- .4 After test pumping has ceased, record water level at same time intervals as in 3.7.3.3 until static water level is reached.
- .5 Take temperature of water discharged from well during test pumping at intervals of 1 hour.

.4 When test pumping is to be conducted after disinfection, swab with strong chlorine solution all parts of test pump coming into contact with well water prior to start of test pumping.

.5 Should test pump fail during pump test, allow water to reach static level prior to recommencing test. No payment will be made for pump time prior to such failure.

.6 Do not allow pumping level to fall below an elevation 2 m above top of well screen.

3.8 WELL DEVELOPMENT

The contractor shall furnish all necessary pumps, compressors, plungers, bailing or other needed equipment that shall be necessary to effectively extract from the water bearing formation the maximum practical quantity of sand, drilling mud and other fine materials in order to bring the well to maximum yield per foot of drawdown and to a sand-free condition. Compressed air, surge plungers, high velocity jetting equipment and pumps may be used for the development work. This work must be done in a manner that does not cause undue settlement and disturbance of the strata above the water-bearing formation nor disturb the natural seal effected around the well casing and thereby reduce the sanitary protection otherwise effected by such seal.

Development of the well shall be continued until water pumped from the well at the maximum test pumping rate is clear and free of sand. The water shall be considered sand-free when no samples, taken during test pumping, contain more than 5 parts per million of sand by weight.

.1 Pumping or Bailing Method

Development process shall be carried out by surging and bailing the well. The surging shall be done by a single or double solid (or valved) surge block. Surging shall start at the bottom of the lowest screen in the well and proceed upwards.

.2 Hydraulic Jetting Method

Development shall be accomplished by simultaneous high-velocity, horizontal-jetting and pumping. The outside diameter of the jetting tool shall be one inch less in diameter than the screen inside diameter. The minimum exit velocity of the jetting fluid at the jet nozzle shall be 150 feet/second. The tool shall be rotated at a speed less than 1 rpm. It shall be positioned at one level for not less than two minutes and then shall be moved to the next level which shall be no more than 6 inches vertically from the preceding jetting level.

The jetting shall proceed form the bottom of the screen to the top. Pumping from the well shall be at a rate of 5 to 15 per cent more than the rate at which water is introduced through the jetting tool. Water to be used for jetting must contain less than 1 ppm suspended solids.

.3 Air Development Method

Development shall be done by the utilization of single pipe air pumping system using the casing or the borehole itself as the eductor line. The compressors, air lines, hoses, fittings, etc., shall be of adequate size to pump the well by the air lift principle at 1½ to 2 times the design capacity of the well. The Contractor shall initially pump the well with air until the well is developed to the point that it yields clear, sand-free water. He shall then shut off the air and allow water in the well to return to a static condition. He shall then re-open the valve and re-introduce air into the well until water is again brought to the surface by the air lift, at which time he will close the air valve and allow the water to drop back down the well and return to a static condition. He shall repeat this lifting and dropping of the column of water until the water in the well becomes turbid at which time he will continuously pump the well with air until it again yields clear sand-free water. The Contractor shall repeat the above operations until the well no longer produces fine material when it is surged and backwashed as described above.

The bottom of the air line shall be placed at different levels in order to facilitate development of all intake areas and multiple water-producing zones, and the process repeated until all zones yield water free of turbidity when surged and backwashed.

.4 Sand Content Testing

The sand content shall be determined by averaging the results of five (5) samples collected at the following times during the intermediate pumping test:

(a) 15 minutes after start of the test,
(b) after ¼ of the total planned test time has elapsed,
(c) after ½ of the total planned test time has elapsed,
(d) after ¾ of the total planned test time has elapsed,
(e) near the end of the pumping test.

The minimum volume of water sample collected for testing for sand content shall be the test rate of flow in gpm multiplied by 0.05.

Sand content shall be determined in the following manner. When the circular orifice meter is used to measure flow rate, the sample shall be withdrawn from a measuring flow rate. On wells of a lower production rate, a sample may be collected directly from the full and open discharge. The sample shall be allowed to settle not less than 10 minutes before the liquid is decanted. The sand content as determined above shall not be greater than 5 ppm.

.5 Record of Measurement

A record shall be made showing time, type of operation, pumping rate, and the sand content measured and recorded. These records shall be submitted to the Owner or his representative.

3.9 AQUIFER TEST

.1 Aquifer Test shall be as recommended in the Guidelines for Aquifer Pumping Tests, item 3.3, published by the Department of Environment.

.2 Perform bacteriological and chemical water quality testing as required in the Guidelines for Aquifer Pumping Tests published by the Department of Environment.

3.10 SEALING WELLS

Seal abandoned wells in accordance with the "Guidelines For Sealing Groundwater Wells" as published by the Department of Environment and Labour.

3.11 BASIS FOR PAYMENT

.1 All costs associated with the work specified in this section shall be deemed to be included in the appropriate unit and lump sum prices quoted in the Schedule of Quantities and Prices.

This section covers the requirements for the supply and installation of chain link security fence and gates.

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

.1 Install chain link fence in accordance with CAN2-138.3-M80 unless otherwise specified.

1.2 MEASUREMENT FOR PAYMENT

.1 Supply and erection of chain link fence will be measured in metres installed and shall include the length of brace panels. Gate openings shall not be measured.

.2 Supply and erection of chain link fence gates will be measured as units, regardless of the size and type of gate erected.

.3 End, Corner, Gate and Straining Posts will not be measured but considered incidental to the work.

.4 The cost to repair any damage to the zinc coating shall be deemed to be included in the contract price of the appropriate tender item listed above.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Concrete:

.1 To Section 03300 CAN 3-A23.1-M90.
.2 Concrete mix design to produce 30 MPa a minimum compressive strength at 28 days containing 20 mm maximum size coarse aggregate with water/cement ratio and Air Category to CAN3-A23.1M90, Table 8 for Class "C2" exposure and 60 mm slump at time and point of deposit. Air entrainment to CAN3-A23.1-M90 Table 10.

.2 Chain-link fence fabric: to CAN2-138.1-M80.

.1 Type 1, Class A, medium style.
.2 Height of wire: as indicated.
.3 Steel wire fabric shall conform to the requirements of ASTM designation A392-81.
.4 The fabric shall be 1829 mm wide with a uniform 50 mm diamond pattern chain link mesh closed at one edge by knuckling and at the other edge by twisting to form a barb. The wire shall be 3.5 mm diameter.

.3 Posts and rails: to CAN2-138.2-M80+Amdt-June-82, galvanized steel pipe, Schedule 40. All posts shall be fitted with waterproof caps so designed as to fit and fasten securely over the posts and carry the top rail.

.4 Bottom tension wire: single strand, galvanized, steel wire, 5 mm diameter as indicated.

.5 Tie wire fasteners: single strand, galvanized steel wire conforming to requirements of fence fabric, 5 mm diameter.

.6 Tension bar: 5 x 20 mm minimum galvanized steel.

.7 Tension bar bands: 3 x 20 mm minimum galvanized steel or 5 x 20 mm minimum aluminum.

.8 Gates: to CAN 2-138.4-M82. Gates shall be in sizes defined as the distance between the inside faces of the gate posts.

.9 The fabric and other components used on gates shall match those of the fence and shall be subject to the same quality requirements.

.10 Gate frames: to ASTM A120-82, galvanized steel pipe, standard weight 42.9 mm O.D. pipe for outside frame, 31.8 mm O.D. pipe for interior bracing.

.1 Fabricate gates as indicated with electrically welded joints, and hot-dip galvanized or painted with zinc pigmented paint with welding.
.2 Fasten fence fabric to gate with twisted selvage at top.
.3 Furnish gates with galvanized malleable iron hinges, latch and latch catch with provision for padlock which can be attached and operated form either side of installed gate.
.4 Furnish double gates with chain hook to hold gates open and center rest with drop bolt for closed position.

.11 Fittings and hardware: cast aluminum alloy, galvanized steel or malleable or ductile cast iron. Post caps to provide waterproof fit, to fasten securely over posts and to carry rail. Overhang tops to provide waterproof fit, to hold top rails and an outward project to hold barbed wire overhang (when indicated on drawings). Provide project with clips or recesses to hold 3 strands of barbed wire spaced 100 mm apart. Project of approximately 300 mm long to project from fence at 45 deg above horizontal. Turnbuckles to be drop forged.

.12 Zinc pigmented paint: to CGSB 1-GP-178Ma.

.13 Barbed wire: 2 mm diameter galvanized steel wire to ASTM A121-81 4 point barbs 125 mm spacing.

2.2 FINISHES

.1 Galvanizing:

.1 For chain link fabric: 490 g/m^2 minimum to CAN2-138.1-M80.
.2 For pipe: 550 g/m^2 minimum to ASTM A90-81.
.3 For barbed wire: to ASTM A121-81 Class 2.
.4 For other fittings: to CSA G164-M1981.

.2 Aluminum coating:

.1 For barbed wire: to ASTM A585-81 Class 2.

.3 Vinyl coating:

.11.8 mil dry film thickness minimum.

PART 3 - EXECUTION

3.1 GRADING

.1 Remove debris and correct ground undulations along fence line to obtain smooth uniform gradient between posts. Provide clearance between bottom of fence and ground surface neither less than 30 mm nor more than 50 mm.

3.2 ERECTION OF FENCE

.1 Erect fence along lines indicated or as directed, and in accordance with CAN 2-138.3-M80.

.2 Excavate post holes to dimensions indicated on contract drawings. Bulb bottom of holes for corner, end and gate posts and for intermediate posts at every 60 m along fence line.

.3 Space line posts 3 m apart, measured parallel to ground surface.

.4 Space straining posts at equal intervals not exceeding 150 m if distance is greater than 150 m between end or corner posts on straight continuous lengths of fence over reasonably smooth grade.

.5 Install additional straining posts at sharp changes in grade and where directed.

.6 Install corner post where change in alignment exceeds 10 deg.

.7 Install end posts at end of fence and at buildings. Install gate posts on both sides of gate openings.

.8 Place concrete in post holes then embed posts into concrete to depths indicated. Extend concrete 50 mm above ground level and slope to drain away from posts. Brace to hold posts in plumb position and true to alignment and elevation until concrete has set.

.9 Do not install fence fabric until concrete has cured a minimum of 5 days.

.10 Install brace between end and gate posts and nearest line post, placed in center of panel and parallel to ground surface. Install braces on both sides of corner and straining posts in similar manner.

.11 Install overhang tops and caps.

.12 Install top rail between posts and fasten securely to terminal posts and secure waterproof caps and overhang tops.

.13 Install bottom tension wire, stretch tightly and fasten securely to end, corner, gate and straining posts with turnbuckles and tension bar bands.

.14 Lay out fence fabric. Stretch tightly to tension recommended by manufacturer and fasten to end, corner, gate and straining posts with tension bar secured to post with tension bar bands spaced at 300 mm intervals. Knuckled selvedge at bottom. Twisted selvedge at top.

.15 Secure fabric to top rails, line posts and bottom tension wire with tie wires at 450 mm intervals. Give tie wires minimum two twists.

.16 Install barbed wire strands and clip securely to lugs of each bracket.

3.3 INSTALLATION OF GATES

.1 Install gates in locations indicated or where directed.

.2 Set gate bottom approximately 40 mm above ground surface.

.3 Determine position of center gate rest for double gate. Cast gate rest in concrete. Dome concrete above ground level to shed water.

.4 Install gate stops where indicated.

3.4 TOUCH UP

.1 Repair damaged galvanized surfaces. Clean damaged surfaces with wire brush removing loose and cracked coatings. Apply two coats of approved zinc pigmented paint to damaged areas.

3.5 CLEANING

.1 Clean and trim areas disturbed by operations. Dispose of surplus excavated material and replace damaged sod as directed.

3.6 BASIS FOR PAYMENT

.1 All costs associated with the work specified in this section shall be deemed to be included in the appropriate unit and lump sum prices quoted in the Schedule of Quantities and Prices.

This section covers the requirements for the supply and installation of farm wire fences, posts and gates.

PART 1 - GENERAL

1.1 MEASUREMENT FOR PAYMENT

.1 Supply and erection of wire fence will be measured in metres installed.

.2 Supply and erection of wire gates will be measured in units of each regardless of variance in size of gates.

PARTE 2 - PRODUCTS

2.1 MATERIALS

.1 Wire fence:

- .1 Farm-field type: Bel-Air Ltd style 948, class III or approved equal.
- .2 Barbed wire: to ASTM A121-81.
  - .1 Galvanized steel.
  - .2 Wire size; 2 mm diameter.
  - .3 Barbs; 4 point at 125 mm spacing.

.2 Gates:

- .1 Frame: to ASTM A120-82, galvanized steel pipe, standard weight, 25 mm O.D.
- .2 Size: as indicated.
- .3 Joints: electrically welded.

.3 Wood components: pressure-treated wood unless indicated otherwise.

.4 Wood posts:

- .1 Sound, straight, round or square sawn square at bottom and at 45 deg at top as indicated.
- .2 Intermediate posts: 2.5 m long and 100 mm x 100 mm.
- .3 Corner, end, gate and anchor posts to be 2,.7 m long and minimum 150 mm x 150 mm.
- .4 Posts to be treated in accordance with CSA 080-M1983.
- .5 Cleats for anchoring corner, gate, end and anchor posts: 38 x 140 x 910 mm.
- .6 Braces for end, corner and gate posts: 89 x 89 mm x 3 m long.

.5 Steel posts:

- .1 Corner, end, ate and intermediate posts, projection arm with clips, corner and gate post braces, gate posts as indicated.
- .2 Galvanizing: zinc coating not less than 92 g/m2 of surface area.
- .3 Paint: to CGSB-1-GP-69M, CGSB-1-GP-48M
- .4 Concrete: to Section 03300 CAN3-A23.1-M90.
- .5 Concrete mix design to produce 30 MP a minimum compressive strength at 28 days and containing 20 mm maximum size coarse aggregate with water/cement ratio and Air Category to CAN3-A23.1M90, Table 8 for Class "C2" exposure and 80 mm slump at time and point of deposit. Air Entrainment to CAN3-A23.1-M90, Table 10.

.6 Ground rod: 16 mm diameter copperweld rod 3 m in length.

PART 3 - EXECUTION

3.1 GRADING

.1 Level contours of ground along fence line in order that bottom wire of fence between post can be maintained at not more than 150 mm above ground.

3.2 ERECTION OF FENCE

.1 Erect fence along lines indicated or as directed by Engineer.

.2 Excavate post holes to dimensions indicated.

.3 Installation of posts:

- .1 Space intermediate posts at 2.5 m unless otherwise directed.
- .2 Space corner, end and gate posts 2.5 m from adjacent post.
- .3 Locate and erect gate posts as indicated.
- .4 Install posts true to line and plumb with 1.5 m of post projecting above ground.

.4 Fencing with wood posts:

- .1 Slant of post tops to be perpendicular to fence line and facing outward.
- .2 Install cleats for anchoring at corner, gate, end and anchor posts as indicated.
- .3 Backfill around posts and compact to same density as surrounding ground. Dispose of surplus excavated material as directed by Engineer.
- .4 Install braces at end, corner and gate posts as indicated. Join braces into posts and spike securely.
- .5 Erect wires and stretch to have uniform tension. Splice wires with standard wire splices.
- .6 Attach top wires to posts with minimum two stapes. Fasten other wires to posts and cross braces with at least one staple. Staple wires securely at end, anchor and gate posts.
- .7 Stretch two stands of barbed wire along tops of posts and double staple on posts.

.5 Fencing with steel posts:

- .1 "Bulb" bottom part of holes when excavating holes for corner, end and gates posts. "Bulb" holes also for intermediate posts every 60 m along fence line.
- .2 Space intermediate posts at 3 m and corner, end and gate posts at 3 m from adjacent post.
- .3 Install posts true to line and plumb with a minimum of 1.5 m of post projecting above ground.
- .4 Set following posts in concrete:
  - .1 End, corner and gate posts.
  - .2 Intermediate posts adjacent to end, corner and gate posts.
  - .3 Intermediate posts every 60 m along fence line.
  - .4 Ends of braces for corner, end and gate posts.
- .5 Drive line posts into ground.
- .6 Concrete: in accordance with Section 03300.
- .7 Brace corner, end and gate posts as specified.
- .8 Clamp a studded steel projection arm to each post as specified.
- .9 Erect woven and barbed wire as specified.

.10 Stretch wires to have uniform tension. Splice wires with standard wire splices.
.11 Attach wires to posts and projection arms with approved metal clips.
.12 Paint post, braces and projection arms with coating adequate to protect against rust.

3.3 INSTALLATION OF GATES

.1 Install gates in locations indicated or where directed by Engineer.

.2 Install gates on previously erected posts, n a manner to prevent over-stress on gate posts when gates are open. Install with ground clearance of 100 mm.

.3 Determine location of anchor pipe for drop bolt and drive pipe flush with road surface.

3.4 GROUNDING

.1 Install grounding rods as indicated or as directed by Engineer.

3.5 CLEANING

.1 Clean and trim areas disturbed by operations. Dispose of surplus excavated material.

3.6 TOUCH UP

.1 Repair damaged galvanized surfaces. Clean damaged surfaces with wire brush removing loose and cracked coatings. Apply two coats of approved pigmented paint to damaged areas.

3.7 BASIS FOR PAYMENT

.1 All coats associated with the work specified in this section shall be deemed to be included in the appropriate unit and lump sum prices quoted in the Schedule of Quantities and Prices.

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This section specifies requirements for supply and installation of synthetic filter fabric (Geotextiles) to be used for separation membranes, reinforcing membranes and hydraulic filters.

PART 1 - GENERAL

1.1 APPROVAL

.1 Obtain written approval of Engineer for filter fabric before installation of material in work.

1.2 SHIPPING AND STORAGE

.1 The geotextile shall be protected at all times against exposure from the sun, and contamination from dirt, dust, and any other deleterious materials until it is used. The bales or rolls of geotextile shall be wrapped in a protective covering. The material shall be protected from temperatures higher than $60^{o}C$.

1.3 MEASUREMENT FOR PAYMENT

.1 Filter fabric will be measured in square metres of material incorporated into work.

.1 Payment at the contract price shall be full compensation for all labour, equipment, and materials necessary to supply and install the geotextile to locations specified in the contract documents.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Synthetic fibre: rot proof, unaffected by action of oil or salt water and not subject to attack by insects or rodents.

