

DIVISION 600 - MISCELLANEOUS CONSTRUCTION

SECTION 601 - GABIONS AND MATTRESSES

601.01 Description This work shall consist of furnishing, assembling, filling with stones and lacing wire mesh baskets, hereafter called gabions or mattresses, constructed in accordance with these specifications and placed in conformity with the lines, grades and dimensions shown on the plans or established.

601.02 Materials Materials shall conform to the requirements specified in the following Sections of Division 700 - Materials.

Gabion	711.02
Stones for Gabions	711.03
Mattresses	711.07
Stones for Mattresses	711.08

601.03 Fabrication Gabions and mattresses shall be manufactured so that their sides, ends, lid, and diaphragm(s) can be assembled to form rectangular units of the specified dimensions.

Gabions shall be of a single unit construction. The front, base, back and lid shall be woven into a single unit. The ends and diaphragm(s) shall be factory connected to the base.

The base, sides, and two ends of mattresses shall be of a single unit construction woven into a single unit. Diaphragm(s) shall be factory connected to the base. The lid may be a separate unit.

Perimeter edges of the mesh forming the gabion or mattress shall be securely fastened so that joints have at least the same strength as the wire mesh itself.

The wire mesh shall be fabricated to be non-raveling. Non-raveling is defined as the ability to resist pulling apart at any of the twists or connections forming the mesh when a single wire in a section of mesh is cut and the section of mesh then subjected to the load test described in the materials specification.

The gabion length shall be 1½, 2, 3, or 4 times its horizontal width. The horizontal width shall not be less than 900 mm [36 in]. However, all gabions furnished by the manufacturer shall be of uniform width. Where the gabion length exceeds 1½ times its horizontal width, the gabion shall be equally divided into cells by diaphragm(s) of the same mesh and gauge as the gabion body.

Mattresses shall be at least 1.8 m by 1.8 m [6 ft by 6 ft] and equally divided by transverse diaphragms.

601.04 Assembling Gabions and mattresses shall be supplied folded flat, tied in pairs and packed in bundles. Single units shall be removed from the bundle; unfolded flat on the ground and all kinks and bends flattened.

The units shall be assembled individually by erecting the front side, back side, ends, and diaphragm(s), assuring that all creases are in the correct position and the tops of all sides level.

The four corners of each unit shall be laced first, followed by the edges of internal diaphragm(s) to the sides.

The lacing procedures for lacing corners and units together shall consist of cutting a length of lacing wire approximately 1½ times the distance to be laced, not to exceed 1.5 m [5 ft], securing the wire terminal at the corner by looping and twisting, then proceeding to lace with alternating single and double loops at approximately 125 mm [5 in] intervals and securely fasten the other wire terminal.

The mattresses shall not be assembled in their final location, except as required for lacing adjacent units together. This is to maintain a uniform bedding surface for installation as described in Section 601.051.

At the option of the Contractor, approved locking wire fasteners may be used in lieu of lacing wire provided they are used in every mesh opening along the joint, each ring is formed such that the ends interlock and the fasteners be of stainless steel construction with a minimum thickness of 3.17 mm [0.125 in], meeting the requirements of ASTM A213, Type 302.

601.05 Installation of Gabions The assembled gabion units shall be placed in the proper location. All adjoining empty gabions shall be placed along the perimeter of the gabion contact surfaces to obtain a monolithic structure.

Once the gabion units are laced together, they shall be stretched to effective alignment. This operation shall be carried out after several empty gabion units have been positioned. The first gabion in the line shall be partially filled to provide the necessary anchorage prior to stretching. Stretching shall be carried out using a means of stretching of at least 900 kg [1 ton] capacity.

While under tension, the gabion shall be carefully controlled against any possible unraveling.

Whenever gabion structures require more than one tier, the upper empty gabion tier, while under tension, shall be laced to the top of the lower one.

601.051 Installation of Mattresses If the mattress is to be placed in the dry, the assembled unit shall be placed in the proper location after it is assembled as described in Section 601.04. Several empty units shall be laced together along the contact surfaces to obtain a monolithic structure. Care shall be taken to maintain a uniform surface on the bedding material.

If the mattresses are to be placed underwater, they may be laced together, filled in the dry, and then placed in final position.

If the mattresses are polyvinyl chloride coated, they shall not be dragged, but shall be placed in a manner so as not to damage the coating.

601.052 Filter Fabric A filter fabric in accordance with Section 722.02 - Drainage Geotextile, shall be placed on the subgrade, backslope, and sides of the excavation. If earthfill is to be placed over the gabions, filter fabric shall be placed top of the gabions before earthfill placement.

601.06 Filling Gabions and mattresses shall be filled in strict accordance with the manufacturer's recommendations, one copy of these recommendations will be supplied to the Resident. Care shall be taken when placing stones inside gabions and mattresses in an effort to prevent distortion and ensure proper alignment.

Care shall be taken when placing fill material to assure that the sheathing on coated units will not be broken or damaged.

Gabions shall be filled in layers, 300 mm [1 ft] at a time. Two connecting wires shall be placed between each layer in all cells along all exposed faces of the gabion structure. All connecting wires shall be looped around two mesh openings and the wire terminals shall be securely twisted to prevent their loosening.

The cells in any row shall be filled in stages so that local deformation will be avoided. At no time shall any cell be filled to a depth exceeding 300 mm [1 ft] more than the adjoining cell.

Along all exposed gabion faces, the outer layer of stone shall be carefully placed and packed by hand to ensure proper alignment and a neat, compact, square appearance. No sharp edges of stone shall protrude through the wire mesh. The last layer of stone shall be leveled with the top of the gabion or mattress to allow proper closing of the lid and provide an even surface for the next course.

Gabions and mattresses shall be well packed and full without excessive bulging.

601.061 Filling of Hand Filled Gabions The assembled gabion units shall be placed in the proper location. A form shall then be placed along the front face and any side face not adjacent to an already placed gabion, and anchored to formwork on the back face to provide a rigid frame rectangle before filling with stone.

The forms shall be sufficiently braced and tied to prevent distortion while the stones are being placed.

On all exposed gabion faces, the outer layer of stone shall be carefully placed and packed by hand to ensure proper alignment and a neat, compact, square appearance. No sharp edges of stone shall protrude through the wire mesh.

Care shall be taken when placing fill material to assure that the sheathing on coated units will not be broken or damaged.

Gabions shall be filled by hand in 300 mm [1 ft] layers. Two connecting wires shall be placed between each layer in all cells along all exposed faces of the gabion structure. All connecting wires shall be looped around two mesh openings and the wire terminals shall be securely twisted to prevent their loosening.

The cells in any row shall be filled in stages so that local deformation will be avoided. At no time shall any cell be filled to a depth exceeding 300 mm [1 ft] more than the adjoining cell.

The last layer of stone shall be leveled with the top of the gabion or mattress to allow proper closing of the lid and provide an even surface for the next course.

At no time will any stones be placed by machine.

Complete gabions shall have a maximum deviation from the designated shape of 25 mm in 1 m [1 inch in 3 ft]. Gabions not meeting this tolerance will be emptied, adjustments made, and refilled.

601.07 Lid Closing The lids shall be stretched tightly over the filling, using crowbars or lid closing tools, until the lid meets the perimeter edges of the front and end panels. The lid shall then be tightly laced along all edges, ends, and diaphragms in the same manner as described above for assembly.

601.08 Cutting and Folding Mesh Where shown on the drawings or when otherwise directed, the mesh shall be cut, folded, and wired together to suit existing site conditions. The mesh must be cleanly cut and the surplus mesh cut out completely or folded back and neatly wired to an adjacent face. The cut edges of the mesh shall be securely laced together with lacing wire in the manner as described above for assembling.

601.09 Method of Measurement Gabions and mattresses will be measured for payment by the cubic meter [cubic yard] to the neat line dimensions shown on the plans.

601.10 Basis of Payment Payment for gabions and mattresses will be made at the contract unit price per cubic meter [cubic yard] in place. Payment will be full compensation for excavating to place gabions and backfill material, for preparing and fine grading the foundations area, for furnishing and placing backfill material under and behind the gabions and for furnishing and placing all necessary gabion units including wire mesh baskets, lacing wire, rock fill and all labor and equipment necessary to complete the work.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
601.21 Gabions, Galvanized	cubic meter [Cubic Yard]

601.211	Gabions, Galvanized and Hand Filled	cubic meter [Cubic Yard]
601.22	Gabions, PVC Coated	cubic meter [Cubic Yard]
601.221	Gabions, PVC Coated and Hand Filled	cubic meter [Cubic Yard]
601.23	Mattresses, Galvanized: _____	cubic meter [Cubic Yard]
601.24	Mattresses, PVC Coated: _____	cubic meter [Cubic Yard]

## SECTION 602 - PIPE LINING

Reserved

## SECTION 603 - PIPE CULVERTS AND STORM DRAINS

603.01 Description This work shall consist of constructing or reconstructing pipe culverts and storm drains, in accordance with these specifications, the Standard Detail plans and in reasonably close conformity with the lines and grades shown on the plans or established.

The word "pipe" in these specifications shall include both round pipe and pipe arches..

### 603.02 Materials Meet Sections:

Joint Mortar	705.02
Flexible Gaskets	705.03
Flexible Culvert Polyvinylchloride (PVC) Pipe	706.08
Corrugated Steel, Metallic Coated Pipe	707.02
Fiber-bonded Corrugated Steel Pipe & Pipe Arches	707.04
Corrugated Aluminum Alloy Pipe & Pipe Arches	707.06
Polymer Precoated, Galvanized Corrugated Steel	707.07
Pipe & Pipe Arches	
Aluminum Coated (Type 2) Corrugated Steel Pipe	707.10
Zinc-Coated (Galvanized) Corrugated Steel Pipe	707.11
Rigid Culvert	
Reinforced Concrete Pipe	706.02
Corrugated Polyethylene Pipe	706.06

Flexible culverts with a diameter of 1200 mm [48 in] or more shall have the ends cut to a partial bevel as called for on the plans. The cut ends of galvanized steel pipe shall be regalvanized or painted with a zinc aluminum paint conforming to Federal Specification TT-P-1561A or an approved equal.

Helical corrugated pipe shall be re-rolled to form angular corrugations on the ends.

The corrugated bands for connecting pipe with 68 mm by 13 mm [ $2\frac{2}{3}$  in by  $\frac{1}{2}$  in] corrugations shall be not less than 265 mm [ $10\frac{1}{2}$  in] wide.

Rigid culverts, designated to have the ends shaped to a partial bevel, shall be either cast or cut to the required shape and dimensions. In either case, the edges of the pipe shall be even and true with no exposed reinforcing.

### 603.03 Construction Requirements

603.031 General Culvert pipe and pipe arches shall be furnished under the following options unless otherwise specified.

Option I The Contractor shall furnish any of the following type of pipe under Option I:

- Corrugated Steel, Metallic (zinc or aluminum) Coated Pipe
- Reinforced Concrete Pipe
- Corrugated Polyethylene Pipe
- Any of the metal pipes allowed under Option III.

Option III The Contractor shall furnish any of the following types of pipe under Option III. (Corrugated pipe used under this option shall be adequate to equal the flow capacity of comparable smoothlined pipe):

- Fiber-bonded Corrugated Steel Pipe
- Corrugated Aluminum Alloy Pipe
- Polyvinylchloride (PVC) Pipe
- Polymer-Precoated Galvanized Corrugated Steel Pipe
- Reinforced Concrete Pipe
- Corrugated Polyethylene Pipe

Within any single run of culvert pipe, including extensions of existing culverts, the type of pipe shall be the same unless otherwise specified or as directed by the Engineer. In a closed drainage system, a run of culvert pipe shall be considered from catch basin to catch basin. In an open drainage system, a run of culvert shall be considered from inlet to outlet.

Option III polyvinylchloride (PVC) pipe shall only be used in closed drainage systems, between catch basins.

603.0311 Corrugated Polyethylene Pipe for Option III If inspection by the Resident reveals an unsatisfactory installation, the Resident may direct the contractor to test installed Smooth Lined Corrugated Polyethylene Pipe for Option III to ensure the vertical deflection does not exceed the maximum allowable deflection. Maximum allowable deflection shall be 5 percent of the sum of the nominal inside diameter minus a 1.5 percent undersize tolerance.

Deflection tests shall not be performed until at least 30 days after completion of installation and compaction of backfill. The pipe shall be cleaned and inspected for offsets and obstructions before testing.

For all pipes 600 mm [24 in] and smaller, a mandrel shall be pulled through the pipe by hand to ensure the maximum allowable deflections have not been exceeded. The mandrel shall be certified by the Department prior to use. If the mandrel fails to pass through the pipe, the pipe will be deemed overdeflected.

For pipes greater than 600 mm [24 in], deflections shall be determined by a method submitted and approved by the Department. If a mandrel is selected, the minimum diameter and length and other requirements shall conform to the dimensions and requirements stated below. If other methods are used the measurements shall meet the minimum mandrel diameter requirements.

Any overdeflected pipe shall be uncovered and if not damaged as determined by the Department shall be allowed for reinstallation. Damaged pipe shall not be reinstalled and shall be removed from the work site.

The mandrel shall be a rigid non-adjustable, odd numbered-leg (9 legs minimum) mandrel having an effective length not less than its nominal diameter and having a minimum diameter at any point along the full length as follows:

Nominal Size	Minimum Mandrel Diameter
mm [in]	mm [in]
300 [12]	285 [11.23]
375 [15]	356 [14.02]
450 [18]	428 [16.84]
600 [24]	570 [22.46]
750 [30]	713 [28.07]
900 [36]	856 [33.69]
1050 [42]	998 [39.30]
1200 [48]	1141 [44.92]

When deflection testing reveals overdeflected pipe, all costs incurred by the Contractor including mandrel and deflection testing, reinstallation of pipe and delays shall be the responsibility of the Contractor. When deflection testing reveals satisfactory pipe, all costs for deflection testing will be paid for by the Department.

603.032 Excavation Trenches shall be excavated in accordance with the requirements of Section 206 - Structural Excavation and wide enough to allow joining the culvert and compacting the bedding and backfill material under and around the culvert. Unless otherwise designated, trench walls shall be as nearly vertical as possible and the trench width no greater than necessary for installation of the culvert.

603.04 Bedding Culverts, less than 1050 mm [42 in] in diameter, shall be bedded on a firm foundation of uniform density. After placing the culvert pipe, backfill material shall be placed along the bottom of the trench, thoroughly tamped against the lower portion of the pipe with special care taken not to move the bedded pipe.

For culverts 1050 mm [42 in] in diameter and larger, the bottom of the trench shall be compacted to uniform density and shaped to fit a template with reasonable closeness for at least 10 percent of the culvert's total height.

On all bedding, when bell and spigot pipe is used, the portion of trench at the joints shall be shaped to fit the bell.

603.05 Laying Culvert The Contractor shall not install nor backfill culverts between December 15<sup>th</sup> and April 1<sup>st</sup> without written permission. Installing shall begin at the downstream end of the culvert line. Bell or groove ends of rigid culverts shall be placed facing upstream.

Elliptically shaped culverts shall be placed with the major axis within 5 degrees of vertical. Elliptically reinforced concrete pipe shall be placed with the vertical axis, indicated by the manufacturer, within 5 degrees of vertical.

603.06 Joining Culverts The method of joining rigid culvert sections shall be such that the ends are fully entered and the inner surfaces are reasonably flush and even. Joints shall be made with portland cement mortar, portland cement grout, rubber ring gaskets, or flexible plastic gaskets.

The pipe ends shall be thoroughly cleaned before the joint is made. Mortared joints shall be made with an excess of mortar to form a bead around the outside of the culvert and finished smooth inside. For grouted joints, molds or runners shall be used to retain the poured grout.

Joints with rubber ring gasket or flexible plastic gasket shall be made in accordance with the manufacturer's recommended procedures.

When portland cement mixtures are used, the completed joints shall be covered to protect against drying.

Flexible culvert section and metal end sections shall be firmly jointed by coupling bands. These bands shall meet the same applicable requirements as the flexible culvert being joined.

603.07 Shop Strutting All flexible circular culvert pipe 1200 mm [48 in] in diameter and larger shall be elongated along the vertical diameter in accordance with one of the following two methods:

- a) The pipe shall be elongated by the manufacturer after fabrication by increasing the diameter along the vertical axis approximately 3 percent with a corresponding decrease along the horizontal axis. The elongation shall be obtained by installing rods and tightening

the rods, uniformly from end to end of the pipe, obtaining approximately one quarter of the required elongation each time throughout the length of the pipe.

The rods shall be 16 mm [ $\frac{5}{8}$  in] diameter threaded 180 mm [7 in] at both ends with washers and nuts. The length of the rods shall be the diameter of the pipe plus 200 mm [8 in]. The rods shall be placed on the horizontal axis of the pipe at 600 mm [2 ft] spacing and located halfway between the circumferential riveting. A block of soft wood 50 mm by 100 mm by 300 mm long [2 in by 4 in by 12 in long], shall be placed over the rods at each end to provide contact against the outside of the pipe. The long dimension of the blocks shall be parallel with the horizontal axis of the pipe. The rods shall be left in the pipe until the fill is completed and compacted, unless for some unusual condition their removal is ordered. The rods shall be removed by cutting from the inside adjacent to the pipe.

(b) The pipe shall be elongated by the manufacturer by increasing the diameter along the vertical axis approximately 5 percent with a corresponding decrease along the horizontal axis by applying sufficient pressure to the sides of the pipe after fabrication to produce the specified distortion. The elongation shall be maintained by drilling holes in the ends of the pipe sections and placing and tightening horizontal wires. After the pipe sections have been installed with coupling bands, the wires shall be removed.

Helically corrugated culvert sections shall be match marked before being elongated by the manufacturer or before the 16 mm [ $\frac{5}{8}$  in] diameter rods are installed.

603.08 Backfilling Culverts and Storm Drains After the pipe is installed, it will be inspected before any backfill material is placed. All pipe found to be out of alignment, unduly settled or damaged to the extent that full performance is impaired, shall be taken up and re-laid or replaced.

Trenches shall be backfilled in accordance with Section 206.03 and as follows. The backfill material shall be thoroughly rammed under the haunches of the pipe with power or pneumatic operated hand tampers. The remainder of the backfill shall be thoroughly compacted with power tampers or vibratory compactors or other approved equipment or combination of equipment.

When the top of the pipe is exposed above the top of the trench, the embankment material around the pipe shall be placed and compacted on each side of the pipe in the aforementioned manner described for backfilling trenches, for a width of 1.5 m [5 ft] measured from the outside diameter of the pipe. Only that portion of the embankment on each side and top of the pipe, for a minimum distance of 375 mm [15 in] measured from the outside diameter of the pipe, must be of material conforming to the requirements described for backfilling in Section 206.03. Backfill material beyond these limits may contain stones larger than 75 mm [3 in] but no greater than the thickness of the layer being placed. The embankment construction around the pipe shall continue up to an elevation 375 mm [15 in] above the top of the pipe. Beyond these limits, the embankment shall be placed and compacted in accordance with the embankment construction requirements specified for the work except where the induced trench method is called for on the plans.

When construction equipment is used or traffic is maintained the Contractor shall provide a minimum cover of 1 m [3 ft] over all pipes, if possible. Whenever this cover extends above the subgrade the Contractor shall temporarily place earth, which shall be removed when necessary to complete the work in accordance with the plans, or as directed. Any deviation from this practice shall have prior approval.

603.09 Induced Trench Under this method, for designated rigid pipes only, the embankment shall be completed as specified above, to a height above the culvert equal to the vertical outside diameter of the pipe plus 300 mm [1 ft]. A trench, equal in width to the outside horizontal diameter of the pipe, shall then be excavated to within 300 mm [1 ft] of the top of the pipe. Trench walls shall be as nearly vertical as possible. Hay bales shall be used to fill the lower 1/4 to 1/3 of the trench. Construction of the embankment above shall then proceed in a normal manner. The trench shall be loosely filled with highly compressible soil.

603.10 Removing and Relaying Culverts The pipe shall be carefully removed from its existing location, transported to and installed in the new location in accordance with these specifications for the particular type of pipe involved. Pipe damaged by the Contractor shall be replaced with pipe of similar type by the Contractor without additional compensation.

New metal bands or joint material shall be supplied and installed when necessary.

603.11 Method of Measurement Culvert and storm drain pipe of the different types and sizes, both new and re-laid, will be measured by the length in meter [linear foot] along the invert, laid as directed, complete in place, and accepted. Pipe laid in excess of the authorized length will not be included.

When the ends of a pipe are sloped or skewed, the amount to be included for payment shall be the length along the invert of the pipe.

When elbows, tees, wyes, or other special fittings are required, each fitting shall be included for payment as 1 additional meter [3 additional linear feet] of the largest pipeline involved.

Inlet grate units will be measured by each unit installed, complete in place, and accepted.

603.12 Basis of Payment The accepted quantities of pipe for culverts and storm drains will be paid for at the contract unit price per meter [linear foot], for the types and sizes specified, complete in place.

No payment will be made for pipe ordered without written approval of the Resident when such pipe is not required to be installed for completion of the work.

Excavation for culverts and storm drains, including excavation below the pipe, for induced trench and for bedding and backfilling will be measured and paid for as provided in Section 206 - Structural Excavation.

Whenever minimum cover material extends above the subgrade, removal of the cover material necessary to complete the work will not be paid for directly but shall be considered part of the work specified herein.

Coupling bands and joint material will not be paid for separately but shall be considered included in the unit bid price for the type of pipe being used or re-laid.

Existing culverts to be re-laid, salvaged, or wasted shall be removed and disposed of as directed. The excavation for removal of these culverts that is not paid for under other items or incidental to other items shall be paid for as Common Excavation.

Inlet grate units will be paid for at the contract unit price each for the size specified, complete in place.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
603.15 300 mm [12 in] Culvert Pipe Option I	meter [Linear Foot]
603.16 375 mm [15 in] Culvert Pipe Option I	meter [Linear Foot]
603.17 450 mm [18 in] Culvert Pipe Option I	meter [Linear Foot]
603.18 525 mm [21 in] Culvert Pipe Option I	meter [Linear Foot]
603.19 600 mm [24 in] Culvert Pipe Option I	meter [Linear Foot]
603.20 750 mm [30 in] Culvert Pipe Option I	meter [Linear Foot]
603.21 900 mm [36 in] Culvert Pipe Option I	meter [Linear Foot]
603.159 300 mm [12 in] Culvert Pipe Option III	meter [Linear Foot]
603.169 375 mm [15 in] Culvert Pipe Option III	meter [Linear Foot]
603.179 450 mm [18 in] Culvert Pipe Option III	meter [Linear Foot]
603.189 525 mm [21 in] Culvert Pipe Option III	meter [Linear Foot]
603.199 600 mm [24 in] Culvert Pipe Option III	meter [Linear Foot]
603.2009 675 mm [27 in] Culvert Pipe Option III	meter [Linear Foot]
603.209 750 mm [30 in] Culvert Pipe Option III	meter [Linear Foot]
603.2019 825 mm [33 in] Culvert Pipe Option III	meter [Linear Foot]
603.219 900 mm [36 in] Culvert Pipe Option III	meter [Linear Foot]
603.229 1050 mm [42 in] Culvert Pipe Option III	meter [Linear Foot]
603.239 1200 mm [48 in] Culvert Pipe Option III	meter [Linear Foot]
603.249 1350 mm [54 in] Culvert Pipe Option III	meter [Linear Foot]
603.259 1500 mm [60 in] Culvert Pipe Option III	meter [Linear Foot]
603.269 1650 mm [66 in] Culvert Pipe Option III	meter [Linear Foot]
603.279 1800 mm [72 in] Culvert Pipe Option III	meter [Linear Foot]
603.289 2100 mm [84 in] Culvert Pipe Option III	meter [Linear Foot]
603.30 525 mm [21 in] span 375 mm [15 in] rise Pipe Arch Option III	meter [Linear Foot]
603.31 600 mm [24 in] span 450 mm [18 in] rise Pipe Arch Option III	meter [Linear Foot]
603.32 700 mm [28 in] span 500 mm [20 in] rise	

603.33	Pipe Arch Option III 875 mm [35 in] span 600 mm [24 in] rise	meter [Linear Foot]
603.34	Pipe Arch Option III 1050 mm [42 in] span 725 mm [29 in] rise	meter [Linear Foot]
603.35	Pipe Arch Option III 1225 mm [49 in] span 825 mm [33 in]rise	meter [Linear Foot]
603.36	Pipe Arch Option III 1425 mm [57 in] span 950 mm [38 in] rise	meter [Linear Foot]
603.37	Pipe Arch Option III 1600 mm [64 in] span 1075 mm [43 in] rise	meter [Linear Foot]
603.38	Pipe Arch Option III 1650 mm [66 in] span 1275 mm [51 in] rise	meter [Linear Foot]
603.39	Pipe Arch Option III 1825 mm [73 in] span 1375 mm [55 in] rise	meter [Linear Foot]
603.40	Pipe Arch Option III 2025 mm [81 in] span 1475 mm [59 in] rise	meter [Linear Foot]
603.41	610 mm [24 in] Reinforced Conc. Pipe Class IV	meter [Linear Foot]
603.42	762 mm [30 in] Reinforced Conc. Pipe Class IV	meter [Linear Foot]
603.43	914 mm [36 in] Reinforced Conc. Pipe Class IV	meter [Linear Foot]
603.44	1067 mm [42 in] Reinforced Conc. Pipe Class IV	meter [Linear Foot]
603.45	1219 mm [48 in] Reinforced Conc. Pipe Class IV	meter [Linear Foot]
603.46	1372 mm [54 in] Reinforced Conc. Pipe Class IV	meter [Linear Foot]
603.47	1524 mm [60 in] Reinforced Conc. Pipe Class IV	meter [Linear Foot]
603.48	1676 mm [66 in] Reinforced Conc. Pipe Class IV	meter [Linear Foot]
603.49	1829 mm [72 in] Reinforced Conc. Pipe Class IV	meter [Linear Foot]
603.73	Remove and Relay Metal Pipe: _____	meter [Linear Foot]
603.7315	Remove and Relay 375 mm [15 in] Metal Pipe: __	meter [Linear Foot]
603.7318	Remove and Relay 450 mm [18 in] Metal Pipe: __	meter [Linear Foot]
603.7324	Remove and Relay 600 mm [24 in] Metal Pipe: __	meter [Linear Foot]
603.733	Remove and Relay 750 mm [30 in] Metal Pipe: __	meter [Linear Foot]
603.7336	Remove and Relay 900 mm [36 in] Metal Pipe: __	meter [Linear Foot]
603.7348	Remove and Relay 1200 mm [48 in] Metal Pipe: __	meter [Linear Foot]
603.7372	Remove and Relay 1800 mm [72 in] Metal Pipe: __	meter [Linear Foot]
603.74	Remove and Relay Concrete Pipe: _____	meter [Linear Foot]
603.7415	Remove and Relay 375 mm [15 in] Concrete Pipe:	meter [Linear Foot]
603.7418	Remove and Relay 450 mm [18 in] Concrete Pipe:	meter [Linear Foot]
603.7421	Remove and Relay 525 mm [21 in] Concrete Pipe:	meter [Linear Foot]
603.7424	Remove and Relay 600 mm [24 in] Concrete Pipe:	meter [Linear Foot]
603.743	Remove and Relay 750 mm [30 in] Concrete Pipe:	meter [Linear Foot]
603.7436	Remove and Relay 900 mm [36 in] Concrete Pipe:	meter [Linear Foot]
603.7442	Remove and Relay 1050 mm [42 in] Concrete Pipe:	meter [Linear Foot]
603.7448	Remove and Relay 1200 mm [48 in] Concrete Pipe:	meter [Linear Foot]
603.7454	Remove and Relay 1350 mm [54 in] Concrete Pipe:	meter [Linear Foot]
603.746	Remove and Relay 1500 mm [60 in] Concrete Pipe:	meter [Linear Foot]
603.7472	Remove and Relay 1800 mm [72 in] Concrete Pipe:	meter [Linear Foot]

603.75	150 mm [6 in] Inlet Grate Unit	Each
603.76	300 mm [12 in] Inlet Grate Unit	Each
603.77	375 mm [15 in] Inlet Grate Unit	Each
603.78	450 mm [18 in] Inlet Grate Unit	Each
603.79	525 mm [21 in] Inlet Grate Unit	Each
603.80	600 mm [24 in] Inlet Grate Unit	Each
603.81	750 mm [30 in] Inlet Grate Unit	Each
603.82	900 mm [36 in] Inlet Grate Unit	Each

## SECTION 604 - MANHOLES, INLETS, AND CATCH BASINS

604.01 Description Construct manholes, inlets, and catch basins.

604.02 Materials Materials shall meet the requirements specified in the following Sections of Division 700 - Materials:

Portland Cement	701.01
Clay or Shale Brick	704.01
Concrete Masonry Blocks	704.03
Joint Mortar	705.02
Reinforcing Steel	709.01
Stone Curbing and Edging	712.04
Precast Concrete Units	712.06

Except as otherwise provided on the plans, concrete for these structures shall meet the requirements of Section 502 - Structural Concrete.

Catch basin grates shall be either the type of grate shown on the Standard Details or an approved equal. The corners shall be notched by the Contractor at the project site by grinding the corner to fit the cast iron frames.

604.03 Construction Requirements Concrete catch basins and manholes shall be constructed of precast units, except that concrete blocks may be used around inlet and outlet pipes. Joints for precast concrete units shall be of portland cement mortar, rubber gaskets, flexible plastic rings, mastic joint filler or other approved types to form a watertight joint. Joints for concrete blocks shall be of portland cement mortar, not more than 12 mm [ $\frac{1}{2}$  in] wide, completely filled and neatly tooled on the inside of the structure.

Metal catch basins shall be corrugated metal pipe units mounted on a portland cement concrete foundation.

Catch basins and manholes shall be placed to the required grade on a compacted foundation of uniform density. Inlet and outlet pipe elevations may vary from the elevations shown on the plans depending upon field conditions.

Pipe sections entering catch basins shall be firmly connected to the structure wall with no part of the pipe projecting more than 150 mm [6 in] inside the wall. When a section of culvert is cut, the end shall be finished in a skillful manner.

Metal frames and traps, when called for, shall be set in a bed of clay bricks or shale bricks and mortar, or otherwise secured as shown on the plans. Castings shall be set to the correct elevation before the next final course of paving material has been placed.

Upon completion, each catch basin and manhole shall be cleaned of all accumulation of silt, debris, or foreign matter and shall be kept clean until final acceptance of the work.

604.04 Altering, Adjusting, and Rebuilding Catch Basins and Manholes Existing catch basins and manholes shall be dismantled sufficiently to allow altering, adjusting, or rebuilding in accordance with the applicable requirements as shown on the Standard Detail plans for complete catch basins and manholes. When existing frames, covers, and grates are used, they shall be thoroughly cleaned of existing mortar before placing to the new grade.

a. Altering Catch Basin The existing top assembly shall be removed and replaced with a new Type A or Type B frame and special grate set to the required grade using approved clay brick and mortar.

b. Adjusting Catch Basins and Manholes The existing top assembly shall be removed, thoroughly cleaned, and reset to the new grade using approved clay brick and mortar.

c. Rebuilding Catch Basins and Manholes The existing top assembly, cone section, and barrel section shall be removed down to the outlet flow line grade to the extent required, as determined by the Resident, and shall be rebuilt and a new frame and grate furnished and installed at the required line and grade directed. Concrete blocks may be used to rebuild the barrel section, if necessary, due to existing conditions.

All salvaged material not reused, including grates, and frames, and curb inlets will remain the property of the present owner unless otherwise specified.

Each catch basin and manhole altered, adjusted, or reconstructed, shall be cleaned of all accumulated silt, debris, and other foreign matter before final acceptance of the work.

604.05 Method of Measurement Catch basins, manholes, and accessories of the respective types will be measured by the number of units, measured as follows, complete, and accepted in place.

a. Complete Structures Each catch basin and manhole having a depth up to 2.5 m [8 ft] from the top of the grate or cover to the top of the floor, measured to the nearest 0.5 m [ft], will be one unit. 1/5 of a unit [1/8 of a unit] will be added for each additional 0.5 m [ft] over 2.5 m [8 ft] measured to the nearest 0.5 m [ft]. Depth measurements in excess of the dimensions authorized will not be included.

b. Existing Structures Existing catch basins and manholes to be altered, adjusted or rebuilt will be one unit each. Existing catch basins and manholes that are cleaned will be one unit each.

c. Trap Each trap included in the completed structure will be one unit each.

d. Step Each step included in the completed structure will be one unit each.

e. Grate Each grate altered under item 604.167 will be measured by each unit, complete in place and accepted.

604.06 Basis of Payment The accepted quantities of catch basins, manholes, altered grates, traps, and steps, will be paid for at the contract unit price each of the respective types complete in place. Payment for rebuilding, adjusting or altering catch basins and manholes shall include furnishing all materials including new blocks, bricks, mortar, metal tops, covers, and curb inlets when required. Frames, grates, and covers for new or rebuilt catch basins or manholes shall be considered part of the structure and no separate payment will be made. Payment for cleaning existing catch basins and manholes will be paid for at the contract unit price each. There will be no payment for cleaning new, altered, adjusted, or rebuilt catch basins and manholes. Payment will be full compensation for supplying all equipment and labor to clean the basins and manholes and to dispose of the waste.

Excavation and backfill will be measured and paid for as provided in Section 206 - Structural Excavation.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
604.072 Catch Basin Type A1-C	Each
604.082 Catch Basin Type A2-C	Each
604.09 Catch Basin Type B1	Each
604.092 Catch Basin Type B1-C	Each
604.10 Catch Basin Type B2	Each
604.102 Catch Basin Type B2-C	Each
604.11 Catch Basin Type C1	Each
604.12 Catch Basin Type C2	Each
604.13 600 mm [24 in] Catch Basin Type E	Each
604.14 750 mm [30 in] Catch Basin Type E	Each
604.15 Manhole	Each
604.16 Altering Catch Basin to Manhole	Each
604.161 Altering Catch Basin	Each
604.164 Rebuilding Catch Basin	Each
604.166 Rebuilding Manhole	Each
604.167 Alter Catch Basin Grate to Cascade Grate	Each
604.17 Altering Manhole to Catch Basin	Each

604.18	Adjusting Manhole or Catch Basin to Grade	Each
604.182	Cleaning Existing Catch Basin and Manhole	Each
604.19	200 mm [8 in] Trap	Each
604.20	300 mm [12 in] Trap	Each
604.21	375 mm [15 in] Trap	Each
604.22	450 mm [18 in] Trap	Each
604.23	Step	Each
604.242	Catch Basin Type F3	Each
604.243	Catch Basin Type F3-C	Each
604.244	Catch Basin Type F4	Each
604.245	Catch Basin Type F4-C	Each
604.246	Catch Basin Type F5	Each
604.247	Catch Basin Type F5-C	Each
604.248	Catch Basin Type F6	Each
604.249	Catch Basin Type F6-C	Each
604.25	Catch Basin Type A5	Each
604.252	Catch Basin Type A5-C	Each
604.26	Catch Basin Type B5	Each
604.262	Catch Basin Type B5-C	Each

## SECTION 605 - UNDERDRAINS

605.01 Description This work shall consist of the construction of underdrain, using pipe and filter material and pipe outlets in accordance with these specifications and the standard detail plans and in reasonably close conformity with the lines and grades shown on the plans or established.

605.02 Materials. Materials shall meet the requirements specified in the following Sections of Division 700 - Materials:

Granular Borrow	703.19
Underdrain Backfill Material	703.22
<u>Underdrain Pipe</u>	
Corrugated Polyethylene Pipe	706.06
Polyvinylchloride (PVC) Perforated Pipe	706.09
Corrugated Steel, Metallic Coated Pipe for Underdrain	707.05
Corrugated Aluminum Alloy Pipe for Underdrain	707.08
<u>Underdrain Outlet Pipe</u>	
Corrugated Polyethylene Pipe	706.06
Corrugated Steel, Metallic Coated Pipe for Underdrain	707.02
Corrugated Aluminum Alloy Pipe	707.06

Connections for polyethylene pipe shall be made with external wrap-around split couplings, screw-on type couplings, external snap-on couplings, or bell and spigot and ring gasket. External wrap-around split couplings shall be secured with heavy duty splicing tape or plastic or wire ties placed on each side of the coupling. External snap-on couplings shall comply with the appropriate section of AASHTO Specifications.

Connections for other plastic underdrain pipe shall be made with bell and spigot and ring gasket.

Connections for metallic underdrain pipe shall be made with corrugated metal bands secured with bolts. Dimpled bands shall not be used.

Other types of connectors for underdrain may be used upon approval by the Resident.

605.021 Fittings The material for elbows, tees and wyes for Underdrain pipe shall be at least as thick as the largest size pipe being connected.

605.03 General Underdrain pipe for Underdrain, Type B shall, at the Contractor's option, consist of any one of the following types:

- Corrugated Aluminum Alloy Pipe for Underdrain
- Corrugated Polyethylene Pipe for Underdrain (Smoothlined)
- Metallic Coated (Zinc or Aluminum Coated) Corrugated Steel Pipe for Underdrain
- Polyvinylchloride (PVC) Perforated Pipe

At the Contractor's option, underdrain pipe for Underdrain Type C shall consist of any one of the following types:

- Corrugated Aluminum Alloy Pipe for Underdrain
- Corrugated Polyethylene Pipe (Smoothlined)
- Metallic Coated (Zinc or Aluminum Coated) Corrugated Steel Pipe for Under-drain
- Polyvinylchloride (PVC) Perforated Pipe

605.04 Underdrain Construction

a. Underdrain, Type B The trench shall be excavated to the required width and depth and a bed of the specified granular material, 75 mm [3 in] in depth, prepared in the trench. 150 mm [6 in] perforated pipe shall be laid on this bed with the perforations as shown on the Standard Detail plans.

After the pipe has been firmly bedded and joints securely connected, it will be inspected before any backfill is placed. The remaining backfill shall be granular material meeting the same requirements as that used for bedding the pipe.

For underdrain placed under areas of proposed pavement, the material shall be placed in 200 mm [8 in] layers, loose measure and thoroughly compacted except that the initial layer

of backfill around the pipe may be placed in a layer not exceeding 300 mm [12 in]. For underdrains placed under areas not proposed to be paved, the initial layer of backfill shall not exceed 300 mm [12 in] and the remaining material may be placed in one lift to the elevation of the subgrade and compacted with heavy rubber tired or vibratory compaction equipment to the satisfaction of the Resident.

The upstream end of all completed underdrain pipe shall be sealed with cement mortar or other acceptable material. Care shall be taken that soil does not enter the pipe. Pipe contaminated before backfilling shall be removed, cleaned, and re-laid.

b. Underdrain, Type C The trench shall be excavated to the width and depth as determined by the size and depth of the pipe to be installed.

The perforated pipe shall be laid to line and grade centered on the bottom of the trench with the perforations as shown on the Standard Detail plans.

After the pipe has been firmly bedded and all joints securely connected, it will be inspected before any backfill is placed. The backfill shall be placed in accordance with Section 603.08 and as shown on the Standard Detail plans using the materials specified.

When Underdrain Type B or Underdrain Type C is constructed, backfill material beyond the underdrain trench lateral limits designated on the plans shall be material conforming to the requirements of Granular Borrow, Underwater Backfill. Material within the underdrain trench limits shall conform to the requirements of the type underdrain being constructed. The Contractor shall take precautions to prevent the underdrain backfill material from becoming contaminated with clay, silts, organic matter, or other foreign matter. Methods of placing backfill material shall be limited to the use of equipment that will place material directly into the trench. Pushing material into the trench will not be allowed.

When underdrain is to be constructed in embankment fill, the excavation for the trench shall be done after the embankment has been completed to subgrade elevation.

605.05 Underdrain Outlets Trenches for underdrain outlets shall be excavated to the required width and depth. These outlets shall be metal pipe of the same size and wall thickness used in the underdrain, except that the perforations may be omitted.

The pipe shall be laid in the trench with all ends firmly joined by the applicable methods and means. After inspection and approval of the pipe installation, the trench shall be backfilled with suitable material in layers and compacted as provided for in Section 603.08.

605.06 Method of Measurement Underdrain and underdrain outlets will be measured by the length in meters [linear feet] along the centerline of underdrains and underdrain outlets of the types and sizes completed and accepted.

When elbows, tees, wyes, or other special fittings are required in underdrain, each fitting shall be included for payment as 1 additional meter [3 additional linear feet] of the largest pipe size involved.

605.07 Basis of Payment The accepted quantities of underdrains and underdrain outlets will be paid for at the contract unit price per meter [linear foot] of each type and size specified complete in place. Outlet pipe for Underdrain, Type C will be paid for under Section 603 - Pipe Culverts and Storm Drains.

Within and beyond the trench limits, backfill, couplings and bands and other related items will not be paid for separately, but shall be considered included in the unit bid price for the type of underdrain being installed.

Excavation will be measured and paid for as provided in Section 206 - Structural Excavation. No allowance for payment will be made for excavating or material excavated beyond the horizontal dimensions shown for Underdrain, Type B or Underdrain, Type C.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
605.09 150 mm [6 in] Underdrain Type B	meter [Linear Foot]
605.10 150 mm [6 in] Underdrain Outlet	meter [Linear Foot]
605.11 300 mm [12 in] Underdrain Type C	meter [Linear Foot]
605.12 375 mm [15 in] Underdrain Type C	meter [Linear Foot]
605.13 450 mm [18 in] Underdrain Type C	meter [Linear Foot]
605.14 525 mm [21 in] Underdrain Type C	meter [Linear Foot]
605.15 600 mm [24 in] Underdrain Type C	meter [Linear Foot]
605.17 750 mm [30 in] Underdrain Type C	meter [Linear Foot]
605.18 900 mm [36 in] Underdrain Type C	meter [Linear Foot]

## SECTION 606 - GUARDRAIL

606.01 Description This work shall consist of furnishing and installing guardrail components in accordance with these specifications and in reasonably close conformity with the lines and grades shown on the plans or as established. The types of guardrail are designated as follows:

- Type 3-Galvanized steel "w" beam, wood posts or galvanized steel posts.
- Type 3a-Galvanized steel "w" beam, wood posts, wood or composite offset brackets.
- Type 3aa-Corrosion resistant steel "w" beam, wood posts, wood or composite offset brackets.
- Type 3b-Galvanized steel "w" beam, galvanized steel posts, galvanized steel offset brackets.

Type 3c-Galvanized steel "w" beam, wood posts or galvanized steel posts, wood or composite offset brackets.

Type 3d-Galvanized steel "w" beam, galvanized steel posts, wood or composite offset brackets.

Thrie Beam-Galvanized steel thrie beam, wood posts or galvanized steel posts.

Median barriers shall consist of two beams of the above types, mounted on single posts. Except for thrie beam, median barriers may include rub rails when called for.

Bridge mounted guardrail shall consist of furnishing all labor, materials, and equipment necessary to install guardrail as shown on the plans. This work shall also include drilling for and installation of offset brackets if specified, back-up plates and incidental hardware necessary for satisfactory completion of the work.

Remove and Reset and Remove, Modify, and Reset guardrail shall consist of removing the existing designated guardrail and resetting in a new location as shown on the plans or directed by the Resident. Remove, Modify, and Reset guardrail and Modify guardrail include the following guardrail modifications: Removing plate washers at all posts, except at anchorage assemblies as noted on the Standard Details, Adding backup plates at intermediate posts, Adding offset brackets, Other modifications as listed in the Construction Notes or General Notes. Modifications shall conform to the guardrail Standard Details.

Bridge Connection shall consist of the installation and attachment of beam guardrail to the existing bridge. This work shall consist of constructing a concrete end post or modifying an existing endpost as required, furnishing, and installing a terminal connector, necessary hardware, and incidentals required to complete the work as shown on the plans. Bridge Transition shall consist of a bridge connection and furnishing and installing guardrail components as shown in the Standard Details.

606.02 Materials Materials shall meet the requirements specified in the following Sections of Division 700 - Materials:

Timber Preservative	708.05
Metal Beam Rail	710.04
Guardrail Posts	710.07
Guardrail Hardware	710.08

Guardrail components shall meet the applicable standards of "A Guide to Standardized Highway Barrier Hardware" prepared and approved by the AASHTO-AGC-ARTBA Joint Cooperative Committee, Task Force 13 Report.

Posts for guardrail delineators shall be "U" channel steel, 2.44 m [8 ft] long, 3.72 kg/m [2½ lb/ft] minimum and have 9.5 mm [¾ in] round holes, 25 mm [1 in] center to center for a minimum distance of 610 mm [2 ft] from the top of the post.

Retroreflective beam guardrail delineators shall be steel conforming to ASTM A635/A635M, galvanized in accordance with AASHTO M111 (ASTM A123) with a minimum thickness of 2.8 mm [12 gauge].

Single wood post shall be of cedar, white oak, or tamarack, well seasoned, straight, and sound and have been cut from live trees. The outer and inner bark shall be removed and all knots trimmed flush with the surface of the post. Posts shall be uniform taper and free of kinks and bends.

Single steel post shall conform to the requirements of Section 710.07 b.

Single steel pipe post shall be galvanized, seamless steel pipe conforming to the requirements of ASTM A120, Schedule No. 40, Standard Weight.

The sole patented supplier of multiple mailbox assemblies is Foresight Products, Inc. of Northglenn, Colorado.

The Guardrail 350 Flared Terminal shall be a terminal with a 1.2 M (4 ft) offset as shown in the Manufacturer's installation instructions.

Existing materials damaged or lost during adjusting, removing and resetting, or removing, modifying, and resetting, shall be replaced by the Contractor without additional compensation. Existing guardrail posts and guardrail beams found to be unfit for reuse shall be replaced when directed by the Resident.

606.03 Posts Posts for guardrail shall be set plumb in holes or they may be driven if suitable driving equipment is used to prevent battering and distorting the post. When posts are driven through pavement, the damaged area around the post shall be repaired with approved bituminous patching. Damage to lighting and signal conduit and conductors shall be repaired by the Contractor.

When set in holes, posts shall be on a stable foundation and the space around the posts, backfilled in layers with suitable material, thoroughly tamped.

Guardrail delineator posts shall be set plumb with the outstanding legs of the channel facing the oncoming traffic. Posts, which become bent or otherwise damaged, shall be removed and replaced with new posts.

Single wood posts shall be set plumb in holes and backfilled in layers with suitable material, thoroughly tamped. The Resident will designate the elevation and shape of the top. The posts, that are not pressure treated, shall be painted two coats of good quality oil base exterior house paint.

Single steel posts shall be set plumb in holes as specified for single wood posts or they may be driven if suitable driving equipment is used to prevent battering and distorting the post.

Additional bolt holes required in existing posts shall be drilled or punched, but the size of the holes shall not exceed the dimensions given the Standard Details. Metal around the holes shall be thoroughly cleaned and painted with two coats of approved aluminum rust resistant paint. Holes shall not be burned.

606.04 Rails Brackets and fittings shall be placed and fastened as shown on the plans. Rail beams shall be erected and aligned to provide a smooth, continuous barrier. Beams shall be lapped with the exposed end away from approaching traffic.

End assemblies shall be installed as shown on the plans and shall be securely attached to the rail section and end post.

All bolts shall be of sufficient length to extend beyond the nuts but not more than 13 mm [ $\frac{1}{2}$  in]. Nuts shall be drawn tight.

Additional bolt holes required in existing beams shall be drilled or punched, but the size of the holes shall not exceed the dimensions given the Standard Details. Metal around the holes shall be thoroughly cleaned and painted with two coats of approved aluminum rust resistant paint. Holes shall not be burned.

606.045 Offset Brackets Offset brackets shall be of the same material as the posts specified except Guardrail Types 3c and 3d or when an alternative composite material is substituted. The same material is to be provided for the entire project unless otherwise specified.

606.05 Shoulder Widening At designated locations the existing shoulder of the roadway shall be widened as shown on the plans. All grading, paving, seeding, and other necessary work shall be in accordance with the Specifications for the type work being done.

606.06 Mail Box Post Single wood post shall be installed at the designated location for the support of the mailbox. The multiple mailbox assemblies shall be installed at the designated location in accordance with the Standard Details and as recommended by the Manufacturer. Attachment of the mailbox to the post will be the responsibility of the home or business owner.

606.07 Abraded Surfaces All galvanized surfaces of new guardrail and posts, which have been abraded so that the base metal is exposed, and the threaded portions of all fittings and fasteners and cut ends of bolts shall be cleaned and painted with two coats of approved rust resistant paint.

606.08 Method of Measurement Guardrail will be measured by the meter [linear foot] from center to center of end posts along the gradient of the rail except where end connections are made to masonry or steel structures, in which case measurement will be as shown on the plans.

Terminal section, sloped end, modified eccentric loader terminal, breakaway cable terminal, low volume end, 350 flared terminal, delineator post, terminal end, bridge transition, bridge connection, multiple mailbox post, and single post will be measured by each unit of the kind specified and installed.

Widened shoulder will be measured as a unit of grading within the limits shown on the plans.

Excavation in solid rock for placement of posts will be measured by the cubic meter [cubic yard] determined from the actual depth of the hole and a hypothetical circle diameter of 600 mm [2 ft].

606.09 Basis of Payment The accepted quantities of guardrail will be paid for at the contract unit price per meter [linear foot] for the type specified, complete in place. Reflectorized silver white beam guardrail delineators shall be mounted on all new guardrail installations, spaced at 19 M [62.5 ft], meet the requirements of section 719.01, and mounted on the guardrail beam at the posts. Beam guardrail delineators will not be paid for directly, but will be considered incidental to the guardrail items. Terminal section, buffer end, flared end, bridge connection and single post will be paid for at the contract unit price each for the kind specified complete in place.

NCHRP 350 end treatments, breakaway cable terminals, low volume guardrail ends, and modified eccentric loader terminals will be paid for at the contract price each, complete in place which price shall be full payment for furnishing and installing all components including the terminal section, posts, brackets, "w" rail, cable foundation posts, plates and for all incidentals necessary to complete the installation within the limits as shown on the Standard Details or the Manufacturer's installation instructions. Such payment shall also be full compensation for furnishing all material, excavating, backfilling holes, assembling, and all incidentals necessary to complete the work, except that for excavation for posts or anchorages in solid ledge rock, payment will be made under Pay Item 206.07. Type III Retroreflective Adhesive Sheeting shall be applied to the approach buffer end sections and sized to substantially cover the end section. On two-way roadways, the ends shall be yellow on the left and white on the right for approaching traffic. On one-way or divided roadways, only the leading ends will receive the sheeting (yellow on the left and white on the right). Guardrail 350 flared terminal shall also include a set of installation drawings supplied to the Resident, and the Contractor shall provide one complete set of replacement parts per contract and deliver the spare parts to the local Division Office.

Anchorage to bridge end posts will be part of the bridge work. Connections thereto will be considered included in the unit bid price for guardrail.

Guardrail to be placed on a radius of curvature of 45 m [150 ft] or less will be paid for under the designated radius pay item for the type guardrail being placed.

Widened shoulder will be paid for at the contract unit price each complete in place and will be full compensation for furnishing and placing, grading and compaction of aggregate subbase and any required fill material.

Adjust guardrail will be paid for at the contract unit price per meter and will be full compensation for adjusting to grade. Payment shall also include adjusting terminal end treatments where required.

Modify guardrail will be paid for at the contract unit price per meter and will be full compensation for furnishing and installing offset brackets, backup plates, additional posts, and other specified modifications; removing, modifying, installing, and adjusting to grade existing posts and beams; removing plate washers and all incidentals necessary to complete the work. Payment shall also include removing and resetting terminal ends where required

Remove and Reset guardrail will be paid for at the contract unit price per meter and will be full compensation for removing, transporting, storing, reassembling all parts, necessary cutting, furnishing new parts when necessary, reinstalling at the new location, and all other incidentals necessary to complete the work. Payment shall also include removing and resetting terminal ends when required. No payment will be made for guardrail removed, but not reset and all costs for such removal shall be considered incidental to the various contract pay items.

Remove, Modify, and Reset guardrail will be paid for at the contract unit price per meter and will be full compensation for the requirements listed in Modify guardrail and Remove and Reset guardrail.

Bridge Connections will be paid for at the contract unit price each. Payment shall include, attaching the connection to the endpost including furnishing and placing concrete and reinforcing steel necessary to construct new endposts if required, furnishing and installing the terminal connector, and all miscellaneous hardware, labor, equipment, and incidentals necessary to complete the work.

Bridge Transitions will be paid for at the contract unit price each. Payment shall include furnishing and installing the thrie beam or W-beam terminal connector, doubled beam section, and transition section, where called for, posts, hardware, precast concrete transition curb, and any other necessary materials and labor, including the bridge connection as stated in the previous paragraph.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
606.15 Guardrail Type 3a-Single Rail	meter [Linear Foot]
606.151 Guardrail Type 3aa-Single Rail	meter [Linear Foot]
606.17 Guardrail Type 3b-Single Rail	meter [Linear Foot]
606.1721 Bridge Transition - Type I	Each
606.1722 Bridge Transition - Type II	Each
606.1731 Bridge Connection - Type I	Each
606.1732 Bridge Connection - Type II	Each
606.178 Guardrail Beam	meter [Linear foot]
606.18 Guardrail Type 3b - Double Rail	meter [Linear foot]
606.19 Guardrail Type 3a - 4.5 m [15 ft] radius and less	meter [Linear Foot]
606.191 Guardrail Type 3aa - 4.5 m [15 ft] radius and less	meter [Linear Foot]
606.20 Guardrail Type 3a - over 4.5 m [15 ft] radius	meter [Linear Foot]
606.201 Guardrail Type 3aa - over 4.5 m [15 ft] radius	meter [Linear Foot]

606.21	Guardrail Type 3b - 4.5 m [15 ft] radius and less	meter [Linear Foot]
606.22	Guardrail Type 3b - over 4.5 m [15 ft] radius	meter [Linear Foot]
606.23	Guardrail Type 3c - Single Rail	meter [Linear Foot]
606.2301	Guardrail Type 3c - Double Rail	meter [Linear Foot]
606.231	Guardrail Type 3c - 4.5 m [15 ft] radius and less	meter [Linear Foot]
606.232	Guardrail Type 3c - over 4.5 m [15 ft] radius	meter [Linear Foot]
606.24	Guardrail Type 3d - Single Rail	meter [Linear Foot]
606.2401	Guardrail Type 3d - Double Rail	meter [Linear Foot]
606.241	Guardrail Type 3d - 4.5 m [15 ft] radius and less	meter [Linear Foot]
606.242	Guardrail Type 3d - over 4.5 m [15 feet] radius	meter [Linear Foot]
606.25	Terminal Connector	Each
606.257	Terminal Connector - Thrie Beam	Each
606.265	Terminal End-Single Rail - Galvanized Steel	Each
606.266	Terminal End-Single Rail - Corrosion Resistant Steel	Each
606.275	Terminal End-Double Rail - Galvanized Steel	Each
606.276	Terminal End-Double Rail - Corrosion Resistant Steel	Each
606.35	Guardrail Delineator Post	Each
606.351	Remove and Reset Guardrail Delineator Post	Each
606.357	Guardrail, Modify, Type 3b	meter [Linear Foot]
606.361	Guardrail, Removed and Reset, Type 3b	meter [Linear Foot]
606.362	Guardrail, Adjust	meter [Linear Foot]
606.364	Guardrail, Remove, Modify, and Reset, Type 3b	meter [Linear Foot]
606.367	Replace Unusable Existing Guardrail Posts	Each
606.47	Single Wood Post	Each
606.48	Single Galvanized Steel Post	Each
606.50	Single Steel Pipe Post	Each
606.51	Multiple Mailbox Support	Each
606.55	Guardrail Type 3 - Single Rail	meter [Linear Foot]
606.551	Guardrail Type 3 - Single Rail with Rub Rail	meter [Linear Foot]
606.56	Guardrail Type 3 - Double Rail	meter [Linear Foot]
606.561	Guardrail Type 3 - Double Rail with Rub Rail	meter [Linear Foot]
606.566	Guardrail, Modify Type 3b-Double Rail	meter [Linear Foot]
606.59	Guardrail Type 3 - 4.5 m [15 ft] radius and less	meter [Linear Foot]
606.60	Guardrail Type 3 - over 4.5 m [15 ft] radius	meter [Linear Foot]
606.621	Twisted End Section - Guardrail Type 3	Each
606.63	Thrie Beam Rail Beam	meter [Linear Foot]
606.64	Guardrail Thrie Beam - Double Rail	meter [Linear Foot]
606.65	Guardrail Thrie Beam - Single Rail	meter [Linear Foot]
606.66	Terminal End Thrie Beam	Each
606.70	Transition Section - Thrie Beam	Each
606.71	Guardrail Thrie Beam - 4.5 m [15 ft] radius and less	meter [Linear Foot]
606.72	Guardrail Thrie Beam - over 4.5 m [15 ft] radius	meter [Linear Foot]
606.73	Guardrail Thrie Beam - Single Rail Bridge Mounted	meter [Linear Foot]
606.74	Guardrail Type 3 - Single Rail Bridge Mounted	meter [Linear Foot]

606.751	Widen Shoulder for Breakaway Cable Terminal	Each
606.752	Widen Shoulder for Modified Eccentric Loader Terminal	Each
606.753	Widen Shoulder for Low Volume Guardrail End - Type 3	Each
606.754	Widen Shoulder for Guardrail 350 Flared Terminal	Each
606.76	Modified Eccentric Loader Terminal	Each
606.77	Breakaway Cable Terminal	Each
606.78	Low Volume Guardrail End - Type 3	Each
606.79	Guardrail 350 Flared Terminal	Each

## SECTION 607 - FENCES

607.01 Description Construct fence and gates.

607.02 Materials Materials shall meet the requirements specified in the following Sections of Division 700 - Materials:

Barbed Wire	710.01
Woven Wire	710.02
Chain Link Fabric	710.03
Cedar Rail Fence	710.05
Fence Posts and Braces	710.06

Bars for barways shall be of eastern hemlock, northern white pine, Norway pine, spruce, cedar, or tamarack, equal in quality to the wood posts. The bark shall be removed and all knots hewn flush.

Metal gates shall be of galvanized steel.

Staples shall be of galvanized or aluminum coated steel.

Concrete for anchoring metal posts, metal braces and wooden gate posts shall meet the requirements of Section 502 - Structural Concrete, except air entraining will not be required. The class of concrete shall be optional.

Drive anchors shall be an approved anchorage consisting of two steel angles driven diagonally into the ground through metal clamps bolted to the post. All parts shall be galvanized.

607.03 General The Contractor shall perform clearing and grubbing necessary to construct the fence to the required grade and alignment.

Posts shall be spaced as called for on the plans except that a variation of 600 mm [2 ft] back or ahead on line may be allowed at approved locations. The tops of posts shall be set to the required grade and alignment. Cutting off the posts may be allowed with approval.

Posts for cedar rail fence shall be set plumb in drilled or hand dug holes. After posts are placed, rails installed and the posts aligned, the post holes shall be backfilled. The completed fence shall have the tops of the posts at uniform height above ground following the gradient of the ground.

Posts for woven wire fence and barbed wire fence shall be braced with Type I or Type II bracing at designated location as hereafter specified. Type I bracing shall include diagonal brace and one post of the designated size. Type II bracing shall include two diagonal braces and one post of the designated size.

When the plans require posts or braces to be anchored into the soil, concrete anchors or metal drive anchors shall be used. If concrete is used, temporary guys to hold the posts in position shall be installed until the concrete has set. Unless otherwise permitted, no material shall be installed on posts or strain placed on guys and bracing set in concrete until 48 hours after the concrete has been placed.

If metal drive anchors are used they shall be installed according to the manufacturer's instructions so all parts will be below the ground surface. One drive anchor shall be used on line posts; two drive anchors shall be used on bracing assemblies. Where two drive anchors are used, they shall be placed perpendicular to each other.