.2 Geotextiles meeting the requirements of Class I are suitable for application where the main stresses imposed on the geotextile are a result of hydrostatic pressures. Geotextiles that meet the requirements of Class II are suitable, where the stresses governing the design are the result of earth pressures.

.3 When the Contract specifies a particular thickness, the geotextile shall be evaluated using the standard test procedure in CAN2-4.2 Method 5.A. Alternatively the standard test procedure in ASTM Standard D-1777 may be used.

.4 When the Contract specifies a particular mass, the geotextile shall be evaluated using the standard test procedure in CAN2-4.2 Method 37. Alternatively the standard test procedure in Option C of ASTM Standard D-3776 may be used.

.5 When fabric sections are factory joined, seam strength shall not be less than 90% of the tensile strength of the unaged geotextile in any principal direction.

.6 Seams of the geotextile shall be sewn with thread of a material having the same chemical requirements, or shall be bonded by cementing or by heating.

.7 The plastic fibre or yarn shall be composed of at least 85% by mass of polypropylene, polyethylene, polyester, polyamide, or other synthetic polymers, and shall contain stabilizers or inhibitors added to the base plastic, if necessary, to make the filaments resistant to deterioration by ultra-violet and heat exposure. Filtration geotextiles shall be fixed so that the fibres or yarns will retain their respective position with respect to each other. The edge of the geotextile shall be finished to prevent the outer yarn from pulling away from the geotextile.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Place material by unrolling on to graded surface and retain in position with securing pins or fine sand.

.2 Protect fabric from displacement or damage until and during placement of overlaid material layers.

.3 Place fabric on sloping surfaces in one continuous length from toe of slope to upper extent of fabric.

.4 Overlap each successive strip of fabric 600 mm over previously laid strip.

.5 Remove and replace fabric damaged or deteriorated as directed by Engineer.

.6 Do not permit passage of any vehicle directly on filter fabric at any time.

3.6 BASIS FOR PAYMENT

.1 All costs associated with the work specified in this section shall be deemed to be included in the appropriate unit and lump sum prices quoted in the Schedule of Quantities and Prices.

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

.1 Do concrete formwork in accordance with ACI-347-78, CSA S269.3-92 and CAN3-A23.1-M90, except where specified otherwise.

.2 Do falsework in accordance with CSA S269.1-1975, except where specified otherwise.

1.2 MEASUREMENT FOR PAYMENT

.1 No measurement will be made under this Section. Include costs in items of work for which Concrete Formwork and Falsework is required.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Formwork lumber: plywood and wood formwork materials to CAN3-A23.1-M90.

.2 Falsework materials: to CSA S269.1-1975.

.3 Form release agent: chemically active release agents containing compounds that react with free lime present in concrete to provide water insoluble soaps, preventing concrete from sticking to forms.

.4 Form stripping agent: colourless mineral oil, free of kerosene, with viscosity between 15 to 24 mm/s at 40^{o}C, flash point minimum 150^{o}C, open cup.

.5 Pan forms: as indicated.

.6 Tubular column forms: round spirally wound laminated fibre forms, internally treated with release material. Spiral of form must now show in hardened concrete.

.7 Form ties: removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm diameter in concrete surface. All such devices shall be so arranged that when the forms are removed no permanently embedded tie metal shall be less than 15 mm from the form face.

.8 Form liner:

.1 Plywood: Douglas Fir to CSA 0121-M1978 Poplar to CSA 0153-M1980.

PART 3 - EXECUTION

3.1 ERECTION

.1 Verify lines, levels and column centres before proceeding with formwork and ensure dimensions agree with drawings. Construct forms to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerance required by CAN3-A23.1-M90, ACI 347-78. Line forms for following surfaces with material only as approved by Engineer:

.1 Outer face of outside girders beams and vertical edge of bridge sidewalk slab.

.2 Soffit of girders and underside of bridge decks if exposed.

.3 Exposed faces of abutments, wing walls, piers and pylons. Do not stagger joints of form lining material. Align joints to obtain a uniform pattern.

.2 Slip forming may be approved by Engineer subject to evaluation of procedures and mechanical equipment proposed for use.

.3 Construct falsework in accordance with CSA S269.1-1975. Obtain Engineer's permission before framing openings not indicated in concrete joists, beams or columns.

.4 Obtain Engineer's approval for use of earth forms. Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.

.5 Align form joints and make watertight. Keep form joints to minimum. Locate horizontal form joints for exposed columns 2400 mm above finished floor elevation. Set 25 mm chamfer strips on external corners of beams, joints and columns. Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.

.6 Clean formwork in accordance with CAN3-A23.1-M90.

.7 Leave formwork in place for following minimum periods of time after placing concrete.

.1 7 days for walls and side of beams.
.2 14 days for columns
.3 14 days for beam soffits, slabs, decks and other structural members.
.4 4 days for footings and abutments.

3.2 BASIS FOR PAYMENT

.1 All costs associated with the work specified in this section shall be deemed to be included in the appropriate unit and lump sum prices for Cast-In-Place Concrete quoted in Schedule of Quantities and Prices.

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

.1 Do reinforcing work in accordance with CAN3-A23.1-M90, ACI-315-1974, CAN3-S6-M88, CAN3-S6S1-1990 and welding of reinforcing with CSA W186-M1990, except where specified otherwise.

1.2 MEASUREMENT FOR PAYMENT

.1 No measurement will be made under this section. Include costs in items of concrete work for which reinforcement is required.

1.3 SUBSTITUTES

.1 Substitution of different size bars permitted only upon written approval of Engineer.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Reinforcing steel: billet steel, deformed bars to CSA G30.18-M92 unless indicated otherwise.

.2 Cold-drawn annealed steel wire ties: to CSA G30.3-M1983, (R1991). Deformed steel wire for concrete reinforcement: to CSA G30.14-M1983, (R1991).

.3 Welded steel wire fabric: to CSA G30.5-M1983, (R1991). Furnish in flat sheets for wire with cross-section area of 21 mm^2 or greater.

.4 Galvanizing of non-prestressed reinforcement: to CSA G164-M92.

.5 Chairs, bolsters, bar supports, spacers: to CAN3-A23.1-M90.

.6 Mechanical splices: subject to the approval of the Engineer.

2.2 FABRICATION

.1 Fabricate reinforcing in accordance with CAN3-A23.1-M90 and to the following tolerances:

- .1 Sheared length: plus or minus 25 mm.
- .2 Stirrups, ties and spirals: plus or minus 12 mm.
- .3 Other bends: plus or minus 25 mm.

.2 Obtain Engineer's approval for locations of reinforcement splices other than shown on steel placing drawings.

.3 Fabricate steel bar or rod mats together in accordance with CSA G30.5-M1983, (R1991) using bars to CSA G30.18-M92.

.4 Ship bundles of bar reinforcement, clearly identified in accordance with bar list.

PART 3 - EXECUTION

3.1 FIELD BENDING

.1 Do not field bend reinforcement except where indicated or authorized by Engineer. When field bending is authorized, bend without heat, applying a slow and steady pressure.

.2 Replace bars which develop cracks or splits.

3.2 PLACING REINFORCEMENT

.1 Place reinforcing steel as indicated on approved shop drawings and in accordance with CAN3-A23.1-M90. Tie reinforcing where spacing in each direction is:

.1 Less than 300 mm: Tie at alternate intersection.
.2 300 mm or more: Tie at each intersection.

.2 Paint portion of dowel intended to move within hardened concrete with one coat of lead or asphalt paint. When paint is dry, apply a thick even film of mineral lubricating grease.

.3 Obtain Engineer's approval of reinforcing steel and position before placing concrete.

3.3 BASIS FOR PAYMENT

.1 All costs associated with the work specified in this section shall be deemed to be included in the appropriate unit and lump sum prices quoted in the Schedule of Quantities and Prices.

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

.1 Do cast-in-place concrete work in accordance with CAN3-A23.1-M90, and testing in accordance with CAN3-A23.2-M90, except where specified otherwise.

.2 Production facilities supplying ready mixed concrete shall be certified by the Atlantic Provinces Ready Mixed Concrete Association.

1.2 MEASUREMENT FOR PAYMENT

.1 Cast-in-place concrete will be measured in cubic metres calculated from dimensions specified or authorized in writing by Engineer. Concrete placed beyond dimensions specified will not be measured.

.2 No deductions will be made for volume of concrete displaced by reinforcing steel, structural steel, or piles.

.3 No deductions will be made for volume of concrete less than 0.1 m^3 in volume displaced by individual drainage openings.

.4 Cast-in-place concrete in structures where specified in the Schedule of Quantities and Prices will not be measured but be paid for as a fixed price item for that structure.

.5 Heating of water and aggregates and providing cold weather protection will not be measured by considered incidental to work.

.6 Supply and installation of anchor bolts and bolt grouting, anchor bolt washers and nuts will not be measured by considered incidental to work.

.7 Supply and installation of water stops will be considered incidental to the work unless specified otherwise.

.8 Reinforcing steel rebar, fibreglass reinforcing and mats will not be measured and considered incidental to the work, unless otherwise specified.

.9 Concrete for pipe bedding, encasement of pies, supports, cut off walls and thrust blocks will be measured in cubic metres within measurement limits specified.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Portland cement: to CAN3-A5-M88.

.2 Cementitious hydraulic slag: to CSA A363-M88.

.3 Blended hydraulic cement: to CAN3-A362-M88.

.4 Water: to CAN3-A23.1-M90.

.5 Aggregates: to CAN3-A23.1-M90. Coarse aggregates to be normal density.

.6 Low density aggregate for insulating concrete: to CAN3-A23.1-M90 and ASTM C332-82 group I or group II.

.7 Air entraining admixture: to CAN3-A266.1-M78.

.8 Chemical admixtures: to CAN3-A266.2-M78 water reducing type WN. Engineer to approve accelerating or set retarding admixtures during cold and hot weather placing.

.9 Superplasticing admixtures: to CAN3-A266.6-M85.

.10 Non-shrink grout: premixed compound consisting of metallic or non-metallic aggregate as specified, Portland cement, water reducing and plasticizing agents, of pouring consistency, capable of developing compressive strength as specified.

.11 Dry pack: premixed or non premixed composition of non metallic aggregate Portland cement with sufficient water for the mixture to retain its shape when made into a ball by hand and capable of developing compression strength as specified.

.12 Post-Tensioning ducts: to CAN3-A23.1-M90.

.13 Curing compound: to CAN3-A23.1-M90.

.14 Ribbed water stops: extruded PVC of sizes indicated with shop welded corner and intersecting pieces with legs not less than 500 mm long.

.1 Tensile strength: to ASTM D412-80 Die "C" method, minimum 11.4 MPa.
.2 Elongation: to ASTM D412-80, Die "C" method, minimum 275%.
.3 Tear resistance: to ASTM D624-81, Die "B" method, minimum 48 kN/m.

.15 Labyrinth water stops: extruded PVC indicated corner and intersecting pieces with legs not less than 500 mm long:

.1 Tensile strength: to ASTM D412-80, Die "C" method, minimum 8.3 MPa.
.2 Elongation: to ASTM D412-80, Die "C" method, minimum 250%.
.3 Tear resistance: to ASTM D624-81, Die "B" method, minimum 30 kN/m.

.16 Pre-moulded joint fillers:

.1 Bituminous impregnated fibre board: to ASTM D1751-73 (1978).
.2 Sponge rubber: to ASTM D1752-67 (1978), Type I.

.17 Weep hole tubes: purpose made plastic.

.18 Dovetail anchor slots: minimum 0.6 mm thick galvanized steel with insulation filled slots.

.19 Damp proof membrane:

.1 Kraft/polyethylene membrane:

.1 Lamination polyethylene film asphalt bonded both sides to 2.44 kg/m^2 asphalt treated kraft.

.20 Reinforcement: 13 x 13 mm glass fibre cross directional scrim embedded in asphalt laminate.

.21 Membrane adhesive: as recommended by membrane manufacturer.

.22 Emulsified asphalt, mineral colloid type, unfilled: to CGSB 37-GP-2M.

.23 Polyethylene film: to CGSB 51-GP-51M and to thickness specified.

PART 3 - EXECUTION

3.1 WORKMANSHIP

.1 Obtain Engineer's approval before placing concrete. Give 24 hours notice prior to placing of concrete.

.2 Pumping of concrete is permitted only after approval of equipment and mix.

.3 Ensure reinforcement and inserts are not disturbed during concrete placement.

.4 Prior to placing of concrete obtain Engineer's approval of proposed method for protection of concrete during placing and curing in adverse weather.

.5 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.

.6 In locations where new concrete is doweled to existing work, drill holes in existing concrete. Place steel dowels and pack solidly with non-shrink grout to positively position and anchor dowels.

.7 Do not place load upon new concrete until authorized by Engineer.

3.2 INSERTS

.1 Set sleeves, ties, pipe hangers and other inserts and openings as indicated or specified elsewhere. Sleeves and openings greater than 100 mm x 100 mm not indicated on structural or civil drawings must be approved by Engineer.

.2 No sleeves, ducts, pipes or other openings shall pass through joists, beams, column capitals or columns, except where expressly detailed on structural or civil drawings or approved by Engineer.

.3 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval of all modifications from Engineer before placing of concrete.

.4 Check locations and sizes of sleeves and openings shown on structural and civil drawings with architectural, mechanical and electrical drawings.

.5 Set special inserts for strength testing as indicated and as required by Non-Destructive Method of Testing Concrete.

.6 Anchor bolts:

- .1 Set anchor bolts to templates under supervision of appropriate trade prior to placing concrete.
- .2 With Engineer's approval, grout anchor bolts in performed holes or holes drilled after concrete has set. Formed holes to be at least 100 mm in diameter. Drilled holes to be minimum 25 mm larger in diameter than bolts used.
- .3 Protect anchor bolt holes from water accumulations.
- .4 Set bolts and fill holes with non-shrink grout.
- .5 Locate anchor bolts used in connection with expansion shoes, rollers and rockers with due regard to temperature at time of erection.

.7 Drainage holes and weep holes:

- .1 Form weep holes and drainage holes in accordance with Section 03100. If wood forms are used, remove them after concrete has set.
- .2 Install weep hole tubes and drains as indicated.

.8 Dovetail Anchor Slots:

.1 Install continuous vertical anchor slot to forms where masonry abuts concrete wall or columns.
.2 Install continuous vertical anchor slots at 800 mm o.c. where concrete walls are masonry faced.

3.3 GROUTING & DRY PACKING

.1 Grout underside of steel column and beam bearing plates with non-shrinking grout to manufacturer's instructions or dry packing. Place grout to cover steel shims left in place.

3.4 FINISHING

.1 Finish concrete in accordance with CAN3-A23.1-M90.

.2 Rub exposed sharp edges of concrete with carborundum to produce 3 mm radius edges unless otherwise detailed.

.3 All concrete surfaces, unless specified otherwise, that will be visible on completion of the work shall conform to surface finish Class 2. The surface shall be uniform in colour and texture when viewed from a distance of 15m.

.4 Class 2 - Rubbed Finish

.1 Immediately following the removal of forms, all fins and irregular projections shall be removed from all surfaces except from those which are not to be exposed or are not to be waterproofed. On all surfaces, the cavitied produced by form ties and all other holes, honeycombs, spots, broken corners or edges and other defects shall be cut back to sound concrete and thoroughly cleaned. No feather edging is permissible. If reinforcing steel is exposed, concrete shall be cut back for at least 50 mm around the reinforcement.

.2 After having been kept saturated with water for a period of not less than three hours, the cavities shall be carefully pointed and trued with a 30 mPa non-shrink grout. The patches shall be placed and cured as specified by the manufacturer. All construction and expansion joints in the completed work shall be left carefully tooled and free of all grout and concrete. The joint filler shall be left exposed for its full length with clean and true edges. The resulting surfaces shall be true and uniform. After removal of forms, the rubbing of concrete shall be started as soon as its condition will permit. However, before starting this work the concrete shall be kept thoroughly saturated with water for a minimum period of three hours but sufficient time shall have elapsed before the wetting down to allow the grout used in the pointing of rod holes and defects to thoroughly set. Surfaces to by finished shall be rubbed with a medium coarse carborundum stone, using a small amount of mortar on its face. The mortar shall be composed of extra cement and fine sand mixed in proportions such as to match existing concrete verified by a patch test. Rubbing shall be continued until all form marks, projections and irregularities have been removed, all voids filled, and a uniform surface has been obtained. The paste produced by this rubbing shall be left in place at this item. After all concrete above the surface being treated has been cast, the final finish shall be obtained by rubbing with a fine carborundum stone and water. This rubbing shall be continuous until the entire surface is of a smooth texture and uniform colour. After the final rubbing is completed and the surface has dried, it shall be rubbed with burlap to remove loose powder and shall be left free from all unsound patches, paste, powder and objectionable marks.

3.5 WATER STOPS

.1 Install water stops to provide continuous water seal. Do not distort or pierce water stop to hamper performance. Do not displace reinforcement when installing water stops. Use equipment to manufacturer's requirements to field splice water stops. Tie water stops rigidly in place.

.2 Use only straight heat sealed butt joints in field. Field welded corners and intersections.

3.6 JOINT FILLERS

.1 Furnish filler for each joint in single piece for depth and width required for joint, unless otherwise authorized by Engineer. when more than one piece is required for a joint, fasten abutting ends and hold securely to shape by stapling or other positive fastening.

.2 Locate and form isolation and expansion joints as indicated. Install joint filler.

.3 Use 12 mm thick joint filler to separate slabs-on-grade from vertical surfaces and extend joint filler from bottom of slab to within 12 mm of finished slab surface unless indicated otherwise.

3.7 DAMP PROOF MEMBRANE

.1 Install damp proof membrane under concrete slabs-on-grade inside building.

.2 Lap damp proof membrane minimum 150 mm at joints and seal.

.3 Seal punctures in damp proof membrane before placing concrete. Use patching material at least 150 mm larger than puncture and seal.

3.8 FIELD QUALITY CONTROL

.1 Inspection and testing of concrete and concrete materials will be carried out by a Testing Laboratory in accordance with CAN3-A23.1-M90 and paid for by the owner.

.2 Engineer will take additional test cylinders during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.

.3 Non-destructive Methods for Testing Concrete shall be in accordance with CAN3-A23.2-M90.

.4 Inspection or testing by Consultant will not augment or replace Contractor quality control nor relieve him of his contractual responsibility.

3.9 BASIS FOR PAYMENT

.1 All costs associated with the work specified in this section shall be deemed to be included in the appropriate unit and lump sum prices quoted in the Schedule of Quantities and Prices.