Backfill with earth placed in 200 mm [8 in] layers, loose measure, and each layer thoroughly tamped.

Metal posts to be set in solid rock shall be placed in drilled holes and grouted with a cement grout composed of 1 part portland cement and two parts sand mixed with water.

All surplus material and other debris shall be removed and disposed of.

607.04 Woven Wire or Barbed Wire Fencing Wood posts shall be set plumb in holes dug to full depth. Metal posts shall be set plumb by an approved post driver. Posts, which are bent or otherwise damaged, shall be removed and replaced.

a. Bracing At changes in horizontal alignment in excess of 30°, bracing will be required. At changes in horizontal alignment of 15° to 30°, bracing may be called for on the plans or required by the Resident. At changes in horizontal alignment angles of less than 15°, bracing will not be required except at intervals of 200 m [660 ft].

In depressions where tension in the fencing may cause lifting, the post will require bracing.

End, corner, gate, barway, and intermediate posts shall be braced and anchored as shown in the Standard Details.

If metal posts are to be placed in concrete, the concrete shall be allowed to set before the space around the base is backfilled. Backfill with satisfactory material thoroughly tamped. If directed, the Contractor shall place a minimum of 150 mm [6 in] of gravel in the bottom of the post hole.

b. Gates All gates and the bracing assemblies at gates shall be constructed of metal.

c. Barways Barways shall be constructed of posts corresponding to the type of fence posts used. Wood crossbars shall be furnished.

d. Erection of Fabric or Wire Fabric or wire shall be stretched taut. Each strand of barbed wire shall be attached to wood posts with staples. Top and bottom strands of woven wire shall be attached to each post and alternate interior strands of woven wire fencing shall be attached to alternate posts. Staples shall not be driven into line posts to restrict the horizontal movement of wire except at corner posts, end posts and bracing where staples shall be fully driven. When attaching fencing to metal posts, approved stay fasteners shall be used.

Except as otherwise provided, splicing wire will be permitted at posts only with each horizontal strand of wire wrapped completely around the post. The wire strand shall be fastened by winding the wire about the same strand where it leads to the post. This type of fastening shall be used at each end post, corner post, and gate post and at barway posts. Other devices designed specifically to splice fencing wire may be used, subject to approval.

607.05 Chain Link Fence Foundations for posts for chain link fence shall be cast-in-place portland cement concrete placed in approved forms or shall be approved metal drive anchors. If wood forms are used, they shall be removed before backfilling. If fiber forms are used, they need not be removed.

a. Braces Fences less than 1.8 m [6 ft] in height that are installed with a top rail shall not require any brace rails. Fences less than 1.8 m [6 ft] in height installed without a top rail and all fences with heights of 1.8 m [6 ft] or more shall have brace rails installed midway between the top and bottom of the fabric as shown on the plans. Braces shall be securely fastened to the posts then trussed from the line post to the base of the end, intermediate or corner post with a 10 mm [ $\frac{3}{8}$  in] diameter truss rod and tightened. At changes in horizontal alignment of less than 15°, bracing will not be required except at intervals of 100 m [330 ft]. At changes in alignment of 15° to 30°, bracing may be required as called for on the plans or requested. At changes in alignment in excess of 30°, bracing will be required. One brace assembly shall be furnished with each end or gate post and two assemblies with each corner or intermediate post and at grade changes specified above.

b. Gates Where gates are required for chain link fence, they shall be constructed of metal.

c. Erection of Chain Link Fabric The grade of fence shall be approximately parallel with the grade of the ground. When directed, abrupt depressions shall be filled.

Top rails when required, shall pass through post caps and be securely fastened to end, corner, brace and gate posts. Joints in top rails shall be made with expansion sleeve couplings. On curves with a radius of less than 150 m [500 ft], the top rail shall be bent to the arc.

The fabric shall be pulled taut, the ends attached to the posts with stretcher bars, and bands or other approved devices. When required, wire fabric shall be joined by weaving a single strand of mesh wire into the ends of the rolls to form a continuous mesh.

d. Tension Wire When called for on the plans, a tension wire of seven gage galvanized wire shall be used in place of the top rail.

607.06 Method of Measurement Fence will be measured by the meter [linear foot] accepted in place. Measurement will be along the gradient of the fence from outside to outside of end posts for each continuous run of fence and shall include fence at bracing assemblies but shall not include space at gates and barways. Gates, barways, and bracing assemblies will be measured by the unit of the size and type specified. Excavation in rock for placement of fence posts in drilled holes will be measured by the cubic meter [cubic yard] determined from the actual depth of the drilled hole in the rock and a hypothetical circle diameter of 600 mm [2 ft].

607.07 Basis of Payment The accepted quantities of fence will be paid for at the contract unit price per meter [linear foot] of the type and size specified complete in place. Barways, gates, and bracing assemblies will be paid for at the contract unit price for each type specified complete in place. Payment shall be full compensation for furnishing and assembling all materials, for excavating and backfilling holes, and for all incidentals necessary to complete the work except that in rock, payment for drilled holes will be made under Pay Item 206.07. Excavation of earth to exposed rock shall be incidental to the several items for erection of the fence.

Payment for bracing assemblies shall include furnishing and installing the various larger size and longer length posts, diagonal bracing, ties, anchors and all incidental hardware necessary to complete the type of assembly required, all as shown in the Standard Details. At gateways, payment will be made for bracing assemblies and there will be no separate payment for the gate posts. All extra costs incurred for furnishing and installing the oversize posts at gateways shall be considered included with the various contract items.

Clearing or removal of trees, stumps or boulders, required to install the fence shall be included in the work of the respective pay items of this section.

Payment will be made under:

Pay Item

Pay Unit

607.08	Woven Wire Fence - Wood Posts	meter [Linear Foot]
607.09	Woven Wire Fence - Metal Posts	meter [Linear Foot]
607.10	Barbed Wire Fence - Wood Posts	meter [Linear Foot]
607.11	Barbed Wire Fence - Metal Posts	meter [Linear Foot]
607.12	Barway - Wood Posts	Each
607.13	Barway - Wood Posts	Each
607.14	Walk Gateway 1.2 m [4 ft] - Metal	Each
607.15	Drive Gateway 4.9 m [16 ft] - Metal	Each
607.16	Chain Link Fence - 1.2 m [4 ft]	meter [Linear Foot]
607.163	Chain Link Fence - 1.2 m [4 ft] - PVC Coated	meter [Linear Foot]
607.165	Chain Link Fence - 1.2 m [4 ft] - without Top Rail	meter [Linear Foot]
607.17	Chain Link Fence - 1.8 m [6 ft]	meter [Linear Foot]
607.173	Chain Link Fence - 1.8 m [6 ft] - PVC Coated	meter [Linear Foot]
607.175	Chain Link Fence - 1.8 m [6 ft] - without Top Rail	meter [Linear Foot]
607.22	Cedar Rail Fence	meter [Linear Foot]
607.23	Chain Link Fence Gate	Each
607.24	Remove and Reset Fence	meter [Linear Foot]
607.25	Remove and Reset Chain Link Fence	meter [Linear Foot]
607.30	Bracing Assembly Type I - Wood Posts	Each
607.31	Bracing Assembly Type II - Wood Posts	Each
607.32	Bracing Assembly Type I - Metal Posts	Each
607.33	Bracing Assembly Type II - Metal Posts	Each
607.34	Bracing Assembly Chain Link Fence	Each
607.35	Bracing Assembly Chain Link Fence - PVC Coated	Each

## SECTION 608 - SIDEWALKS

608.01 Description Construct asphalt, brick paved, or concrete sidewalks.

608.02 Materials Materials shall meet the requirements specified in the following Sections of Division 700 - Materials:

Preformed Expansion Joint Filler	705.01
Welded Steel Wire Fabric	709.02
Brick for Paving	704.02

Portland cement concrete for sidewalks shall be class LP and meet the requirements of Section 502 - Structural Concrete.

Bituminous paved sidewalks shall meet the requirements of Section 403 - Hot Bituminous Pavement.

The new aggregate required to build new sidewalk shall meet the requirements of Standard Specification 703.06(a) Aggregate Base and Subbase, Type B. New aggregate for regrading an

existing sidewalk shall meet the requirements of Section 703.10 - Untreated Surface Course and Leveling.

Standard compacting will be required for all areas where 150 mm [6 in] or more new or disturbed aggregate is placed. Where 150 mm [6 in] or less is placed, compaction will be achieved by plate compactor, hand tamp or other means approved by the Resident.

#### 608.03 Portland Cement Concrete Sidewalks

a. Excavation Excavation shall be to the depth and width that will permit the installation and bracing of the forms. The foundation shall be shaped and compacted to a firm even surface conforming to the section shown on the plan. All soft and yielding material shall be removed and replaced with acceptable material.

b. Forms Forms shall be of wood or metal and shall extend for the full depth of the concrete. All forms shall be true, free from warp and of sufficient strength to resist the pressure of the concrete without springing. Bracing and staking of forms shall be such that the forms remain in both horizontal and vertical alignment until their removal.

c. Placing Concrete The foundation shall be thoroughly moistened immediately prior to placing the concrete. The proportioning, mixing and placing of the concrete shall be in accordance with the requirements of Section 502 - Structural Concrete.

d. Finishing The surface shall be finished with a wooden float, which shall be moved in a circular motion to produce a shell-like pattern. No plastering of the mortar will be permitted. All outside edges of the slab and all joints shall be rounded with a 6 mm [ $\frac{1}{4}$  in] radius-edging tool.

e. Joints Joints shall be located as shown on the plans. Slabs shall be placed alternately and the joints coated with an approved bituminous material before placing the adjacent slab.

When a concrete sidewalk is constructed adjacent to a curb, building, retaining wall, or other fixed structure, a preformed joint filler 6 mm [ $\frac{1}{4}$  in] thick shall be used between the slab and the structure.

f. Curing Concrete shall be cured for at least 72 hours. Curing shall be by moist burlap or mats, white-pigmented curing compound or by other approved methods. During the curing period, all traffic, both pedestrian and vehicular, shall be excluded. Vehicular traffic shall be excluded for such additional time as may be directed.

#### 608.04 Hot Bituminous Sidewalk

a. Excavation Excavation shall be to the required depth and width. The foundation shall be shaped and compacted to a firm even surface conforming to the section shown on the plan. All soft and yielding material shall be removed and replaced with acceptable material.

b. Base Course Base course material shall be placed as shown on the plans and each layer thoroughly compacted.

c. Placing Bituminous Sidewalk Material Bituminous sidewalk material shall be placed on the compacted base course in two courses to provide the required depth when rolled. Compaction shall be by a power roller having a minimum total weight of 900 kg [1 ton] with a minimum of 1160 kg/m [65 lb/in] of width of the drive roll or by satisfactory power vibratory compaction equipment. In areas inaccessible to other equipment, hand tamping will be permitted. In any case, the bituminous sidewalk material shall be uniformly compacted.

608.41 Brick Sidewalk Excavation shall be to the required depth and width and the foundation shaped and compacted to a firm even surface conforming to the section shown on the plan. All soft and yielding material shall be removed and replaced with acceptable material.

608.42 Construct Sidewalk The work shall consist of excavating the existing ground, placing and compacting new aggregate as necessary to build the sidewalk in the new location as shown on the plans and typical sections.

608.43 Regrading Sidewalk The work shall consist of removing the existing pavement, adding and compacting new aggregate as necessary and regrading the gravel base to conform to the grading limits shown on the plans and typical sections.

608.05 Method of Measurement Construct sidewalk, regrading sidewalk, Portland cement concrete sidewalks, and brick sidewalk will be measured by the square meter [square yard] of finished surface. Bituminous concrete sidewalks will be measured by the megagram [ton] of bituminous mixture placed.

608.06 Basis of Payment The accepted quantities of sidewalk will be paid for at the contract unit price per square meter [square yard] for portland cement concrete sidewalk and brick sidewalk, per megagram [ton] for hot bituminous sidewalk and cubic meter [cubic yard] for base course material complete in place. Excavation will be paid for under Section 203 - Excavation and Embankment. Expansion joint material, joint filler, and other related items will not be paid for separately but the cost thereof shall be included in the cost of the sidewalk. Base and subbase material will be paid for under Section 304 - Aggregate Base and Subbase Course. Bituminous mixture for sidewalk will be paid for under Section 403 - Hot Bituminous Pavement.

For constructing sidewalk, payment will be for excavation, new aggregate and necessary incidentals to bring the grade to prepave grade. For regrading sidewalk, payment will be for removing existing pavement regrading existing gravel base and adding new material as necessary.

Payment for reinforcement will be considered included in the contract unit price for reinforced concrete sidewalk.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
608.07 Plain Concrete Sidewalk	square meter [Square Yard]
608.08 Reinforced Concrete Sidewalk	square meter [Square Yard]
608.10 Brick Sidewalk (Remove and Rebuild)	square meter [Square Yard]
608.15 Brick Sidewalk with Bituminous Base	square meter [Square Yard]
608.16 Brick Driveway Aprons with Bituminous Base	square meter [Square Yard]
608.45 Construct Sidewalk	square meter [Square Yard]
608.46 Regrading Sidewalk	square meter [Square Yard]

### SECTION 609 - CURB

609.01 Description Construct or reset curb, gutter, or combination curb and gutter, paved ditch, and paved flume. The types of curb are designated as follows:

- Type 1 - Stone curbing of quarried granite stone
- Type 2 - Precast Portland Cement Concrete Curbing
- Type 3 - Bituminous curbing
- Type 5 - Stone edging of quarried granite stone

609.02 Materials Except as provided below, the materials used shall meet the requirements of the following Sections of Division 700 - Materials:

Joint Mortar	705.02
Reinforcing Steel	709.01
Portland Cement Concrete for Concrete Curb	712.03
Stone Curbing and Edging	712.04
Epoxy Resin	712.35
Bituminous Curbing	712.36

Circular curb, terminal sections and transition sections shall be in reasonably close conformity with the shape and dimensions shown on the plans and to the applicable material requirements herein for the type of curb specified.

Dowels shall be reinforcing steel deformed bars.

609.03 Vertical Stone Curb, Terminal Section and Transition Sections and Portland Cement Concrete Curb, Terminal Sections and Transition Sections

a. Installation The curb stone shall be set on a compacted foundation so that the front top arris line conforms to the lines and grades required. The foundation shall be prepared in advance of setting the stone by grading the proper elevation and shaping to conform as closely as possible to the shape of the bottom of the stone. The required spacing between

stones shall be assured by the use of an approved spacing device to provide an open joint between stones of at least 6 mm [ $\frac{1}{4}$  in] and no greater than 15 mm [ $\frac{5}{8}$  in].

b. Backfilling All remaining spaces under the curb shall be filled with approved material and thoroughly hand tamped so the stones will have a firm uniform bearing on the foundation for the entire length and width. Any remaining excavated areas surrounding the curb shall be filled to the required grade with approved materials. This material shall be placed in layers not exceeding 200 mm [8 in] in depth, loose measure and thoroughly tamped.

When backfill material infiltrates through the joints between the stones, small amounts of joint mortar or other approved material shall be placed in the back portion of the joint to prevent such infiltrating.

c. Protection The curb shall be protected and kept in good condition. All exposed surfaces smeared or discolored shall be cleaned and restored to a satisfactory condition or the curb stone removed and replaced.

d. Curb Inlets Curb placed adjacent to curb inlets shall be installed with steel dowels cemented into each stone with epoxy grout as shown in the Standard Details.

The epoxy grout shall be used in accordance with the manufacturer's instructions. The grout shall be forced into the hole, after which the dowel shall be coated with grout for one-half its length and inserted into the grout filled hole. The hole shall be completely filled with grout around the dowel. All tools and containers must be clean before using.

#### 609.04 Bituminous Curb

a. Preparation of Base Before placing the curb, the foundation course shall be thoroughly cleaned of all foreign and objectionable material. String or chalk lines shall be positioned on the prepared base to provide guide lines. The foundation shall be uniformly painted with tack coat at a rate of 0.2 to 0.7 L/m<sup>2</sup> [0.04 to 0.14 gal/yd<sup>2</sup>].

b. Placing The curb shall be placed by an approved power operated extruding type machine using the shape mold called for. A tight bond shall be obtained between the base and the curb. The Resident may permit the placing of curbing by other than mechanical curb placing machines when short sections or sections with short radii are required. The resulting curbing shall conform in all respects to the curbing produced by the machine.

c. Sealing The curb will be sealed with bituminous sealing compound, only when directed by the Resident, in accordance with Section 612 - Bituminous Sealing. Before sealing, the curb shall be clean, dry and shall have reached the ambient temperature.

d. When required, the curb shall be painted and coated with glass beads in accordance with Section 627 - Pavement Marking. Curb designated to be painted shall not be sealed with bituminous sealing compound.

e. Acceptance Curb may be accepted or rejected based on appearance concerning texture, alignment, or both. All damaged curb shall be removed and replaced at the Contractor's expense.

f. Polyester fibers shall be uniformly incorporated into the dry mix at a rate of 0.25 percent of the total batch weight. Certification shall be provided from the supplier with each shipment meeting the following requirements:

Average Length	6.35 mm ±0.127 [0.25 in ± 0.005]
Average Diameter	20 m± 2.5 [0.0008 in ±0.0001]
Specific Gravity	1.32-1.40
Melting Temperature	250 °C [480 °F] Minimum
Color	Natural (White)

609.06 Stone Edging The curb shall be installed, backfilled and protected in accordance with Section 609.03, except as follows:

a. Slope The edging shall be set on a slope as shown on the plans or as directed.

b. Joints Joints shall be open and not greater than 40 mm [1½ in] in width.

#### 609.07 Stone Bridge Curb

a. Installation Each stone and the bed upon which it is to be placed shall be cleaned and thoroughly wetted with water before placing the mortar for bedding and setting the stone. The stone shall be set on a fresh bed of joint mortar and well bedded before the mortar has set so that the front top arris line conforms to the line and grade required. Whenever temporary supporting wedges or other devices are used in setting the stones, they shall be removed before the mortar in the bed has become set, and the holes left by them shall be filled with mortar. Concrete behind the stones shall not be placed until the stones have been in place at least two days. Bedding and pointing mortar for joints shall be cured as required under Section 502 - Structural Concrete.

b. Joints Vertical joints shall be 13 mm [½ in] in width plus or minus 3 mm [⅛ in]. Whenever possible, the face and top of the joint shall be pointed with joint mortar to a depth of 40 mm [1½ in], before the bedding mortar has set. Joints which cannot be so pointed, shall be prepared for pointing by raking them to a depth of 40 mm [1½ in] before the mortar has set. Joints not pointed at the time the stone is laid shall be thoroughly wetted with clean water and filled with mortar. The mortar shall be well driven into the joint and finished with an approved pointing tool, flush with the pitch line of the stones.

#### 609.08 Resetting Stone or Portland Cement Concrete Curb, Including Terminal Sections and Transitions

The curb shall be installed, backfilled and protected in accordance with Section 609.03, except as follows:

a. Removal of Curbing The Contractor shall carefully remove and store curb specified on the plans or designated for resetting. Curb damaged or destroyed, because of the Contractor's operations or because of their failure to store and protect it in a manner that would prevent its loss or damage, shall be replaced with curbing of equal quality at the Contractor's expense.

b. Cutting and Fitting Cutting or fitting necessary in order to install the curbing at the locations directed shall be done by the Contractor.

609.09 Method of Measurement Curb, both new and reset, will be measured by the meter [linear foot] along the front face of the curb at the elevation of the finished pavement, complete in place and accepted. Curb inlets at catch basins, including doweling, will not be measured for payment but shall be considered included in the cost of the catch basin. New transition sections and terminal curb will be measured by the unit. Reset transition sections and terminal curb will be included in the measurement for resetting curb.

609.10 Basis of Payment The accepted quantities of curbing will be paid for at the contract unit price per meter [linear foot] for each kind and type of curbing as specified.

Payment for terminal curb shall include only that portion of the curbing modified for installation at ends of curb runs shown in the Standard Details. Curb adjacent to terminal ends shall be paid for at the contract unit price per meter [linear foot] for the type of curb installed.

Vertical Curb Type 1 and Type 2 required to have a radius of 20 m [60 ft] or less, will be paid for as Vertical Curb Type 1 - Circular.

Curb, Type 5 required to have a radius of 10 m [30 ft] or less will be paid for as Curb Type 5 - Circular.

There will be no separate payment for cement, reinforcing steel, anchors, tack coat, drilling for and grouting anchors, pointing and bedding of curbing, and for cutting and fitting, but these will be considered included in the work of the related curb.

Removal of existing curb and necessary excavation for installing new or reset curbing will not be paid for directly, but shall be considered to be included in the appropriate new or reset curb pay item. Base and Subbase material will be paid for under Section 304 - Aggregate Base and Subbase Course. Backing up bituminous curb is incidental to the curb items.

Payment will be made under:

	<u>Pay Item</u>	<u>Pay Unit</u>
609.11	Vertical Curb Type 1	meter [Linear Foot]
609.12	Vertical Curb Type 1 - Circular	meter [Linear Foot]
609.13	Vertical Bridge Curb Type 1	meter [Linear Foot]

609.131	Vertical Bridge Curb Type 1A	meter [Linear Foot]
609.132	Vertical Bridge Curb Type 1B	meter [Linear Foot]
609.142	Vertical Bridge Curb Type 1B - Circular	meter [Linear Foot]
609.15	Sloped Curb Type 1	meter [Linear Foot]
609.151	Sloped Curb Type 1 - Circular	meter [Linear Foot]
609.19	Vertical Curb - Type 2	meter [Linear Foot]
609.20	Vertical Curb - Circular-Type 2	meter [Linear Foot]
609.23	Terminal Curb Type 1	Each
609.234	Terminal Curb Type 1 - 1.2 m [4 ft]	Each
609.237	Terminal Curb Type 1 - 2.1 [7 ft]	Each
609.2371	Terminal Curb Type 1 - 2.1 [7 ft] - Circular	Each
609.238	Terminal Curb Type 1 - 2.4 m [8 ft]	Each
609.244	Terminal Curb-Type 2 - 1.2 m [4 ft]	Each
609.247	Terminal Curb-Type 2 - 2.1 m [7 ft]	Each
609.26	Curb Transition Section B Type 1	Each
609.31	Curb Type 3	meter [Linear Foot]
609.34	Curb Type 5	meter [Linear Foot]
609.35	Curb-Type 5 - Circular	meter [Linear Foot]
609.38	Reset Curb Type 1	meter [Linear Foot]
609.39	Reset Curb Type 2	meter [Linear Foot]
609.40	Reset Curb Type 5	meter [Linear Foot]

#### SECTION 610 - STONE FILL, RIPRAP, STONE BLANKET, AND STONE DITCH PROTECTION

610.01 Description This work shall consist of excavating for and constructing a protective covering of stone. The types of protective covering of stone are designated as follows:

- a. Stone fill Machine placed embankment for fill slope
- b. Plain Riprap Machine placed stones on earth bedding
- c. Hand Laid Riprap Hand placed stones on earth bedding
- d. Stone Blanket Machine placed stones around piers and Abutments
- e. Heavy Riprap Machine placed stones on earth bedding
- f. Stone Ditch Protection Machine placed ditch protection of rock

610.02 Materials Materials shall meet the requirements of the following Sections of Division 700 - Materials:

Stone Fill	703.25
Plain and Hand Laid Riprap	703.26
Stone Blanket	703.27
Heavy Riprap	703.28
Stone Ditch Protection	703.29

610.031 General Suitable material removed when excavating for the placing of riprap, stone fill, stone blanket or stone ditch protection shall be used in the formation of embankments, subgrade and for backfilling as shown on the plans or as directed.

610.032 Placing Stones

a. Stone Fill and Stone Blanket Material for stone fill shall be deposited to provide a compact mass. The exposed slope shall be finished to the line and grade required without special handling or handwork. Material for stone blanket shall be deposited for protection around piers or abutments as shown on the plans. The stones shall be placed individually to form a reasonably compact mass. Spaces between the larger stones shall be filled with stone or spall of suitable size to leave an even surface conforming to the contour required.

b. Riprap Stones for riprap shall be placed upon a slope properly graded and compacted as called for. When required, the bottom of the riprap shall be placed in a trench at the toe of the slope. Plain riprap shall be placed full depth in one operation without special handwork and shall be placed approximately true to the required slope line and grade and be uniform in appearance. Hand laid riprap shall be random rubble, hand laid stones for the full depth placed in one operation to secure interlocking of all face stones and stones placed as backing. Larger stones shall be laid at the base of the slope. The stones shall be laid in close contact with the longer axis perpendicular to the plane of the slope to stagger joints. Except when required to be grouted the openings between the stones in all riprap shall be filled with spall, or rocks securely rammed into place.

Stones for heavy riprap shall be placed to the full depth in one operation without special handwork or machine work upon a properly graded and compacted slope. Above the low water elevation, stones shall be placed to form an approximate uniform surface, free from humps or depressions, with no excessively large stones projecting from the general surface. Loose stones or excessively large stones tending to extend above the average general surface shall be embedded, reoriented, or discarded. The openings between stones on the face of heavy riprap shall be filled with spall or small rocks, securely rammed into place.

c. Stone Ditch Protection The ditch shall be excavated below the flow line to allow placement of the rock material to the specified depth. The stone ditch protection shall be placed, full depth, in one operation without special handwork, shall be approximately true to line and grade and shall be uniform in appearance.

610.05 Method of Measurement Stone fill, plain riprap, hand laid riprap, stone blanket, heavy riprap and stone ditch protection will be measured by the cubic meter [cubic yard], complete in place, except that when placed under water the quantity may be measured by truck load count with no reduction in volume.

610.06 Basis of Payment The accepted quantities of stone fill, plain riprap, hand laid riprap, stone blanket, heavy riprap and stone ditch protection and materials to fill the voids will be paid for at the contract unit price per cubic meter [cubic yard] complete in place.

Costs of all required excavation below the slope line for the placement of bedding, riprap, stone fill, stone blanket, stone ditch protection and for furnishing and placing the bedding material itself, will be considered incidental to the contract items and no separate payment will be made.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
610.07 Stone Fill	cubic meter [Cubic Yard]
610.08 Plain Riprap	cubic meter [Cubic Yard]
610.09 Hand Laid Riprap	cubic meter [Cubic Yard]
610.11 Stone Blanket	cubic meter [Cubic Yard]
610.16 Heavy Riprap	cubic meter [Cubic Yard]
610.18 Stone Ditch Protection	cubic meter [Cubic Yard]

#### SECTION 611 - SLAB FOR BACKSLOPE PROTECTION

611.01 Description This work shall consist of slabs of stone or precast concrete placed on backslopes in accordance with these specifications and in reasonably close conformity with the lines and grades shown on the plans or established.

611.02 Materials Materials shall conform to the requirements specified in the following Sections of Division 700 - Materials:

Joint Mortar	705.02
Reinforcing Steel	709.01
Precast Concrete Slab	712.37
Stone Slab	712.38

611.03 Excavation The slope behind the slabs shall be carefully graded, by hand if necessary, to avoid disturbing earth beyond the designated limits.

611.04 Placement of Slab The slabs shall be placed to conform to the required line and grade. They shall be fitted together to form a vertical joint of not less than 5 mm [ $\frac{1}{4}$  in] and not greater than 20 mm [ $\frac{3}{4}$  in] wide. The space behind the slabs shall be backfilled with approved granular material thoroughly compacted. Special care shall be taken not to disturb the slabs.

The vertical joints shall be filled with approved caulking compound and neatly smoothed. The surface of the slab shall be protected from all caulking compound.

The slabs shall be protected and kept in good condition with particular care being taken to prevent discoloration of exposed surfaces. All exposed surfaces smeared or discolored shall be cleaned and restored to a satisfactory condition or removed and replaced with a new slab.

Lift holes shall be filled with cement mortar.

611.05 Method of Measurement Slab for backslope protection will be measured by the square meter [square yard] of slab complete in place, measured parallel to the slope but not to exceed the dimensions shown on the plans or authorized by the Resident.

611.06 Basis of Payment The accepted quantity of slab for backslope protection will be paid for at the contract unit price per square meter [square yard] complete in place including caulking of joints.

Excavation to the face of the slab will be measured and paid for as provided in Section 203 - Excavation and Embankment. Excavation and backfill beyond the face of the slab will be considered incidental to the various contract items and no separate payment will be made.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
611.16 Stone Slab for Backslope Protection	square meter [Square Yard]
611.17 Concrete Slab for Backslope Protection	square meter [Square Yard]

## SECTION 612 - BITUMINOUS SEALING

612.01 Description This work shall consist of sealing bituminous mix surfaces with emulsified bituminous sealing compound of the specified color, applied at locations shown on the plans or designated.

612.02 Materials Bituminous material for sealing shall conform to the requirements of Emulsified Bituminous Sealing Compound, Section 702.12.

612.03 General The sealing compound shall be applied in two coats. The first coat shall be diluted by the addition of up to 50% water to a liquid consistency and applied with brooms or other approved methods at a rate of 1.25 L to 2.25 L [0.25 gal to 0.50 gal] of diluted sealer per square meter [square yard]. The second coat shall be diluted only to the extent necessary to obtain workability and applied at a rate of 1.1 L to 2.2 L [0.25 gal to 0.50 gal] of diluted sealer per square meter [square yard].

612.04 Method of Measurement Bituminous sealing will be measured by the square meter [square yard] of surface sealed measured parallel to the surface.

612.05 Basis of Payment The accepted quantities of bituminous sealing will be paid for at the contract unit price per square meter [square yard] complete in place.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
612.06 Bituminous Sealing-Black	square meter [Square Yard]

### SECTION 613 - EROSION CONTROL BLANKETS

613.01 Description This work shall consist of furnishing and installing erosion control blankets on previously prepared areas in accordance with the manufacturer instructions or as called for on the plans or otherwise authorized.

Erosion control blankets shall be installed on critical slopes, shoulder berms, esplanade strips, curb sections, in ditches and drainage ways, and other previously prepared areas or as shown.

613.02 Materials Erosion control blanket shall conform to the requirements specified in the following Sections of Division 700 - Materials.