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This section specifies requirements for supply and placement of concrete underwater by tremie, pumped concrete, bottom dump bucket, or bagged concrete method.

PART 1 - GENERAL

1.1 TERMINOLOGY

.1 Tremie concrete is placed underwater through a tube called a tremie pipe. Tremie pipe has a hopper at upper end and may be open ended or may have a foot valve, plug or travelling plug to control flow of concrete. Concrete is placed in hopper and a sufficient head of concrete is maintained in tremie pipe to provide desired rate of flow.

.2 Pumped concrete method of placing concrete underwater uses a concrete pump with a discharge line used in a similar manner to a tremie pipe.

.3 bottom-dump bucket method of placing concrete underwater requires use of a bucket designed to discharge from bottom after it has contacted foundation or surface of previous placed concrete.

.4 Bagged concrete method of placing underwater concrete consists of a diver placing bags partially filled with concrete mix.

1.2 MEASUREMENT FOR PAYMENT

.1 Concrete placed underwater will be measured in cubic metres to specified pay limits unless otherwise specified.

.2 Subject to 1.2.1 pay limits may be up to theoretical volume plus 10%.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Refer to Section 03300 for material requirements for production of concrete except as specified otherwise herein.

.2 Portland cement: Normal (type 10) to CAN3-A5-M88, unless otherwise specified.

.3 For placing bagged concrete, use bags made of coarsely woven material to allow concrete to bond between bags.

2.2 CONCRETE MIXES

.1 Use 42 to 45% fine aggregate by weight in concrete mix for workability.

.2 Use not less than 385 kg of cement per cubic metre.

.3 For tremie concrete produce a mix with a slump of 150 to 200 mm and a water cement radio of not more than 0.45.

.4 For pumped concrete and bottom-dump bucket concrete produce a mix with a slump and fill bags to not more than 0.45.

.5 For bagged concrete thoroughly mix a very dry mix concrete of zero to 25 mm maximum slump and fill bags to not more than 80% full just before placing.

.6 Produce concrete with a minimum compressive strength of 25 Mpa at 28 days unless otherwise specified.

2.3 ADMIXTURES

.1 Admixtures will be subject to approval of Engineer. Admixtures will only be permitted to correct deficiencies in mix or to improve placement of concrete.

.2 Engineer may withdraw prior approval of admixture if conditions encountered during course of work indicate unsatisfactory performance.

.3 Do not use calcium chloride.

PART 3 - EXECUTION

3.1 GENERAL

.1 Do concrete work in accordance with Section 03300 and as specified herein.

3.2 PREPARATION

.1 Where concrete must bond to existing concrete surfaces, rock surfaces, piling, sheet piling or anchor rods, clean thoroughly just prior to starting concrete placement. Use water jets and when quantities of silt or mud are present remove by air lift.

.2 Place concrete in one continuous operation to full depth required. Provide sufficient supply of concrete to complete pour without interruption and supply complete equipment for every phase of operation.

3.3 TREMIE METHOD

.1 Provide a tremie pipe which is watertight and sufficiently large to allow free flow of concrete. Diameter of tremie pipe to be not less than 200 mm or less that eight times maximum size of coarse aggregate.

.2 Provide a hopper at top of tremie pipe and means to raise and lower tremie. Provide plug or foot valve at end of tremie pipe to permit filling pipe with concrete initially.

.3 Provide a minimum of one tremie pipe for every 30 m^2 of pour plan area. Do not move tremie pipes laterally by dragging through concrete.

.4 Start pour with tremie pipe full of concrete and keep end of pipe buried in freshly placed concrete at least 300 mm. Control rate of flow by increasing or decreasing depth of end in concrete.

.5 If seal is lost, allowing water to enter pipe, withdraw pipe immediately.

.6 If tremie operation is interrupted so that a horizontal construction joint has to be made, cut surface laitance by jetting, within 24 to 36 hours and remove loose material by pumping or air lifting before placing next lift.

.7 Do not place concrete in flowing water. Do not vibrate, disturb or puddle concrete after it has been placed.

3.4 PUMPED CONCRETE METHOD

.1 Follow procedures as for tremie method in placing concrete using discharge line from concrete pump as a tremie pipe.

3.5 BOTTOM-DUMP BUCKET METHOD

.1 Completely filly bucket, cover top surface and lower slowly through water to prevent backwash. Discharge concrete from bucket only when it is in contact with surface on which concrete is to be deposited. Withdraw bucket slowly until it is well above concrete to maintain as nearly as possible still water at point of discharge.

.2 Do not place concrete in flowing water.

3.6 BAGGED CONCRETE METHOD

.1 Fill bags not more that 80% full before placing. Place each concrete bag individually so that bag is stable and securely resting on foundation material or previously placed bags.

3.7 BASIS FOR PAYMENT

.1 All costs associated with the work specified in this section shall be deemed to be included in the appropriate unit and lump sum prices quoted in the Schedule of Quantities and Prices.

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PART 1 - GENERAL

1.1 REFERENCE STANDARDS

.1 Do concrete floor finishing work in accordance with CAN3-A23.1-M90 except where specified otherwise.

1.2 MEASUREMENT FOR PAYMENT

.1 Finishing, sealing, placement of hardeners and coloration are considered incidental to the work specified in Section 3300 and will not be measured.

PART 2 - PRODUCTS

2.1 MATERIAL

.1 Concrete materials to Section 03300 and reinforcement to Section 03200.

.2 Premixed Metallic or non metallic floor hardener: as specified in contract documents.

.3 Chemical hardener: magnesium fluosilicate and zinc fluosilicate blend.

.4 Wax: concrete floor buffing compound.

.5 Colouring agent: metallic type concrete colouring pigments.

.6 Use compatible additives, admixtures and hardeners.

PART 3 - EXECUTION

3.1 FLOOR FINISH

.1 Finish concrete in accordance with CAN3-A23.1-M90 Class A.

.2 Do not sprinkle dry cement or dry cement and sand mixture over concrete surfaces.

.3 Saw cut crack-control joints to CAN3-A23.1-M90.

.4 Apply floor hardener aggregate to manufacturer's instructions. Cure to manufacturers recommendations.

.5 Apply concrete floor wax in accordance with manufacturer's instructions.

.6 Cure concrete in accordance with CAN3-A23.1-M90 except where specified otherwise.

3.2 TOPPINGS

.1 Place dividers, edge strips, reinforcing mesh, expansion joint assemblies, and other cast-in items as specified.

.2 Apply cement grout to base slab in accordance with CAN3-A23.1-M90.

.3 Apply bonding adhesive to base slab in accordance with manufacturer's instructions.

.4 Apply concrete topping of 30 mPa minimum compressive strength in accordance with CAN3-A23.1-M90.

3.3 BASIS FOR PAYMENT

.1 All costs associated with the work specified in this section shall be deemed to be included in the appropriate unit and lump sum prices quoted in the Schedule of Quantities and Prices.

MISCELLANEOUS STANDARD FORMS

Table of Contents

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CERTIFICATE OF INSURANCE

THIS CERTIFICATE OF INSURANCE SHOULD BE DELIVERED TO CONSULTANT, THE DEPARTMENT OF MUNICIPAL & PROVINCIAL AFFAIRS, AND/OR THE OWNER WITHIN 30 DAYS OF THE AWARD OF THE CONTRACT AND BEFORE CONSTRUCTION BEGINS

DESCRIPTION & LOCATION OF WORK		
PROJECT NO.	AWARD DATE	VALUE $

INSURER	Name: Address:
BROKER	Name: Address:
INSURED	Name: Address:
ADDITIONAL INSURED	___ HER MAJESTY THE QUEEN IN RIGHT OF NEWFOUNDLAND AS REPRESENTED BY THE MINISTER OF MUNICIPAL & PROVINCIAL AFFAIRS ___ THE OWNER (IF NOT DEPARTMENT)_____ ___ ARCHITECTURAL AND ENGINEERING CONSULTANTS OF THE OWNER (EXCLUDING PROFESSIONAL LIABILITIES)

THIS DOCUMENT CERTIFIES THAT THE FOLLOWING POLICIES OF INSURANCE AND INDICATED COVERAGE ARE AT PRESENT IN FORCE SUBJECT TO THE TERMS, CONDITIONS AND EXCLUSIONS AS CONTAINED THEREIN COVERING THE OPERATIONS OF THE INSURED IN CONNECTION WITH THE ABOVE NOTED CONTRACT MADE BETWEEN THE NAMED INSURED AND THE OWNER _____.

POLICY TYPE	NUMBER	INCEPTION DATE	EXPIRY DATE Y/M/D	LIMITS OF LIABILITY
1.1 COMMERCIAL GENERAL LIABILITY 1.2 WRAP-UP LIABILITY INCLUDING WHERE INDICATED: A. BLASTING B. PILE DRIVING OR CAISSON WORK C. REMOVAL OR WEAKENING OF SUPPORT	1.1 _____ 1.2 _____ A (Y/N) _____ B (Y/N) _____ C (Y/N) _____	1.1_____ 1.2_____	1.1_____ 1.2_____	MINIMUM $2,000,000.00
2A. BUILDERS' RISK "BROAD FORM" OR 2B. INSTALLATION FLOATER "BROAD FORM" OR 2C. PIERS, WHARVES, & DOCKS RIDER COVERAGE MAINTAINED UNTIL ARCHITECT/ENGINEER ISSUES CERTIFICATE OF SUBSTANTIAL PERFORMANCE	2A _____ OR 2B _____ OR 2C _____ (Y/N) _____	2A_____ 2B_____ 2C_____	2A_____ 2B_____ 2C_____	100% OF THE VALUE OF WORK COVERED
3. AUTOMOBILE LIABILITY INSURANCE				MINIMUM $2,000,000.00
4. AIRCRAFT AND/OR WATERCRAFT WATERCRAFT LIABILITY (IF APPLICABLE)				MINIMUM $2,000,000.00
5.				

"THE INSURER AGREES TO NOTIFY THE NAMED INSURED, HER MAJESTY AND/OR THE OWNER, IN WRITING, THIRTY(30) DAYS PRIOR TO CANCELLATION OR MATERIAL CHANGE OF ANY POLICY EXCEPT IN THE EVENT OF NON-PAYMENT WHERE POLICY CONDITIONS DEALING WITH TERMINATION WILL APPLY."

NAME OF INSURER'S OFFICER OR AUTHORIZED REPRESENTATIVE	SIGNATURE	DATE TELEPHONE NO.:

ISSUANCE OF THIS CERTIFICATE SHALL NOT LIMIT OR RESTRICT THE RIGHT OF THE OWNER TO REQUEST, AT ANY TIME, DUPLICATE CERTIFIED COPIES OF SAID INSURANCE POLICIES.

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CERTIFICATE OF SAFETY TRAINING AND SUPERVISION

The Contractor shall complete and forward to the Consultant this Certificate before construction commences:

AUTHORITY AND ADDRESS:	FILE NUMBER:
CONTRACTOR AND ADDRESS:	CONTRACT NUMBER:
NAME AND LOCATION OF WORK:	CONTRACT AWARD DATE:

I certify that the work under this Contract shall be completed in conformance, where required, to the following procedures and regulations set out either by the Occupational Health and Safety Branch of the Department of Environment and Labour, the Explosives Division of Energy, Mines and Resources Canada, and other regulatory agencies.

Attached are copies of certificates proving health and safety training of project workers and supervisors (circle the numbers of applicable following procedures and regulations).

1. Transportation of Dangerous Goods
2. Navigation of Overhead Wires
3. Use of Explosives
4. Working in Confined Spaces
5. Highway Flagging and Signage
6. Workplace Hazardous Materials Information System
7. First Aid and CPR
8. Safety Committee
9. Emergency Response Plan Registration Number _____
10. CSA Z 275.2-92 Occupational Safety Code for Diving Operations

_____ _____

DATE **CONTRACTOR**

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DEPT. OF WORKS, SERVICES & TRANSPORTATION - PERMIT

THIS PERMIT ISSUED TO: _____

HEREAFTER CALLED THE "LICENSEE"

This permit authorized the Licensee to enter upon

_____

_____for the purposes of installing

_____

_____as per plans submitted by

_____

in the said highway subject to the terms and conditions hereinafter following:

1. Inspection

All work covered by this permit within the highway right of way must be performed in accordance with approved practices, at the expense of the Licensee and subject to the inspection and approval of authorized Department personnel.

2. Maintenance of Highway

It is the responsibility of the Licensee to maintain, at its own expense, the entire portion of the highway disturbed or altered by the Licensee's work in a condition acceptable to the Department. The Department's opinion as to acceptability of highway condition is final and the Licensee must carry out the Department's instructions without undue delay where the Department feels it necessary that additional work be done by the Licensee to bring the highway to a suitable condition. If the Licensee fails to comply with these instructions, the Department may, in its discretion perform the additional work deemed necessary and will seek compensation therefore from the Licensee.

3. Traffic

(1) Where trench excavation extends beyond one-half the width of the travelled or paved portion of a roadway, the Licensee shall arrange its work so that on-half of the width of the roadway is maintained in a condition suitable to accommodate all vehicular and pedestrian traffic. The Licensee shall complete is work on the initial trenched half of the roadway before excavating or trenching the remaining half of the roadway.

(2) Sufficient and approved warning devices must be placed in accordance with accepted practice for the safety of both vehicular and pedestrian traffic. No highway shall be entirely closed to traffic without the prior written approval of the Department of Works, Services & Transportation.

4. Non-Liability of Department

(1) The Department of Works, Services & Transportation shall not be liable for any interference, delay or damage to the work or facility of the Licensee that may arise as a result of necessary or expedient maintenance operations carried out by the Department within the highway right of way, unless there can be proved negligence on the part of the Department.

(2) The Licensee agrees to indemnify and keep indemnified the Department of Works, Services & Transportation from and in respect of any claim or demand that may arise or that may be related to the work done or the facility installed by the Licensee pursuant to this permit.

5. Scheduling of Work

In the event that the Department of Works, Services & Transportation plans or arranges for paving, maintenance, repairs, upgrading, or reconstruction to the highway at the same time as the Licensee's work is planned or arranged, the Licensee will schedule its work for completion so that it will cause no delay to the work of the Department. The onus is on the Licensee to determine if the department has work scheduled in the area of the Licensee's proposed work or facility.

6. Work

(1) Any pipe, cable or conduit placed in a roadway must be bedded in a firm, well compacted foundation. Backfilling of these structures must be compacted in an approved manner in order to prevent undue settlement. Material for backfilling shall be that which was excavated or similar to that of which the subgrade is constructed.

(2) Where materials used in conjunction with the Licensee's work or excavated as a result of the work is deposited on a paved surface, the Licensee agrees to be responsible for repairing any damage to the paved surface which may result there from. The nature and extent of the repairs to be done by the Licensee must be done to the satisfaction of the Department.

(3) When trenches are cut across a paved surface the paved surface shall be cut only to the nominal width of the trench. During the excavation, installation and backfilling, should any material supporting the paved surface be disturbed the asphalt must be cut back to an undisturbed foundation and the required thickness of granular base course placed and compacted before replacing the asphalt. Backfilling of trenches must allow a combined minimum thickness of 30 cm of Class B granular base course and Class A granular base course or the thickness of the granular base course in place on the roadway which ever is the greater.

(4) Backfilling of trenches in gravel surfaced roads or shoulders must allow for replacing the depth of granular base course on the roadway or a minimum thickness of 15 cm of Class A granular base course whichever is the greater thickness.

(5) Any part of the Licensee's work such as manhole covers, valve covers, accesses to sewage pumping stations, fire hydrants, etc., must not be located such that any part protrudes above the surface of the roadway, the surface of the shoulder or the bottom of drainage ditches of the highway. If any of these items have to be located such that they are to be accessible above the ground level, they must not be located less half the width of the combined roadway and shoulder measured from the center line of the roadway plus 4.6 metres.

(6) Water and sewer lines to be installed must be in accordance with plans approved by the Department. In the event that subsequent revisions or conditions require installation of lines less than 2.5 m from the edge of any paved surface, such installation shall be done only after the Licensee obtains the prior written approval of the Department. Ditches must be restored to the original grade measured vertically from the elevation of the outside edge of the shoulder, amy be backfilled such that the minimum depth of the ditch is one metre.

(7) If there should be more than 20% of any portion of the paved surface of the roadway damaged in excess of normal repair or destroyed by the Licensee's work or more than 20% of the paved roadway in the total length of the highway in which the Licensee's work is incorporated is so damaged or destroyed, then the Licensee, in addition to whatever repairs are required to the existing paved roadway surface, will place an overlay of asphalt to the current specification of the Department for surface asphalt and to a minimum thickness of 3.0 cm over the portion of the paved surface, as may be required by the Department.

(8) If it is found necessary by the Licensee to excavate any portion of the shoulder of a highway, the shoulder must be restored to its original cross section, to the satisfaction of the Department.

(9) Following completion of the work, it is the Licensee's obligation to restore the highway to its former condition, to the satisfaction of the Department.

(10) (a) Backfilling of trenches shall be carried on when temperature is above freezing and compacted to 95% standard proctor density.

(b) 30 cm granular base course Class A is an acceptable substitute to the combined thickness of 30 cm of Class B and Class A granular base course.

(c) Asphalt will be cut using only an approved asphalt cutting tool manufactured for that purpose and in a manner to produce a vertical face in the remaining asphalt.

7. Repairs-Alterations Subsequent to Completion of Work

(1) If there is any settlement of the surface of a paved roadway occurring as a result of the Licensee's work and if the said settlement occurs within 12 months of the completion of the Licensee's work, then the Department will have the right to repair the said settlement and to charge the reasonable costs thereof to the Licensee.

(2) It is the responsibility of the Licensee to ensure that manholes, catch basins and water valve covers or any part of the facility does not protrude from any paved surface nor recess from any paved surface in excess of 15. cm. If any such protrusions or recessions should occur within a period of five years after the completion of the work, the Department will have the right to remedy same and to charge the reasonable costs thereof to the Licensee.

(3) In the event that the Department finds it necessary to alter or relocate any part of the Licensee's facility after the completion of the work by the Licensee, the Department has the right to undertake such alteration or relocation without liability to the Licensee. In the alternative, the Licensee may elect to undertake the alteration or relocation with its own resources without cost to the Department.

8. Miscellaneous

(1) The Licensee will notify the office of the District Manager at telephone number _____before the commencement of any work on the Department of Works, Services & Transportation rights of way.

(2) This permit is valid only for 12 months from the date of issuance.

(3) By signing this permit, the Licensee acknowledges that it has examined and accepted all the terms and conditions herein.

Dated at in the Province of Newfoundland this day of A.D., 19___

_____
Department of Works, Services & Transportation

_____
Licensee

Dept. of Municipal & Provincial Affairs - Municipal Water Sewer & Roads Specifications

MATERIALS ON SITE

SHEET ________

PROGRESS PAYMENT NO. ____________ **PROJECT NAME ______________________________ PERIOD FROM __________ TO __________**

ITEM NO.	INVOICE NO. & DESCRIPTION	UNIT MEASURE	MATERIAL ON SITE FOR THIS RECORD					UNIT PRICE	AMOUNT
			AT START	REC'D DURING	REC'D TO END	USED DURING	NET AT END		

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CONTRACT CHANGE ORDER NOTICE

PROJECT NAME: **PROJECT NO:**

CHANGE ORDER NUMBER: **DATE:**

.1 NOTICE

A change to the Contract is contemplated as indicated herein.

.2 PROCEDURE

The Contractor shall stipulate the effect of the contemplated change of the contract amount in Item 4 below. Where the change increases the amount of the contract, a complete cost breakdown will be returned with each copy of the document. The Contractor shall return three signed copies of this document to the Engineer for approval. Should it be decided to proceed with the work, an approved copy will be returned to the Contractor. Work shall not proceed until the written authorization is received.

.3 DESCRIPTION OF CHANGE

.4 EFFECT OF CHANGE ON CONTRACT

This change order will/will NOT affect the approved completion date (circle correct statement).

If the completion date will be affected, the requested increase in time to the approved completion date is:

WORKING DAYS: _____ REVISED COMPLETION DATE: _____

The change described in Item 3 above will affect the current contract amount as follows:

AMOUNT

( ) No Change
( ) Addition to Contract including GST payable by the Owner $_____
( ) Deduction from Contract including GST payable by the Owner $_____

CONTRACTOR: _____
(Signature)

Authorized Contract Amount	$	
Previous Change Orders		$
This Change Order	$	
New Approved Contract Amount		$

.5 AUTHORIZATION TO PROCEED

The Contractor is authorized to proceed with the changes for the amounts stated in Item 4 above.

DATE: _____ ENGINEER: _____

DATE: _____ OWNER: _____

.6 CANCELLATION OF CONTEMPLATED CHANGE

It has been decided not to proceed with this change which is hereby cancelled.

DATE: _____ ENGINEER: _____

.7 NOTIFICATION TO BONDING AND INSURANCE COMPANIES

The Bonding Company and Insurance Company shall each be immediately notified by the Contractor of this change to the contract by being issued copies of the Change Order.

Dept. of Municipal & Provincial Affairs - Municipal Water Sewer & Roads Specifications

DAILY FORCE ACCOUNT REPORT

Form 6, Page 1 of 2 **May 1995**

Date _____

Project Name: _____

Project No. _____

Contractor: _____

DESCRIPTION OF WORK _____

_____

LABOUR

CLASSIFICATION	NO.	HRS. EACH		MAN HOURS	RATE	TOTAL
SUBTOTAL						

EQUIPMENT

TYPE	MAKE & MODEL	CAPACITY	G-GAS	HRS. WORKED	RENTAL RATE	TOTAL
SUBTOTAL						

MATERIAL SUPPLIED BY CONTRACTOR

TYPE	QUANTITY	UNIT PRICE	TOTAL
SUBTOTAL			

SUMMARY

	ITEM	AMOUNT
1.	Labour	
2.	35% Payroll Burden	
3.	Materials	
4.	SUB TOTAL	
5.	10% Overhead	
6.	SUB TOTAL	
7.	5% (Sub Contractor Total)	
8.	SUB TOTAL	
9.	10% Profit (contractor)	
10.	SUB TOTAL	
11.	Equipment	
12.	**TOTAL**	

_____

ENGINEER'S REPRESENTATIVE

_____

CONTRACTOR'S REPRESENTATIVE

NOTE: To be submitted with Progress Claim.

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TESTING & REINSTATEMENT ALLOWANCE FORM

PROJECT NAME: PROJECT NO.:

REQUEST NUMBER: DATE:

1. TESTING ALLOWANCE

Water pressure test allowance rate shall be 10% of the Unit Price tendered for the item.
Sewer test allowance shall be 10% of the Unit Price tendered for the item.

ITEM	QUANTITY INSTALLED	QUANTITY TESTED	BALANCE	ALLOWANCE RATE	AMOUNT
PRESSURE WATER MAIN TEST				10%	
SEWER TESTS (OTHER THAN MANHOLES)				10%	
MANHOLES				5%	
	(A) SUBTOTAL TESTING ALLOWANCE				

2. REINSTATEMENT ALLOWANCE

Five (5%) of the value of work completed =

Less amount Reinstatement Credited =

(B) Subtotal Reinstatement Allowance =

Total allowance (A + B) =
(transfer this total to Progress Claim Detail Sheet)

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REINSTATEMENT CERTIFICATE

This certificate is to be completed at the time of issuance of the Certificate of Substantial Performance.

Please cross out the incorrect answer listed below.

(YES) (NO) .1 All culverts (driveways, cross-drains, storm drains, etc.) have been repaired/replaced to an acceptable functional condition.

(YES) (NO) .2 All reasonable care has been taken by the Contractor to ensure proper compaction of cross-cuts.

(YES) (NO) .3 Granular ("A" & "B") meet specifications and proper thickness under asphalt.

(YES) (NO) .4 Shoulders have been re-instated to original conditions.

(YES) (NO) .5 Asphalt meets design specifications.

(YES) (NO) .6 Asphalt thickness as required.

(YES) (NO) .7 Tack Coat properly applied (edge of cuts, road surface for recap).

(YES) (NO) .8 Do any areas have 20% of asphalt damaged.

(YES) (NO) .9 If yes to #8, were they properly repaired prior to surfacing.

I hereby certify that the work has been satisfactorily accomplished.

DATE _____ CERTIFIED BY ENGINEER'S REPRESENTATIVE _____

I hereby certify that the work has been done as specified above.

DATE _____ CERTIFIED BY CONTRACTOR'S REPRESENTATIVE _____

I have inspected the work and find it satisfactorily accomplished.

DATE _____ DEPT. WORKS, SERVICES & TRANSPORTATION REPRESENTATIVE _____

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T.V. INSPECTION FORM

The T.V. inspection report shall include a standard cover sheet showing the following information:

.1 LOCATION
.2 PERFORMED BY
.3 DATE

An Index Page is to be included with each report and will state:

Street Name: From M.H. # To M.H. # Page

Whether inspected at the same time or not, the complete sewer inspection report will be presented together, from upstream to downstream manhole.

All pages will be numbered in the upper right hand corner.

A standard form for documenting the television and manhole inspection findings is provided with this specification. The form must show:

(a) For T.V. inspection results the heading will state:

(i) the street name

(ii) the manhole numbers applicable to this section

(iii) the reference drawing number

(iv) prevailing weather on the day of the inspection

(v) statement of soil condition in area of inspection, eg., dry, wet, saturated, frozen

(vi) the date of the inspection

(b) The key plan will consist of a small drawing (not to scale) showing the appropriate location of the two manholes in relation to any nearby reference points such as houses (with corresponding civic numbers), telephone poles (with corresponding pole numbers) etc. This drawing will denote:

(i) the manhole numbers

(ii) the horizontal distance between the manholes

(iii) the direction of sewer flow

The report shall include photographs of: pipe joints that display gaps, spread, or offset; signs of infiltration; protruding service lines; crushed, broken or cracked pipe; variance of the grade of the pipe section; and gravel or debris which may impede flow.

All photographs will appear on the left page only, opposite the corresponding description for the photo which appears on the right hand page. Where there are more pictures in any run than can be placed on the first left page, these will be placed on subsequent pages with the corresponding description appearing opposite.

All photographs will be numbered in order. This number will appear beside them and will be the same number referred to in the description.

The last page of the report will consist of an area sewer plan to scale, showing the street inspected for the report and applicable manhole numbers.

T. V. INSPECTION FORM

DEPARTMENT PROJECT NO:

MUNICIPALITY:
STREET:

FROM MH# TO MH#

REFERENCE DRAWING: LINE SECTION LENGTH:

DATE: PIPE SIZE:

WEATHER CONDITION: PIPE MATERIAL:

PIPE SECTION LENGTH: PIPE MATERIAL TYPE:

SKETCH	LINE LENGTH (M)	PHOTO #	TAPE REFERENCE (HOURS,MINUTES)	OBSERVATIONS

STATUTORY DECLARATION

IN THE MATTER OF a contract for _____ between

_____

herein referred to as the Owner,
and

_____

herein referred to as the Contractor

dated the _____ day of _____, 20__, and;

IN THE MATTER OF a Progress Claim
covering work done thereunder up to
the _____ day of _____, 20__

TO WIT:

I, _____ of _____
do solemnly declare:

.1 That I am _____ and
(title or position with the Contractor)
as such have personal knowledge of the said contract and of the facts and matters stated herein.

.2 That all the Contractor's lawful obligations and suppliers of material in respect of the work contracted for are fully discharged as of the _____ day of _____, 19__

.3 That all the Contractor's lawful obligations to workmen in respect of the work contracted for are fully discharged as of the date of this Progress Claim.

And I make this SOLEMN DECLARATION conscientiously believing it to be true; and knowing that it is of the same force and effect as if made under oath, and by virtue of the CANADA EVIDENCE ACT.

DECLARED before me at _____

this _____ day of _____, 20__

_____

(Signature of Notary Public, Commissioner, etc.)

_____

(Signature of Declarant)

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MONTHLY STATEMENT REGARDING OUTSTANDING CLAIMS

In the matter of Contract No._____ between the Owner_____ and the Contractor _____ for the project_____ dated_____ and in the matter of a request for contract payment for work performed to(date) _____.

___ There are NO outstanding claims for work performed beyond the scope of this contract which have NOT been communicated to the Owner in writing.

___ There ARE outstanding claims which have been communicated to the Owner in writing but for which contract changes have NOT been received as noted on the reverse side of this statement.

___ Contract completion date WILL NOT be delayed.

___ Contract completion date WILL be delayed.

Witnessed_____ Signature_____

- To be signed by an officer of the Contractor. Position_____

Attach additional initialled pages if required.

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CERTIFICATE OF SUBSTANTIAL PERFORMANCE

AUTHORITY AND ADDRESS:		FILE NUMBER:	
CONTRACTOR AND ADDRESS:		CONTRACT NUMBER:	
NAME AND LOCATION OF WORK:		CONTRACT AWARD DATE:	
ORIGINAL CONTRACT	APPROVED ADDITIONS	DEDUCTIONS	REVISED CONTRACT AMOUNT

1. Value of work completed to date as per
   Contract Payment Certificate #_____ _____

2. Value of work certified as Substantially Performed..... _____

3. Percent of Revised Contract Amount_____

4. Deficiencies:

_____ _____
_____ _____
_____ _____
_____ _____
_____ _____
_____ _____

2 X _____ = _____

I certify that the work under this Contract is substantially performed, and is acceptable for use, except for the portion of the work listed under deficiencies. Pursuant to the Authority of Section 21 of the General Conditions, I hereby issue this Certificate of Substantial Performance.

ENGINEER_____ TITLE_____ DATE_____

REMARKS:_____
_____
_____
_____

Notwithstanding this certificate, warranty for Subcontracts will not start until Substantial Performance of the General Contract.

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CERTIFICATE OF TOTAL PERFORMANCE

This Certificate is to be issued on request from the Contractor to the Engineer when the Contract has been Totally Performed.

PROJECT NAME: **PROJECT NO.:**

CONTRACTOR:

In accordance with the conditions established in GC 21 CERTIFICATES AND PAYMENTS, sub-section 21.8, we hereby approve the issuance of this CERTIFICATE OF TOTAL PERFORMANCE for the above noted Contract.

The issuance of the Certificate of Total Performance shall constitute a waiver of all claims by the Owner against the Contractor except those previously made in writing and still unsettled, if any, and those arising from provisions of GC 31 - Warranty, or those arising from negligence on the part of the Contractor.

The acceptance of the Certificate of Total Performance or of the payment due thereunder shall constitute a waiver of all claims by the Contractor against the Owner except those made in writing prior to his application for payment upon Total Performance of the Contract and still unsettled, if any.

DATE: **CONSULTANT:**

DATE: **OWNER:**

DATE: **CONTRACTOR:**

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DAILY CONTRACT TIME CONTROL SHEET

Contract Completion Time: _____

Day	Hours Worked	Inspector Days Used	Cons. Site Rep. Init.	Cont. Site Rep. Init.	Remarks

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CONTRACT PAYMENT

Newfoundland Labrador
DEPARTMENT OF MUNICIPAL AFFAIRS
Municipal Engineering Services Division

CONTRACT PAYMENT

Project Name :	**Payment Period**
Contractor's Name _____ **Address :** _____ **GST Registration Number :**	**From :** _____ **To:** _____
Owner's Name :	**Claim No. :**
Consultant's Name :	

ORIGINAL CONTRACT (Not Including HST)	ADDITIONS/EXTRAS	DEDUCTIONS	13% HST	TOTAL AUTHORIZED

1.	(a)	Total Value Of The Work Done	
	(b)	Less (_____%) Hold Back	
	(c)	Sub-Total, Work Done	
2.	(a)	Total Value Of Material Delivered On Site	
	(b)	Less (_____%) Hold Back	
	(c)	Sub-Total Material	
3.	(a)	Total Value Force Account	
	(b)	Less (_____%) Hold Back	
	(c)	Sub-Total Force Account	
4.	(a)	Total Value, Work & Materials (1a,2a,3a)	
	(b)	Less Hold Back, Work & Material (1b,2b,3b)	
	(c)	Net Total, Work & Material (1c,2c,3c)	
	(d)	Less Previous Payments (item 4(c) from previous claim)	
	(e)	Amount Due	
	(f)	Harmonized Sales Tax 13% (of item 4(e)	
		TOTAL GST TO DATE...	NET AMOUNT DUE...

DATE _____ **CONTRACTOR** _____

DATE _____ **ENGINEER** _____

DATE _____ **MUNICIPALITY OR DEPARTMENT** _____

Department of Municipal Affairs

PAGE _____ OF _____ PAGES

DETAIL SHEET

FOR UNIT PRICE CONTRACT

		CONTRACT NO.				REQUEST NO.	
ITEM NO.	DESCRIPTION	QUANTITIES				VALUE	
		UNIT OF MEASURE	AUTHORIZED	THIS PERIOD	TO DATE	UNIT PRICE	AMOUNT

SIGN LAST PAGE ONLY

I HEREBY CERTIFY THAT THE WORK DONE AND MATERIAL DELIVERED TO SITE UP TO THE DATE SPECIFIED ARE AS LISTED. WORK, MATERIAL AND PRICES ARE ACCORDING TO CONTRACT (IF PRICES NOT SPECIFIED BY CONTRACT THEY ARE REASONABLE).

ENGINEER'S SITE REPRESENTATIVE _____ ENGINEER _____ DATE

FORM 1000

GOVERNMENT OF NEWFOUNDLAND AND LABRADOR
Department of Transportation and Works
Highway Design Division

DIVISION 10

NEWFOUNDLAND EQUIPMENT RENTAL SCHEDULE

FORWARD

Rental rates in this schedule include: depreciation, interest, liability insurance, repairs, maintenance, supplies, fuels, lubricants, overhead and profit.

Rates for equipment sizes not shown will be interpolated.

The rental rates stated in this Schedule are Hourly Rates unless indicated otherwise. These rates do not include the operator's wages.

When equipment is rented on an operated basis, the operator's wages will be added to the rental cost. Operator's wages shall be interpreted to mean the basic wage paid the operator plus 35% burden.

The cost of fuel and lubricants supplied by the Department will be deducted from the rental charge at the commercial rate applying in the area.

Rental rates in this Schedule are maximum hourly rates allowed. When equipment is rented for weekly or monthly periods, the Department reserves the right to negotiate rates lower than the hourly rates shown.

Rentals are to be paid for working time only. Lunch hour is not paid as working time. Down time of less than one hour, in one shift, will not be deducted.

The rental period commences when the unit leaves the owner's premises and shall end on the date of the actual delivery of the unit at the owner's premises or at any other equidistant point, provided transportation conditions are equal and such delivery is requested by the owner. In the case of water transport, the owner will be required to negotiate a rate less than that shown for the period of transport.

Insurance for the unit or units being rented will be the responsibility of the owner.

Machines that may not be represented in this schedule will be subject to rate calculation by the Department.

All rates for equipment rented in Labrador will be increased by 5.8%. This will recognize the different operating conditions associated with work in Labrador.

METRIC CONVERSION			
net flywheel horsepower	X 0.746	- kilowatts	kw
weight (mass)	X 0.45	- kilograms	kg
cubic yards	X 0.7646	- cubic metres	m^3
cubic feet	X 0.028	- cubic metres	m^3
cubic feet per minute (CFM)	X 28.31	- litres/minute	
foot pounds	X 1.355818	- joule	j
feet	X 0.305	- metres	m
inches	X 25.40	- millimetres	mm
ton	X 0.907	- tonne	t
inches	X 2.54	- centimetres	cm
amperes	X NC	- amperes	A
kilowatts (Electric 1,000 watts)	X NC	- kilowatts	kw
gallons - Imperial	X 4.546	- litres	l
NOTE: Model and Specification References are located in the Appendix.			