Erosion Control Blankets	717.061
Ground Anchors	717.063

613.03 Site Preparation The area for erosion control blankets shall be prepared as follows:

Soil must be loose or scarified, smoothly raked and free of stones, litter, and any abrupt ground surface roughness under the blanket.

613.04 Seeding All seed shall be sown before installing erosion control blankets. No loam will be required for Seeding, unless called for on plans or designated. Seeding, Method Number 2 will be used unless otherwise specified.

613.05 Installation On Slopes and in ditches, blankets shall be aligned in the direction of water flow and along the contours of berms. The uphill end of blanket shall be anchored in a trench no less than 150 mm [6 in] deep and overlapped on the adjoining ends no less than 75 mm [3 in]. Parallel strips shall be overlapped 100 mm [4 in] on the sides. Approved anchor staples shall be placed at a maximum spacing of 900mm [3 ft] on center or as required by the manufacturer, whichever is closer.

613.08 Method of Measurement Erosion control blanket will be measured by the square meter [square yard] based on the width and length of the blanket measured on the ground.

613.09 Basis of Payment Erosion control blankets of the type specified will be paid for at the contract unit price per square meter [square yard] complete in place and accepted. Such payment shall be full compensation for furnishing and installing the blankets and initial seeding under blanket in accordance with this specification and for all required maintenance.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
613.319 Erosion Control Blanket	square meter [Square Yard]

SECTION 614 - VACANT

SECTION 615 - LOAM

615.01 Description This work shall consist of furnishing and placing loam for seeding or sodding, in reasonably close conformity with the thicknesses called for on the plans or as authorized.

615.02 Materials Materials shall conform to the requirements specified in the following Sections of Division 700 - Materials:

Humus	717.09
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Loam shall meet the following requirements:

<u>Organic Content</u>	<u>Percent by Volume</u>
Humus	10% - 20%, as determined by Ignition Test.
pH	5.5 - 8.0
<u>Mineral Content</u>	<u>Percent by Volume</u>
Sand - 2.0mm - 0.05mm [0.08 in to 0.002 in] diameter	45% - 75%
Silt - 0.05mm - 0.002mm [0.002 in to 0.00008 in] diameter	20% - 40%
Clay - less than 0.002mm [0.00008 in] diameter	5% - 15%

The loam shall be screened, loose, friable, and shall be free from admixture of subsoil, refuse, large stones, clods, roots, or other undesirable foreign matter. It shall be reasonably free of weeds, roots, or rhizomes.

The Contractor shall submit loam testing results; the cost of testing shall be considered incidental to the Pay Item for Loam.

The Contractor may elect to manufacture loam from a combination of project materials that the Contractor is entitled to use, combined with other suitable materials furnished by the Contractor.

615.03 Preparing Areas All slopes and other areas where loam is to be placed shall be shaped to the required grade. Before placing the loam on hard or compacted soils, the areas under preparation shall be scarified and loosened to a depth of at least 50 mm [2 in].

615.04 Placing Loam Loam shall be spread uniformly on prepared areas to the depth shown on the plans or as directed. Any remaining clods, roots, stones over 50 mm [2 in] in its greatest diameter and all other foreign matter, shall be removed. On areas to be seeded under Method Number 1, all rocks over 25 mm [1 in] in diameter shall be removed. All loam shall be brought to a true, even surface, meeting the required grade. The Contractor shall compact the loam with a 45 kg [100 lb] roller or other approved means. Loam thickness shall meet the specified depth after compaction.

615.05 Method of Measurement Loam will be measured by the cubic meter [cubic yard] complete in place after finishing to the required depths as shown on the plans or directed. Lateral measurements will be parallel with the slope of the ground.

Removal of existing topsoil salvaged from within the lines of improvement will be measured for payment in accordance with Section 203.18. The depth of the salvaged topsoil to be included for payment shall be the depth authorized. There will be no deduction from borrow quantities resulting from the authorized excavation of salvaged topsoil.

615.06 Basis of Payment The accepted quantities of loam will be paid for at the contract unit price per cubic meter [cubic yard] complete in place. Existing topsoil removed from within the lines of improvement and stockpiled for later use as loam will be paid for under Pay Item 203.20, Common Excavation, after removal and stockpiling, and will be paid for under Pay Item 615.07, Loam, when placed in its final position. Grading surplus topsoil, salvaged but not required for use on slopes as loam, will be paid for under the appropriate items of Section 631 - Equipment Rental, Section 618 - Seeding, and Section 619 - Mulch.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
615.07     Loam	cubic meter [Cubic Yard]
615.0701   Loam - Plan Quantity	cubic meter [Cubic Yard]

## SECTION 616 - SODDING

616.01 Description This work shall consist of furnishing and placing approved live sod on a bed of friable soil for the replacement of lawns or other areas called for on the plans or authorized.

616.02 Materials Materials shall meet the requirements in the following Sections of Division 700 - Materials:

Fertilizer	717.01(b)
Agricultural Ground Limestone	717.02

Sod may be either field sod or cultivated sod.

Field sod shall consist of a dense, well-rooted, vigorous growth of turf forming perennials indigenous to the locality where it is to be used. Field sod shall be taken from approved sources where the sod will not break or crumble during cutting, transporting and laying. Field sod shall be reasonably free from noxious weeds, large stones, tree roots, or other materials harmful to growth or subsequent maintenance of the sod. Field sod shall be cut to a uniform thickness of not less than 50 mm [2 in].

Cultivated sod shall consist of a Kentucky Bluegrass/Red Fescue turf obtained from an approved commercial sod farm and shall be substantially free from objectionable grassy and broadleaf weeds. Cultivated sod shall be cut to a uniform minimum thickness of not less than 12 mm [½ in].

Pegs for holding sod shall be of approved sound wood and at least 19mm [¾ in] in thickness and at least 200 mm [8 in] in length.

616.03 Cutting and Transporting The area from which sod is to be cut shall be mowed and cleared of excess clippings and other foreign matter shortly before cutting starts. The sod shall be freshly cut with an approved sod cutter into strips of uniform thickness having a minimum width of 300 mm [12 in] and a minimum length of 300 mm [12 in] and transported in an unbroken condition to the area to be sodded. Sod shall be placed in its final position within 24 hours after cutting. No storage of sod will be allowed unless specifically authorized by the Resident. Cut sod shall be protected from drying during the time between cutting and placing.

616.04 Site Preparation Sod shall be placed over 50mm [2 in] of moist loam in accordance with Section 615. The areas to be sodded shall be brought to the grades shown on the plans, allowing for the thickness of the sod. Areas to be sodded shall be cleared of stones, roots, clods, and other debris that might interfere with laying sod or subsequent maintenance of the sodded area. The fertilizer and agricultural ground limestone shall be applied to the soil by a mechanical spreader or other approved method capable of maintaining a uniform, measurable rate of application. The fertilizer and limestone shall not be applied simultaneously. Fertilizer and limestone shall be applied before laying sod, at the rate of 1.8 kg/100m<sup>2</sup> [4 lb/1000 ft<sup>2</sup>] for fertilizer and 6 kg/100 m<sup>2</sup> [13 lb/1000 ft<sup>2</sup>] for limestone. On hard packed soil, the areas under preparation shall be scarified or otherwise loosened to a depth of at least 50 mm [2 in] before placing loam and laying sod, unless otherwise directed.

616.05 Laying Sod Sod shall be moist when laid and shall be placed on a moist soil bed. The sod shall be placed at a right angle to the slope, commencing at the lower end and tightly fitted, edge to edge, to provide a uniform surface. Transverse joints shall be staggered. Sod shall be fitted to produce a tight surface without gaps.

The sod shall be compacted and bonded to the soil with an approved tamper or light roller. After tamping or rolling, the sod shall have a smooth, even surface free from humps and depressions.

Unless otherwise directed, on areas with a gradient of 2 horizontal to 1 vertical or steeper, the sod shall be anchored with wooden pegs. The pegs shall be spaced no more than 600 mm [2

ft] apart in any direction and driven through the sod into the ground perpendicular to the ground surface. The top of the pegs shall be driven flush with the surface of the sod.

The Contractor shall water the sod as necessary and shall insure continued growth of the sod. Sod not surviving for 3 months after installation shall be removed and replaced by the contractor at their expense.

Frozen sod shall not be used nor shall sod be placed on frozen soil.

616.06 Method of Measurement Sodding will be measured by the square meter [square feet], measured along the slope, complete in place, or as otherwise directed.

616.07 Basis of Payment The accepted quantities of sodding will be paid for at the contract unit price per square meter [square yard] completed and accepted in place, which shall include supplying and installing sod, fertilizer, limestone and watering. Necessary excavation for placing sod will not be paid for separately but will be considered incidental to the contract unit price for sodding.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
616.08 Sodding	square meter [Square Yard]

### SECTION 617 - SOIL CONDITIONERS

Reserved

### SECTION 618 - SEEDING

618.01 Description This work shall consist of furnishing and applying a seed, and other materials to areas shown on the plans or as authorized by the Resident.

a. Seeding Method Number 1 shall consist of the application of “Park Mixture”, fertilizer, and cellulose fiber mulch to loamed areas which are expected to be maintained by frequent mowing: i.e. private lawns.

b. Seeding Method Number 2 shall consist of the application of “Roadside Mixture Number 2”, lime, and fertilizer to existing soils or loamed areas which are expected to be maintained by infrequent mowing: i.e. inslopes, ditches, and rural lawns.

c. Seeding Method Number 3 shall consist of the application of “Roadside Mixture Number 3,” inoculant and lime to existing soils, erosion control mix, or riprap areas which are not expected to be mowed: i.e. backslopes, guardrail areas.

d. Special Seeding shall consist of the application of a special seed mix and amendments as defined by Special Provision.

e. Temporary Seeding shall consist of the application of seed to control erosion to slopes and stockpiles that have been disturbed during construction and will be left incomplete for more than 30 days. Seed for Temporary Seeding shall be oats, wheat, rye, or other seed conforming to the requirements of Section 717.03(e).

f. Crown Vetch Seeding shall consist of the application of seed, inoculant, and lime to areas that will not be mowed: i.e. riprap or erosion control mix.

618.02 Materials Materials shall meet the requirements of the following Sections of Division 700 - Materials:

Fertilizer	717.01
Agricultural Ground Limestone and Liquid Lime	717.02
Seed	717.03

618.03 Rates of Application Application rates are set forth below. One unit is defined as 100 m<sup>2</sup> [1000 ft<sup>2</sup>].

a. The Contractor shall apply agricultural ground limestone at the rate of 15 kg [33 lb] per unit. Liquid lime shall be applied at the rate of 0.25 liters [1 cup] per unit, hydraulic method. Liquid lime shall be one part lime with a minimum of 10 parts water.

b. The fertilizer application rate for seed establishment shall be 4 kg [9 lb] per unit, Seeding Method 1 and 2 only.

c. The seed mixture sowing rate for Seeding Method 1 and 2 shall be 1.8 kg [4 lb]/unit.

d. The seed mixture sowing rate for Seeding Method 3 shall be 1.0 kg [2 lb] per unit.

e. The Temporary Seed sowing rate shall be 1.5 kg [3 lb] per unit.

f. The Crown Vetch Seed sowing rate shall be 0.5 kg [1 lb] per unit.

618.04 Time of Initial Seeding The Contractor shall not seed during January, February, or March, or when the ground is frozen or snow covered, or at other times as the Department may direct.

618.05 Applying Fertilizer and Agricultural Ground Limestone - Conventional Method The Contractor shall apply fertilizer and agricultural ground limestone when the soil is moist and before sowing the seed. The Contractor shall apply these materials to the soil by an approved method capable of maintaining a measured rate of application, thoroughly incorporating materials into the soil to a depth of not less than 25 mm [1 in]. The Contractor shall not apply these materials simultaneously unless using an approved hydraulic method.

618.06 Sowing Seed - Conventional Method The Contractor shall sow seeding materials uniformly at the required rate and mulch seeded areas the same day as sown. The Contractor shall roll lawn areas with a light lawn roller after seeding but before mulch is applied.

618.07 Sowing Seed and Applying Fertilizer and Agricultural Ground Limestone - Hydraulic Method The Contractor may use the hydraulic spray method of sowing seed where approved. The Contractor shall use a commercial machine designed for the hydraulic application of seed, fertilizer, limestone, and mulch in a slurry. The Contractor shall mix seed and added materials with sufficient water in the tank of the machine and keep the slurry thoroughly agitated, so the materials are uniformly mixed and suspended in the water at all times during operation. The Contractor shall uniformly distribute the seed slurry on the designated areas at the required rate. Mulch for Seeding Method Number 1 shall be cellulose fiber mulch as specified in Section 619.04(b).

618.08 Mulching After seeding, the Contractor shall place hay mulch or erosion control blanket unless cellulose fiber mulch is applied with the seed by the hydraulic method. The Contractor shall place Mulch as specified in Section 619 and Erosion Control Blankets as specified in Section 613 . Where hay mulch has been previously applied for erosion control and there is adequate hay mulch still present on the area at the time of seeding, the Department may direct the Contractor to seed over the hay mulch.

#### 618.09 Construction Method

##### a. Seeding Method Numbers 1 and 2

1. After the loamed or unloamed areas to be seeded have been brought to grade, the Contractor shall scarify all ground not sufficiently loose and friable to provide bedding for the seed to a depth of at least 50 mm [2 in] immediately before seeding or mulching. The Contractor shall remove all stones over 100 mm [4 in] in the greatest dimension, tree roots, and refuse and dispose of as directed by the Department. The surface shall be a uniform grade but not smooth.

2. The Contractor shall apply fertilizer and agricultural ground limestone to the prepared areas as specified in Sections 618.05 and 618.07.

3. The Contractor shall sow the seed as specified in Sections 618.06 and 618.07.

4. The Contractor shall apply mulch as specified in Section 618.08. Cellulose fiber mulch only shall be applied with Method 1, and may be used with Method 2.

##### b. Temporary Seeding

1. The Contractor shall apply agricultural ground limestone to the prepared areas as specified in Sections 618.05 and 618.07.

2. The Contractor shall sow seed onto existing ground as specified in Sections 618.06 and 618.07.

3. The Contractor shall apply mulch as specified in Section 618.08.

c. Seeding Method 3 and Crown Vetch Seeding

1. The Contractor may place seed and limestone directly over existing ground without site preparation.

2. The Contractor shall apply agricultural ground limestone to the areas as specified in Section 618.07.

3. The Contractor shall sow seed as specified in Section 618.07.

4. The Contractor shall apply mulch as specified in Section 618.07. The Contractor shall not apply mulch if seeding riprap or erosion control mix.

618.10 Maintenance and Acceptance The Department will accept areas seeded with Seeding Method 1 or 2 upon attainment of a reasonably thick uniform stand of permanent grass species with at least 90 percent coverage, free from sizable thin or bare spots. The Contractor shall perform final reseeding as follows: Upon completion of all other work on the project, seeded areas that have not been accepted shall, within 60 calendar days, meet the 90 percent coverage requirement or be reseeded a final time. Final reseeding shall be done at the end of the 60-day period or at any time within the 60 days, as directed by the Department. The Contractor will not be allowed to perform final reseeding between September 15<sup>th</sup> and April 15<sup>th</sup>, and the Department will not count this time as part of the 60-day period. All reseeding shall comply with Sections 618.03 through 618.09.

The Department will accept areas sown with Method 3, Temporary Seed, Special Seed, or Crown Vetch at the time that areas are satisfactorily completed.

The Contractor shall maintain and protect all seeded areas until acceptance.

618.101 Applied Water The Contractor shall use Applied Water to aid in the establishment of newly planted shrubs, trees, seedlings, and sod during an abnormal drought that requires excessive watering beyond what is expected with each planting in accordance with Sections 621.0024 and 616.05. Applied Water shall be authorized by the Department. The Contractor shall use Applied Water from approved sources in a manner to allow the soil to absorb the water without runoff.

618.11 Method of Measurement The Department will measure Seeding for payment by the area of seeded surface in Units of 100 m<sup>2</sup> [1000 ft<sup>2</sup>] along the slope of the ground. The quantity of seeding measured for payment will be the number of units shown in the Schedule of Items in the contract. This quantity will be considered final, and no adjustments will be made, except

when the actual area seeded varies from the number of units shown in the Schedule of Items by more than 15 percent.

The Department will measure Applied Water for payment by the cubic meter [gallon] in calibrated tanks or by accurate water meters. Delivery slips, as specified in Section 108.1.3-f will be required. Watering deemed necessary by the Contractor to assure a growth of grass under the guarantee provisions of Section 618.10, Maintenance and Acceptance, will not be measured for payment.

618.12 Basis of Payment The Department will pay for the accepted quantities of seeding at the Contract price per Unit for the method specified, which price shall be full compensation for furnishing and spreading seed, limestone, fertilizer, and inoculant. The price shall also include any reseeding, watering, and maintenance necessary to meet the requirements of Section 618.10, Maintenance and Acceptance.

When fertilizer is omitted from Seeding Method Number 1 or Number 2 at the direction of the Department, payment for such seeding will be 85 percent of the Contract price for the appropriate item.

When authorized, the Department will pay for Applied Water at the Contract price per cubic meter [gallon].

When seeding is completed, amounts due for these items will be payable.

The Department will pay for Loam and Mulch as provided in Section 615 - Loam and Section 619 - Mulch.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
618.1301 Seeding Method Number 1, Plan Quantity	Unit
618.1401 Seeding Method Number 2, Plan Quantity	Unit
618.1411 Seeding Method Number 3, Plan Quantity	Unit
618.143 Special Seeding	Unit
618.15 Temporary Seeding	Unit
618.16 Crown Vetch Seeding	Unit
618.25 Applied Water	Cubic Meter [gallon]

#### SECTION 619 - MULCH

619.01 Description This work shall consist of furnishing and applying hay, straw, bark, erosion control mix, or cellulose fiber for covering slopes and other areas with a mulch as shown on the plans or authorized.

619.02 Mulch Material shall conform to the requirements specified in the following Sections of Division 700 - Materials:

Mulch	717.04
Mulch Binder	717.05

619.03 General Cellulose fiber mulch shall be used with Seeding Method 1 and approved areas, which may include, but are not limited to, lawns adjacent to developed property, areas subject to high air blasts created by moving vehicles, and areas where hay mulch would create a hazard.

619.04 Applying Mulch Mulch shall be any of the following types of material.

a. Hay or straw mulch for both seeded and unseeded areas shall be spread evenly and uniformly over the designated areas. Unless otherwise directed, mulch shall be applied at the rate of 3.5 Mg to 4.5 Mg/ha [1.5 ton to 2 ton/acre]. Too heavy an application of mulch shall be avoided. Lumps and thick mulch material shall be thinned.

Unless otherwise authorized, hay or straw mulch shall be anchored in place by uniformly applying an acceptable mulch binder. Mulch binder shall be applied as soon as the mulch is placed. Application of a concentrated stream of mulch binder will not be allowed. Mulch binder will be paper fiber mulch applied at 2.3 Kg/Unit [5 lbs/Unit] or approved equal. Water spray may be used as a temporary binder.

Temporary mulching shall be applied as per the Contractor's SEWPCP, spread immediately to protect soil from erosion during all stages of construction throughout all seasons of the year.

b. Cellulose Fiber Mulch shall be applied as a waterborne slurry. The cellulose fiber and water shall be thoroughly mixed and sprayed on the area to be covered so as to form a uniform mat of mulch at the rate of not less than 20 kg [40 lb] of mulch material per 100 m<sup>2</sup> [1000 ft<sup>2</sup>] unit of area.

Cellulose fiber mulch may be mixed with the proper quantities of seed, fertilizer, and agricultural limestone as required under Section 618 - Seeding or may be applied separately the same day as seeding.

c. Bark mulch and erosion control mix shall be placed to cover the slope with a 100 mm [4 in] deep blanket or as called for on the Plans or by the Resident.

619.05 Maintenance The Contractor shall maintain the hay, straw, or fiber mulch by repairing all damaged mulch and by correcting all shifting of the mulch due to wind, water, or other causes, until an acceptable growth of grass has been achieved.

If cellulose fiber mulch is used, any reseeded will require additional cellulose fiber mulch.

Bark mulch and erosion control mix will be accepted upon completion. Upon acceptance of each area, the Contractor will be relieved of further responsibility for maintaining that area or repairing damage except that resulting from their own or subcontractor's operations.

If water spray is used as a temporary binder, it shall be maintained in a manner acceptable to the Resident.

619.06 Method of Measurement Hay and straw mulch measured and accepted for payment will be the number of units of 100 m<sup>2</sup> [1000 ft<sup>2</sup>] each, shown in the Schedule of Items in the contract.

This quantity will be considered final, and no adjustments will be made, except when the actual area mulched varies from the number of units shown in the Schedule of Items by more than 15%.

The quantity of bark mulch and erosion control mix measured and accepted for payment will be the number of cubic yards each, delivered and installed to the required depth as shown on the plans or as directed. Measurement will be parallel with the slope of the ground.

619.07 Basis of Payment The accepted areas mulched will be paid for at the contract price per unit, which shall be full compensation for furnishing and spreading the hay or straw and mulch binder, cellulose fiber mulch, bark mulch or erosion control mix.

When mulch is measured by bales, each bale will be paid for at 60% of the contract price per unit for Pay Item 619.1201.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
619.1201 Mulch, Plan Quantity	Unit
619.1301 Bark Mulch	cubic meter [Cubic Yard]
619.1401 Erosion Control Mix	cubic meter [Cubic Yard]

## SECTION 620 - GEOTEXTILES

620.01 Description This work shall consist of the furnishing and installing of woven geotextile fabric or nonwoven geotechnical fabric, hereinafter called fabric, as shown in the Contract, or otherwise directed. This Section is intended for use in conjunction with Section 722 - Geotextiles.

620.02 Materials Geotextiles shall meet the requirements in the following Sections of Division 700 - Materials:

Stabilization/Reinforcement Geotextile	722.01
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Drainage Geotextile	722.02
Erosion Control Geotextile	722.03
Separation Geotextile	722.04

### 620.03 Placement

a. Stabilization/Reinforcement and Separation Geotextile The installation site shall be prepared by clearing, grubbing, and excavating or filling the area to the design grade. This includes the removal of topsoil and vegetation. Soft spots and unsuitable areas identified during site preparation shall be excavated and backfilled with select material and compacted using normal procedures, as directed.

The geotextile shall be laid smooth without wrinkles or folds on the prepared subgrade in the direction of construction traffic. The subbase shall be placed by end dumping onto the geotextile from the edge of the geotextile, or over previously placed Subbase aggregate. Construction vehicles shall not be allowed directly on the geotextile. The subbase shall be placed such that at least the minimum specified lift thickness shall be between the geotextile and equipment tires or tracks at all times. Turning of vehicles shall not be permitted on the first lift above the geotextile. Any ruts occurring during construction shall be filled with additional subbase material and compacted to the specified density. In stabilization applications, the use of vibratory compaction equipment is not recommended with the initial lift of subbase as it may cause damage to the geotextile.

When fabric is to be used as a reinforcement geotextile, care shall be taken to tension the fabric before completely covering with aggregate. Cover material shall be placed starting on one edge of the fabric and progress toward the opposite edge, in order to maintain tension in the fabric.

When sloped riprap is to be placed on fabric, the site shall be prepared to provide an undulating and uneven surface, as much as is practical. The fabric shall be placed loosely to prevent any bridging of the uneven surface. Fabric to be placed on slopes shall have the long direction oriented up and down the slope as shown on the Standard Detail.

All joints between adjacent fabric roll ends that may occur on the slope shall be overlapped shingle style. The armor system placement shall begin at the toe and proceed up the slope. Placement shall take place so as to avoid stretching and subsequent tearing of the geotextile. Riprap and heavy stone fill shall not be dropped from a height of more than 300 mm [1 ft]. Stone with a mass of more than 100 kg [220 lb] shall not be allowed to roll down the slope. Slope protection and smaller sizes of stone filling shall not be dropped from a height exceeding 1 m [3 ft], or a demonstration provided showing that the placement procedures will not damage the geotextile. Following placement of the armor stone, grading of the slope shall not be permitted if the grading results in movement of the stone directly above the geotextile.

For Separation Geotextile, when the fabric is to be placed in the roadway, the cover material shall be dumped on previously placed cover material or at the edges of the fabric

and then pushed onto the fabric. The first layer of cover material shall be greater than 200 mm [8 in] and first compacted by a track bulldozer. At no time shall construction equipment be allowed on the fabric when the fabric is covered with less than 200 mm [8 in] of compacted cover material. Ruts shall be filled with additional cover material to maintain the minimum 200 mm [8 in] cover over the fabric. When fabric is placed in the roadway, the fabric roll widths shall be chosen so that there will be a minimum number of overlaps of parallel rolls. The total width of surface covered is shown on the Standard Details

b. Drainage Geotextile Trench excavation shall be done in accordance with details of the project plans. In all instances excavation shall be done in such a way as to prevent large voids from occurring in the sides and bottom of the trench. The graded surface shall be smooth and free of debris. The fabric shall be placed loosely with no wrinkles or folds and with no void spaces between the geotextile and the ground surface.

Placement of the drainage aggregate should proceed immediately following placement of the geotextile. The geotextile shall be covered with a minimum of 300 mm [1 ft] of loosely placed aggregate prior to compaction. If a perforated collector pipe is to be installed in the trench, a bedding layer of drainage aggregate should be placed below the pipe, with the remainder of the aggregate placed to the minimum required construction depth. The aggregate should be compacted with vibratory equipment to a minimum of 95% Standard AASHTO density unless the trench is required for structural support. If higher compactive effort is required, a Class 1 geotextile as described in Section 722.03 - Geotextiles is needed.

c. Non-Woven Geotextile Non-woven Erosion Control Geotextiles require Class 2 geotextile class designation. All other Non-woven Geotextiles require Class 1 geotextile class designation.

The Non-woven Geotextile class selection is appropriate for conditions of equal or less severity than either of the following:

1. Armor layer stone weights do not exceed 100 kg [220 lb], stone drop height is less than 1 m (3 feet), and no aggregate bedding layer is required.
2. Armor layer stone weighs more than 100 kg [220 lb], stone drop height is less than 1 m [3 ft], and the geotextile is protected by a 150 mm [6 in] thick aggregate bedding layer designed to be compatible with the armor layer. More severe applications require an assessment of geotextile survivability based on a field trial section and may require a geotextile of higher strength properties.

The Resident may specify a Class 2 geotextile based on one or more of the following:

- a. The Resident has found Class 2 geotextiles to have sufficient survivability based on field performance of the geotextile.

b. The Resident has found Class 2 geotextiles to have sufficient survivability based on laboratory testing and visual inspection of a geotextile sample removed from a field test section constructed under anticipated field conditions.

c. Armor layer stone weighs less than 100 kg [220 lb], stone drop height is less than 1 m [3 ft], and the geotextile is protected by a 150 mm [6 in] thick aggregate bedding layer designed to be compatible with the armor layer.

d. Armor layer stone weights do not exceed 100 kg [220 lb] and stone is placed with a zero drop height. Note: 703.25 Stone Fill has stones up to 225 kg [500 lb], 703.26 Plain and Hand Held Riprap has stones up to 100 kg [220 lbs], 703.27 Stone blanket has stones up to 1,500 kg [3,300 lb], 703.28 Heavy Riprap has stones up to 450 kg [990 lb]

The geotextile shall be placed in intimate contact with the soils without wrinkles or folds and anchored on a smooth graded surface approved by the Resident. The geotextile shall be placed in such a manner that placement of the overlying materials will not excessively stretch the geotextile, tearing it.

Anchoring of the terminal ends of the geotextile shall be accomplished using key trenches or aprons at the crest and toe of slope. The geotextile shall be placed with the machine direction parallel to the direction of water flow which is normally parallel to the slope of erosion control runoff and wave action and parallel to the stream or channel in the case of stream bank and channel protection. When riprap or stone ditch protection is placed on fabric, the stones shall be placed so that they do not puncture or otherwise damage the fabric.

When sloped riprap is to be placed on fabric, the site shall be prepared to provide an undulating and uneven surface, as much as is practical. The fabric shall be placed loosely to prevent any bridging of the uneven surface. Fabric to be placed on slopes shall have the long direction oriented up and down the slope as shown in the Standard Details.

All joints between adjacent fabric roll ends that may occur on the slope shall be overlapped shingle style. The armor system placement shall begin at the toe and proceed up the slope. Placement shall take place so as to avoid stretching and subsequent tearing of the geotextile. Riprap and heavy stone fill shall not be dropped from a height of more than 300 mm [1 ft]. Stone with a mass of more than 100 kg [220 lb] shall not be allowed to roll down the slope. Slope protection and smaller sizes of stone filling shall not be dropped from a height exceeding 1 m [3 ft], or a demonstration provided showing that the placement procedures will not damage the geotextile. Following placement of the armor stone, grading of the slope shall not be permitted if the grading results in movement of the stone directly above the geotextile.

In underwater applications, the geotextile and backfill material shall be placed the same day. All void spaces in the armor stone shall be backfilled with small stone to ensure full coverage.

620.04 Overlap and Seams Adjacent lengths of fabric shall be joined by overlapping a minimum of 450 mm [18 in] at the ends and sides except when sewing is specified or fabric is placed on slopes. All overlaps on slopes shall be placed as follows:

- a. For slopes steeper than 1 vertical to 3 horizontal: Sewn seams or minimum 1 m [3 ft] overlaps with no pinning or staking allowed.
- b. For slopes flatter than 1 vertical to 3 horizontal: Sewn seams or minimum 450 mm [18 in] overlaps and pins or stakes may be used to anchor the overlaps per the manufacturer's recommended spacing.
- c. Overlaps shall be in the direction of flow.

When fabric is placed in the roadway, the fabric roll widths shall be chosen so that there will be a minimum number of overlaps of parallel rolls. The total width of surface covered is shown on the Standard Details.