FORM 1000

TABLE OF CONTENTS

SECTION 1

AIR EQUIPMENT AND TOOLS

1-1 Compressor (Portable or Self-Propelled)

Rated Litre/Minute	Rated C.F.M.	Rate Per Hour
1700 - 2400	60 - 85	$ 8.25
2450 - 3550	86 - 125	$10.00
3600 - 5000	126 - 180	$11.95
5100 - 7000	181 - 250	$18.12
7140 - 7900	252 - 280	$26.25

Rated Litre/Minute	Rated C.F.M.	Rate Per Hour
17000	600	$37.88
21200	750	$47.25
24000	850	$49.32
25400	900	$51.38

1-2 Pneumatic Tools and Accessories

Rock Drills NOTE: (1) Schedule of rates not including steels or bits. Crawler mounted with hammer off:

Bore - Millimetres	Bore - Inches	Rates Per Hour
82.6 - 101.6	3¼" - 4"	$25.48
108.0 - 127.0	4¼" - 5"	$40.98

Bore - Millimetres	Bore - Inches	Rates Per Hour
133.4 - 152.4	5¼: - 6"	$42.70

1-3 Jackhammer

SIZE - Kilograms	SIZE - Pounds	Rate Per Hour
Up to 27 kg	Up to 60 lbs	$3.75
36 kg	80 lbs.	$4.24

1-4 Pavement Breakers

SIZE - Kilograms	SIZE - Pounds	Rate Per Hour
14 - 18	30 - 40	$3.12
23 - 27	50 - 60	$3.75

SIZE - Kilograms	SIZE - Pounds	Rate Per Hour
32 - 36	70 - 80	$4.25

1-5 Grinders

	Rate Per Hour
Bit Grinders - Bench Type	$1.15
- Pedestal Type	$4.98

	Rate Per Hour
Surface Grinders - 152.4 mm or 6" diameter stone	$1.08

1-6 Blasting Apparatus

	Millimetres	Inches	Rate Per Hour
50 Shot Blaster	10	0.40	$0.49
1,000 Shot Blaster	27	1.06	$1.19

	Millimetres	Inches	Rate Per Hour
Sequential Blaster	142	5.60	$6.23

1-7 Air Tracks, Crawler Mounted, Compressor, Drill Steel, Bits, Hose and Incidental Hardware Included in Rate

Bore		Rate Per Hour
Millimetres	Inches	
Up to 127.0	Up to 5	$119.67
Over 127.0 to 165.1	Over 5 to 6.5	$123.10

Bore		Rate Per Hour
Millimetres	Inches	
Over 165.1 to 177.8	Over 6.5 to 7	$130.18
Over 177.8 to 203..2	Over 7 to 8	$141.87

1-8 Hydraulic Track Drill, Power Drill Steel and Bit Extra

Millimetres	Rate Per Hour
Up to 127.0 bore	$102.89

SECTION 2

ASPHALT AND BITUMINOUS EQUIPMENT

2-1 Spreaders and Finishers - Crawler or Rubber Tire Mounted

Metres	Feet	Rate Per Hour
Small - basic 2.44m	Small - basic 8'	$45.08
Medium - 3.05m - 4.27m	Medium - 10' - 14'	$90.95

Metres	Feet	Rate Per Hour
Large - 3.05m - 4.88m	Large - 10' - 16'	$126.25
With electric screed control		$15.84

2-2 Distributors - Truck mounted complete with power unit and spray bars

Litres	Imperial Gallons	Rate Per Hour
6819	1500	$42.70
9092	2000	$47.82
11365	2500	$51.23

Litres	Imperial Gallons	Rate Per Hour
13638	3000	$55.15
18184	4000	$58.32

2-3 Pavement Profilers/ Cold Planers (Including replacement teeth)

Cut Width - Centimetres	Cut Width - Inches	Rate Per Hour
Under 30	Under 12	$98.25
30-45	12-18	$127.20
76	30	$238.50

Cut Width - Centimetres	Cut Width - Inches	Rate Per Hour
137	54	$291.50
168	66	$414.75

2-4 Asphalt Recyclers

Capacity - tonnes per hour	Rate per Hour
4-9	$33.30

SECTION 3

COMPACTION EQUIPMENT

3-1 Rammer Type

Strokes/Minute	Mass Kilograms	Mass Pounds	Rate Per Hour
300 - 800	Up to 67.5	Up to 150	$5.48
300 - 800	68 - 112.5	151 - 250	$6.63

Strokes/Minute	Mass Kilograms	Mass Pounds	Rate Per Hour
300 - 800	113 - Over	251 - Over	$7.05

3-2 Vibratory Plate Type - Manually Guided

Mass (kilograms)	Plate Width (millimetres)	Mass (pounds)	Plate Width (inches)	Rate Per Hour
Up to 126	Up to 610	Up to 280	Up to 24"	$4.98
126.5 - 225	457 - 914	281 - 500	18" - 36"	$10.26
225.5 - 360	508 - 813	501 - 800	20" - 32"	$11.25
360.5 & over	508 - 914	801 - over	20" - 36"	$14.62

3-3 Vibratory Rollers - Manually Guided

Drum Length - Centimetres	Drum Length - inches	Rate Per Hour
71.1cm - 76.2cm single drum	28" - 30" single drum	$7.68
38.1cm - 55.9cm tandem drum	15" - 22" tandem drum	$8.82
61.0cm - 66.0cm tandem drum	24" - 26" tandem drum	$10.08

Drum Length - Centimetres	Drum Length - inches	Rate Per Hour
71.1cm - 76.2cm tandem drum	28" - 30" tandem drum	$12.50
81.3cm - 91.4cm tandem drum	32" - 36" tandem drum	$17.42

3-4 Self-Propelled - Tandem Vibrating, Smooth Drums

Centimetres	Kilograms	Inches	Pounds	Rate Per Hour
Up to 106.7	Up to 3175	Up to 42	Up to 7000	$19.13
109.0 - 139.7	3629 - 5670	43 - 55	8000 - 12500	$46.45
142.0 - 185.0	6804 - 10433	56 - 73	15000 - 23000	$62.83
188.0 - 216.0	Over 10886	74 - 85	Over 24000	$81.98

3-5 Self-Propelled - Single Drum, Smooth, Single Drive

Centimetres	Kilograms	Inches	Pounds	Rate Per Hour
101.6 - 127	2722 - 3269	40 - 50	6000 - 8000	$42.88
129.5 - 152	3856 - 5443	51 - 60	8500 - 12000	$50.41
154.9 - 215	5670 - 9072	61 - 85	12500 - 20000	$59.35
218.4 - 266	9526 - 13608	86 - 105	21000 - 30000	$64.98

3- 6 Self-Propelled - Multiple Drum, Smooth, for Asphalt or Soils

Centimetres	Kilograms	Inches	Pounds	Rate Per Hour
109.0 - 203	3628 - 5440	43 - 55	8000 - 12000	$45.08
152.4 -	5443 - 7258	60 - 80	12000 - 16000	$56.91

3-7 Pneumatic Tired

No of Wheels	Operating Mass - Tonne	Operating Mass - Ton	Rate Per Hour
9 wheel	Up to 8.7	Up to 10	$16.06
9 wheel	8.7 - 13	10 - 15	$25.60
7 - 9 wheel	14 - 22	16 - 25	$34.95

No of Wheels	Operating Mass - Tonne	Operating Mass - Ton	Rate Per Hour
7 - 9 wheel	23 - 27	26 - 30	$44.40
7 wheel	28 - 32	31 - 35	$46.86

3-8 Steel Wheel - Tandem Smooth Drums, for Asphalt, 2 Axles

Working Mass - Tonne	Working Mass - Ton	Rate Per Hour
2.7 - 4.5	3.1 - 5	$22.20
4.6 - 7.2	5.1 - 8	$32.06

Working Mass - Tonne	Working Mass - Ton	Rate Per Hour
7.3 - 10.8	8.1 - 12	$37.00
10.9 - 14.5	12.1 - 16	$39.45

3-9 Self-Propelled, Vibratory, Single Drum, Smooth Drum, Drum Drive

Centimetres	Kilograms	Inches	Pounds	Rates Per Hour
154.9 - 177.8	4990 - 6804	61 - 70	11000 - 15000	$44.38
180.5 - 215.9	6350 - 9752	71 - 85	14000 - 21500	$55.49
180.5 - 215.9	9752 - 11340	71 - 85	21500 - 25000	$64.11

SECTION 4

CONCRETE PLACING EQUIPMENT

4-1 Concrete Saws - Self-Propelled - Single Blade

Kilowatts	Horsepower	Rate Per Hour
13	18	$8.79
22	30	$10.96

Kilowatts	Horsepower	Rate Per Hour
28	37	$12.04
45	60	$20.71

4-2 Curb Machines

	Rate Per Hour
Slip form Curb and Gutter Machine - Fully Automatic	$97.47

SECTION 5

CRANES

5-1 Mobile or Self-Propelled - Hydraulic

Tonne	Ton	Rate Per Hour
4.5 - 7.3	5 - 8	$47.85
9.7 - 13.6	10 - 15	$59.77
15.5 - 16.3	16 - 18	$70.62
18.1 - 27.2	20 - 30	$90.52

Tonne	Ton	Rate Per Hour
36.3 - 40.8	40 - 45	$111.00
45.3 - 49.9	50 - 55	$124.27
54.4 - 58.9	60 - 65	$133.20

5-2 Boom Trucks - Hydraulic

Tonnes	Rate per Hour
< 8.0	$35.00
8.0 to 11.99	$57.00
12.0 to 17.99	$65.00

Tonnes	Rate per Hour
18.0 to 23.99	$74.00
24.0 and over	$85.00

SECTION 6

GENERATORS

6-1 Engine Driven - Gasoline or Diesel - Air or Water Cooled

Description	Rate Per Hour
Less than 3 KW	$4.00
3kW to 3.99kW	$5.00
4kW to 4.99kW	$5.75
5kW to 5.99kW	$6.87
6kW to 6.99kW	$8.03
7kW to 9.99 kW	$9.50

Description	Rate Per Hour
10kW to 14.99kW	$10.00
15kW to 24.99kW	$12.22
25kW to 34.99kW	$14.38
35kW to 39.99kW	$17.35
40kW to 49.99kW	$19.67
50kW to 129.99kW	$21.08

Description	Rate Per Hour
130kW to 149.99kW	$31.56
150kW to 174.99kW	$38.91
175kW and Greater	$49.53

SECTION 7

FLOATS

7-1 Floats with Tractor - Rigid Gooseneck

Tonnes	Tons	Rate Per Hour
14.5-18.1 tonnes single axle trailer	16-25 tons single axle trailer	$50.41
23.6-31.7 tonnes tandem axle trailer	26-35 tons tandem axle trailer	$75.33
32.7-40.8 tonnes tandem axle trailer	36-45 tons tandem axle trailer	$88.91
41.7-49.9 tonnes tandem axle trailer	46-55 tons tandem axle trailer and up	$101.21

7-2 Detachable Gooseneck

Tonnes	Rate Per Hour
Up to - 36 tonnes	$92.45
42 - 50 tonnes	$108.49

Tonnes	Rate Per Hour
54 tonnes and up	$111.95

SECTION 8

EXCAVATORS

8-1 Hydraulically Operated, Rubber Tired, Four Wheel Drive, Capacity Heaped

Cubic Metres	Cubic Yards	Rate Per Hour
0.38 - 0.56	1/2 - 5/8	$72.08
0.57 - 0.67	3/4 - 7/8	$83.09

8-2 Hydraulically Operated, Crawler Mounted, Capacity Heaped

Cubic Metres	Cubic Yards	Rate Per Hour
.38 - .56	1/2 - 5/8	$69.03
.57 - .75	3/4 - 7/8	$78.45
.76 - 1.13	1 - 1 1/4	$93.50
1.14 - 1.52	1 1/2 - 1 7/8	$126.73
1.53 - 1.89	2 - 2 1/4	$156.79

Cubic Metres	Cubic Yards	Rate Per Hour
1.90 - 2.28	2 1/2 - 2 7/8	$210.00
2.29 - 3.05	3 - 3 7/8	$267.00
3.06 - 3.81	4 - 4 7/8	$329.25
3.82 -	5 -	$359.75

8-3 Hydraulic Excavator Attachments

Hydraulic Breakers

Impact Energy (ft-lb)		Rate Per Hour
Joules	Foot Pounds	
205 - 675	150 - 499	$11.16
676 - 1355	500 - 999	$16.14
1356 - 2710	1000 - 1999	$34.92
2711 - 4065	2000 - 2999	$46.14
4066 - 5422	3000 - 3999	$64.62

Impact Energy (ft-lb)		Rate Per Hour
Joules	Foot Pounds	
5423 - 6778	4000 - 4999	$70.92
6779 - 8134	5000 - 5999	$85.92
8135 - 9490	6000 - 6999	$97.44
>9490	>7000	$108.90

Hydraulic Brush Cutters

Cutting Swath		Rate Per Hour
Millimetres	Inches	
1321	54	$15.16
1676	66	$24.15

Hydraulic Concrete Crushers/Shears

Crushing Force in Tonnes	Rate Per Hour
15 - 30	$18.74
31 - 50	$39.53
51 - 100	$61.51

Crushing Force in Tonnes	Rate Per Hour
101 - 150	$64.82
151 - 200	$78.08

Hydraulic Tamper

Maximum Impulse Force - Kilograms	Rate per Hour
1000 - 2500	$6.01
2501 - 5000	$7.96
5001 - 7500	$13.97

Maximum Impulse Force - Kilograms	Rate per Hour
7501 - 10000	$17.33
10001 - 12500	$20.74

8-4 Mini Excavators - Tracked

Operating Weight (kg)	Rate per Hour
Up to 1999	$23.04
2000 to 2999	$35.63

Operating Weight (kg)	Rate per Hour
3000 to 3999	$44.25
4000 and Over	$52.00

SECTION 9

MOTOR GRADERS

9-1 Rigid Frame

Kilograms	Rate per Hour
Up to 4999	$41.15
5 000 - 10 999	$56.32
11 000 - 13 999	$64.33

Kilograms	Rate per Hour
14 000 - 18 999	$68.34
19 000 and Over	$71.26

9-2 Articulated

Kilograms	Rate per Hour
Up to 9999	$55.25
10 000 - 10 999	$61.00
11 000 - 11 999	$66.75
12 000 - 12 999	$72.60

Kilograms	Rate per Hour
13 000 - 13 999	$78.30
14 000 - 14 999	$84.30
15 000 - 15 999	$90.00
16 000 - 16 999	$96.00

Kilograms	Rate per Hour
17 000 - 17 999	$101.75
18 000 - 18 999	$107.50
19 000 and Over	$113.00

9-3 With Scarifier

Kilograms	Rate per Hour
Up to 10999	$4.00
11 000 - 12 999	$7.00

Kilograms	Rate per Hour
13 000 - 18999	$14.00
19 000 and Over	$20.00

With Vee Plow Add $5.60 Per Hour - With Wing Add $4.40 Per Hour

SECTION 10

FORM 1000

RUBBER TIRED FRONT END LOADER (FOUR WHEEL DRIVE)

10-1 Minimum S.A.E. Operating Weight Rating

Minimum Operating Weight kgs	S.A.E. Bucket Sizes (m_3)	Rate Per Hour
Less than 6570	Up to 1.14	$38.23
6570 to 8069	1.15 - 1.52	$45.93
8070 to 9519	1.53 - 1.90	$53.46
9520 to 10879	1.91 - 2.28	$58.21
10880 to 13483	2.29 - 2.67	$67.82
13484 to 14959	2.68 - 3.05	$84.20

Minimum Operating Weight kgs	S.A.E. Bucket Sizes (m_3)	Rate Per Hour
14960 to 18589	3.06 - 3.43	$98.63
18590 to 23119	3.44 - 3.81	$117.15
23120 to 24929	3.82 - 4.19	$137.35
24930 to 26290	4.20 - 4.58	$159.71
More than 26290	4.59 -	$184.95

Attachments - wing add $4.40 per hour

NOTE: "Operating weights will be the final authority on rates to be charged. Additional weight caused by the usage of any form of counter weight devices will not change the rate classification."

SECTION 11

CRAWLER TYPE LOADERS

11-1 Crawler Type Loaders Minimum S.A.E. Operating Weight Rating

Kilograms	Pounds	Rate Per Hour
4536 - 6123	10000 - 13500	$30.83
7484	16500	$39.09
9526	21000	$52.41

Kilograms	Pounds	Rate Per Hour
13608	30000	$69.05
16782	37000	$84.77
19505	43000	$107.89

SECTION 12

FRONT END LOADER / BACKHOE COMBINATION

12-1 Rubber Tired

Kilowatts	Horsepower	Rate Per Hour
23 - 33	31 - 44	$31.54
34 - 48	45 - 65	$38.59
49 - 63	66 - 85	$53.70

Kilowatts	Horsepower	Rate Per Hour
64 - 82	86 - 110	$70.95
83 - 112	111 - 150	$100.15

If backhoe bucket is not required, reduce appropriate loader backhoe rate by 33 1/3%.

SECTION 13

PUMPS

13-1 Centrifugal

Including 6.1m - 20' Suction Hose, 7.6m - 25' Discharge Hose

Millimetres	Inches	Rate Per Hour
50.8mm - gasoline	2" - gasoline	$ 3.50
76.2mm - gasoline	3" - gasoline	$4.75
101.6mm - gasoline	4" - gasoline	$6.22
152.4mm - gasoline	6" - gasoline	$10.92
203.2mm - gasoline	8" - gasoline	$11.62

Millimetres	Inches	Rate Per Hour
76.2mm - diesel	3" - diesel	$4.97
101.6mm - diesel	4" - diesel	$9.90
152.4mm - diesel	6" - diesel	$17.00
203.2mm - diesel	8" - diesel	$21.05
254.0mm - diesel	10" - diesel	$25.85

13-2 Electric Sumbersible Including cable and 7.6 m - 25' discharge hose

Millimetres	Inches	Rate Per Hour
50.8 mm	2"	$3.25
76.2 mm	3"	$5.00
101.6 mm	4"	$8.46

Millimetres	Inches	Rate Per Hour
152.4 mm	6"	$10.26
203.2 mm	8"	$22.02
254.0 mm	10"	$26.00

13-3 Diaphragm - Gasoline portable including 6.1m - 20' suction, 7.6 - 25' discharge hose

Millimetres	Inches	Rate Per Hour
50.8mm	2"	$4.38
76.2mm	3"	$5.62

Millimetres	Inches	Rate Per Hour
101.6mm	4"	$6.71

13-4 Pump Discharge Hoses - for each metre in excess of 7.6m

Millimetres	Inches	Rate Per Hour
50.8mm	2"	$0.02
76.2mm	3"	$0.03
101.6mm	4"	$0.04

Millimetres	Inches	Rate Per Hour
152.4mm	6"	$0.08
203.2mm	8"	$0.13
254.0mm	10"	$0.21

13-5 Test/Fire Pump - Gasoline with attachments

Millimetres	Inches	Rate Per Hour
50.8mm	2"	$6.77

SECTION 14

SNOW CLEARING EQUIPMENT

14-1 Snowblowers, Loader Mounted

NOTE:

1. Hourly rate does not include Carrier

Model	Rate Per Hour
Vohl DV4000	$91.00
SMI 3200	$91.00
SnoGo MP-3D	$91.00
RPM Tech RPM-227	$91.00

14-2, Plow Trucks

NOTE:

1. Plow trucks are to be complete with a front blade, side wing and a spreader capable of dispensing ice control materials
2. Rate does not include operator

Model	Rate per Hour
Single Axle	$85.00
Tandem Axle	$90.00

SECTION 15

TRACTOR - DOZERS

15-1

NOTE:

1. Tractor-Dozers that have been discontinued or put out of production for 15 years are deleted from the current reference lists.
2. Any crawler Tractor-Dozer not included in these lists will be rated by using a comparable Tractor-Dozer chosen by the Department.
3. The owner shall supply the Department with proof of net kilowatt or net horsepower capacities.
4. Power shift machines are rated by net engine kilowatt or net engine horsepower.