When sewn seams are to be used, field or factory seaming by machine will be allowed. If a sewn seam is to be used for the seaming of the geotextile, the thread used shall consist of high strength Kevlar aramid, polyethylene, polyester, or polypropylene and shall have the same or greater durability as the geosynthetic being seamed. Nylon thread shall not be used. The thread shall be adjusted in the field to be sufficiently tight but not cut the geotextile. For Erosion Control applications, the thread shall also be resistant to ultraviolet radiation. The thread shall be of contrasting color to that of the geotextile itself. Flat/prayer seams or J-/Double J-type seams shall be used with double-locked stitches (Class 40I), except the "flat" seam may be used for repair of damaged in-place fabric. A stitch density of 200 to 400 stitches per meter shall be used for lighter-weight geotextiles while heavier geotextiles shall have 150 to 200 stitches per meter. All field seams shall be double stitched with two parallel passes and the 2 rows of stitching shall be approximately 13 mm [ $\frac{1}{2}$  in] apart and shall not cross at any point. All stitching shall be at least 25 mm [1 in] from the fabric edge.

For seams that are sewn in the field, the Contractor shall provide at least a 2 m [6.5 ft] length of sewn seam for sampling by the Resident before the geotextile is installed. For seams that are sewn in the factory, the Resident shall obtain samples of the factory seams at random from any roll of geotextile that is used on the project. For seams that are field sewn, the seams sewn for sampling shall be sewn using the same equipment and procedures as will be used for the production seams. If seams are sewn in both the machine and cross machine direction, samples of seams from both directions shall be provided. The Contractor shall submit the seam assembly description along with the sample of the seam. The description shall include the seam type, stitch type, sewing thread, and stitch density. To facilitate inspection all seams shall be placed with the seam up so that repairs can easily be made if faulty seams are encountered during inspection, as shown on the Standard Detail. Procedures for testing sewn seams are given in ASTM D 4884 - Standard Test Method for Seam Strength of Sewn Geotextiles.

a. Stabilization/Reinforcement and Separation Geotextile Adjacent geotextile rolls shall be overlapped, sewn, or joined as required in the plans. Overlaps shall be in the direction shown on the plans. On curves the geotextile may be folded or cut to conform to the curves. The fold or overlap shall be in the direction of construction and held in place by pins, staples, or piles of fill or rock. The following Table summarizes the minimum overlap for geotextiles in this application:

AASHTO Classification	Minimum Overlap
A-1, A-2, A-3, A-4	450 mm [18 in]
A-5, A-6, A-7	1 m [3 ft] or sewn <sup>a</sup>
All roll ends	1 m [3 ft] or sewn <sup>a</sup>
<sup>a</sup> Seams shall be sewn when the soils have a CBR equal to or less than 1, unless otherwise specified.	

**b. Drainage Geotextile** Successive sheets of geotextiles shall be overlapped a minimum of 300 mm [1 ft], with the upstream sheet overlapping the downstream sheet. In trenches equal to or greater than 300 mm [1 ft] in width, after placing the drainage aggregate the geotextile shall be folded over the top of the backfill material in a manner to produce a minimum overlap of 300 mm [1 ft]. In trenches of less than 300 mm [1 ft] but greater than 100 mm [4 in] wide, the overlap shall be equal to the width of the trench. Where the trench is less than 100 mm [4 in] the geotextile overlap shall be sewn or otherwise bonded. All seams shall be subject to the approval of the Resident.

**c. Erosion Control Geotextile** Adjacent geotextile sheets shall be joined by either sewing or overlapping. Overlapped seams of roll ends shall be a minimum of 450 mm [18 in] except where placed under water. In such instances the overlap shall be a minimum of 1 m [3 ft]. Overlaps of adjacent rolls shall be a minimum of 450 mm [18 in] in all instances. When overlapping, successive sheets of the geotextile shall be overlapped upstream over downstream, and/or upslope over downslope. In cases where wave action or multidirectional flow is anticipated, all seams perpendicular to the direction of flow shall be sewn. For Erosion Control applications, the thread shall also be resistant to ultraviolet radiation.

**620.05 Certification** The Contractor shall provide to the Resident a certificate stating the name of the manufacturer, product name, style number, chemical composition of the filaments or yarns and other pertinent information to fully describe the geotextile. This information shall be furnished to the Resident for approval of the fabric before installation. The Manufacturer is responsible for establishing and maintaining a quality control program to assure compliance with the requirements of Section 722 - Geotextiles. Documentation describing the quality control program shall be made available upon request. The Manufacturer's certificate shall state that the furnished geotextile meets MARV requirements of the specification as evaluated under the Manufacturer's quality control program. A person having legal authority to bind the Manufacturer shall attest to the certificate. Either mislabeling or misrepresentation of materials shall be reason to reject those geotextile products.

**620.06 Sampling and Acceptance** Geotextiles shall be subject to sampling and testing to verify conformance with this specification. Sampling for testing shall be in accordance with the most current ASTM D4354, using the section titled, "Procedure for Sampling for Purchaser's Specification Conformance Testing." In the absence of purchaser's testing, verification may be based on manufacturer's certifications as a result of testing by the manufacturer of quality assurance samples obtained using the procedure for Sampling for Manufacturer's Quality Assurance (MQA) Testing. A lot size for conformance or quality assurance sampling shall be

considered the shipment quantity of the given product or a truckload of the given product, whichever is smaller.

Testing shall be performed in accordance with the methods referenced in Section 722 - Geotextiles for the indicated application. The number of specimens to test per sample is specified by each test method. Geotextile product acceptance shall be based on ASTM D4759. Product acceptance is determined by comparing the average test results of all specimens within a given sample to the specification MARV. Refer to ASTM D4759 for more details regarding geotextile acceptance procedures.

620.07 Shipment, Storage, Protection, and Repair of Fabric Geotextile labeling, shipment and storage shall follow ASTM D4873. Product labels shall clearly show the manufacturer or supplier name, style number, and roll number. Each shipping document shall include a notation certifying that the material is in accordance with the manufacturer's certificate. Each geotextile roll shall be wrapped with a material that will protect the geotextile from damage due to shipment, water, sunlight and contaminants. The protective wrapping shall be maintained during periods of shipment and storage. During storage, geotextile rolls shall be elevated off the ground and adequately covered to protect them from the following: site construction damage, precipitation, extended ultraviolet radiation including sunlight, chemicals that are strong acids or strong bases, flames including welding sparks, temperatures in excess of 71°C [160°F], and any other environmental condition that may damage the physical property values of the geotextile.

To prevent damaging the fabric, the Contractor shall exercise necessary care while transporting, storing, and installing the fabric. Atmospheric exposure of geotextiles to the elements following laydown shall be a maximum of 5 days to minimize damage potential. At no time shall riprap stones be rolled down the slope where fabric has been placed.

Before installation, the fabric shall be protected from rain, from sunlight or other ultraviolet exposure and from dust, mud, debris, or other elements that may affect its performance. Fabric that is torn, punctured, or otherwise damaged shall not be placed. During installation, direct weather exposure of the fabric shall be limited to a maximum of 5 days, from laydown to covering of the fabric.

a. Stabilization/Reinforcement Geotextile Before covering, the geotextile shall be inspected by the Resident to ensure that the geotextile has not been damaged during installation. Damaged geotextiles shall be repaired immediately. Cover the damaged area with a geotextile patch that extends an amount equal to the required overlap beyond the damaged area. If placement of the backfill material causes damage to the geotextile, the damaged area shall be repaired as previously described. The placement procedure shall then be modified to eliminate further damage from taking place.

b. Drainage Geotextile Should the geotextile be damaged during installation or drainage aggregate placement, a geotextile patch shall be placed extending beyond the damaged area by a distance of 450 mm [18 in], or the specified seam overlap, whichever is greater.

c. Erosion Control Geotextile The geotextile shall be placed in such a manner that placement of the overlying materials will not excessively stretch the geotextile, tearing it. Care shall be taken during installation so as to avoid damage occurring to the geotextile as a result of the installation process. Should the geotextile be damaged during installation, a geotextile patch shall be placed over the damaged area extending 1 m [3 ft] beyond the perimeter of the damage. When riprap or stone ditch protection is placed on fabric, the stones shall be placed so that they do not puncture or otherwise damage the fabric. Field monitoring shall be performed to verify that the armor system placement does not damage the geotextile. Any geotextile damaged during backfill placement shall be replaced as directed by the Resident at the Contractor's expense.

620.08 Method of Measurement The quantity of geotextile will be measured by the number of square meters [square yards] of surface area covered and in direct contact with the cover material. Measurement will not be made for overlaps, patches and repairs of damaged geotextile unless additional overlap width is required by the Resident in which case measurement will be made for that added overlap area.

620.09 Basis of Payment Geotextiles will be paid for at the contract unit price per square meter [square yard]. Such payment shall be full compensation for furnishing and placing geotextile fabric; for all required surface preparation; for all labor, tools, materials and equipment; for repairing torn and damaged geotextile; and when required, for sewing seams and for furnishing and placing all pins or stakes or other hold down devices; for excavation for and furnishing and placing protective aggregate cushion; and for all other incidentals necessary to complete the work.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
620.54 Stabilization/Reinforcement Geotextile	square meter [Square Yard]
620.55 Stabilization/Reinforcement Geotextile (sewn seams)	square meter [Square Yard]
620.56 Drainage Geotextile	square meter [Square Yard]
620.57 Drainage Geotextile (sewn seams)	square meter [Square Yard]
620.58 Non-woven Geotextile	square meter [Square Yard]
620.59 Non-woven Geotextile (sewn seams)	square meter [Square Yard]
620.60 Separation Geotextile	square meter [Square Yard]
620.61 Separation Geotextile (sewn seams)	square meter [Square Yard]

## SECTION 621 - LANDSCAPING

621.0001 Description This work shall consist of the Contractor furnishing and planting trees, shrubs, vines, and other plants and shall include all planting operations and material as well as the care and replacement of the plants during the establishment period, all in accordance

with the specifications, planting plans and schedules and the directions of the Resident. Planting operations will be divided into two classes.

a. Class A Planting will consist of planting into the existing soil that has been amended with organic humus.

b. Class B Planting will consists of planting into the existing soil without amendments.

Unless otherwise specified, all planting shall be Class A.

621.0002 Materials - General All non-planting material shall conform to the requirements specified in the following Sections of Division 700 - Materials.

Fertilizer	717.01
Mulch	717.04
Organic Humus	717.09

Water shall be free from oil, acids, alkalines, salts, or any other substances harmful to plantings.

621.0003 Plant Material-All Classes

a. All plants shall conform to the current edition of the "USA Standard for Nursery Stock" sponsored by the American Association of Nurserymen (AAN), unless otherwise indicated in the plans or specifications.

b. All plants shall be first class representatives of their normal species or varieties, unless otherwise specified. All plants must have a good, healthy, well-formed upper growth and a large, fibrous, compact root system. Plants sheared into stiff or formal shapes will be rejected unless they have outgrown such shearing.

Large-growing, deciduous trees shall have straight trunks and a single leader or as may be characteristic of the species. Tops shall be thickly branched, densely foliated, well balanced and in good proportion to the height of the tree. Trees with weak trunks, thinly or irregularly branched or with unnatural shape of proportions due to undesirable pruning or for any other cause will be rejected. Trees with leaders or branches too severely cut back or with bottom limbs trimmed too high will be rejected.

Small-growing deciduous trees shall be thickly branched with a well-balanced, natural shape. Plants which are poorly furnished or have grown or been pruned into unnatural shapes will be rejected.

Tree "Clumps" shall have three or more main stems starting from the ground.

"Bush-form" trees shall be those with branches, which start from the main trunk close to the ground.

c. All plants shall have been grown under climatic conditions similar to those in the locality of the site of the project under construction or have been acclimated to such conditions for at least two years. All plants must have been grown in a latitude north of Washington, D.C. The Resident may require a sworn affidavit from the contractor stating the source where all plants were grown. Payment for plants may be withheld until this affidavit is received.

All plants shall be nursery grown unless otherwise stipulated. No plant will be considered nursery grown unless it has been transplanted at least once and has been growing in a nursery for at least 2 years. Where collected stock is allowed, all plants in addition to meeting all other requirements for nursery-grown stock, shall have a diameter of ball or root spread at least one-third greater than that required for nursery stock. Plants showing signs of lack of root pruning, cultivation or other proper nursery care will be classified as collected stock regardless of their source.

d. All plants must be healthy and vigorous; free from disease, injurious insects and their eggs or larva, mechanical wounds, broken branches, decay, or any other defects.

e. All plants shall be true to name. Each bundle or each plant when not tied in bundles, shall be labeled legibly and securely. The current edition of "Standardized Plant Names" prepared by the Editorial Committee of the American Joint Committee on Horticultural Nomenclature shall be the authority for all plant names.

Care shall be taken throughout the operation to keep each plant species or variety segregated and labeled. The Resident will reject any plants concerning any doubt or confusion arising about nomenclature, either at the time of delivery or at any subsequent time.

f. The Contractor shall take all precautions that are customary in good trade practice to insure upon arrival at the planting site the plants are in good condition for successful growth. All plants must show appearance of normal health and vigor. Plants with loose or broken balls; dried out roots, twigs or needles; or plants which have become overheated in transit or are found not to comply with these specifications in any way will be rejected. The Resident will not assume responsibility for such rejected material.

The Resident reserves the right to plainly mark all rejected plants with paint or by other means to ensure that they are not used on the job. Rejected plants may not be used on the project, will not be paid for, and must be replaced by the contractor with approved plants. If plants with communicable diseases are not removed or destroyed immediately, upon discovery of the disease, all plants that were left in contact will also be rejected.

#### 621.0004 Plant Size and Root Balls

Class A Plants The plant sizes specified in the "USA Standard for Nursery Stock" are the minimum sizes acceptable. Plants, which meet the sizes specified but do not have a normal shape and balance between height and spread, will be rejected. Thin, poorly

branched, or sparsely rooted plants will be rejected, regardless of whether they meet the minimum technical requirements of the USA Standard.

Where bare roots are irregular, the size of the root spread will be the average root spread considering all sides of the plant and not the maximum root spread. The Resident may allow moderate deviations from exact sizes of plants that normally have irregular root systems.

Coarse-rooted plants, which lack sufficient fibrous feeding roots, will be rejected.

Recently cut stubs of large roots on either balled or bare root stock will be considered evidence of lack of proper nursery care and root-pruning and will be sufficient grounds for rejecting such plants or classifying them as collected stock. Acceptable roots will retain sufficient fibrous feeding roots.

Where a size range with a maximum and minimum is given, an average size is required. At least 40 percent of the plants in a size range shall be at or above the average for this size range.

A solid ball is referred to as one encompassing the roots of a plant. A solid ball shall consist of the soil in which the plant was originally grown. The ball shall have been dug up in such a manner as not to disturb the roots. Where such a ball is required the designation B and B, Balled and Burlapped, will be used. No B and B stock will be accepted if this solid soil ball has disintegrated or if loose soil apparently has been packed around the roots.

Peat Balls and other fiber material will not be acceptable where B and B stock is called for, but said root balls may be furnished where bare root stock is called for if approved by the Resident.

Caliper of trees shall be the diameter of the trunk taken 150 mm [6 in] above the root collar.

Class B Plants Unless otherwise specified, plants used in Class B plantings shall be seedlings, plugs or lining out stock with heavy, fibrous, compact root systems. The comparative size of the plants shall be as stated under the heading "Seedling Trees and Shrubs" in the "USA Standard for Nursery Stock". All conifers must have dormant buds and secondary needles. Where B and B plants are designated, ball sizes shall be the same as Class A plants.

621.0006 Inspection A preliminary check of the plants may be made at the time of delivery for condition of the plants and conformity to the specifications. The Contractor shall inform the Resident at least 48 hours in advance, as to what plants are to be planted and in what location. Inspection will continue throughout the life of the contract up to the time of Final Acceptance. Plants which are not true to name, do not conform to the specifications, show evidence of improper handling or lack of proper care or which appear to be in a seriously unhealthy condition must be removed by the Contractor at once and replaced by acceptable plants as soon as the planting season allows. Any unacceptable plants when pointed out to the Contractor by

the Resident shall be removed at once. If this occurs during the planting season, these plants shall be replaced at once; if between planting seasons, they shall be replaced at the next subsequent planting season, unless conditionally directed by the Resident for evergreens and other preferred spring planted items. Unsatisfactory work will not be paid for during the establishment period.

621.0017 General Construction Requirements Planting operations shall be performed in accordance with the plans and specifications and as directed by the Resident.

621.0018 Layout The location of plants as shown on the plans shall be considered approximate only. The exact locations will be designated on the ground by the Resident, making such changes as may be required to adjust the planting to local conditions. Plant quantities may, in some cases, be increased or decreased as provided in Section 109.1 - Changes in Quantities. Locations for trees and shrubs shall be staked out on the ground by the Contractor as directed by the Resident at least 48 hours before herbicides are applied and any plant pits or beds are dug. Equipment, labor and approved labeled stakes for this purpose are to be furnished by the Contractor.

The Contractor shall furnish the stakes for use in marking plant locations. Stakes shall be wire survey flags at least 375 mm [15 in] tall. Layout stake samples shall be approved by the Resident before the Contractor commences any work on the project.

The Contractor will be required to mark the stakes legibly with indelible marking material and will also be required to furnish personnel, capable of locating plants from plans, to carry out the staking under the direction of the Resident.

Before actively starting work on the project, the Contractor shall provide the Resident with a planting sequence schedule to be used in establishing priorities in staking plant locations. The Contractor shall give the Resident at least four days advance notice of any deviations from this schedule. The Resident will not be responsible for any delay or inconvenience caused by unfinished staking resulting from the Contractors failure to follow the above procedure.

All stakes used to locate plants shall be replaced in the correct plant pits after each operation and shall remain there until the Resident directs their removal. When plants are set out in wrong locations due to stakes being misplaced during digging and planting operations, the Contractor shall be required to move the misplaced plants to the proper location at their own risk and expense.

#### 621.0019 Plant Pits and Beds

a. Plant Beds Areas designated as plant beds must have the entire surface cultivated, cleared of weeds and be completely covered with mulch. Actual mulch limit will extend 750 mm [2½ ft] out from the center of plant or to the pavement edge, bridge wall, and roadside face of guardrail. Cultivation must include complete removal of all weed and grass roots, loose stones over 75 mm [3 in] maximum diameter and any other debris. Approved herbicides are permitted for weed control in place of sod removal.

b. Rock Excavation When ledge or boulders over 0.25 m<sup>3</sup> [ $\frac{1}{4}$  yd<sup>3</sup>] in size are encountered in digging plant pits, the Contractor shall notify the Resident who will change the location of the plants. No excavation of ledge or boulders over 0.25 m<sup>3</sup> [ $\frac{1}{4}$ yd<sup>3</sup>] in volume will be required and no extra payment will be made for rock excavation or for shifting of plant holes due to rock.

c. Class A Planting Size of plant pits shall bear the following relationship to the spread of roots or root ball diameter of the plants to be planted in them:

For root spreads or ball diameters up to 600 mm [2 ft], pit diameters shall be 1½ times the root spread. For root spreads or ball diameters over 600 mm [2 ft] and less than and including 1200 mm [4 ft], pit diameters shall be 600 mm [2 ft] greater. For root spreads or ball diameters over 1200 mm [4 ft], the pit diameter shall be 900 mm [3 ft] greater.

The plant pit shall be deep enough so that when installed the top of the root ball is even with to 12 mm [ $\frac{1}{2}$  in] higher than the existing ground. In all cases, the depth shall be sufficient to contain all the roots of the plant without crowding.

In certain areas of poor drainage or heavy soil, the Resident may require raising the plant elevation. Where shown on the plans or directed by the Resident such pits may also require drains. When such drains are required, they shall be included as a part of the cost of the plant.

Excavated soil mixed with organic humus shall be used as backfill around the roots. Stones larger than 75 mm [3 in] in maximum diameter, large roots, roots or rhizomes of weeds or other injurious materials shall be removed and not used as backfill. Any additional material needed to fill plant pits to the level of the surrounding ground shall be loam (Section 615) furnished by the Contractor at their own expense.

d. Class B Planting Class B plants will be planted in the existing soil. Plant holes must be deep enough to allow room, for the full depth of the root without doubling or folding and wide enough to allow room for its normal spread. Plants must be set straight and at the same depth at which they were previously growing. Soil must be firmly compacted about the roots leaving no air pockets.

621.0020 Planting Seasons Seasons for planting, unless otherwise directed, shall be within the following dates:

Bare Root Plants except Evergreen Seedlings	Spring	April 1 <sup>st</sup> to May 31 <sup>st</sup>
	Fall	Sept. 15 <sup>th</sup> to Nov. 15 <sup>th</sup>
Evergreen Seedlings		April 1 <sup>st</sup> to May 15 <sup>th</sup> only
Potted & Container Grown Plants	Spring	April 1 <sup>st</sup> to July 15 <sup>th</sup>
	Fall	August 15 <sup>th</sup> to Nov. 15 <sup>th</sup>

Balled & Burlapped Plants

Spring  
Fall

April 1<sup>st</sup> to June 15<sup>th</sup>  
August 15<sup>th</sup> to Oct. 15<sup>th</sup>

Plants will not be planted in frozen soil, soil that is excessively wet, or excessively dry.

Preparations for planting may begin earlier than the specified season and planting work may continue beyond the specified time limits if approved by the Resident. However, the Resident may require that all plants planted out-of-season shall receive special attention as directed. Any out-of-season planting shall be at the Contractor's risk and expense.

621.0023 Setting Plants The plants shall be set plumb and straight in the prepared pits and beds and at a level such as will result, after settlement, in the top of the root ball being level with to 12 mm [ $\frac{1}{2}$  inch] above the surrounding ground surface.

621.0024 Backfill Class A For all Class A plants backfill shall consist of 3 parts of soil excavated from the plant pit thoroughly mixed with one part of organic humus. Sods or clods may not be used as backfill. The backfill material shall be placed and compacted in the bottom of the planting pit and shall be worked around the roots and thoroughly compacted as the backfilling proceeds, leaving no air pockets. The backfill shall be filled in around the root ball to half the depth of the ball, and the remaining wire basket shall be removed and the remaining burlap around the ball shall be loosened and spread out away from the plant or if it is too bulky, cut away and removed. The backfilling shall then be completed, watered and tamped firm. Plastic film wraps shall be completely removed during planting. Nursery containers shall be completely removed before planting. The roots of bareroot plant materials shall be placed in their natural arrangement with the backfilling carefully performed to prevent damage to the plant's root system. Broken or bruised roots shall be pruned immediately, making a clean cut. Shallow basins or saucers of earth will be required to be placed around each plant. However, when drainage conditions are poor, as in heavy clay soil, the Resident may require that such saucers be omitted or used only temporarily. All plants shall be thoroughly watered and liquid fed the day they are planted and as often thereafter as necessary for the plants to become safely established. If watering during the establishment period is unsatisfactory, no payment will be made.

#### 621.0025 Fertilizing

a. Water Soluble Fertilizer The Contractor shall liquid feed the plants as the first watering, unless otherwise directed by the Resident. All seedlings will be liquid fed during planting.

Liquid fertilizer shall be completely dissolved and mixed in water at the rate of 3 kg [6 lb] of the fertilizer concentrate to 400 L [100 gal] of water.

The resulting solution shall be poured around the plant in the plant saucer. The solution shall be applied at the following rates for each application:

Class C evergreen plants - 0.5 L [1 pint] per plant.

Class C deciduous plants - 2 L [2 qt] per plant.

Class A and B plants-plants up to 600 mm [2 ft] in height shall receive 3.4 L [4 qt].

Plants above 600 mm [2 ft] and up to 1800 mm [6 ft] shall receive 6 L [6 qt].

Plants above 1800 mm [6 ft] and up to 3600 mm [12 ft] shall receive 11 L [12 qt].

Plants above 1800 mm [12 ft] shall receive 15 L [16 qt].

**b. Slow Release Fertilizer Tablets** All woody plants except evergreen seedlings shall be fertilized with slow release fertilizer tablets at the time of planting, unless otherwise directed by the Resident. Fertilizer tablets shall be placed equidistantly within the planting pit adjacent to the ball or root mass, but not in direct contact with roots. Placement depth shall be 150 to 200 mm [6 to 8 in] below ground level. .

The application rates shall be as follows:

<u>Types of Plants</u>	<u>No. of Tablets</u>
Evergreen Trees	
Under 450 mm [18 in] height	1 tablet
450 mm to 900 mm [18 in to 3 ft] height	2 tablets
900 mm to 1800 mm [3 ft to 6 ft] height	3 tablets
Over 1800 mm [6 ft] height	4 tablets
Deciduous Trees	
Under 1800 mm [6 ft] height	2 tablets
1800 mm to 3600 mm [6 ft to 12 ft] height or under 100 mm [4 in ]caliper	3 tablets
Over 100 mm [4 in] caliper	4 tablets
Shrubs	
Under 600 mm [2 ft] height or spread	1 tablet
600 mm to 900 mm [2 ft to 3 ft] height or spread	2 tablets
Over 900 mm [3 ft] height or spread	3 tablets
Vines and Ground Covers	1 tablet

**621.0026 Mulching** The disturbed surface area of plant beds and pits shall be evenly and uniformly covered to a depth 100 mm [4 in] with bark mulch or as directed by the Resident.

Mulching will not be required on Class B evergreens, unless otherwise stated herein.

Measurement of the depth of mulch will be made after one heavy rain or after a three-week period without heavy rain.

All plant pits and beds must be entirely free of weed or grass growth and free of live roots of all weeds and grasses at the time mulch is applied.

When plant beds are installed near guardrails or as stated in Section 621.0019(a) the space between the plants and the guardrail or the nearest pavement when it extends behind the guardrail, shall be treated as a part of the plant bed and shall be weeded and mulched.

Plants shall not be damaged when the mulch is applied. Smothered or otherwise damaged plants must be replaced. Mulch, in place, will not be permitted to be directly in contact with the base of plant trunks or stems in excess of 50 mm [2 in] of thickness. Plants shall be mulched at the time of installation.

621.0027 Cultivation All plant pits and beds shall be kept free of weeds and grass by the Contractor from the time the plants are planted until final acceptance. This shall be accomplished by manual weeding, cultivation, or use of approved herbicides. Application of herbicides to control weeds or grass shall be performed only by a Maine licensed pesticide applicator with an appropriate category as determined by the Board of Pesticide Control. There will be no payment for unsatisfactory work.

621.0030 Pruning Pruning shall be done to each plant individually in such a manner as to preserve the natural character of the plant and shall be done only after delivery and inspection. All pruning shall be done with sharp tools by experienced persons in accordance with the best horticultural practice. Plants pruned in such a manner as to seriously impair the appearance or character of the plant will be rejected. Bench pruning with knives or axes will not be permitted. Broken or badly bruised branches, soft wood, and sucker growth shall be removed with clean cuts.

Excessive pruning shall not be accepted as a means of disposing of dead wood or unhealthy plants. Plants in such poor condition that they can only be revived by pruning of more than 1/3 or more of the growth will be considered unsatisfactory and will be rejected. At the time of final acceptance, all plants must be at least the size called for in the specification.

621.0031 Potted and Container Grown Plants Plants Supplied in Containers must have been established in containers at least one full growing season before planting and shall have a well rooted condition evidenced by the firmness of the mass of soil and roots. The outside of the ball of soil shall be well matted with healthy working roots, but shall not be pot bound. Plants shall be adequately hardened off before planting.

Containers shall be of such shape as to permit easy removal of the plant.

No plant will be accepted if the container ball is cracked or broken upon removal from the container.

621.0033 Protection From Rodents It will be the responsibility of the Contractor to take necessary steps to protect all plants from rodents during the life of the contract. Protection from rodents will be included in the cost of the individual plants and the Contractor will receive no extra compensation for this work. No payment will be made for unsatisfactory work during the establishment period or planting season.

621.0034 Cleanup and Repair All excess excavated material and debris resulting from the planting operation shall be promptly disposed of outside of and out of sight of the project, unless otherwise directed by the Resident. Any areas disturbed by the Contractor showing bare earth, that do not require mulching, shall be seeded with approved grass seed, fertilized and mulched, as directed by the Resident.

The Contractor shall be responsible for any damage caused by their operations and shall restore the disturbed areas to their original condition. Cost of cleanup and repair shall be incidental to the work.

621.0035 Prosecution and Progress It is essential that each portion of the planting work in any area be promptly followed by cleanup of subsoil and debris, fertilization, watering, cultivation, pruning, mulching, spraying as needed, repair and restoration of damage caused by the Contractor, etc. The Contractor shall provide sufficient labor and supervisory personnel to carry out this work without undue delay. Any delay in carrying out this phase of the work which, results either in danger to the health or growth of the plants or a poor appearance of the project from the point of view of the public will be considered due cause for withholding all or part of any payment due the Contractor for plants delivered and planted or for any other work done.

Partial payments on the contract do not constitute approval or acceptance of any specific plants or work operations. The right is reserved to reject any plants or work, which are discovered to be unsatisfactory at any time before Final Acceptance.

621.0036 Establishment Period During the months of March through November, the Contractor shall make monthly visits to the site. The Contractor shall supply the Department with an approved written report monthly, detailing the activities performed and the condition of the plant material during the visit.

The acceptability of the plant material furnished and planted under this contract shall be at the end of a period of establishment, during which the Contractor, as necessary, shall employ all possible means to preserve the plants in a healthy and vigorously growing condition and to insure their successful establishment. During this period, the Contractor shall water, cultivate and prune the plants, and do any other work necessary to maintain the plants in a healthy growing condition. This shall include seasonal spraying with approved insecticides or fungicides as may be required. The Contractor shall also be responsible for protecting the plants from rodents. All dead or rejected plants shall be promptly removed from the project and replaced by live healthy plants meeting the same specifications. If such plants are declared unacceptable during the planting season, they shall be replaced during this planting season, otherwise, they shall be replaced during the next subsequent planting season. No payment shall be made for unsatisfactory work during the establishment period.

Such replacement plants are subject to the same requirements as the original plants and must be replaced in turn if they fail to meet the required standards. Plants designated for spring planting only, will be replaced only during the spring planting season unless otherwise directed by the Resident.