Rates for Tractor, Crawler - Complete with Blade

Kilowatt	Horsepower	Rate Per Hour
30 - 41	40 - 55	$32.83
42 - 52	56 - 70	$45.40
53 - 60	71 - 80	$50.71
61 - 75	81 - 100	$58.67
76 - 101	101 - 135	$75.37

Kilowatt	Horsepower	Rate Per Hour
102 - 131	136 - 175	$95.73
132 - 168	176 - 225	$119.65
169 - 254	226 - 340	$177.10
255 - 328	341 - 440	$288.50

Hydraulic Ripper - Rear Mounted

Rating	Rate Per Hour
up to 135 Hp	$10.80
136 to 175 Hp	$12.00
176 to 225 Hp	$16.20

Rating	Rate Per Hour
226 to 340 Hp	$26.50
341 to 440 Hp	$40.70

SECTION 16

TRUCKS

16-1 Pickup Trucks - capacity shown is Gross Vehicle Mass Two Wheel Drive

Kilograms	Pounds	Rate Per Hour
2268 - 2812	5000 - 6200	$16.58
2812 - 3810	6200 - 8400	$17.88

Kilograms	Pounds	Rate Per Hour
3855 - 4175	8500 - 9200	$18.18
4200 - 4536	9300 - 10000	$18.56

Four Wheel Drive - Add $0.45 per hour

16-2 OFF HIGHWAY TRUCKS

- diesel powered, rear dump, full cab
- capacity shown is "Rated Payload Capacity"

Tonne	Ton	Rate Per Hour
19.0 - 22.7	21 - 25	$113.86
23.6 - 27.2	26 - 30	$142.33

Tonne	Ton	Rate Per Hour
28.1 - 31.8	31 - 35	$170.78
32.7 - 40.8	36 - 45	$196.71

16-3 ARTICULATED ROCK TRUCKS

- diesel powered, rear dump, full cab
- capacity shown is "Rated Payload Capacity"

Tonne	Ton	Rate Per Hour
19.0 - 22.7	21 - 25	$142.33
23.6 - 27.2	26 - 30	$170.78

Tonne	Ton	Rate Per Hour
28.1 - 31.8	31 - 35	$196.71
32.7 - 40.8	36 - 45	$216.38

16-4 Water Trucks

Hourly truck rates will apply according to manufacturer's GVM rating plus the following: Tank, Water Pump and Spray Bar.

Tank Capacity - Litre	Tank Capacity - Gallons	Rate Per Hour
up to 4541	up to 999	$30.61
4546 - 6814	1000 - 1499	$32.78

Tank Capacity - Litre	Tank Capacity - Gallons	Rate Per Hour
6819 - 9087	1500 - 1999	$36.45

16-5 Paint Stripers

Tank Capacity - Litre	Tank Capacity Gallons	Rate Per Hour
45 - 63 litre hand or self-propelled	10 - 14 gal.	$30.83
67.5 - 81 litre self-propelled	15 - 18 gal.	$53.94

16-6 Truck Mounted Stripers

Rating	Rate Per Hour
28,000 lb to 34,000 lb G V W R	$84.77

16-7 Dump Trucks

Vehicle	Rate Per Hour (Operator Included)
Single Axle Vehicle	$35.85
Tandem Axle Vehicle	$51.00
Tandem - Tandem Vehicle	$63.75

Vehicle	Rate Per Hour (Operator Included)
Tractor Dump Trailer (including Belly Dump)	$76.25
Tractor Only	$51.00

16-8 Dump Truck / Tag Along Combinations

Equipment	Rate Per Hour (Operator Included)
Tandem Axle Dump Truck & Single Axle Tag-along	$71.45
Tandem Axle Dump Truck & Tandem Axle Tag-along	$82.93

Equipment	Rate Per Hour (Operator Included)
Tandem Axle Dump Truck & Tri-axle Tag-along	$90.00
Tandem Axle Dump Truck & Hydroseeder	$81.23

16-9 Stone Slingers

Equipment	Rate Per Hour
Stone Slinger	$56.86

16-10 Stake Body Trucks

Manufacturers GVW - kilograms	Rate Per Hour
Up to 6803	$21.60
6804 to 8844	$31.13
8845 to 13607	$32.50

Manufacturers GVW - kilograms	Rate Per Hour
13608 to 20411	$35.05
Over 20412	$40.25

Attachments Hydraulic boom up to 9t add $15.00
Hydraulic boom over 9t add $22.00

SECTION 17

WELDING EQUIPMENT

17-1 Arc Welder

Portable Engine Driven (Diesel or Gasoline). Rods Extra.

Amperes	Rate Per Hour
100 - 200	$5.62
200 - 300	$7.31

Amperes	Rate Per Hour
260 - 500	$11.25

17- 2 Torch including Acetylene and Oxygen (rods extra if required)

	Rate Per Day
Torch	$21.66

SECTION 18

MISCELLANEOUS EQUIPMENT

18-1 Air Benders and Cutters

Benders

Description	Rate Per Hour
Large Hand Operated	$1.23
Power Operated	$9.61

Cutters

Description	Rate Per Hour
Hand Operated	$1.23
Power Operated	$8.20

18-2 Boilers - Oil fired, skid mounted

Kilowatts	Horsepower	Rate Per Hour
15	20	$4.93
22	30	$5.92
37	50	$8.20

Kilowatts	Horsepower	Rate Per Hour
75	100	$11.89
112	150	$18.74

18-3 Steam Cleaners

Litres	Imperial Gallons	Rate Per Hour
455 - 546	100 - 120	$3.95
682 - 818	150 - 180	$5.06

Litres	Imperial Gallons	Rate Per Hour
1023 - 1137	225 - 250	$10.15

18-4 Portable Scales

Tonne	Metres	Ton	Feet	Rate Per Hour
22.7 - 27.2	7.6m - 2.7m	25 - 30	25' x 9' deck	$12.45
27.2 - 36.3	9.1m - 3.1m	30 - 40	30' x 10' deck	$14.56

Tonne	Metres	Ton	Feet	Rate Per Hour
36.3 - 45.4	12.2m - 3.1m	40 - 50	40' x 10' deck	$16.46

18-5 Semi-portable Scales

Tonne	Metres	Rates Per Hour
22.7 - 27.1	7.6m x 2.7m	$8.25
27.2 - 36.3	9.1m x 3.1m	$10.02
36.4 - 45.4	12.2m x 3.1m	$12.87

Tonne	Metres	Rates Per Hour
45.5 - 54.4	13.7m x 3.1m	$16.34
54.5 and Greater	15.2m x 3.7m	$17.74

18-6 Melting Kettle (includes propane)

	Rate Per Hour
Trailer Mounted 750 - 825 litres	$24.66
Level and Equipment	$2.71

18-7 Concrete Routers

	Rate Per Hour
Gas Powered 4.5 W	$11.10
Gas Powered 18.5 W	$22.20

18-8 Gas Powered Jackhammers

	Rate Per Hour
Gas Powered Jackhammers	$1.77

18-9 Survey Equipment

	Rate Per Hour
Sewer Lazer	$4.49
Theodolite and Equipment	$2.69

	Rate Per Hour
Level and Equipment	$2.50
Total Station and Equipment	$3.25

18-10 Tapping Gear

	Rate Per Hour
Up to 2"	$4.58

18-11 Trench Box

	Rate Per Hour
Standard (4' x 8' x 16')	$3.47

18-12 Butt Fushion Machine

	Rate Per Hour
Up to 14" Gen set N/I	$8.67

18-13 Chain Saw

	Rate Per Day
All Sizes	$27.08

18-14 Sweepers - Towed or Attachment

Description	Broom Width	Rate Per Hour
Towed - Traction Type	5 - 6 ft (152 - 183 cm) 7 - 8 ft (213 - 244 cm)	$9.75 $11.05
Towed - Separate Engine	5 - 6ft (152 - 183 cm) 7 - 8 ft (213 - 244 cm)	$11.05 $13.00
Attachment - Hydraulic Driven	5 - 6 ft (152 - 183 cm) 7 - 8 ft (213 - 244 cm)	$10.40 $11.70
Attachment - PTO Driven	5 - 6 ft (152 - 183 cm) 7 - 8 ft (213 - 244 cm)	$9.75 $11.05

18-15 Sweepers - Self Propelled

Description	Capacity	Rate Per Hour
Self Loading	$0.8m^3$ (1yd3) $1.5m^3$ (2yd3) $2.5m^3$ (3yd3) $3.1m^3$ (4yd3) $3.8m^3$ (5yd3)	$37.91 $42.78 $48.46 $55.50 $67.15

TRACTORS - BULLDOZERS - CRAWLERS

POWER RANGE Kw (Hp)	MAKE	MODEL	NET FLYWHEEL ENGINE POWER Kw (Hp)
30-41 (40-55)	KOMATSU	D2OP-6	30 (40)
	KOMATSU	D20A-6	30 (40)
	KOMATSU	D20PL-6	30 (40)
	KOMATSU	D21A-6	30 (40)
	KOMATSU	D21P-6	30 (40)
42-52 (56-70)	J. DEERE	400 G	45 (60)
	CAT	D3	46 (62)
	CAT	D3B	48 (65)
	IHC	TD-7E	48 (65)
	CASE	550	50(67)
	CASE	550G/G LT/LGP	50(67)
	CAT	D3C	52 (70)
	DRESSER	TD-7G	52 (70)
	DRESSER	TD-7H	52 (70)
53-60 (71-80)	CAT	D3C SERIES III	53 (71)
	CASE	850B	54 (72)
	IHC	TD8E	58 (78)
	CASE	650	60 (80)
	CASE	650 G	60 (80)
	CAT	D4E	60 (80)
	CAT	D4C	60 (80)
	DRESSER	TD-8G	60 (80)
61-75 (81-100)	CAT	D4C SERIES III	61 (82)
	CASE	850D	61 (82)
	F-A	8	65 (87)
	F-A	8B	66 (88)
	CASE	850 G	66 (89)
	CASE	850 G LGP	66 (89)
	J. DEERE	650 G	67 (90)
	J. DEERE	650 G SERIES IV	67 (90)
	J. DEERE	650 G LGP SERIES IV	67 (90)
	KOMATSU	D40A-3	67 (90)
76-101 (101-135	CASE	1150B	78 (105)
	CAT	D4H XL	78 (105)
	CAT	D4H LGP	78 (105)
	CAT	D4H SERIES III XL	78 (105)
	CAT	D4H SERIES III LGP	78 (105)
	CAT	D5B	78 (105)
	CAT	D5	78 (105)
	KOMATSU	D41E	78 (105)
	CAT	D5M	82 (110)
	CASE	1150E	84 (113)
	CASE	1150G LGP	88 (118)
	CASE	1150G	88 (118)
	CAT	D5H	90 (120)
	J. DEERE	750B	90 (120)
	KOMATSU	D50A-17	90 (120)
102-131 (136-175)	CAT	D6D/D6M	104(140)
	J. DEERE	750 C	104(140)
	J. DEERE	750 C LGP	104(140)

POWER RANGE Kw (Hp)	MAKE	MODEL	NET FLYWHEEL ENGINE POWER Kw (Hp)
30-41 (40-55)	KOMATSU	D20PLL-6	30 (40)
	KOMATSU	D21PL-6	30 (40)
	J. DEERE	350C	31 (42)
	CASE	350	34(45)
	CASE	450	40 (53)
42-52 (56-70)	J. DEERE	450G	52 (70)
	J. DEERE	450G LGP / LT	52 (70)
	KOMATSU	D31PLL-18	52 (70)
	KOMATSU	D31-18	52 (70)
	KOMATSU	D31PL-18	52 (70)
	KOMATSU	D31P-18	52 (70)
	KOMATSU	D31P-20	52 (70)
	KOMATSU	D31E-20	52 (70)
53-60 (71-80)	DRESSER	TD-8H	60 (80)
	DRESSER	TD-8H LGP	60 (80)
	J. DEERE	550G	60 (80)
	J. DEERE	550G SERIES IV	60 (80)
	KOMATSU	D37P-2	60 (80)
	KOMATSU	D37E-2	60 (80)
	KOMATSU	D37E-5	60 (80)
	KOMATSU	D37P-5	60 (80)
61-75 (81-100)	KOMATSU	D41P-3	67 (90)
	KOMATSU	D41A-3	67 (90)
	KOMATSU	D39E	67 (90)
	CAT	D5C	67 (90)
	DRESSER	TD-9H	67 (90)
	DRESSER	TD-9H LGP	67 (90)
	CAT	D5C SERIES III XL	68 (91)
	CAT	D5C SERIES III LGP	68 (91)
	CAT	D4H	71 (95)
	CAT	D4H SERIES II	71 (95)
76-101 (101-135	F-A	10C	91 (122)
	KOMATSU	D53P-17	93 (124)
	KOMATSU	D53-A17	93 (124)
	DRESSER	TD-12C	93 (124)
	DRESSER	TD-12C LGP	93 (124)
	DRESSER	TD-12C LONG TRACK	93 (124)
	CAT	D5H XL	97 (130)
	CAT	D5H LGP	97 (130)
	CAT	D5H SERIES II XL	97 (130)
	CAT	D5H SERIES II LGP	97 (130)
	CASE	1450B	97 (130)
	KOMATSU	D58P-1	97 (130)
	KOMATSU	D58P-1B	97 (130)
	KOMATSU	D58E-1	97 (130)
	KOMATSU	D68P-1	101 (135)
102-131 (136-175)	KOMATSU	KBD65E-6	119(160)
	CAT	D6H	123(165)
	CAT	D6H SERIES II	123(165)

POWER RANGE Kw (Hp)	MAKE	MODEL	NET FLYWHEEL ENGINE POWER Kw (Hp)
	J. DEERE	750 B LGP	104(140)
	DRESSER	TD12C-XP LONG TK	104(140)
	DRESSER	TD 12C-XP LGP	104(140)
	DRESSER	TD-15C	104(140)
	IHC	TD15C	104(140)
	KOMATSU	D63E-1	104(140)
	CASE	1550	112(150)
	F-A	14-C	112(150)
	CAT	D6E	116(155)
	KOMATSU	D65A-8	116(155)
132-168 (176-225)	J. DEERE	850 C	132(180)
	J. DEERE	850 C LGP	132(180)
	KOMATSU	D68E-1	134(180)
	CAT	D6H LGP	134(180)
	KOMATSU	D65EX-12	142(190)
	KOMATSU	D65PX-12	142(190)
	F-A	16-B	145(195)
	CAT	D7G	149(200)
	KOMATSU	D75A-1	149(200)
169-194 (226-260)	TEREX	82-30B	194(260)
	CAT	D7H - SERIES II	171(230)
195-254 (261-340)	CAT	D8N	213(285)
	KOMATSU	D135A-2	213(285)
	CAT	D8K	224(300)
	F-A	FD30	224(300)
	F-A	21-C	224(300)
	KOMATSU	D155AX3	225 (302)
255-328 (341-440)	CAT	D9N	276(370)
	TEREX	82-50	276(370)
	CAT	D9R	302(405)
	CAT	D9H	306(410)
329- (441-)	CAT	D10N	388(520)
	F-A	41B	391(524)
	KOMATSU	D375A-2	

POWER RANGE Kw (Hp)	MAKE	MODEL	NET FLYWHEEL ENGINE POWER Kw (Hp)
	DRESSER	TD-15E LONG TK	123(165)
	DRESSER	TD-15E LGP	123(165)
	J. DEERE	850B	123(165)
	J. DEERE	850B LGP	123(165)
	J. DEERE	850 B LONG TK	123(165)
	KOMATSU	D65P-8	123(165)
	KOMATSU	D65E-8	123(165)
	KOMATSU	D60E-8	127(170)
	CAT	D6H XL	130(175)
	CAT	D6H XR	130(175)
132-168 (176-225)	KOMATSU	D68E-1	153(205)
	TEREX	82-20B	153(205)
	CAT	D7H	160(215)
	F-A	FD20	166(223)
	DRESSER	TD-20G	168(225)
	KOMATSU	D85A-21B	168(225)
	KOMATSU	D85E-21	168(225)
	KOMATSU	L85A-21	168(225)
	KOMATSU	K85P-21	168(225)
169-194 (226-260)	CAT	D7R	171 (230)
195-254 (261-340)	CAT	D8R	228 (305)
	IHC	TD25C	231(310)
	IHC	TD25E	231(310)
	DRESSER	TD-25G	238(320)
	KOMATSU	D155A-2	238(320)
	CAT	D8L	250(335)
	KOMATSU	D355A-5	306(410)
	KOMATSU	D355A-3	306(410)
	F-A	HD-31	317(425)
329- (441-)	CAT	D10	522(700)
	CAT	D11N	574(770)
	KOMATSU	D475A-2	574(770)

EXCVATORS HYDRAULICALLY OPERATED, CRAWLER MOUNTED

OPERATING WEIGHTS kg	MAKE	MODEL	BUCKET SIZE RANGEm3
11 - 16,000	KOMATSU	PC100L-5	0.18-0.55
	CAT	311	0.32-0.63
	KOMATSU	PC120-3	0.18-0.61
	CAT	E110B	0.22-0.63
	KOMATSU	PC120-5	0.18-0.60
	KOMATSU	PC120-6	0.37-0.76
	LINK BELT	LS-2650C-II	0.37-0.48
	JOHN-DEERE	490E	0.23-0.83
	JOHN-DEERE	490D	0.40-0.60
	CAT	312	0.32-0.63

OPERATING WEIGHTS kg	MAKE	MODEL	BUCKET SIZE RANGEm3
11 - 16,000	SAMSUNG	SE130LC-2	0.40-0.65
	CAT	E140	0.29-0.75
	SAMSUNG	SE 130LCM-2	0.35-0.55
	HITACHI	EX150	0.45-0.70
	JOHN-DEERE	590D	0.30-1.10
	CAT	315	0.28-0.74
	KOMATSU	PC150-5	0.57-0.75
	LINK-BELT	LS2700	0.37-0.76
	CASE	9020	0.38-0.60
	FIATALLIS	FX 150 LC	0.25-1.10