The period of establishment shall commence at the initial acceptance of each planting and shall extend for two years after that date unless otherwise directed. Necessary replacements shall be made so that at the time of Final Acceptance all plants shall be in a healthy, vigorous growing condition and free from sizable die-back.

Replacements will be required for plants lost, damaged, or rejected, whatever the cause. The Contractor will be considered responsible for the plants until the time of Final Acceptance.

It shall be the sole responsibility of the Contractor to replace any unsatisfactory plants on the project regardless of whether they are specifically designated by the Resident. In the case of individual doubtful plants, the Contractor may call upon the Resident to make a determination as to their acceptability, but it shall not be incumbent on the Resident to furnish the Contractor with exact lists of replacements.

All replacements of plants shall be completed by the end of the planting season before the Final Acceptance date. Any small quantity of plants, which fail between the end of the planting season and the Final Acceptance date, shall be canceled from the list of accepted plants and the Contractor will receive no payment for them. If a sizable number fails the Resident may extend the date of Final Acceptance to the subsequent planting season, in which case, the Contractor will be subject to liquidated damages. All replacement planting shall conform in every way to the requirements of the original planting. The Resident may require that any replacement plants that are not dormant, or that are planted late in the season, be sprayed, as directed with an approved anti-desiccant.

621.0037 Method of Measurement The quantity of plants to be measured for payment will be the number of individual plants furnished and planted as required and accepted, excluding replacements.

621.0038 Basis of Payment Each item of "Planting" will be paid for at the contract unit price for each accepted plant furnished and planted. Payment shall constitute full compensation for; furnishing and placing plants, digging, delivering, rodent protection, preparing plant pits, beds and drains; planting, watering, fertilizing, mulching, pruning, and the cleanup of planting areas; for all, fertilizer, mulch and other necessary materials; all labor, equipment, tools and any other incidentals necessary to complete the work.

When a bid item calls for a "Group" of trees, shrubs, vines or other plants, the Contractor shall furnish each individual species within this "Group" for the same unit bid price.

The name and estimated number of individual species within each "Group" will be shown on the estimated quantities sheet of the plans.

The establishment item will be paid on a lump sum basis.

Payment will be made under:

Pay Item

Pay Unit

621....	Name plant or plant group as detailed in Schedule of Items in Proposal Book	Each
621.80	Establishment Period	Lump Sum

SECTION 622 - TRANSPLANTING SHRUBS, HEDGES, AND TREES

622.01 Description This work shall consist of digging, moving and replanting existing shrubs, hedges, and trees in accordance with these specifications and in conformity with the plans or as directed.

622.02 Loam Loam shall conform to the requirements of Section 615.02. Fertilizer shall meet the requirements specified in Section 717.01.

622.03 Shrubs and Hedges

a. Digging The earth of shrubs and hedges to be moved shall be carefully encompassing the roots as is customary in good nursery practice. Minimum size of the rootball shall be as indicated in the current edition of the "American Standard for Nursery Stock" sponsored by the AAN.

b. Moving The earth rootball shall be maintained as a solid unit during the moving of the shrubs and hedges and must be protected from breaking or cracking by careful handling. The rootball shall be tightly wrapped with burlap or similar material. Earth rootballs greater than 450 mm [18 in] in diameter shall be tightly bound with cord or rope placed over the burlap unless the shrubs or hedges are to be replanted immediately after digging.

c. Planting The plants shall be planted in the designated new location at the same depth below ground surface as before they were moved. Loam shall be placed to a thickness of not less than 200 mm [8 in] under and around the rootball to eliminate all air pockets and to support the plant. Insofar as feasible, when hedges are to be transplanted, the individual plants shall be replanted in the same relationship to each other that existed before they were moved.

Fertilizer shall be mixed evenly into the backfill soil at the rate of 0.4 kg/m [ $\frac{1}{4}$  lb/ft] of height for each plant. Water soluble fertilizer and slow release fertilizer packets shall be applied at the following rates.

Shrubs to 600 mm [2 ft] high or spread	4 L[4 qt] water soluble or 1 packet
Shrubs to 1200 mm [4 ft] high or spread	6 L[6 qt] water soluble or 2 packets
Shrubs to 1800 mm [6 ft] high or spread	8 L[8 qt] water soluble or 3 packets

d. Time of Transplanting Plants shall be dug and transplanted only when dormant, preferably in the early spring, unless otherwise directed by the Resident. When dug, shrubs and hedges shall be moved directly to the final planting site and planted immediately, if

possible. The rootball must be kept moist at all times during transplanting operations. If construction makes it impossible to replant the plants immediately after digging, the rootballs of the plants shall be kept completely covered with a thick layer of earth, hay, peat moss, or similar material which shall be kept moist at all times while the plants remain unplanted. Shrubs may be held in approved pots under conditions of delayed replanting.

e. Pruning All pruning shall be done in accordance with the best horticultural practice. Dead, diseased, or injured shoots and branches shall be removed. In order to restore a normal balance between top and roots, deciduous shrubs shall be thinned by removing uniformly scattered, selected branches which shall be cut back to the main stem, as directed. The Resident may also require tip pruning. Tip pruning may also be required for evergreens. In the case of hedges, the Resident may require shearing to uniform, even surfaces.

f. Watering As soon as the plants are planted they shall be thoroughly watered to the point where the roots and the surrounding earth are well saturated. The first application of liquid fertilizer shall be made during planting.

g. Mulch After removing all weeds and grass, the ground surface over the entire area of the planting pit shall be covered to a depth of 100 mm [4 in] with a mulch of bark, stone or other approved material. Sawdust, hay, or straw will not be accepted as mulching material.

#### 622.04 Trees

a. Digging All trees to be moved and replanted shall be dug with a solid ball of earth around the roots as is customary in good nursery practice. The diameter of the ball shall be not less than 10 times the diameter of the trunk of the tree measured 300 mm [1 ft] above the surface of the ground. Depth of the ball shall be not less than 60% of its diameter for balls up to 1200 mm [48 in] diameter. For balls over 1200 mm [48 in] diameter the ball shall have sufficient depth to maintain a solid structure and to encompass all the feeding roots under the ball area. Power shovels and similar machinery may not be used in digging the ball except with written permission.

b. Moving The ball must be maintained as a solid unit during the moving of the tree. The ball must be protected from breaking or cracking by careful handling and by being tightly bound with cord or rope over canvas, burlap, or similar wrapping. The ball shall be firmly attached to a tree platform of suitable size during moving operation, as required.

c. Planting The trees shall be planted in the designated new location at the same depth in relation to the ground surface as before they were moved. Loam shall be placed to a distance of not less than 300 mm [12 in] under the ball and around the periphery of the ball. Loam shall be puddled and firmed in place to eliminate all air pockets and give adequate support to the ball. Fertilizer shall be applied as specified in Section 621.0025 b.

d. Protection Every care shall be taken to prevent injury to the tree during the transplanting operation. All parts of the tree shall be carefully protected. Branches shall be

tied out of the way of possible injury. No chain, cable, or heavy rope may be attached to the trunk or branches without protective padding adequate to prevent bruising or other injury.

e. Time of Transplanting Trees shall be dug and transplanted only when dormant, preferably in the early spring, unless otherwise directed. When dug, trees shall be moved directly to the final planting site and planted immediately if possible. The ball must be kept moist at all times during transplanting operations. If construction problems make it impossible to replant the tree immediately after digging, the ball of the tree must be completely covered with a thick layer of earth, bark mulch, peat moss or similar material which shall be kept moist at all times while the tree remains unplanted. Pruning, watering, fertilizing, mulching, and supporting shall be as specified in the applicable Sections of Section 621 - Landscaping.

622.05 Maintenance It shall be the Contractor's responsibility to protect and care for the plants during the life of the contract. They shall be watered weekly during dry weather or as otherwise directed. The Contractor shall take steps required to protect the plants from damage and from diseases and insect pests. Should damage occur it shall be repaired by the Contractor, according to the best horticultural practice.

622.06 Replacement If the ball is badly broken or the plants are otherwise badly damaged or if, in the opinion of the Resident, during the life of the contract the plants show such signs of loss of health or appear to be in danger of dying, the Contractor will be required to replace the plants with others of the same size and variety or approved plants of equal value, at the proper season.

622.07 Method of Measurement Transplanting hedges will be measured by the meter [linear foot] in place after transplanting, measured from the extremities of the branches at each end. A hedge shall be defined as an evenly spaced row of plants of uniform size, growing close to each other so that the branches are intermingled.

Transplanting shrubs or trees will be measured in place after transplanting by the single shrub or tree unit.

622.08 Basis of Payment The accepted quantities of transplanting hedges will be paid for at the contract unit price per meter [linear foot] of hedges properly transplanted and accepted, which price and payment shall include digging, binding, moving, replanting, pruning, mulching, care and maintenance and if required, replacement of the hedges and for all loam, mulch and all other materials and incidentals necessary to complete the item.

The accepted quantities of transplanting shrubs or trees will be paid for at the contract unit price for each plant properly transplanted and accepted, which payment shall include digging, binding, moving, replanting, pruning, mulching, care and maintenance and if required, replacement of the shrubs, and for all loam, mulch and other materials, and for all incidentals necessary to complete the item.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
622.09 Transplanting Hedge	meter [Linear Foot]
622.10 Transplanting Shrub	Each
622.11 Transplanting Tree	Each

## SECTION 623 - MONUMENTS

623.01 Description This work shall consist of furnishing and placing, or removing and resetting right-of-way monuments and survey monuments at locations shown on the plans or otherwise designated.

623.02 Materials Monuments shall be of granite or of reinforced portland cement concrete. When of granite, the stone shall be of a quality conforming to the applicable requirements of Section 712.04. When concrete is called for, portland cement concrete for monuments shall be of Class A and shall meet the requirements of Section 502 - Structural Concrete. Reinforcement shall conform to the requirements of Section 503 - Reinforcing Steel.

623.03 General Monuments shall be placed in vertical positions in excavated holes at depths shown on the plans or designated, with two sides approximately parallel with the roadway. The backfill material shall be placed in layers not exceeding 200 mm [8 in] in depth, loose measure and firmly tamped.

When removing and resetting monuments, special care shall be taken that the stone shall not be broken or damaged. Monuments broken or damaged by the Contractor shall be replaced with monuments of similar type without added compensation.

When a monument is to be set and it is found that rock exists below ground, it will be permissible to cut off the monument at an authorized length to allow setting on the rock. A concrete collar with dowels shall be placed around the monument to secure it to the rock, as shown on the plans. If the rock is rough enough to provide firm attachment for the concrete, collar dowels will not be necessary. The concrete shall meet the requirements of Section 502 - Structural Concrete. The class of concrete shall be optional.

When a monument is to be set in the surface of exposed rock it may consist of a bronze pin marker embedded in the ledge as shown on the Standard Detail Sheets.

623.04 Method of Measurement Monuments and markers, both new and reset, will be measured by each unit. Excavation in solid rock will be measured by the cubic meter [cubic yard] determined from the actual depth of the hole and a hypothetical circle diameter of 600 mm [2 ft].

623.05 Basis of Payment The accepted quantities of monuments and markers will be paid for at the contract unit price each complete in place. Payment for placement of monuments in solid rock shall be considered included in the contract unit bid price except that actual

excavation into solid rock will be paid for under Pay Item 206.07 - Structural Rock Excavation, Drainage and Minor Structures.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
623.06 Right-of-Way Monument	Each
623.07 Survey Monument	Each
623.08 Bronze Pin Marker	Each
623.09 Remove and Reset Monument	Each

### SECTION 624 - VACANT

### SECTION 625 - WATER SERVICE SUPPLY LINES

625.01 Description This work shall consist of installing water pipe and pipe sleeve in reasonably close conformity with the lines and grades shown on the plans or established. The installation shall include the assembly of all components and materials shown on the plans or as directed.

625.02 Materials Materials shall meet the requirements specified in the following Sections of Division 700 - Materials:

Copper Tubing	712.32
Non-metallic Pipe, Flexible	712.33
Non-metallic Pipe, Rigid	712.34
Metallic Pipe	712.341

625.03 General This work shall be done with as little interruption of water service as possible. Ample notification shall be given to the users of the water before any disruption of water service.

625.04 Sleeve Pipe for sleeves shall be metallic or non-metallic rigid and be laid on a firm foundation at the line and grade designated. When the pipe installation is in a trench all excavating and backfilling shall be in accordance with Section 206 - Structural Excavation.

After installation of the pipe, special care shall be taken to protect the pipe from heavy hauling equipment loads, rocks or any other damage caused by the Contractor's work. All pipe broken from such causes shall be removed and replaced at the Contractor's expense.

Pipe sleeves to be placed in concrete shall be supported during placement of concrete. Special care shall be taken while placing and compacting concrete around the sleeves to prevent

voids around the outside of the sleeves. Ends of the sleeves shall be capped with end plates until the water pipes are installed through the sleeves.

625.05 Water Pipe Water pipe shall be copper tubing or non-metallic flexible pipe, as called for. After the sleeve has been placed, the water pipe shall be inserted into the sleeve and connected to the existing pipes at each end. All connections to existing pipes shall be done in accordance with recognized plumbing practices.

Necessary fittings, adapters, and reducers shall be furnished as required.

625.06 Method of Measurement Pipe sleeve, copper tubing, and non-metallic pipe will be measured by the meter [linear foot].

625.07 Basis of Payment The accepted quantities of pipe sleeve, copper tubing and non-metallic pipe will be paid for at the contract unit price per meter [linear foot] for the types and sizes specified complete in place, which payment will be compensation for furnishing and installing all necessary fittings, for connecting to existing systems and for capping the ends of the pipe sleeve.

Excavation will not be paid for separately but will be considered included in the work of the contract items.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
625.081 19 mm (¾ in) Copper Tubing	meter [Linear Foot]
625.082 25 mm (1 in) Copper Tubing	meter [Linear Foot]
625.083 32 mm (1¼ in) Copper Tubing	meter [Linear Foot]
625.084 38 mm (1½ in) Copper Tubing	meter [Linear Foot]
625.085 44 mm (1¾ in) Copper Tubing	meter [Linear Foot]
625.086 50 mm (2 in) Copper Tubing	meter [Linear Foot]
625.101 19 mm (¾ in) Non-metallic Pipe-Flexible	meter [Linear Foot]
625.102 25 mm (1 in) Non-metallic Pipe-Flexible	meter [Linear Foot]
625.103 32 mm (1¼ in) Non-metallic Pipe-Flexible	meter [Linear Foot]
625.104 38 mm (1½ in) Non-metallic Pipe-Flexible	meter [Linear Foot]
625.105 44 mm (1¾ in) Non-metallic Pipe-Flexible	meter [Linear Foot]
625.141 50 mm (2 in) Pipe Sleeve	meter [Linear Foot]
625.142 75 mm (3 in) Pipe Sleeve	meter [Linear Foot]
625.143 100 mm (4 in) Pipe Sleeve	meter [Linear Foot]
625.144 150 mm (6 in) Pipe Sleeve	meter [Linear Foot]
625.145 200 mm (8 in) Pipe Sleeve	meter [Linear Foot]

SECTION 626 - FOUNDATIONS, CONDUIT, AND JUNCTION BOXES FOR  
HIGHWAY SIGNING, LIGHTING, AND SIGNALS

626.01 Description This work shall consist of furnishing, installing, modifying, or removing concrete foundations, conduits, and junction boxes for highway lighting, highway signing, and traffic signal installations in accordance with these specifications and in reasonably close conformity with the plans.

626.02 General The materials furnished by the Contractor shall be new. Where an existing system is to be modified, the existing material shall be removed and abandoned or salvaged as shown on the plans or as directed.

All electrical equipment shall conform to NEMA or UL standards, wherever applicable. In addition to these requirements, all materials and workmanship shall conform to the requirements of: NEC, ASTM Standards, the ANSI, the local electrical Utility Company, and any local ordinances that may apply.

Materials shall meet the requirements specified in the following Sections of Division 700, Material Details.

Reinforcing Steel	709.01
Precast Concrete Units	712.06
Steel Conduit	715.02
Non-metallic Conduit	715.03
Prewired Conduit	715.04
Metallic Junction and Fuse Box	715.05
Anchor Bolts	720.07

626.021 Miscellaneous Material Gravel backfill shall meet the requirements for Aggregate Base-Screened, Section 703.06 a., Type A.

Transformer pads shall conform to the requirements of the local electrical Utility Company.

If grouting is necessary to correct surface irregularities in the top of the concrete foundations, a non-shrink material satisfactory to the Resident shall be used.

All concrete foundations shall be constructed of Class A concrete in accordance with the applicable requirements of Section 502 - Structural Concrete.

626.022 Equipment List and Drawings Unless otherwise permitted in writing, the Contractor shall within 30 days following execution of the contract, submit a list of equipment and materials which are to be installed. The list shall include the name of manufacturer, size, and identifying number of each item. The list shall be supplemented by such other data as may be required, including detailed scale drawings of proposed minor deviations from the plans. If requested, the Contractor shall submit for review, design data and sample articles of the material proposed for use. All of the above data shall be submitted in duplicate except samples for

testing. Following checking, correcting, and reviewing, two complete sets of drawings shall be submitted. The Department will not be liable for material purchased, labor performed, or work delayed before such review.

Upon completion of the work, the Contractor shall submit three complete sets of corrected plans showing all construction changes.

626.03 General All work shall conform to NEC and NESC standards as set forth in the NIST Handbook H-32, except when otherwise noted on the plans or in the Special Provisions.

The Contractor shall be responsible for and shall repair all damage caused to underground drainage structures, utilities or lighting conduit, which are encountered during construction.

626.031 Conduit If the trench for conduit is located in wet, spongy or otherwise unsuitable ground, the trench shall be further excavated to a depth sufficient to overcome this condition and shall be backfilled with approved gravel. The gravel shall be compacted in layers not exceeding 200 mm [8 inches], loose measure. The grade of the bottom of the trench shall be parallel to the proposed grade of the conduit.

Trenches for conduits shall be excavated to a width that will permit proper installation of the conduit and to the depth shown on the plans or as directed.

Junction or pull boxes shall be installed as shown on the plans.

Where conduits enter exposed junction boxes, they shall be sloped to drain towards the conduit entrance holes, unless otherwise directed. Weepholes of 6 mm [ $\frac{1}{4}$  in] diameter shall be placed in all pull boxes, junction boxes, and fuse boxes.

After the trench has been excavated as specified, the bottom of the trench shall be prepared with a sand bedding material. After placing the conduit, sand shall be placed around the sides and over the top of the conduit, when shown in the special details. The entire trench shall then be backfilled with approved material, placed in layers not exceeding 200 mm [8 in], and thoroughly tamped.

All underground conduit shall be placed to at least the depth shown on the plans and shall not interfere with poles, guardrail posts, sign foundations or other objects.

All conduit ends shall be capped with conduit caps until wiring has begun. Prewired conduit shall be sealed during construction to prevent entry of moisture, dirt, or rocks.

The size and type of conduit required will be noted on the plans, except that the minimum size of conduit risers required for traffic signal installations shall be determined by percentage fill in a single conduit, as specified in the latest revision of the NEC. Where more than one conduit is required to be installed in the same location, the conduits may be placed in the same trench.

The weatherhead on conduit risers on Utility Company poles shall not be less than 300 mm [1 ft] from any utility wires. Conduit risers on Utility Company poles shall be located as required by the Utility Company.

Within 10 days after completion of each section of conduit, the Contractor, in the presence of the Resident, shall rod and pull through each duct a mandrel and brush of a pattern satisfactory to the Resident, but which shall not be more than 3 mm [ $\frac{1}{8}$  in] smaller than the bore of the ducts. Where obstructions in the ducts prevent passage of the mandrel, the Contractor shall, at their own expense, remove and relay those portions of the ducts necessary to clear the obstruction.

The Contractor shall install Number 9 US Steel Wire Gauge galvanized iron pull-wire in all unused conduits. The ends of the wire shall be secured in such manner as to prevent accidental withdrawal of the wire.

626.032 Metallic Conduit Installation Conduits shall be of the sizes noted on the plans, which are indicated as the nominal inside diameter. All conduits shall be joined with threaded couplings using approved thread sealant. Conduit shall be installed so that it is continuous and watertight between boxes or equipment. Running threads will not be permitted. When necessary, the Contractor shall use an approved electrical union-type coupling. Conduits shall be protected at all times from the entrance of water or other foreign matter. Conduit runs shall be made with as few couplings as standard lengths will permit. The total angle of all bends in one run and the radius of conduit bends shall conform to the NEC requirements. All field bends and offsets shall be made with approved hickey or conduit benders. Pull boxes shall be used wherever necessary to facilitate the installation of the wires.

In making up a run of conduits, all cut ends shall be reamed to remove rough edges and cut threads shall be painted with an approved thread sealant in such a manner that there will be no unprotected surfaces and joints will be watertight. All conduits shall have electrical continuity and shall be adequately grounded.

Conduits to be placed in the concrete superstructure of bridges and similar structures shall be securely supported and fastened, in order to maintain the conduits' position within the concrete superstructure, as shown on the plans. Pull boxes shall be located as shown on the plans. Clearance between conduit runs shall preferably be 50 mm [2 in], but at no time shall be less than the maximum size of the aggregate used in the embedding concrete. At all joints where relative movement between adjacent parts of a structure can occur, a double "O"-ring expansion coupling, or other approved expansion device shall be installed.

Exposed conduit shall be rigidly and securely fastened with acceptable fasteners or supports, as indicated on the plans or approved. Fasteners or supports shall not be placed more than 1.8 m [6 ft] apart on centers, except as otherwise authorized. Conduits shall generally be supported by an approved spacer at the point of support, so that there is an air space between the conduit and the supporting surface. Ends of conduit runs terminating in a metallic box without a threaded hub shall be provided with a metallic locknut on the outside of the box, and a metallic locknut

and insulated bushings on the inside. A lock washer and a galvanized steel flat washer shall be installed between the outside locknut and face of the box.

626.033 Polyvinylchloride Conduit Installation Polyvinylchloride conduit, hereafter called PVC conduit, shall be installed in accordance with the applicable methods as specified in Section 626.032 for metallic conduits.

PVC conduit shall be made watertight by joining with solvent or in accordance with the manufacturer's specifications.

Conduit shall be bent carefully to avoid damage and without the use of an open flame. Bends sharper than 45° [ $\frac{1}{8}$  bend] will not be permitted in PVC conduit. The total angle of all bends in one run and the radius of bends shall conform to the NEC requirements.

Conduits to be placed in the concrete superstructure of bridges and similar structures shall be securely supported and fastened, in order to maintain the conduits' position within the concrete superstructure, as shown on the plans. Pull boxes shall be located as shown on the plans. Clearance between conduit runs shall preferably be 50 mm [2 in], but at no time shall be less than the maximum size of the aggregate used in the embedding concrete. At all joints where relative movement between adjacent parts of a structure can occur, a double "O"-ring expansion coupling, or other approved expansion device shall be installed.

To allow for expansion and contraction of PVC conduit during installation of long runs, one end shall be left unconnected or a double "O"-ring expansion coupling shall be inserted near one end of the run until final covering of the conduit is in progress.

Where PVC conduit runs are placed parallel to other conduit runs or cross one over another, they shall be separated by a minimum of 75 mm [3 in] of sand or soil cushion. The bottom of trenches for PVC conduit shall be lined with a 75 mm [3 in] minimum bedding of tamped sand or soil before laying the conduit. Backfill to a compacted depth of 150 mm [6 in] above the top of the conduit shall be sand or soil, free from rocks or hard lumps.

At locations shown on the plans, or otherwise designated, conduit shall be constructed of schedule 80, PVC non-metallic conduit pipe encased in approved granular material as shown on the detail sheets.

When prewired conduit is installed, only those junction boxes necessary for underground splices shall be installed, unless otherwise directed.

Conduit and wire sizes of prewired conduit shall be as shown on the plans.

If the Contractor elects to plow-in the prewired conduit, the plowing shall be done with approved vibratory plowing equipment.

When prewired conduit is installed in a trench, the trench shall be prepared as previously noted in this Section for PVC conduit.

626.034 Concrete Foundations before placing concrete, the required elbows of entrance conduits, reinforcing steel and anchor bolts shall be carefully positioned. The anchor bolt size and the bolt circle diameter shall be determined from data furnished by the supplier of the poles or as shown on the plans. Anchor bolts for use with breakaway couplings, longitudinally grooved-type, shall be 25 mm [1 inch] diameter and shall project between 65 mm to 75 mm [2½ in and 3 in] above the top of the foundation. All other anchor bolts shall be a minimum of 25 mm [1 in] diameter and shall project sufficiently to accommodate the thickness of the base plus all nuts and washers. The bolt length shall also be sufficient to allow clearances of approximately 13 mm [½ in] below the leveling nut and 6 mm [¼ inch] above the top nut. At least two threads on each anchor bolt shall project beyond the outside of the nuts holding the plumbed pole.

Foundations shall be constructed of reinforced concrete with anchor bolts in accordance with the applicable requirements of Section 502, Section 503 and in conformity with the dimensions and details shown on the plans or the Contractor's approved design.

If the foundation is located in wet, spongy, or otherwise unsuitable material, the hole shall be further excavated to a depth sufficient to overcome this condition and backfilled with aggregate subbase material. The aggregate material shall be firmly compacted in layers not more than 200 mm [8 in], loose measure. Backfilling of foundation material shall conform to Section 206.03.

The surface area around the foundations shall be loamed and seeded in accordance with the requirements of Section 615 and Section 618.

Concrete foundations designated to be modified or removed shall be modified or removed as shown on the plans. Debris resulting from the modification or removal shall be removed. After removal has been completed, the area shall be brought to grade by addition of granular material and loam, or by loam only, depending on the extent of modification or removal. The area shall then be seeded in accordance with Section 618.

Backfilling around the foundations shall conform to the requirements of Section 206.03. Backfill material shall be excavated material, unless considered unsatisfactory, in which case the material used for backfill shall meet the requirements of Aggregate Base-Screened. The finished ground at each foundation shall be graded flush with the top of the foundation, except at locations where the foundation is protected by guardrail. If required, approved backfill material shall be added to grade the slopes as specified. There will be no additional compensation for furnishing, placing and compacting material flush around the foundation.

When solid rock is encountered at less than the required distance below existing ground level, the construction method shown on the plans shall be followed.

The concrete portion of the foundations exposed to view shall have a troweled finish. A drainage groove shall be formed in the horizontal surface of the foundation. The top of the concrete foundation shall be horizontal.

When the anchor bolt template is removed, the threads of the anchor bolts shall be greased and protected with a metal sleeve, held in position with nuts and washers to be furnished with the bolts. This thread protection shall remain in place until the pole or other equipment is installed.

A copper-clad steel ground rod shall be installed when shown on the plans.

626.04 Method of Measurement Precast Concrete Junction Box, Foundations (all) and Remove or Modify Concrete Foundation will be measured by each unit.

All conduit will be measured by the number of meters [linear feet].

The quantity of structural earth excavation to be measured for payment below grade will be the amount actually excavated from 300 mm [1 ft] below the bottom of the foundation, junction box or sand bedding to the required elevation, provided the maximum allowable horizontal dimensions do not exceed those bounded by vertical surfaces 230 mm [9 in] each side of the installation, as shown on the plans. The quantity of structural rock excavation to be measured for payment will be the number of cubic meters [cubic yards] actually removed, provided the maximum allowable horizontal dimensions do not exceed those bounded by vertical surfaces specified herein.

626.05 Basis of Payment The accepted quantity of foundations will be paid for at the contract unit price each for the number of foundations of the respective types. This payment shall include: anchor bolts, reinforcing steel, conduit within the foundation and extending 300 mm [12 in] from the foundation, loam, seeding, mulching and all incidentals necessary to complete the work.

The accepted quantity of junction boxes will be paid for at the contract unit price each. Payment for junction boxes shall include furnishing and installing precast concrete or bituminized fiber boxes as designated, including that portion of conduit extending 300 mm [12 in] outside the box.

Payment will be made for the total number of meters [linear feet] of each type of underground or exposed conduit actually furnished, installed, and accepted at the contract price per meter [linear foot]. This price shall include the cost of: furnishing and installing the conduit; excavating; furnishing special backfilling materials, pull wire, fittings, groundings and bonding; test cleaning interiors of conduits and all materials, labor, equipment and incidentals necessary to complete the work.

Excavating and backfilling for junction boxes, foundations and excavating, backfilling and sand bedding for conduit ducts will be considered included in the respective contract unit prices and no separate payment will be made, except as hereafter provided.

Excavating and backfilling as shown on the plans, or as required to overcome soft or otherwise unsuitable material, or for excavating rock will be paid for as provided in Section 206.

Required backfill material, except sand bedding as shown on the detail plan, will be paid for as provided in Section 304.

Payment will be made for the total number of meters [linear feet] of prewired conduit actually furnished, installed, and accepted at the contract price per meter [linear foot]. This price shall include the cost of hand digging, trenching, or plowing; furnishing and installing the prewired conduit; and all labor, equipment and incidentals necessary to complete the work.

The accepted quantity of ground mounted cabinet foundations will be paid for at the contract unit price each, which payment shall include conduit within the foundation and extending 300 mm [12 in] from the foundation and for loam, seeding, mulching and all incidentals necessary to complete the work.

Prewired conduit within the foundations and extending 300 mm [12 in] from the foundation, and prewired conduit within the junction box and extending 300 mm [12 in] outside the junction box, shall be considered incidental to the respective contract unit prices for light standard foundations and junction boxes and no additional payment will be made.

The accepted quantity of Remove or Modify Concrete Foundations will be paid for at the contract unit price each. Such price shall include disposing of concrete removed, backfilling with granular material, loaming, seeding, and all incidentals necessary to complete the work.

Payment for restoration of roadway pavement, sidewalks, grass areas and resetting curbing removed in conjunction with this work, shall be considered incidental to the respective contract prices for each related item, except as otherwise provided.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
626.11 Precast Concrete Junction Box: ____	Each
626.21 Metallic Conduit	meter [Linear Foot]
626.22 Non-metallic Conduit	meter [Linear Foot]
626.23 Prewired Conduit Secondary Wiring	meter [Linear Foot]
626.24 Prewired Conduit Primary Wiring	meter [Linear Foot]
626.31 450 mm [18 in] Foundation	Each
626.32 600 mm [24 in] Foundation	Each
626.33 750 mm [30 in] Foundation	Each
626.331 900 mm [36 in] Foundation	Each
626.34 Signal Pole Foundation	Each
626.35 Controller Cabinet Foundation	Each
626.36 Remove or Modify Concrete Foundation	Each
626.37 Special Foundation	Each
626.38 Ground Mounted Cabinet Foundation	Each

## SECTION 627 - PAVEMENT MARKINGS

627.01 Description This work shall consist of furnishing and placing reflectorized pavement lines and markings, removing pavement lines and markings, and furnishing and applying reflectorized paint to curbing in reasonably close conformity with the plans and as designated.

627.02 Materials Materials shall conform to the requirements specified in the following Sections of Division 700 - Materials.

Pavement Marking Paint	708.03
Reflectorized Plastic Pavement Marking	712.05

Temporary Bi-directional Yellow Delineators shall be Temporary Object Markers (T.O.M.) as manufactured by the Davidson Plastic Company, 18726 East Valley Highway, Kent, WA 98031 or an approved equal.

627.04 General All pavement lines and markings shall be applied in accordance with the Manual on Uniform Traffic Control Devices.

Longitudinal lines placed on tangent roadway segments shall be straight and true. Longitudinal lines placed on curves shall be continuous smoothly curved lines consistent with the roadway alignment. All pavement markings placed shall meet the tolerance limits shown on the plans.

Broken lines shall consist of alternate 3 m [10 ft] painted line segments and 9m [30 ft] gaps.

Temporary pavement marking lines, defined in Special Provision Section 652, Maintenance of Traffic, Temporary Centerline, will be applied as many times as necessary to properly delineate traffic lanes for the safe passage of traffic. Bi-directional delineators may be used in place of temporary lines, except where specified otherwise in Special Provision 652 Maintenance of Traffic, Temporary Centerline. Delineators will be applied at 12 m [40 ft] intervals.

In overnight lane closure areas that are not to be overlaid, temporary plastic lines or raised pavement markers shall be used through the length of the taper.

Newly painted lines, markings and curb shall be protected from traffic by the use of cones, stationary vehicles or other approved methods until the paint is dry.

627.05 Preparation of Surface Immediately before applying the pavement marking paint to the pavement or curb, the surface shall be dry and entirely free from dirt, grease, oil, or other foreign matter.

Surface preparation for application of plastic markings shall conform to the manufacturer's recommendations.

627.06 Application Prior to applying paint for final pavement lines, the Contractor shall perform a test for paint thickness by furnishing and placing a piece of smooth, clean metal with an area of at least 0.1 m<sup>2</sup> [144 in<sup>2</sup>] in the path of the striping truck. The striping truck shall be passed over the piece of metal, painting the surface as it passes, without applying beads. The result of this test will be used to determine the pressure setting and speed of the truck when applying paint to obtain the specified thickness. Additional paint thickness testing may be required on the final paint markings. The wet thickness of paint without beads on final pavement lines shall be a minimum of 0.400 mm [16 mils].

On other final pavement markings and on curb, where the paint is applied by hand painting or spraying, application shall be in two uniform covering coats, each at least 0.25 mm [10 mils] thick. Before the second coat of paint has dried, the glass beads shall be applied by a pressure system that will force the glass beads onto the undried paint as uniformly as possible.

Glass beads shall be applied to the final and temporary pavement lines, marking and curb at the rate of 0.54 kg/L [4.5 lb/gal] of paint and in sufficient quantity to assure complete and uniform coverage of hand painted surfaces.

Temporary painted lines and markings shall be applied as specified for permanent painted lines, except that the thickness shall be a minimum of 0.400 mm [16 mils].

Temporary pliant polymer marking material shall be used for temporary markings on the final pavement and on pavements not to be resurfaced when such pavement markings do not conform to the final pavement markings pattern.

The plastic final pavement lines and markings shall be applied in accordance with the manufacturer's recommendations by the inlay method of application.

627.07 Establishment Period Inlaid plastic pavement lines and marking material furnished and installed under this contract for final pavement markings shall still be subject to a six-month period of establishment.

The period of establishment shall commence as soon as the plastic pavement lines and markings are complete and in place and shall continue for six months. At the end of the establishment period, a minimum of 95% of the plastic pavement lines and markings shall still be in place to be acceptable.

If less than 95% of the plastic pavement lines and markings are in place after six months, the Contractor shall replace all unsatisfactory plastic pavement lines and markings on the project without additional payment. Plastic pavement lines and markings designated for replacement shall be installed according to these specifications, unless otherwise directed. Plastic pavement lines and markings replaced at the end of the six month establishment period will not be subject to a further establishment period.

627.08 Removing Lines and Markings When it is necessary to remove pavement lines and markings, it shall be done by grinding, high temperature flame, sand blasting, solvent or other

acceptable means. The method chosen must be capable of completely eradicating the existing line or marking without damage to the pavement. Burning and grinding to remove temporary markings from final pavement or from existing pavement not to be resurfaced will not be permitted.

627.09 Method of Measurement The quantity of permanent pavement marking lines measured for payment will be the number of meters [feet] shown in the Schedule of Items in the contract. This quantity will be considered final and no adjustments will be made except when changes resulting in increases or decreases are made by the Resident.

Double yellow centerline, broken or solid, will be considered one line for measurement purposes. The measurement of broken lines will include the gaps when painted and will not include the gaps when plastic. Temporary pavement marking lines will be measured as one lump sum for work accepted. All other pavement markings will be measured by the square meter [square foot] for work actually done.

Reflectorized curb will be measured or computed by the square meter [square foot] of curb surface actually painted and reflectorized.

The accepted quantity of removing existing pavement markings will be measured by the square meter [square foot].

Temporary Bi-directional Yellow Delineators will be measured by each unit, complete in place, maintained, and accepted.

627.10 Basis of Payment The accepted quantity of permanent pavement marking lines will be paid for at the contract unit price per meter [foot]. No adjustment will be made to the quantity for payment, except as described under Method of Measurement above. All other permanent pavement markings will be paid for at the contract unit price per square meter [square foot].

Payment for final plastic pavement lines and markings will be made in two parts. The first payment of 75% will be made when plastic pavement lines and markings are placed. The payment of the remaining 25% will be made at the end of the establishment period for all plastic line and pavement markings accepted.

The accepted quantity of temporary pavement marking lines will be paid for at the contract lump sum price and will include as many applications as required and removal when required.

The accepted quantity of Temporary Bi-directional Yellow Delineators will be paid for at the contract unit price.

Payment will be made under:

Pay Item

Pay Unit

627.18	300 mm [12 in] Solid White Pavement Marking Line	Meter [Linear Foot]
627.711	White or Yellow Pavement Marking Line - Plan Quantity	Meter [Linear Foot]
627.75	White or Yellow Pavement & Curb Marking	Square Meter [Square Foot]
627.76	Temporary Pavement Marking Line, White or Yellow	Lump Sum
627.77	Removing Existing Pavement Marking	Square Meter [Square Foot]
627.407	Reflectorized Plastic, White or Yellow Pavement Marking	Square Meter [Square Foot]
627.4071	Reflectorized Plastic, White or Yellow Pavement Marking Line - Plan Quantity	Meter [Linear Foot]
627.811	Temporary Bi-directional Yellow Delineators	Each

SECTION 628 - VACANT

SECTION 629 - HAND LABOR

629.01 Description This work shall consist of furnishing and supervising laborers when authorized or directed by the Resident in accordance with these specifications.

629.02 General Work under this section shall require no special skill but shall be accomplished in a competent manner. The personnel shall be physically and mentally capable of efficiently performing the assigned duties.

Nothing in this section shall be construed to relieve the Contractor of their responsibility for furnishing personnel under other contract items. The intent is that this item shall be used to perform necessary work not covered or provided for under existing contract items or other sections of the specifications.

629.03 Method of Measurement Hand labor will be measured by the hours of work actually performed, measured to the nearest ¼ hour.

629.04 Basis of Payment The accepted quantities of labor will be paid for at the contract unit price per hour

The contract unit price shall be full compensation for hiring, transporting, supervising, payment of workmen's compensation, social security taxes, unemployment insurance, overtime, benefits and for all hand tools, protective clothing and all incidentals necessary to complete the work.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
629.05 Hand Labor, Straight Time	Hour

SECTION 630 - VACANT

SECTION 631 - EQUIPMENT RENTAL

631.01 Description This work shall consist of furnishing and operating construction equipment as directed by the Resident.

631.02 General Equipment used for work under this section shall conform to the following minimum sets of requirements:

<u>Equipment</u>	<u>Description</u>	<u>Minimum Size</u>
<u>Air Compressor</u>	Gasoline or diesel powered unit with compressor, receiver and adequate air hose	2.4 m <sup>3</sup> [85 ft <sup>3</sup> ] per minute at 690 kPa [100 psi]
<u>Air Tool</u>	Single compressed air driven hand drill, tamper, hammer, chipper, or pavement breaker	
<u>All Purpose Excavator</u>	Approved truck, mounted type class	2.75 Mg [3 ton] capacity lifting at 4.5 m [15 ft] radius
<u>Heavy Duty Purpose Excavator</u>	Approved truck, mounted type class	6.3 Mg [7 ton] capacity lifting at 4.5 m [15 ft] radius
<u>Bulldozer</u>	Crawler or pneumatic tired tractor with pushing blade	69 kW [93 hp] (flywheel), Weight(tractor) 7900 kg [8.75 ton]
<u>Small Bulldozer</u>	Crawler with pushing blade	22 kW [30 hp]
<u>Chain Saw</u>	Gasoline or electric powered with endless chain type blade	450 mm [18 in] cutting blade
<u>Culvert Cleaner</u>	Water Jet nozzle, pump and tank	130 L [35 gal] per minute 8620 kPa [1,250 psi]
<u>Front End Loader</u>	Front end scoop mounted on pneumatic tires	1.5 m <sup>3</sup> [2 yd <sup>3</sup> ] rated capacity
<u>Small Front End Loader</u>	Front end scoop mounted on crawler or pneumatic tires	0.17 m <sup>3</sup> [6 ft <sup>3</sup> ] minimum rated capacity
<u>Grader</u>	Tandem drive	6350 kg [7 ton]
<u>Road Broom</u>	Engine driven rotary broom	2.1 m [7 ft] broom

Roller (earth or base course) - Self-propelled  
pneumatic tire type

Gross wt. 3700 kg/m [2,500 lbs/ft]  
of rolling width. 1 m [40 in] width  
Tire ground pressure 450 kPa [65 psi]

Roller (pavement) - Self-propelled pneumatic  
minimum, 7 wheels

Gross weight 25,400 kg [28 ton]  
300 mm by 600 mm [12 in by 24 in]  
smooth tread tires capable of 760  
kPa [110 psi] inflation pressure;  
pressure fully ballasted wheel loads  
= 3600 kg [8,000 pounds] or more

Rototiller - Rotary cultivator mounted on pneumatic  
tired tractor

18 kW [25 hp]

Stump Chipper - Gasoline powered stump chipping  
machine

44 kW [60 hp]

Truck, small - Pneumatic tired with dump body  
rated capacity

3.8 m<sup>3</sup> to 6.1 m<sup>3</sup> [5 yd<sup>3</sup> to 8 yd<sup>3</sup>],  
manufacturers rating

Truck, large - Pneumatic tired with dump body  
rated capacity

Over 6.1 m<sup>3</sup> [8 yd<sup>3</sup>]  
manufacturers rated

631.03 General Nothing in this section shall be construed to relieve the Contractor of the responsibility for completing work under other contract items. These items shall be used to perform only such work as directed by the Resident.

631.05 Grading All grading shall be done in a manner to leave the area smooth and suitable for machine mowing and to provide proper drainage or as otherwise directed by the Resident. Suitable excavated material shall be placed and compacted on embankment slopes or other areas as directed. Unsuitable material shall be disposed of in approved waste areas.

631.06 Rolling All material under this item shall be compacted to the satisfaction of the Resident. Only those portions of roadway designated for rolling shall be rolled. The work shall be performed under such conditions that maximum compaction can be obtained.

631.07 Method of Measurement Equipment rental will be measured by the hour to the nearest ¼-hour. Time spent moving to and from the site within the project limits and from beyond the project limits, servicing, maintaining, and changing attachments will not be measured for payment.

Supervision required in the performance of hourly equipment rental work will be measured for payment only when called for on the Plans. This item does not relieve the Contractor of the responsibility to supervise other contract items. Foreman will be measured by the hour to the nearest ¼ hour of time actually spent supervising operators of hourly equipment rental pay items. The name of the supervisor will be supplied to the Resident.

631.08 Basis of Payment The accepted quantities of equipment rental will be paid for at the contract unit price per hour for each type of equipment used. Payment shall include operators, fuel, grease, oil, and other incidentals necessary to operate the equipment.

No separate payment will be made to direct work done under these items, except when called for on the Plans. Payment will then be made under Pay Item 631.36. Payment made will be limited to the grade of foreman and limited to hours spent in actually supervising equipment operators. Such related costs as use of pickup truck, meal and room expenses, benefits, insurance, retirement, travel time, and overtime will not be paid for separately but will be considered incidental to the unit price bid for this pay item.

Payment for equipment rental will be based on experienced operators, familiar with the work being performed. Operators, determined to be below normal acceptable standards of production or workmanship, will be paid for at reduced hours as determined by the Resident.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
631.10 Air Compressor (including operator)	Hour
631.11 Air Tool (including operator)	Hour
631.12 All Purpose Excavator (including operator)	Hour
631.121 Heavy Duty All Purpose Excavator (including operator)	Hour
631.13 Bulldozer (including operator)	Hour
631.131 Small Bulldozer - Grader (including operator)	Hour
631.132 Small Bulldozer (including operator)	Hour
631.14 Grader (including operator)	Hour
631.15 Roller, earth and base operator)	Hour
631.16 Roller, Pavement (including operator)	Hour
631.171 Truck-small (including operator)	Hour
631.172 Truck-large (including operator)	Hour
631.18 Chain Saw Rental (including operator)	Hour
631.20 Stump Chipper Rental (including operator)	Hour
631.21 Road Broom (including operators and hauler)	Hour
631.22 Front End Loader (including operator)	Hour
631.221 Small Front End Loader (including operator)	Hour
631.29 Rototiller (including operator)	Hour
631.32 Culvert Cleaner (including operators)	Hour
631.36 Foreman	Hour

SECTION 632 and 633 - VACANT

## SECTION 634 - HIGHWAY LIGHTING

634.01 Description This work shall consist of furnishing and installing a highway lighting system or modifying or removing an existing highway lighting system in accordance with these specifications and in reasonably close conformity with the plans.

634.02 General All material furnished by the Contractor shall be new unless otherwise specified. Substitutes for specified material may be accepted, upon approval of the Fabrication Engineer. Substitutes shall provide equal or better service. Where an existing system is to be modified, the existing material shall be removed, upgraded, or disposed of as shown on the plans or as directed.

All electrical equipment shall conform to NEMA, UL, or EIA standards, wherever applicable. In addition, all materials and workmanship shall conform to the requirements of the NEC, the local electrical Utility Company, and all local ordinances, which may apply.

634.021 Materials Materials shall meet the requirements specified in the following Section of Division 700 - Materials:

Steel Conduit	715.02
Non-metallic Conduit	715.03
Prewired Conduit	715.04
Metallic Junction and Fuse Box	715.05
Secondary Wiring	715.07
Luminaires, Lamps and Ballast	715.08
Luminaires, Lamp and Ballast for High Mast Lighting	715.09
Photo Electric Control	715.10
Service Equipment	715.11
Lowering System for High Mast Lighting	715.12
Aluminum Supports	720.01
Aluminum Mast Arm and Bracket Arm	720.02
Steel Supports	720.03
Steel Mast Arm and Bracket Arm	720.04
High Mast Light Standard	720.05
Steel H-beam Poles	720.06
Anchor Bolts	720.07
Wood Ornamental Light Standard	720.09
Wood Utility Pole	720.10
Mast Arm for Wood Utility Pole	720.11
Breakaway Devices	721.01

Transformer enclosures shall conform to NESC requirements. They shall be approximately 1175 mm [46 in] high, 1050 mm [42 in] wide, and 1050 mm [42 in] deep. Dimensions should be verified with the electrical Utility Company before ordering. Clearances shall be provided as required by the NESC. The enclosure shall be painted inside and outside with one coat of red

iron-oxide primer and a finish coat of gray baked enamel. Doors shall be furnished with padlock lugs.

The electric portable power unit shall be a heavy-duty reversing electric motor for the voltage and frequency shown on the plans and shall have a remote control.

The following are the minimum requirements for the high mast lighting lowering system:

- Ball bearing motor
- Grounded frame
- Torque limiter
- Power unit mounting frame
- Coupling to winch drive shaft
- Remote control unit with cable
- Cable with twist lock receptacle and plug for operator of power unit

All bolts for mounting lighting fixtures under bridge structures shall conform to the requirements of ASTM A307. These bolts and other fastening hardware shall be hot-dipped galvanized in accordance with ASTM A153.

Screened sand for bedding and covering direct buried cables shall meet the requirements of Section 703.14, except that there shall be 0-10% passing the 75  $\mu\text{m}$  [No. 200] sieve.

634.022 Equipment List and Drawings Unless otherwise permitted in writing, the Contractor shall submit for review a list of equipment and materials which is proposed to be furnished. The list shall include the name of manufacturer, size, and identifying number of each item and other necessary data, including detailed scale drawings, wiring diagrams of special equipment and any proposed minor deviations from the plans. If requested, the Contractor shall submit sample articles of the material proposed for use. All of the above data except sample articles, shall be submitted in duplicate. Following checking, correction, and approval, not less than two complete sets of approved drawings shall be submitted. The Department will not be liable for material purchased, labor performed, or work delayed before such review. Where electrical equipment is to be constructed as shown on the plans, the submission of detailed drawings and diagrams will not be required.

Upon completion of the work, the Contractor shall submit three complete sets of corrected plans showing all construction changes.

634.023 Miscellaneous Material Insulating tape shall be of the self-bonding type. Jacket tape shall be of the water- resisting type. Friction tape shall be rubber-impregnated, woven cotton fabric.

634.024 Light Standards The terms "conventional standard" or "conventional light standard" shall mean the assembled metal base flange, transformer base or breakaway device, metal columnar shaft, metal overhanging bracket arm and incidental hardware.

The term "high mast pole" shall mean the assembled base plate flange, metal columnar shaft, luminaire tenon, mounting and lowering device and incidental hardware. For purposes of this specification, a structure shall be considered a high mast pole if the pole height, from base plate to the center of the luminaire, exceeds 15 m [50 ft].

The design materials and fabrication of structural supports for luminaires shall meet the requirements of the current edition of AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals" and interims thereto, except as otherwise indicated within these specifications or on the contract plans. Light standards with a luminaire mounting height in excess of 15 m [50 ft] shall be designed using wind speeds based on a 50-year mean recurrence interval. Minimum design default values for these structures shall be:  $I_r = 1.00$ ;  $C_v = 1.00$ ;  $K_z =$  as specified in Table 3-5 in the current edition of AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals" and interims thereto; and  $G = 1.14$ . Light standards with a luminaire mounting height of 15 m [50 ft] or less shall be designed using wind speeds based on a 25-year mean recurrence interval. Minimum design default values for these structures shall be:  $I_r = 0.87$ ;  $C_v = 0.93$ ;  $K_z =$  as specified in Table 3-5 in the current edition of AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals" and interims thereto; and  $G = 1.14$ . For structural design purposes the luminaire mounting height for roadside installation is defined as the distance from the center of luminaire to the base plate bottom. For luminaire supports mounted on structures and approaches to structures, the luminaire mounting height shall be defined and measured as the distance of the center of the luminaire to one of the following:

- a. For bridges over bodies of water Above the prevailing water level or, in the case of tidal waters, above mean high tide.
- b. For overpass structures Above the lower roadway level.
- c. For approach ramps Above the average adjacent ground level, if said ground level is more than 3 meters [10 ft] below the base of the light standard.

The design weight of luminaires shall be 27 kg [60 lb] with an effective projected area of 0.2 m<sup>2</sup> [2.5 ft<sup>2</sup>], except that poletop-mounted luminaires shall have an effective projected area of 0.45 m<sup>2</sup> [5.0 ft<sup>2</sup>].

Light standards mounted on a bridge structure or light standards fabricated with aluminum shall be equipped with an approved damping or energy-absorbing device.

Deflections of light standards and bracket arms shall be limited as follows:

- a. Conventional Light standards shall be able to support a 225 kg [500 lb] transverse load, applied at 450 mm [18 in] below the pole top with a maximum deflection of 5% of the nominal pole length. A computer simulation or detailed computation using full design load (as specified in the AASHTO Standard Specification for Structural Supports for Highway

Signs, Luminaires and Traffic Signals) establishing a maximum of 7% deflection of the nominal pole length may be used as an alternate method.

b. Bracket arms shall be able to support a horizontal load, perpendicular to the axial vector of the arm, of 23 kg [50 lb] and a concurrent vertical load of 45 kg [100 lb], both loads applied at the luminaire tenon, without developing a measurable permanent set.

c. High mast light standards shall have a maximum deflection of 7% of the nominal pole length under full design load when equipped with four luminaires.

Conformance to the above deflection criteria for light standards, bracket arms and high mast light standards shall be substantiated by detailed computations or computer simulation, accompanied by written methodology, or actual tests on materials produced for delivery under a Maine Department of Transportation contract.

The base plates of light standards shall have workable leveling nuts beneath and above them with flat washers against both nuts, when erected. The distance between the bottom of the base plate and top of the foundation shall not exceed twice the diameter of the anchor bolts. Grout, or other material, shall not be placed between the base plate and foundations.

Approval for deviations from the contract drawings and/or specifications shall be requested in writing and shall be approved by the Fabrication Engineer before being incorporated in the manufacturer's drawings. Requests for substitution for all specified material shall be submitted in writing with full documentation (specifications, mill certifications, etc.) enabling the Department to evaluate the proposal.

A Certificate of Compliance shall be provided for all material in accordance with the requirements of the General Statement of Division 700 - Materials. Shop certification in accordance with Section 504.04 is required.

634.025 Conventional Light Standards After execution of the contract for conventional light standard(s), and before any shop work is commenced, the Contractor shall submit 3 sets of the manufacturer's drawings of all standards and accessories proposed to be furnished and erected under this contract. The drawings shall be of sufficient detail to indicate material and/or dimensional conformance with these specifications and the contract drawings. Each drawing shall contain a reference to the design criteria and certification that the design criteria have been met for the light standards, bracket arms and associated hardware, fittings and breakaway devices, as submitted. A Registered Professional Engineer shall sign the certification under their official seal. The drawings shall use the same units as found in the project plans.

It is the intent of these specifications that the Contractor shall be fully responsible for the adequacy of the sizes, wall thickness, materials and connections of the standards, bracket arms and associated hardware, fittings and breakaway devices. Approval of the drawings will signify only approval of the material(s), mounting heights(s) and bracket arm length(s).

634.026 High Mast Light Standard For all high mast light standards, as defined in this Section, the Contractor shall submit, in addition to the manufacturer's drawings, 3 sets of the design computations, including fatigue considerations consistent with AASHTO requirements. Approval of the drawings and computations will signify approval of all structurally significant details of the light standard and if any, the luminaire mounting and lowering device. All drawings and computations shall be signed by a Registered Professional Engineer. Approval will be based on the applicable provisions of Section 105.7.

The shaft shall be provided with an equipment access opening approximately 0.19 m<sup>2</sup> [2 ft<sup>2</sup>] and centered approximately 600 mm [2 ft] above the base. The access opening shall be reinforced to maintain the full design strength of the shaft and shall be provided with a hinged, removable, access door equipped with a vandal proof means of being locked in place. A positive means of internal grounding shall be provided inside of the access door.

All shaft sections shall be one plate thickness, except that a doubler plate may be used around the equipment access opening. The walls of polygonal shafts shall have an inside corner radius to wall thickness ratio not less than 2.

The Contractor may propose a galvanized and painted pole, in lieu of using weathering type steel. The steel shall be a base metal listed in the current edition of the AWS Structural Welding Code, D1.1. Paint color will be designated by the Fabrication Engineer. Galvanizing and surface preparation shall be in accordance with Section 504 and paint shall be a two-coat system designed for use on galvanized surfaces approved by the Engineer. The Contractor shall supply sufficient additional coating material and instructions for touchup work.

634.027 Breakaway Supports Breakaway supports, approved by the Engineer, shall be supplied for use at all locations designated as breakaway. Breakaway Support Certification of both, breakaway and structural adequacy, shall be provided by the Manufacturer. Design calculations or test data of production samples to support certification shall be provided. Breakaway support components shall provide the same or greater structural strength than the support post or pole utilizing the breakaway device. Breakaway couplings shall not be used in conjunction with transformer bases. Breakaway devices are subject to the applicable provisions of Section 721 - Breakaway Devices.

634.03 General The location of the roadway lighting systems and other incidental work will be shown on the plans. They are diagrammatic only, but shall be followed as closely as actual conditions at the site and the work of other Contractors will permit. As the work progresses, the drawings may be revised or supplemented by the Resident, and the Contractor shall perform the work required by such revisions or supplements without additional compensation, except as provided in Section 109.

Work shall be scheduled to assure that each highway lighting system shall be completed and ready for operation upon completion of the corresponding section of the roadway or as specified in Special Provision 107.

Before proceeding with any work under this Contract, the Contractor shall conduct continuity and insulating tests to establish the integrity of cable runs already in place. The Contractor shall report all cable faults to the Resident. In cases faults are located while contract work is in progress and the Contractor does not report them, the Contractor will be responsible for correcting those faults without extra compensation.

634.04 Cable Installation The Contractor shall pull all wires through conduits without overstressing or stretching any wire or scoring, cutting, twisting or damaging the protective covering or insulation. When pulling cable into conduits, if the strain on the cables is likely to prove excessive, the Contractor shall use soapstone powder as a lubricant. Where two or more cables are to occupy the same conduit, they shall be drawn in together and kept parallel to each other by the use of a pulling head.

Both ends of each length of cable shall be sealed to prevent the entrance of moisture during shipment or during outdoor storage. Defective and damaged cable will be rejected and shall be replaced at no cost to the State.

Secondary wiring shall be installed as shown on the plans. Secondary wiring shall not be spliced except in junction boxes, hand holes in poles, transformer bases or locations shown on the plans. The wire for secondary circuits, which is pulled through ducts, shall be fed slack from the feed end.

Cables in junction boxes shall be provided with adequate slack for splicing and shall be arranged as directed. After cables have been installed and before permanent splicing, the end of each section of cable in light standards, junction boxes and panel boxes shall be carefully sealed, using rubber tape, and painted with a sealing-type of waterproof compound. All wiring shall be finished to provide a neat and orderly appearance. Ends of cable not connected to any device shall be insulated and sealed.

The trench for direct-buried cable shall be excavated to the width and depth shown on the plans or as directed.

Placement of the sand bedding shall be coordinated with the installation of the cables. After the cables and screened sand have been placed, the remainder of the trench shall be promptly backfilled with selected excavated material. Surplus material shall be disposed of as directed and the surface of the trench shall be loamed and seeded in accordance with Sections 615 and 618.

When connecting sockets, outlets and other similar equipment, the most accessible bare parts of each piece of equipment shall be connected to the grounded neutral. In order to ensure this has been done, each piece of equipment shall be tested after installation, under the supervision of the Resident, with a test lamp or other instrument, one leg of which has been connected to a definite ground, or by other approved means of testing.

All cables in junction boxes and light standards shall be tested for circuit connections, which shall be in conformity with those indicated on the plans. After verification of circuit

connections, all cables in junction boxes, light standards and service panels shall be provided with individual metal tags, die-stamped with a phase designated A or B, as applicable. The tags shall be securely attached to the cables.

Splices to form continuous circuits shall be made by the Contractor and will only be permitted in accessible locations. All splices in underground junction boxes shall be made with cast epoxy splice kits to provide a waterproof splice. All other splices shall be made with approved crimp-type connectors.

Conductors shall not be pulled into conduit until pull boxes are set to grade, crushed rock sumps installed, grout placed around the conduit, concrete bottom of pull boxes placed and the metallic conduit bonded.

Where roadways are to remain open to traffic and existing lighting systems are to be modified, the existing lighting system shall remain in operation and the final connection to the modified circuit shall be made so that the modified circuit will be in operation by nightfall of the same day.

634.05 Light Standard To provide continuously aligned lamp post installations, light standards shall be located in accordance with the details governing the spacings and set backs shown on the plans, unless otherwise directed.

The bracket arms shall be set normal to the edge of the roadway, unless otherwise directed. The bracket shall be assembled and attached to the shaft before the light standard is erected. If it is anticipated that there will be a period in excess of 24 hours between the erection of the light standards and the installation of the luminaires, the Contractor shall install a weight, weighing between 23 kg to 34 kg [50 lb to 75 lb], at the outboard end of each bracket arm. This weight shall be designed and fastened in such a way that it will not pose a hazard to persons passing beneath it.

Light standards shall be erected in a vertical position, with a maximum deviation from the vertical of 6 mm [ $\frac{1}{4}$  in] in 1500 mm [5 ft], using either the leveling nuts provided with the anchor bolts or the breakaway couplings. Once the light standard is in its final position, the top nuts shall be tightened as follows:

a. Anchor Bolts with Breakaway Couplings The manufacturer's recommendation shall be used.

b. Anchor Bolts without Breakaway Couplings the nut shall be tightened to snug tight condition by utilizing the full effort of a worker using a standard spud wrench or comparable tool. After all nuts have been brought to a snug tight condition, each nut shall be tightened an additional  $\frac{1}{3}$  turn using an impact wrench, torque wrench or large crescent wrench.

A minimum of 2 bolt threads shall project beyond the outside face of the nut.

Nuts for bolts other than anchor bolts shall be tightened as outlined under b. above, for anchor bolts.