FORM 1000

OPERATING WEIGHTS kg	MAKE	MODEL	BUCKET SIZE RANGE m^3
	CASE	9010	0.38-0.70
	CASE	9010B	0.38-0.70
	LINK BELT	2650 QUANTUM	0.37-0.67
	CAT	E120B	0.22-0.71
	CAT	205B	0.28-0.79
	SAMSUNG	SE130-LC	0.40-0.65
	FIATALLIS	FX130LC	0.38-0.81
	CASE	688	0.38-0.76
16 - 21,000	DRESSER	6200LC	0.53-1.17
	KOMATSU	PC180NLC-3	0.57-1.00
	KOMATSU	PC180LC-3	0.57-1.00
	CAT	317	0.47-1.00
	CAT	215	0.57-1.00
	KOMATSU	PC180LLC-3	0.57-1.00
	KOMATSU	PC180LC-5	0.57-1.00
	KOMATSU	PC180NLC-5	0.57-1.00
	HITACHI	EX200	0.45-1.00
	HITACHI	UH081	0.76-0.95
	HITACHI	UH082	0.76-0.95
	HITACHI	UH083	0.76-0.95
	CAT	213BLC	0.45-0.98
	KOMATSU	PC210-3	0.36-1.40
	KOMATSU	PC180LLC-5	0.57-1.00
	CAT	E200B	0.67-1.10
	KOMATSU	PC200-5	0.36-1.17
	CAT	320	0.70-1.40
21 - 26,000	AKERMAN	H10B	0.28-1.30
	LINK-BELT	LS2800LF	0.37-0.57
	LINK-BELT	2800 QUANTUM	0.37-0.57
	CASE	9030B LR	0.51-0.69
	CASE	9030 LR	0.51-0.69
	CAT	219D	0.44-1.04
	KOMATSU	PC210LC-5	0.36-0.71
	KOMATSU	PC220-5	0.44-1.26
	CAT	219DLC	0.44-1.04
	CAT	320S	0.70-1.40
	CAT	322N	0.90-1.40
	CAT	322	0.90-1.40
	KOMATSU	PC240-3	0.44-1.26
	KOMATSU	PC240-3	0.44-1.26
	CAT	E240B	0.58-1.44
	KOMATSU	PC220LC-5	0.44-1.26
	CAT	225	0.57-1.34
	DRESSER	6220LC	0.60-1.26
	JOHN DEERE	790ELC	0.73-1.55
26 - 31,000	HITACHI	EX270	0.80-1.40
	KOMATSU	PC280NLC-3	0.44-1.40
	CAT	325LN	0.70-1.70
	CASE	9040 LR	0.51-0.69
	LINK-BELT	LS3400CF	0.48-0.67
	CAT	225DLC	0.56-1.80

OPERATING WEIGHTS kg	MAKE	MODEL	BUCKET SIZE RANGE m^3
	KOMATSU	PC150NHD-5	0.18-0.65
	CASE	888	0.43-0.96
	CASE	880B	0.43-0.96
	KOMATSU	PC 150LC-5	0.41-0.75
	KOMATSU	PC150HD-5	0.18-0.65
	CAT	211BLC	0.34-0.86
	CAT	315L	0.28-0.74
	CASE	9020B	0.38-0.86
16 - 21,000	JOHN DEERE	690DLC	0.46-1.15
	FIATALLIS	FX200 LC	0.25-1.30
	HITACHI	EX200LC	0.45-1.20
	LINKBELT	LS-2800C-II	0.48-0.96
	KOMATSU	PC200LC-5	0.36-1.17
	KOMATSU	PC210LC-3	0.36-1.40
	FIATALLIS	FX210 LC	0.27-1.31
	CAT	215DLC	0.44-1.04
	CASE	9030	0.56-1.06
	CAT	320N	0.70-1.40
	DRESSER	6150LC	0.43-0.75
	CAT	EL200B	0.67-1.10
	LINKBELT	2800 QUANTUM	0.48-1.15
	CASE	980B	0.70-1.40
	CAT	320L	0.73-1.17
	JOHN DEERE	690ELC	0.46-1.22
	KOMATSU	PC210-5	0.36-1.17
	SAMSUNG	SE210-LC	0.46-1.21
21 - 26,000	CAT	EL240B	0.58-1.44
	KOMATSU	PC240-5	0.44-1.26
	CAT	322LN	0.63-1.90
	HITACHI	EX220 LC-3	0.80-1.40
	KOMATSU	PC240LC-3	0.44-1.26
	KOMATSU	PC240LC-3	0.44-1.26
	CAT	322L	0.90-1.50
	LINK-BELT	LS3400C-II	0.57-1.00
	CASE	9040 B	0.73-1.39
	JOHN DEERE	790D	0.40-1.50
	LINK-BELT	3400 QUANTUM	0.57-1.34
	KOMATSU	PC240LC-6	0.57-1.34
	CASE	9040	0.73-1.39
	KOMATSU	PC240LC-5	0.44-1.26
	CAT	EL240C	0.50-0.76
	CAT	225D	0.56-1.60
	CAT	325	0.82-1.60
	HITACHI	UH123	1.14-1.33
	HITACHI	UH122	1.14-1.33
26 - 31,000	HITACHI	EX300	0.40-0.59
	HITACHI	EX300LC	0.40-0.59
	KOMATSU	PC300-5	0.52-1.80
	SAMSUNG	SE280LC-2	0.65-1.50
	CAT	E300B	0.76-1.82
	HITACHI	SUPER EX300LC-3	1.15-1.86

OPERATING WEIGHTS kg	MAKE	MODEL	BUCKET SIZE RANGEm_3
	KOMATSU	PC280LC-3	0.44-1.40
	CAT	325L	0.82-1.60
	LINK BELT(LONG REACH)	3400 QUANTUM	0.57-0.67
	HITACHI	EX270LC	0.80-1.70
	KOMATSU	PC250LC-6	0.76-1.52
	AKERMAN	H14B	0.52-1.70
	SAMSUNG	SE280-LC	0.65-1.70
	KOMATSU	PC300-3	0.50-1.80
31 - 39,000	KOMATSU	PC300LC-5	0.52-1.80
	CAT	EL300B	0.76-1.82
	DRESSER	6300LC	0.86-1.60
	CASE	9050	0.96-1.87
	CAT	330	0.70-2.10
	CASE	9050B	0.92-2.09
	CAT	330LN	1.10-2.10
	LINK-BELT	4300 QUANTUM	0.96-2.10
39 - 49,000	KOMATSU	PC400-5	1.30-2.20
	HITACHI	EX400	1.20-2.00
	HITACHI	EX400H	1.20-2.00
	AKERMAN	H16D	1.14-2.40
	CAT	235C	1.00-2.30
	DRESSER	6400LC	1.15-2.20
	KOMATSU	PC400LC-5	1.30-2.20
	HITACHI	EX400LCH	1.20-2.00
	HITACHI	EX400LC	1.20-2.28
49 - 62,000	CAT	350L	1.30-2.60
	AKERMAN	H25D	1.95-3.06
62 - 71,000	CAT	245	1.52-2.87
	CAT	E650	1.80-3.00
	KOMATSU	PC650-3	2.40-3.70
	KOMATSU	PC650LC-3	2.40-3.70
71 - 82,000	CAT	245B SERIES II	1.90-3.30
	CAT	375	1.50-4.40
	CAT	375L	1.50-4.40

OPERATING WEIGHTS kg	MAKE	MODEL	BUCKET SIZE RANGEm_3
	KOMATSU	PC300NLC-3	0.50-1.80
	FIAT ALLIS	FX300 LC	0.40-1.95
	JOHN DEERE	892E LC	0.92-2.10
	JOHN DEERE	892DLC	0.96-1.70
	KOMATSU	PC300LC-3	0.50-1.80
	LINK-BELT	LS4300	0.96-1.62
	LINK-BELT	LS4300C-II	0.96-1.62
31 - 39,000	CAT	330L	0.70-2.10
	CAT	231D	1.20-2.00
	CAT	231DLC	1.10-1.60
	SAMSUNG	SE350-LC	1.00-1.92
	KOMATSU	PC300HD-5	0.86-1.44
	SAMSUNG	SE350LC-2	0.90-1.75
	KOMATSU	PC360LC-5	0.50-1.80
	CAT	235	0.80-2.10
39 - 49,000	JOHN DEERE	992DLC	0.96-2.60
	JOHN DEERE	992E LC	1.36-2.28
	LINK-BELT	LS-5800 C II	1.43-3.06
	CASE	9060	1.27-2.52
	KOMATSU	PC400HD-5	1.15-1.62
	CASE	9060B	1.27-3.19
	SAMSUNG	SE450LC-2	1.70-2.10
	CAT	E450	1.15-2.35
	CAT	350	1.30-2.60
49 - 62,000	LINK-BELT	LS6400	
	KOEHRING-BANTAM	866E	
62 - 71,000	HITACHI	EX700	1.80-3.60
	HITACHI	EX700H	1.80-3.60
	HITACHI	EX700BE	1.80-3.60
71 - 82,000	LINK-BELT	LS7400A	
	KOEHRING-BANTAM	1066E	

MACHINE SIZE RANGE, SAE RATED BUCKET M3(Yd3)	MAKE	MODEL	SAE RATED BUCKET SIZE M3(Yd3)	OPERATING WEIGHT Kg (Lbs)
0.0 - 1.14	KOMATSU	WA20-1	0.26 (0.34)	1730 (3810)
(0.0 - 1.49)	KOMATSU	WA70-1	0.76 (1.00)	4510 (9940)
	JOHN DEERE	244 E	0.76 (1.00)	5327 (11746)
	MICHIGAN	L30	0.76 (1.00)	5940 (13100)
	JCB	409	0.91 (1.20)	5430 (11967)
	CASE	WIL	0.96 (1.25)	5440 (12000)

MACHINE SIZE RANGE, SAE RATED BUCKET M3(Yd3)	MAKE	MODEL	SAE RATED BUCKET SIZE M3(Yd3)	OPERATING WEIGHT Kg (Lbs)
0.0 - 1.14	IHC	H30B	0.96 (1.25)	5440 (12000)
(0.0 - 1.49)	IHC	510	0.96 (1.25)	6280 (13850)
	CAT	910	0.96 (1.25)	6490 (14300)
	CAT	910F	1.00 (1.30)	7248 (15982)
	CAT	910E	1.10(1.40)	7320 (16130)

1.15 - 1.52	TEREX	22C	1.15 (1.50)	5950 (13120)
(1.50 - 1.99)	F-A	345-B	1.15 (1.50)	7300 (16095)
	CAT	922B	1.15 (1.50)	7660 (16990)
	IHC	H50B	1.15 (1.50)	7940 (17500)
	IHC	H50C	1.15 (1.50)	7940 (17500)
	MICHIGAN	L50	1.15 (1.50)	8217 (18120)
	KOMATSU	WA100-1	1.20 (1.60)	7250 (15980)
	JOHN DEERE	344G	1.24 (1.63)	8103 (17865)
	CASE	W14	1.34 (1.75)	6700 (14765)
	IHC	515	1.34 (1.75)	7530 (16610)

1.15 - 1.52	CASE	W14C	1.34 (1.75)	8089 (17853)
(1.50 - 1.99)	DRESSER	512	1.34 (1.75)	8150 (17970)
	CAT	920	1.34 (1.75)	8530 (18800)
	CAT	926	1.34 (1.75)	8800 (19404)
	JOHN DEERE	444G	1.34 (1.75)	9226 (20340)
	KOMATSU	WA120-1	1.40 (1.80)	8030 (17700)
	CAT	910F	1.40 (1.80)	6914 (15243)
	CAT	914G	1.40 (1.80)	7211(15864)
	CAT	916	1.40 (1.80)	8580 (18920)

1.53 - 1.90	VOLVO	BM L50C	1.53 (2.00)	8140 (17950)
(2.00 - 2.49)	CAT	918F	1.53 (2.00)	9040(19933)
	CAT	944	1.53 (2.00)	10070 (22200)
	DRESSER	510C	1.53 (2.00)	7490 (16512)
	ALLIS	545	1.53 (2.00)	8110 (17890)
	ALLIS	545H	1.53 (2.00)	8800 (19410)
	IHC	H60B	1.53 (2.00)	9070 (20000)
	CASE	W18	1.53 (2.00)	9100 (19981)
	F-A	545B	1.53 (2.00)	9200 (20290)
	TEREX	72-21	1.53 (2.00)	9840 (21700)
	VOLVO	400	1.61 (2.10)	8990 (19820)
	CAT	924F	1.70(2.25)	9025(19900)

1.53 - 1.90	KOMATSU	WA180-1	1.70 (2.25)	9070 (20000)
(2.00 - 2.49)	DRESSER	518	1.70 (2.25)	9360 (20639)
	CAT	926E	1.70 (2.25)	9480 (20900)
	MICHIGAN	L70	1.70 (2.25)	9774 (21550)
	TEREX	72-20	1.70 (2.25)	10070 (22210)
	TEREX	L-20	1.70 (2.25)	10990 (24240)
	IHC	H60E	1.70 (2.25)	9540 (21040)
	CAT	930	1.70 (2.25)	9660 (21300)
	JOHN DEERE	544G	1.70 (2.25)	10262 (22624)
	CASE	621 B XT	1.70 (2.25)	12415 (27374)
	JOHN DEERE	444E	1.80 (2.38)	9555 (21640)

1.91 - 2.28	JCB	418	1.91 (2.50)	10200 (22500)
(2.50 - 2.99)	F-A	605B	1.91 (2.50)	10430 (23009)
	VME VOLVO	BM L70B	1.91 (2.50)	10340 (22796)
	VME VOLVO	BM L70C	1.91 (2.50)	10840 (23910)
	IHC	H65C	1.91 (2.50)	11110 (24500)
	CLARK	55H	1.91 (2.50)	11650 (25680)
	TEREX	72-31	1.91 (2.50)	11790 (26000)
	DRESSER	515C	1.91 (2.50)	8490 (18718)
	CASE	W20B	1.91 (2.50)	9830 (21683)
	IHC	H70C	1.91 (2.50)	-
	IHC	H70F	1.91 (2.50)	-

1.91 - 2.28	CASE	621 B	1.91 (2.50)	12025 (26511)
(2.50 - 2.99)	CAT	928F	2.00(2.60)	10852(23874)
	KOMATSU	WA250-1	2.10 (2.75)	10785 (23775)
	TEREX	72-30	2.10 (2.75)	10980 (24210)
	DRESSER	525	2.10 (2.75)	11420 (25181)
	CASE	621	2.10 (2.75)	11158 (24600)
	TEREX	L-25	2.10 (2.75)	11730 (25860)
	CAT	936	2.10 (2.75)	11800 (26020)
	CAT	936E	2.10 (2.75)	12320 (27170)
	JOHN DEERE	544B	2.20 (2.88)	10730 (23660)
	JOHN DEERE	544G	2.20 (2.88)	10728 (23655)

2.29 - 2.67	DRESSER	520C	2.29 (3.00)	10059 (22177)
(3.00 - 3.49)	CAT	938F	2.29 (3.00)	12320 (27170)
	CAT	966B	2.29 (3.00)	14380 (31700)
	IHC	H80A	2.29 (3.00)	14780 (32600)
	CASE	W24B	2.29 (3.00)	10880 (24000)
	CASE	W24C	2.29 (3.00)	10880 (24000)
	VOLVO	4400	2.29 (3.00)	11250 (24800)
	IHC	530	2.29 (3.00)	12560 (27700)
	TEREX	72-31B	2.29 (3.00)	12570 (27710)
	F-A	645B	2.29 (3.00)	12790 (28210)
	CAT	950	2.29 (3.00)	12790 (28600)
	CLARK	75B	2.29 (3.00)	13310 (29340)
	JCB	423	2.29 (3.00)	14240 (31400)
	VME VOLVO	BM L90B	2.47 (3.25)	12800 (28200)

2.29 - 2.67	CAT	950B	2.47 (3.25)	14650 (34800)
(3.00 - 3.49)	DRESSER	532	2.48 (3.25)	13105 (28896)
	TEREX	L-30	2.48 (3.25)	13630 (30050)
	TEREX	72-41	2.48 (3.25)	14150 (31200)
	TEREX	72-40	2.48 (3.25)	14630 (32255)
	CAT	936F	2.50(3.25)	12345(27220)
	KOMATSU	WA320-1	2.50 (3.25)	12585 (27745)
	CAT	938F	2.50(3.25)	13030(28731)
	CASE	721	2.50 (3.25)	13161 (29014)
	CASE	721 B	2.50 (3.25)	13383 (29014)
	CAT	950F	2.50 (3.25)	15660 (34530)
	JOHN DEERE	624E	2.60 (3.38)	14060 (31000)
	JOHN DEERE	624G	2.60 (3.38)	12745 (28103)

MACHINE SIZE RANGE, SAE RATED BUCKET M3(Yd3)	MAKE	MODEL	SAE RATED BUCKET SIZE M3(Yd3)	OPERATING WEIGHT Kg (Lbs)
2.68 - 3.05	VOLVO	BM L90C	2.68 (3.50)	14760 (32550)
(3.50 - 3.99)	CAT	950E	2.68 (3.50)	15780 (34800)
	TEREX	72-51AA	2.68 (3.50)	15280 (33700)
	IHC	H80B	2.68 (3.50)	15300 (33739)
	IHC	H90C	2.68 (3.50)	15330 (33800)

MACHINE SIZE RANGE, SAE RATED BUCKET M3(Yd3)	MAKE	MODEL	SAE RATED BUCKET SIZE M3(Yd3)	OPERATING WEIGHT Kg (Lbs)
2.68 - 3.05	MICHIGAN	L120	2.68 (3.50)	15471 (34110)
(3.50 - 3.99)	CASE	821 B	2.68 (3.50)	16824 (37090)
	DRESSER	530C	2.86 (3.75)	13484 (29728)
	CAT	950F - SERIES II	2.90(3.75)	16451(36274)

3.06 - 3.43	VOLVO	4500	3.06 (4.00)	13990 (30843)

3.06 - 3.43	F/A	756C	3.06 (4.00)	18300 (40360)

(4.00 - 4.49)	CASE	W36	3.06 (4.00)	15030 (33150)	(4.00 - 4.49)	CLARK	125B	3.06 (4.00)	18680 (41190)
	VOLVO	BM L120B	3.06 (4.00)	15700 (34700)		CAT	980	3.06 (4.00)	19950 (44000)
	ICH	54O	3.06 (4.00)	16210 (35750)		KOMATSU	WA380-1	3.06 (4.00)	16200 (35710)
	F/A	745B	3.06 (4.00)	16290 (35910)		CASE	821	3.06 (4.00)	16420 (36210)
	DRESSER	538	3.06 (4.00)	16730 (36885)		CAT	966C	3.06 (4.00)	16730 (36890)
	CAT	960F	3.06(4.00)	17545 (38687)		JOHN DEERE	644E	3.20 (4.25)	17230 (38000)
	IHC	H90E	3.06 (4.00)	18258 (40260)		JOHN DEERE	644G	3.20 (4.25)	16035 (35357)
3.44 - 3.81	TEREX	72-51B	3.44 (4.50)	17770 (39177)	**3.44 - 3.81**	CAT	966F	3.60 (4.75)	20490 (45160)
(4.50 - 4.99)	IHC	H100B	3.44 (4.50)	18800 (41500)	(4.50 - 4.99)	JCB	428	3.60 (4.75)	15260 (33650)
	F/A	FR20	3.44 (4.50)	19270 (42500)		KOMATSU	WA420-1	3.60 (4.75)	18165 (40050)
	IHC	H100C	3.44 (4.50)	21540 (47508)		VOLVO	BM L120C	3.60 (4.75)	18530 (40850)
	MICHIGAN	L160	3.44 (4.50)	22260 (49080)		DRESSER	542	3.60 (4.75)	18930 (41733)
	CAT	966F - SERIES II	3.60(4.75)	20725(45699)					
3.82 - 4.19	CAT	970F	3.82(5.00)	22682(50014)	**3.82 - 4.19**	CAT	980B	3.82 (5.00)	24220 (53400)
(5.00 - 5.49)	CASE	921	3.82 (5.00)	22725 (50100)	(5.00 - 5.49)	IHC	H120C	3.82 (5.00)	25030 (55200)
	CASE	921 B	3.82 (5.00)	22928 (50547)		MICHIGAN	L150	3.90 (5.10)	20588 (45400)
	IHC	H120B	3.82 (5.00)	23130 (51000)		VOLVO	BM L150C	4.00 (5.20)	22210 (48960)
	CLARK	175B	3.82 (5.00)	23450 (51710)		CAT	980C	4.01 (5.25)	26910 (59335)
4.20 - 4.58	DRESSER	545	4.20 (5.50)	22025 (48555)	**4.20 - 4.58**	TEREX	72-61	4.20 (5.50)	25810 (56908)
(5.50 - 5.99)	JOHN DEERE	744	4.20 (5.50)	22680 (50000)	(5.50 - 5.99)	CAT	980F	4.20 (5.50)	27314(60217)
	KOMATSU	WA470-1	4.20 (5.50)	21245 (46840)		CAT	980F - SERIES II	4.20 (5.50)	27314(60217)
	KOMATSU	WA450-2	4.20 (5.50)	21700 (47840)		MICHIGAN	L190B	4.40 (5.80)	27561 (60770)
	TEREX	80C	4.20 (5.50)	26843 (59190)		KOMATSU	WA500-1	4.40 (5.80)	27285 (60150)
4.59 - 4.96	CAT	988	4.59 (6.00)	32070 (70720)	**4.59 - 4.96**	DRESSER	555	4.60 (6.00)	28708 (63290)
(6.00 - 6.49)	CLARK	275B	4.59 (6.00)	35910 (79180)	(6.00 - 6.49)	CAT	980F	4.70 (6.00)	27390 (60380)
4.97 - 5.34	F/A	945B	4.97 (6.50)	29610 (65300)					
(6.50 - 6.99)	IHC	560	4.97 (6.50)	36590 (80690)					
5.35 -7.0	TEREX	72-71	5.35 (7.00)	31750 (70002)	**5.35 -7.0**	CAT	992	7.60 (10.00)	47620 (105000)
	KOMATSU	WA600-1	5.70 (7.50)	40770 (89880)		CAT	990	8.40 (11.00)	73480(161994)
	TEREX	90C	5.70 (7.50)	44407 (97920)		MICHIGAN	L480	9.60 (12.50)	80480 (177460)
	CAT	988B	6.00 (7.80)	42640 (94000)		CAT	994	10.00 (13.00)	170740 (376400)
	MICHIGAN	L270B	6.00 (7.80)	41208 (90860)		CAT	992C	10.40 (13.50)	87450 (192780)
	CAT	988F	6.00(7.80)	44328(97727)		CAT	992D	10.70 (14.00)	87590 (193110)
	MICHIGAN	L320	6.90 (9.00)	44805 (98800)		CAT	994	14.00 (18.00)	175500(387000)

OFF HIGHWAY TRUCKS

MAKE	MODEL	NET POWER		EMPTY WEIGHT		MAX PAYLOAD	
		kW	HP	kg	LB	tonne	Ton
KOMATSU	HD025-3	221	296	39180	86392	20.0	22.0
TEREX	3305B	242	324	22660	49965	31.0	34.2
CATERPILLAR	769B	309	414	28000	61740	32.0	35.3
KOMATSU	HD325-5	346	463	59255	130657	32.0	35.3
DRESSER	140M	336	450	31411	69261	36.2	39.9
CATERPILLAR	769C	336	450	31178	68747	36.3	40.0

MAKE	MODEL	NET POWER		EMPTY WEIGHT		MAX PAYLOAD	
		kW	HP	kg	LB	tonne	Ton
KOMATSU	HD325-6	364	488	60755	133965	36.5	40.2
EUCLID	R35	321	430	28440	62710	37.6	41.4
CATERPILLAR	771C	336	450	31178	78750	40.0	44.0
TEREX	3307	380	509	33710	74331	45.0	49.6
CATERPILLAR	773B	485	650	39396	86869	52.6	58.0

ARTICULATED ROCK TRUCKS

MAKE	MODEL	NET POWER		EMPTY WEIGHT		MAX PAYLOAD	
		kW	HP	kg	LB	tonne	Ton
CATERPILLAR	D20D	134	479	15000	33075	18.0	19.8
VOLVO	A20	137	183	15720	34663	18.5	20.4
CATERPILLAR	D22	175	234	17700	39029	20.0	22.0

MAKE	MODEL	NET POWER		EMPTY WEIGHT		MAX PAYLOAD	
		kW	HP	kg	LB	tonne	Ton
CATERPILLAR	D300D	213	285	20680	45599	27.2	30.0
CATERPILLAR	D300E	213	285	21180	46695	27.2	30.0
CATERPILLAR	D30D	213	285	21900	48290	27.2	30.0

MOXY	5222B	161	216	16800	37044	22.0	24.2
VOLVO	A25B	177	237	15515	34211	22.5	24.8
CATERPILLAR	D250B	163	218	17963	39608	22.7	25.0
CATERPILLAR	D25	175	234	17300	38147	22.7	25.0
CATERPILLAR	D25B	190	254	17900	39470	22.7	25.0
CATERPILLAR	D25D	194	260	19700	43439	22.7	25.0
CATERPILLAR	D25C	194	260	19233	42409	22.7	25.0
CATERPILLAR	D250D	160	214	17300	38147	22.8	25.0
CATERPILLAR	D250E	194	260	21000	46300	22.7	25.0
TEREX	2566	167	224	16800	37044	23.0	25.3
CATERPILLAR	D275	175	234	18700	41234	25.0	27.6
CATERPILLAR	D250	175	234	18500	40793	25.0	27.6
TEREX	2766	177	237	17200	37926	25.0	27.6
MOXY	6225B	187	250	16275	35886	25.0	27.6
CATERPILLAR	D275B	190	254	19200	42336	25.0	27.6
MOXY	6227B	187	250	17619	38850	27.0	29.8
TEREX	3066	192	257	19220	42380	27.0	29.8
CATERPILLAR	D30C	194	260	21320	47011	27.2	30.0
CATERPILLAR	D300B	194	260	19800	43659	27.2	30.0
CATERPILLAR	D300	190	254	19500	42998	30.0	33.1
CATERPILLAR	D330B	190	254	20200	44541	30.0	33.1
CATERPILLAR	D330	190	254	20000	44100	30.0	33.1
CATERPILLAR	D350	190	254	21000	46305	31.8	35.0
CATERPILLAR	D35	190	254	20000	44100	31.8	35.0
CATERPILLAR	D350B	190	254	21400	47187	31.8	35.0
CATERPILLAR	D35C	194	260	23860	52611	31.8	35.0
CATERPILLAR	D350C	194	260	23315	51410	31.8	35.0
CATERPILLAR	D350D	213	285	24595	54232	31.8	35.0
CATERPILLAR	D35HP	287	384	24950	55015	31.8	35.0
VOLVO	A35	240	321	24400	53802	32.0	35.3
MOXY	7235B	307	411	25720	55720	35.0	38.6
CATERPILLAR	D40D	287	384	28027	61800	36.3	40.0
CATERPILLAR	D400	287	384	25765	56812	36.3	40.0
CATERPILLAR	D400D	287	384	28027	61800	36.3	40.0
CATERPILLAR	D400E	287	384	29263	64512	36.3	40.0
TEREX	4066	278	372	25500	56228	36.5	40.2
CATERPILLAR	D44	336	450	28000	61740	40.0	44.1
CATERPILLAR	D44B	343	459	32296	71213	40.0	44.1

MOTOR GRADER - ARTICULATED FRAME

MINIMUM OPERATING WEIGHT	MINIMUM NET FLYWHEEL POWER	MAKE	MODEL	NET FLYWHEEL ENGINE POWER kW (Hp)	OPERATING WEIGHT KG (LB)
9,072 (20,000)	60 (80)	KOMATSU	GD313A-1	63 (85)	7,390 (16,290)
		KOMATSU	GD461A-1	84 (113)	9,050 (19,950)
		JOHN DEERE	570B	67 (90)	9,545 (21,000)
		JOHN DEERE	570A	67 (90)	9,545 (21,000)
		KOMATSU	GD523A-1	101 (135)	10,800 (23,810)
		KOMATSU	GD521A-1	101 (135)	10,800 (23,810)
		KOMATSU	GD511A-1	101 (135)	10,800 (23,810)
		KOMATSU	GD611A-1	116 (155)	12,500 (27,558)
12,701 (28,000)	100 (135)	CHAMPION	710A	101 (135)	12,701 (28,000)
		KOMATSU	GD621A-1	116 (155)	12,701 (28,000)
		KOMATSU	GD623A-1	116 (155)	12,701 (28,000)
		JOHN DEERE	670A	101 (135)	12,805 (28,230)
		JOHN DEERE	670B	101 (135)	12,805 (28,230)
		CATERPILLAR	135 H NA	101 (135)	12,950 (28,550)
		KOMATSU	GD661A-1	134 (180)	13,300 (29,320)
		CHAMPION	710A S III	101 (135)	13,318 (29,360)
		CATERPILLAR	12 G	101 (135)	13,325 (29,375)
		CATERPILLAR	140H	138 (185)	13,581 (29,941)
		GALION	850	124 (166)	13,682 (30,100)
		GALION	850 B	124 (166)	13,682 (30,100)
		GALION	850 VHP	124 (166)	13,682 (30,100)
		GALION	850B VHP	124 (166)	13,682 (30,100)
MINIMUM OPERATING WEIGHT	MINIMUM NET FLYWHEEL POWER	MAKE	MODEL	NET FLYWHEEL ENGINE POWER kW (Hp)	OPERATING WEIGHT KG (LB)

MINIMUM OPERATING WEIGHT	MINIMUM NET FLYWHEEL POWER	MAKE	MODEL	NET FLYWHEEL ENGINE POWER kW (Hp)	OPERATING WEIGHT KG (LB)
9,072 (20,000)	60 (80)	CATERPILLAR	120H NA	93 (125)	12,519 (27,600)
		GALION	830	107 (144)	12,600 (27,800)
		GALION	830 B	107 (144)	12,600 (27,800)
		KOMATSU	GD525A-1	101 (135)	12,620 (27,830)
		GALION	830 AWD	107 (144)	12,600 (27,800)
		GALION	830BAWD	107 (144)	12,600 (27,800)
		CATERPILLAR	120G	93 (125)	12,863 (28,359)
12,701 (28,000)	100 (135)	KOMATSU	GD625A-1	116 (155)	13,700 (30,210)
		JOHN DEERE	672 B	101 (135)	13,710 (30,230)
		CATERPILLAR	130G	101 (135)	13,736 (30,220)
		CHAMPION	720A	114 (153)	13,817 (30,460)
		CHAMPION	716A S III	101 (135)	14,003 (30,871)
		CHAMPION	710A S IV	101 (135)	14,084 (31,050)
		CATERPILLAR	140G VHP	112 (150)	14,106 (31,100)
		JOHN DEERE	770B	116 (155)	14,175 (31,250)
		JOHN DEERE	770A	116 (155)	14,175 (31,250)
		JOHN DEERE	770 B H	116 (155)	14,195 (31,300)
		CATERPILLAR	12 H NA	104 (140)	14,247 (31,410)
		CHAMPION	716A S IV	101 (135)	14,270 (31,460)
		CHAMPION S III	720A	114 (153)	14,474 (31,910)
		CHAMPION S III	720AVHP	116 (155)	14,479 (31,920)
MINIMUM OPERATING WEIGHT	MINIMUM NET FLYWHEEL POWER	MAKE	MODEL	NET FLYWHEEL ENGINE POWER kW (Hp)	OPERATING WEIGHT KG (LB)

14,515 (32,000)	112 (150)	GALION	870 AWD	152 (204)	14,534 (32,400)
		GALION	870 B	152 (204)	14,534 (32,400)
		DRESSER	870	160 (215)	14,607 (32,400)
		CHAMPION	720A S IV	114 (153)	14,620 (32,230)
		CHAMPION S IV	720 A VHP	114 (153)	14,642 (32,280)
		CHAMPION	726A S IV	114 (153)	14,642 (32,280)
		JOHN DEERE	772B	116 (155)	14,717 (32,450)
		CATERPILLAR	140H VHP	112 (150)	14,724 (32,460)
		CATERPILLAR	143H VHP	112 (150)	14,724 (32,460)
		CHAMPION	730A	139 (187)	14,724 (32,460)
		CATERPILLAR	140 H NA	112 (150)	14,724 (32,460)
		JOHN DEERE	772 BH	116 (155)	14,739 (32,500)
		CATERPILLAR	143 H NA	112 (150)	14,774 (32,570)
		CHAMPION SIII	726A VHP	116 (155)	15,205 (33,521)
		CHAMPION	730A SIII	139 (187)	15,341 (33,820)
		CHAMPION	730A SIV	139 (187)	15,341 (33,820)

14,515 (32,000)	112 (150)	CHAMPION	736A S IV	139 (187)	15,341 (33,820)
		CHAMPION	740A	157 (210)	15,565 (34,315)
		CATERPILLAR	160 H NA	134 (180)	15,586 (34,360)
		CATERPILLAR	160 H VHP	134 (180)	15,586 (34,360)
		CATERPILLAR	140GAWD	134 (180)	15,787 (34,732)
		CHAMPION	736A S III	139 (187)	16,026 (35,331)
		CATERPILLAR	163 H NA	134 (180)	16,538 (36,460)
		CATERPILLAR	163 H VHP	134 (180)	16,538 (36,460)
		CHAMPION	750A	150 (200)	16,919 (37,300)
		KOMATSU	GD705A-4	149 (200)	17,620 (38,580)
		CHAMPION	780A	150 (200)	18,416 (40,600)
		KOMATSU	GD725A-1	149 (200)	18,500 (40,790)
		CATERPILLAR	14G	149 (200)	20,534 (45,175)
		KOMATSU	GD825A-1	209 (280)	25,750 (56,770)
		CATERPILLAR	140G	112 (150)	15,627 (34,380)
		CATERPILLAR	16G	205 (275)	27,323 (60,110)

Rubber Tired Backhoe / Loader Combinations

POWER RANGE		MAKE	MODEL	NET FLYWHEEL ENGINE POWER	
KILOWATTS	HORSE POWER			KILOWATTS	HORSE POWER
49 - 63	66 - 85	JCB	214	57	
		JOHN DEERE	310E	53	71
		CASE	580L	54	73
		FORD-NEW HOLLAND	555E	56	75
		FORD-NEW HOLLAND	NH75	56	75
		CAT	416C	56	75
		CAT	428C	56	75
		CAT	426C	60	80
		JOHN DEERE	310SE	60	80
64 - 82	86 - 110	JOHN DEERE	410E	67	90
		CASE	580 SUPER L	67	90
		JCB	1600B	67	90
		JCB	214-4WD	69	92
		JCB	215S	69	92
		JCB	217	69	92
		JCB	217S	69	92
83 - 112	111 - 150	JOHN DEERE	710D	86	115

POWER RANGE		MAKE	MODEL	NET FLYWHEEL ENGINE POWER	
KILOWATTS	HORSE POWER			KILOWATTS	HORSE POWER
49 - 63	66 - 85	JOHN DEERE	315SE	60	80
		CASE	580L TURBO	60	80
		JCB	215	63	85
		CAT	436C	63	85
		CAT	438C	63	85
		FORD-NEW HOLLAND	575E	63	85
		FORD-NEW HOLLAND	NH85	63	85
		FORD-NEW HOLLAND	655E	63	85
64 - 82	86 - 110	FORD-NEW HOLLAND	675E	70	95
		FORD-NEW HOLLAND	NH95	70	95
		CASE	590 SUPER L	74	99
		JCB	214S	75	101
		CAT	446B	76	102
		FORD-NEW HOLLAND	LB115	79	106

PAVEMENT PROFILERS / COLD PLANERS

CUT WIDTH		MAKE	MODEL
CM	INCHES		
LESS THAN 30	LESS THAN 12	CAT	PR75
30 - 46	12 - 18	CAT INGERSOLL RAND	PR105 MW175
76	30	INGERSOLL RAND	MW250C
137	54	CAT	PR225
168	66	CAT GALION/DRESSER	PR275 SP600

Mini Excavators

MAKE	MODEL	OPERATING WEIGHT (kgs)	MAKE	MODEL	OPERATING WEIGHT (kgs)

CATERPILLAR	301.5	1673
	301.6	1770
	301.8	1800
	302.5	2734
	303.5	3550
	304.5	4595
JOHN DEERE	17ZTS	1730
	27ZTS	2885
	35ZTS	3530
	50ZTS	4792

KUBOTA	K008	866
	KX41	1685
	KX61	2685
	KX91	3250
	KX121	3885
	KX161	5530