The bottom of all transformer bases shall be coated with a bitumen-mastic, epoxy paint.

When foundations and anchor bolts for light standards have been installed by others, the Contractor shall verify the anchor bolt dimensions at each location so that bases will be furnished with the proper bolt holes.

Wires in the shaft shall be supported with a Kellum-type, braided, strain-relief grip attached to a "J" hook mounted inside the shaft near the top.

Wood Ornamental Light Standards shall be installed as shown on the plans.

634.051 Removing Light Standards Before removing light standards, the luminaires shall be removed from the light standards and disposed of as noted on the plans.

Care shall be exercised in removing and transporting the light standards. The Contractor will be required to replace, at their expense, all equipment damaged or destroyed by their operations.

634.052 Portable Power Unit for Lowering Luminaires The number of portable electric power units with remote control required for operation of the high mast luminaire lowering system, will be 1 for every 10 high mast poles, or as shown on the plans.

634.06 Luminaires Luminaires shall not be installed until the lamp socket position has been inspected and approved for conformance with the manufacturer's recommended position for the specified distribution. All luminaires shall be adjusted to produce the maximum illumination on the roadway surface.

The connections between the luminaires and connector kits shall be made with single conductor, number 12 wires AWG copper stranded THHN, minimum size. A 355 mm [14 in] long Teflon sleeve shall be placed over each end of each conductor in the luminaire.

Installation of a connector kit, fused or non-fused, shall be in accordance with the manufacturer's instructions to provide watertight connections.

634.061 Under-Bridge Lighting Under-bridge lighting shall be installed in accordance with the plans and specifications, or as directed.

Circuits shall be fused in fuse boxes with 5-ampere cartridge-type, midget fuses, 9.5 mm [<sup>3</sup>/<sub>8</sub> in] diameter and 38 mm [1½ in] long, unless otherwise indicated on the plans. Wiring connections in the under-bridge lighting units shall be made with 150°C [300°F] wire.

All under bridge lighting, luminaires shall be installed and adjusted for maximum illumination of the roadway surface. The beam angle shall be adjusted as indicated on the plans.

In vehicular undercrossings, underpass lights shall be placed in operation as soon as practicable after falsework has been removed from the structure. Lighting for pedestrian structures shall be placed in operation before opening the structure to pedestrian traffic.

634.08 Service The Contractor shall install metal conduit riser with entrance cap, entrance switch, multiple control relay, and other equipment as shown on the plans.

The lighting system will be supplied with electrical power by the local power company. The type of service will be single phase, three wire, 240/480 volt or the voltage indicated on the plans, 60 hertz, alternating current. The power company will make all connections of the roadway lighting system cables at the power company's service pole. The Contractor shall notify the power company at least two weeks in advance of the time they intend to start construction at each of the sites and shall make all necessary arrangements with the power company for the required installation.

Roadway lighting cabinets shall be installed on stub poles with doors accessible from the roadway. All connections to equipment and terminals shall be neat and orderly conforming to the requirements specified.

Details for the fabrication and installation of service poles with cabinets and other equipment are shown on the plans.

Transformer enclosures used to protect overhead type transformers mounted on concrete pads shall be installed as shown on the plans. Transformers will be furnished by the power company.

634.081 Bonding and Grounding All metal conduit ends, light standards, luminaires, control cabinets, and exposed noncurrent carrying metal parts of fixed equipment shall be connected to the grounding conductor. All grounding and bonding shall conform to the current provisions of the NEC.

634.09 Testing Before acceptance of the work and in the presence of the Resident, the Contractor shall cause the following tests to be made on all lighting circuits.

a. Continuity Each circuit shall be tested for continuity.

b. Ground Each circuit shall be tested for grounds.

c. Resistance The resistance to ground on non-ground conductors shall be at least five megaohm at 15°C [60°F] measured with a 1,000 volt megger. The ground resistance shall not be more than 25 ohms.

d. Voltage Voltage readings shall be made at each service pole, in the load contractor, with load and without load, and at each fixture with load.

e. Current Current readings shall be made on the load side of each load contractor phase and neutral. Readings shall be made at night with lighting systems in normal operation.

f. Test Data Electrical test data obtained from the above tests shall be furnished in writing.

g. Operational Test The Contractor shall conduct an operational test for the completed installation under normal operating conditions. This operational test shall have a duration of not less than two full days. The Resident shall be the sole authority to judge the adequacy of the length of the testing period in order to assure the satisfactory operation of the entire system or any of its sections. The work will not be accepted until the operational test has been successfully completed.

h. Functional Test With all equipment connected to the wiring system, a functional test shall be performed by the Contractor, in the presence of the Resident, to demonstrate that the system and all parts thereof function as specified. All defective materials or faulty installations shall be corrected by repairs or replacements by the Contractor to the satisfaction of the Resident at no additional cost.

Lighting circuits shall be subjected to such other tests as may be required and it shall be the responsibility of the Contractor to ascertain what tests are required and to perform these tests in the presence of the Resident. All tests shall be performed at the expense of the Contractor. Cost for power to conduct tests shall be paid by the Contractor.

634.091 Acceptance All systems shall be complete and in operation to the satisfaction of the Resident at the time of acceptance of the work.

The Contractor shall be responsible for the proper performance in service, in whole or in part, of the various lighting systems and all other electrical installations furnished and installed under this Contract and shall correct, at their own expense, all deficiencies in the operation which may arise prior to acceptance of the work. The Contractor shall be responsible for the cost of power until the work is accepted.

634.092 Method of Measurement Highway lighting system will be measured by the lump sum.

Light standards will be measured by the single unit, complete in place and accepted.

The quantity of luminaires for high mast lighting will be measured by each single unit.

634.093 Basis of Payment The accepted quantity of light standards will be paid for at the contract unit price each for the number of units of the respective types. Payment shall be full compensation for the light standard and breakaway transformer base or breakaway device, bracket arm and all incidentals necessary to complete the work.

Payment for furnishing and installing luminaires for high mast lighting will be made for the accepted quantity at the contract unit price each, which shall include luminaire, ballast, lamp, and incidentals necessary to complete the work.

The accepted highway lighting system will be paid for at the contract lump sum price for the complete lighting system shown on the plans, except that luminaires for high mast lighting and light standards will be paid for at the contract unit price each.

Lump sum payment for highway lighting system shall be full compensation for furnishing, installing and erecting: ballast, lamps, wiring in underground conduit, pole wiring, and all other wiring (except prewired conduit), transformer enclosures, luminaires (except luminaires for high mast lighting), all identification tags, and all materials, labor, equipment, tools, miscellaneous hardware and incidentals necessary to complete the work. Payment shall also include removing and resetting light standards, installing breakaway devices on existing poles, disposing of unused light standards, as noted on the plans, and for furnishing portable electric power units.

No separate payment will be made for bonding, grounding and ground rods; these costs shall be included in the contract price for conduit, light standards, service panels, or other items requiring bonding and grounding.

Trenching for direct buried cable will be incidental to highway lighting system and shall include excavating, furnishing and placing screened sand and backfilling.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
634.160 Highway Lighting	Lump Sum
634.164 Luminaires for High Mast Lighting	Each
634.2041 Luminaires	Each
634.206 Light Standard for Post Top Luminaire	Each
634.207 High Mast Light Standard	Each
634.209 Wood Ornamental Light Standard	Each
634.210 Conventional Light Standard	Each

#### SECTION 635 - PREFABRICATED BIN TYPE RETAINING WALL

635.01 Description This work shall consist of the construction of bin type retaining wall in accordance with these specifications and in reasonably close conformity with the lines and grades shown on the plans or established.

635.02 Materials Materials shall meet the requirements specified in the following Section of Division 700 - Materials:

Gravel Borrow	703.20
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Precast Concrete Units	712.06
Metal Bin Type Retaining Wall	713.07

Bedding and backfill material shall be gravel borrow.

635.03 Shop Drawings The Contractor shall prepare shop detail erection and other working plans and shall submit two copies for approval. Approval of the plans shall be obtained before fabrication of the work is commenced. Changes in the approved plans shall be subjected to further approval and the Resident shall be supplied with a record of such changes. The drawings shall use the same units found in the project plans.

The Contractor will be responsible for the correctness of their plans, even though plans have been approved.

635.04 Excavation and Foundation Excavation for erection of the retaining wall shall be in accordance with Section 203 - Excavation and Embankment, to a width sufficient to allow the proper erection of the wall.

The foundation under the entire area of the wall shall be firm. The bedding and backfill material shall be thoroughly compacted. If ledge rock is encountered, a gravel foundation of at least 300 mm [12 in] in thickness shall be provided.

635.05 Erection The retaining wall members shall be erected in accordance with the manufacturer's instructions and as shown on the plans. Members shall be handled carefully and all members that are damaged shall be replaced at the Contractor's expense. All bolts for metal walls shall be placed so that heads will be exposed and the nuts tightened on the inside.

635.06 Backfill The backfilling of the interior of the wall and behind the wall shall progress simultaneously. The material shall be placed in layers not over 200 mm [8 in] in depth, loose measure and thoroughly compacted by mechanical or vibratory compactors. Puddling for compaction will not be allowed.

635.07 Method of Measurement Bin type retaining wall will be measured by the square meter [square foot] of front surface not to exceed the dimensions shown on the plans or authorized. The area of each panel shall be determined by multiplying the width of each panel, center-to-center distance of the columns, by the total height of the panel.

635.08 Basis of Payment The accepted quantity of bin type retaining wall will be paid for at the contract unit price per square meter [square foot] complete in place.

Excavating beyond the face of the wall, including excavating for bedding and backfill, and furnishing and placing bedding, and backfill material itself will be considered incidental to the contract items and no separate payment will be made.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
635.10 Concrete Bin Type Retaining Wall, Closed Face	square meter [Square Foot]
635.11 Concrete Bin Type Retaining Wall, Open Face	square meter [Square Foot]
635.12 Galvanized Metal Bin Type Retaining Wall	square meter [Square Foot]
635.13 Galvanized Metal Bin Type Retaining Wall with Fiber Coating	square meter [Square Foot]

## SECTION 636 - MECHANICALLY STABILIZED EARTH RETAINING WALL

636.01 Description The work under this item shall consist of design, fabrication, furnishing, transportation, and erection of Mechanically Stabilized Earth (MSE) retaining wall system of the required type, including miscellaneous items necessary for a complete installation.

The MSE retaining walls shall consist of reinforcing strips or reinforcing mesh earth wall systems utilizing architectural precast concrete facing panels supported on cast-in-place concrete leveling pads. All reinforcing strips or mesh material shall consist of galvanized steel. The wall structures shall be dimensioned to achieve the design criteria shown on the plans and specified herein.

The MSE retaining walls shall be constructed in accordance with these specifications and in conformity with the lines, grades, design criteria, and dimensions shown on the plans or established by the Geotechnical Engineer.

636.02 Quality Assurance The MSE retaining wall system shall be one of the approved wall systems noted in the Contract Documents. Alternate systems will not be considered. Value engineering is not applicable to the work of this Item.

All necessary materials, except backfill and cast in-place concrete shall be obtained from the approved system designer.

Mechanically Stabilized Earth (MSE) retaining walls shall be designed and constructed as specified herein. The design shall be subject to review and acceptance by the Geotechnical Engineer. The acceptability of a MSE retaining wall design shall be at the sole discretion of the Geotechnical Engineer. Any additional design, construction, or other costs arising as a result of rejection of a retaining wall design by the Geotechnical Engineer shall be borne by the Contractor.

Precast facing panels shall be manufactured in a concrete products plant with approved facilities. Before proceeding with production, precast sample units shall be provided for the Geotechnical Engineer's acceptance. These samples shall be kept at the plant to be used for comparison purposes during production.

All calculations and Shop Drawings shall be signed and stamped by a Professional Engineer registered in the State of Maine and specializing in geotechnical construction.

The Contractor installing the MSE retaining walls shall have demonstrated experience constructing MSE walls and shall use personnel having demonstrated experience in the installation procedures recommended by the manufacturers and as specified herein.

Requirements for the precast facing panels are different from the standard panels from the approved systems. The Contractor shall prepare appropriate, alternate details.

All MSE walls shall be built in accordance with the plans and accepted shop drawings for the proposed wall systems.

A qualified representative from the wall design-supplier shall be present during construction of the MSE walls. The services of the qualified representative shall be at no additional cost to the project. The qualified experienced technical representative to advise the Contractor and the Engineer concerning proper installation procedures.

The vendor's representative shall specify the required back-batter so that the final position of the wall is vertical. Furthermore, footing berms shall be placed in front of the first 3 levels of panels erected, to maintain verticality.

636.03 Design Requirements The MSE retaining walls shall be designed to provide the grade separation shown on the plans with a service life of not less than 100 years.

In general, the MSE wall system shall be designed in accordance with the manufacturer's requirements, as specified herein and shown on the plans, and in accordance with the Special Provisions. Where conflicting requirements occur, the more stringent requirement shall govern.

The MSE wall design shall follow the general dimensions of the wall envelope shown on the plans. Base of footing elevation shall be as shown on the plans, or may be lower. All wall elements shall be within the right-of-way limits shown on the plans. The panels shall be placed so as not to interfere with drainage or other utilities, or other potential obstructions.

All appurtenances behind in front of, under, mounted upon, or passing through the wall such as drainage structures, utilities, fences, concrete parapet wall or other appurtenances shown on the plans shall be accounted for in the stability design of the wall.

Facing panels shall have tongue and groove, ship lap or similar approved connections along all joints, both vertical and horizontal. The shape of the panels shall be such that adjacent panels will have continuous, vertical joints, or as noted on the plans.

MSE facing panels shall be installed on cast-in-place concrete leveling pads. The top of the leveling pad shall be located at or below the theoretical leveling pad elevation. The minimum wall embedment shall be 1.22 meters [4.0 ft] as measured to the top of the leveling pad, or as shown on the plans, whichever is greater. The top of the face panels shall be at or above the top of the panel elevation shown on the plans. Where coping or barrier are used, the wall face shall extend up into the coping or barrier a minimum of 50 mm [2 in].

The MSE walls shall be dimensioned so that the allowable bearing pressures, noted on the plans, are not exceeded. Requirements for over excavation of native foundation soils and replacement with compacted structural fill are detailed on the plans.

The design by the wall system supplier shall consider the stability of the wall as outlined below and in the Contract Documents:

(a) Failure Plane The theoretical failure plane within the reinforced soil mass shall be determined per the Special Provisions and be analyzed so that the soil stabilizing components extend sufficiently beyond the failure plane within the reinforced soil mass, as determined by the specified design code, to stabilize the material. External loads which affect the internal stability such as those applied through piling, bridge footings, traffic, slope surcharge, hydrostatic, and seismic loads shall be accounted for in the design.

(b) MSE walls shall be designed to resist failure by overturning, sliding, instability of temporary construction slope, bearing capacity, reinforcement pullout, panel connection pullout or rupture. The design methodology shall be as noted in the Special Provisions.

Calculations for stresses and factors of safety shall be based upon assumed conditions at the end of the design life.

The actual applied bearing pressures under the MSE Mass for each reinforced length shall be clearly indicated on the design drawing.

Passive pressure in front of the wall mass shall be assumed to be zero for design purposes. Calculations for stresses and factors of safety shall be based on assumed conditions at the end of the design life.

(c) Backfill and Foundation Soils Parameters The friction angle of the select backfill used in the reinforced fill zone for the internal stability design of the wall shall be assumed to be 34° unless noted otherwise. The friction angle of the foundation soils and random backfill shall be assumed to be 30° unless otherwise shown on the plans.

(d) Reinforcement length The soil reinforcement shall be the same length from the bottom to the top of each wall section. The reinforcement length defining the width of the entire reinforced soil mass may vary with wall height. The minimum length of the soil reinforcement shall be 2.44 meters [8 ft], but shall not be less than 0.7 H for walls with level surcharges or 0.7 H1 for walls with a sloped surcharge or walls supporting an abutment. The mechanical height, H or H1, shall be the vertical difference between the leveling footing and the elevation at which the failure surface, as described above, intercepts the ground surface supported by the wall.

(e) Steel Reinforcement For steel reinforcements, all structural connections, tie strips and loop inserts, the following galvanization and carbon steel loss rates shall be assumed:

	microns/year/side
Zinc galvanizing (first 2 years)	15
Zinc galvanizing (subsequent years to depletion):	4
Carbon Steel (after galvanizing depletion):	12
Carbon Steel (75 to 100 years)	12

When the expected differential settlement normal to the wall exceeds 75 mm [3 in], the lower level reinforcement facing connections shall be designed to accommodate the increased tensile forces due to settlement.

(f) Facing Panel Requirements

1. The wall facing shall be designed to accommodate differential settlements of 305 mm [1.0 in] in 30.5 meters [100 ft].

2. The minimum spacing between adjacent panels shall be 19 mm [ $\frac{3}{4}$  in] in order to accommodate differential settlements without impairing the appearance of the facing or compromising the structural integrity of the individual panels. Joints between panels shall be no more than 19 mm [ $\frac{3}{4}$  in]. Joint between panels shall have a ship lap configuration or tongue and groove connection. There shall be no openings through the wall facing, except for utilities to pass through the wall. Slip joints to accommodate differential settlement shall be included where shown on the plans.

3. Where wall or wall sections intersect with an angle of 130° or less, a special vertical corner element panel shall be used. The corner element panel shall cover the joint of the panels that abut the corner and allow for independent movement of the abutting panels. Corner elements shall not be formed by connecting standard facing panels that abut the acute corner.

636.04 Materials The Contractor shall be responsible for the purchase or manufacture of the precast concrete facing panels, reinforcing mesh or strips, panel/reinforcement connections, bearing pads, joint filler, and all other necessary components. The Contractor shall furnish to the Geotechnical Engineer the appropriate Certificates of Compliance certifying that the applicable wall materials meet the requirements of the project specifications. All materials used in the construction of the MSE retaining walls shall meet the requirements specified in the following subsections of the Maine Standard Specifications and as specified herein.

Materials not conforming to this section of the specifications, or from sources not listed in the contract documents, shall not be used without written consent from the Geotechnical Engineer.

636.041 Reinforced Concrete Facing Panels Reinforced concrete facing panels shall meet the requirements specified in the following subsections:

Structural Precast Concrete Units	712.061
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636.0411 Precast Panel Tolerances and Surface Finish Concrete surface for the front face shall be as noted on the plans. The rear face shall have an unformed surface finish. The rear face of the panel shall be roughly screeded to eliminate open pockets of aggregate and surface distortions in excess of 6 mm [ $\frac{1}{4}$  in]. All uncoated steel projecting from the panel unit shall be galvanized in accordance with AASHTO M111 (ASTM A123) with a minimum coating thickness of  $610\text{g/m}^2$  [ $2\text{oz/ft}^2$ ]

Precast panel tolerances shall comply with the following; units that do not meet the listed tolerances will be rejected.

1. Panel dimensions (edge to edge of concrete) within  $\pm 5$  mm [ $\frac{3}{16}$  in].
2. Panel thickness:  $\pm 6$  mm [ $\frac{1}{4}$  in].
3. Squareness. The length difference between the two diagonals shall not exceed 12 mm [ $\frac{1}{2}$  in].
4. Distance between the centerline of dowel and dowel sleeve, and to centerline of reinforcing steel shall be  $\pm 3$  mm [ $\frac{1}{8}$  in].
5. Face of panel to centerline of dowel and dowel sleeve, and to centerline of reinforcing steel shall be  $\pm 3$  mm [ $\frac{1}{8}$  in].
6. Position of panel connection devices Tie Strip shall be  $\pm 25$  mm [1 in].
7. Location of Coil and loop Imbeds shall be  $\pm 3$  mm [ $\frac{1}{8}$  in].
8. Warping of the exposed panel face shall not exceed 6 mm [ $\frac{1}{4}$  in] in 1.52 meters [5 ft].
9. Surface defects on smooth-formed surfaces measured over a length of 1.52 meters [5 ft] shall not exceed 3 mm [ $\frac{1}{8}$  in]. Surface defects on textured-finished surfaces measured over a length of 1.52 meters [5 ft] shall not exceed 5 mm [ $\frac{5}{16}$  in].

636.042 Reinforcing All reinforcing, tie strips, and attachment devices shall be carefully inspected to insure they are true to size and free from defects that may impair their strength and durability.

A. Reinforcing Mesh shall be shop fabricated from cold drawn steel wire conforming to the requirements of AASHTO M 32M/M 32 (ASTM A 82) yield strength minimum of 450 MPa [65 ksi] and shall be welded into the finished mesh fabric in accordance with AASHTO M 55M/M 55 (ASTM A 185). Galvanizing shall be in accordance with AASHTO M 111 (ASTM A 123) after fabrication. The minimum coating thickness shall be  $610\text{g/m}^2$  [ $2\text{ oz/ft}^2$ ]. Any damage done to the mesh galvanization prior to the installation shall be repaired in an acceptable manner and provide a minimum galvanized coating of  $610\text{g/m}^2$  [ $2\text{ oz/ft}^2$ ].

B. Reinforcing Strips shall be fabricated from hot rolled bars to the required shape and dimensions. Their physical and mechanical properties shall conform to ASTM A572/A 572M Grade 450 (65), or approved equal. Reinforcing strips shall be hot dipped galvanized in accordance with AASHTO M111 (ASTM A 123) after fabrication. The minimum galvanization coating thickness shall be  $610\text{g/m}^2$  [ $2\text{ oz/ft}^2$ ]. Any damage done to the mesh galvanization prior to the installation shall be repaired  $610\text{g/m}^2$  [ $2\text{ oz/ft}^2$ ].

C. Tie strips shall be fabricated of hot rolled steel conforming to ASTM A 570/A 570M Grade 345(50) or equivalent. Tie strips shall be hot dipped galvanized in accordance with

AASHTO M111 (ASTM A 123) after fabrication. The minimum coating thickness shall be  $610\text{g/m}^2$  [2 oz/ ft<sup>2</sup>].

D. The tie strips and reinforcing strips shall be cut to lengths and tolerances shown on the submitted plans. Holes for bolts shall be punched in the locations shown.

#### 636.043 Attachment Devices

A. Loop Embeds shall be fabricated of cold drawn steel wire conforming to ASTM A510M, UNS G 10350 or AASHTO M 32M/M32 (ASTM A82). Loop imbeds shall be welded in accordance with AASHTO M 55M/M55 (ASTM A185). Both shall have electrodeposited coatings of zinc applied in accordance with ASTM B633.

B. Fasteners shall consist of hexagonal cap screw bolts and nuts, which are galvanized and conform to the requirements of AASHTO M164M (ASTM A325M) or equivalent.

C. Connector Pins and mat bars shall be fabricated from AASHTO M 183M/ M 183 (ASTM A 36/A 36M) steel and welded to the soil reinforcement mats as shown on the plans. Galvanization shall conform to AASHTO M111 (ASTM A123) with a minimum coating thickness of  $610\text{g/m}^2$  [2 oz/ ft<sup>2</sup>]. Connector bars shall be fabricated of cold drawn steel wire conforming to the requirements of ASTM A 82 (AASHTO M32) and galvanized in accordance with ASTM A 123.

D. Structural plate connectors and fasteners used for yokes to connect reinforcements to wall panels around pile or utility conflicts shall conform to the material requirements for reinforcing strips and fasteners in 636.042 (c).

636.044 Joint Materials Joint material shall be installed to the dimensions and thickness in accordance with the plans or approved shop drawings.

A. Provide flexible foam strips for filler for vertical joints between panels, and in horizontal joints where pads are used.

B. Provide either preformed EPDM rubber pads conforming to ASTM D2000 for 4AA, 812 rubbers or neoprene elastomeric pads having a Durometer Hardness of  $55 \pm 5$ .

636.045 Nonwoven Drainage Geotextile The Cover all joints between panels on the back side of the wall with a geotextile fabric. Slit film and multifilament woven and resin bonded woven geotextile fabrics are not allowed for this application. The minimum width of the fabric shall be 300 mm [12 in]. Lap fabric at least 100 mm [4 in] where splices are required. Nonwoven Drainage Geotextile shall be bonded with an approved adhesive compound to the back face covering all joints between panels. Adhesives used to hold the geotextile filter fabric material to the rear of the facing panels prior to backfill placement shall be supplied by the wall supplier and approved by the Geotechnical Engineer.

636.046 Concrete Leveling Pad The cast-in-place leveling pad shall be constructed of Class B concrete conforming to the requirements of Section 502 - Structural Concrete. Leveling pad shall have minimum dimensions of 150 mm [6 in] thickness and 300 mm [12 in] width and be placed at the design elevation shown on the shop drawings within a 3 mm [ $\frac{1}{8}$  in] tolerance.

636.049 Backfill Materials All backfill materials used in the MSE Walls volume shall conform to Gravel Borrow conforming to the requirements of Section 703.20, with the maximum aggregate size limited to 100 mm [4 in] and the following additional requirements:

A. Soundness The material shall be substantially free of shale or other soft, poor durability particles. The materials shall have a magnesium sulfate soundness loss, as determined by AASHTO T104 (ASTM C88), of less than 30% after four cycles.

B. Electrochemical Requirements The backfill materials shall meet the following criteria:

<u>Requirements</u>		<u>Test Methods</u>
Resistivity	>3,000 ohm centimeters	AASHTO T288
pH between	5 and 10, inclusive	AASHTO T289
Chlorides	<100 parts per million	AASHTO T291
Sulfates	<200 parts per million	AASHTO T290
Organic Content	<1%	AASHTO T267-86

C. The plasticity index (P.I.) as determined by AASHTO T90 shall not exceed 6.

D. The select backfill material shall exhibit an angle of internal friction of not less than 34°, as determined by the standard Direct Shear Test, AASHTO T236 (ASTM D3080-72), on the portion finer than the 2 mm [#10] sieve, compacted to 95 percent of AASHTO T99, Methods C or D (with oversized correction as outlined in Note 7) at optimum moisture content. No testing is required for backfills where 80 percent of sizes are greater than 19 mm [ $\frac{3}{4}$  in]. Before construction begins, the borrow selected shall be subject to show conformance with this frictional requirement. Compliance with the test requirements shall be the responsibility of the Contractor, who shall furnish a copy of the backfill test results prior to construction.

636.050 Crushed Stone for Abutment Foundation Crushed stone for use in the foundation layer below the abutment shall be crushed stone conforming to the requirements of Section 703.31.

636.051 Impervious Membrane An impervious geomembrane shall be installed near the top of the reinforced backfill to reduce the chance of water infiltrating into the reinforced backfill. The geomembrane shall be bonded to the inside face of the wall panels and extend perpendicularly from the wall face into the fill, while being parallel to the top of the wall. The membrane should be sloped to drain away from the facing and outlet beyond the reinforcing zone. The impervious geomembrane shall extend into the fill a distance of 0.3 m [1 ft] beyond the MSE reinforcement. The geomembrane shall have a minimum thickness of 0.8 mm [ $\frac{1}{32}$  in].

The geomembrane shall have both sides textured with a rough finish to improve resistance against sliding. The texture shall be approved by the Geotechnical Engineer before installation. The geomembrane shall be shown on the design drawings of the MSE submittal of the Contractor.

636.052 Acceptance of Material The Contractor shall furnish to the Geotechnical Engineer a Certificate of Compliance certifying that the above materials comply with the applicable contract specifications including the backfill material, in accordance with Section 700. A copy of all test results performed by the Contractor necessary to assure contract compliance shall also be furnished to the Geotechnical Engineer. Acceptance will be based on the Certificate of Compliance, accompanying test reports, and visual inspection by the Geotechnical Engineer.

#### 636.07 Submittals

A. Design computations demonstrating compliance with the criteria specified herein and shown on the plans, shall be prepared, signed and stamped by a registered professional engineer license in the State of Maine and specializing in geotechnical engineering.

The design calculations shall include:

1. Statement of all assumptions made and copies of all references used in the calculations.
2. Analyses demonstrating compliance with all applicable earth, water, surcharges, seismic, or other loads, as specified herein and required by AASHTO.
3. Analyses or studies demonstrating durability and corrosion resistance of retaining wall systems for the proposed location and environment. The designers shall provide all corrosion protection devices necessary for the retaining wall to have a minimum service life of 100 years in the proposed location and environment.

B. A detailed resume of the wall designer listing similar projects with references, and demonstrating necessary experience to perform the MSE retaining wall design, including a brief description of each project that is similar in scope.

C. A detailed listing of MSE walls that the Contractor has constructed including a brief description of each project and a listing of personnel who will construct the walls demonstrating their experience in construction of MSE retaining walls. A reference shall be included for each project listed. As a minimum, the reference shall include an individual's name, address and current phone number.

D. Manufacturer's product data for the MSE wall system, including material, manufacture and erection specifications, all specified erection equipment necessary, details of buried MSE wall elements, special details required of reinforcing layout around drainage structures and sign foundations, structures design properties, type of backfill and details for connections between facing panels.

E. Details of precast yard and concrete mix design.

F. Shop drawing showing the configuration and all details, dimensions, quantities and cross sections necessary to construct the MSE wall, including but not limited to the following:

1. A plan view of the wall, which shall include Contract limits, stations and offsets, and the face of wall line shown on the plans.

2. An elevation view of the wall which shall include the elevation at the top of the wall at all horizontal and vertical break points and at least every 15 meters [50 ft] along the face of the wall, all steps in the leveling pads, the designation as to the type of retaining wall system(s), and an indication of the final ground line and maximum calculated bearing pressures. The face of wall shown on the plans shall be indicated.

3. A typical cross section or cross sections showing the elevation relationship between existing ground conditions and proposed grades, and the proposed wall configuration, including details for the proposed methods for connecting to existing conditions. The sections shall also indicate the location of the face of wall shown on the plans.

4. General notes pertaining to design criteria and wall construction.

5. A listing of the summary of material quantities for each wall.

6. Details of sleeves and pipes and other embedded items to be installed through the walls.

7. Clearly indicated details for construction of walls or reinforcing elements around drainage, foundations, utilities or any other potential obstructions.

8. Details of the architectural treatment of facing panels.

9. Drainage design detail and design scheme.

10. Location of utilities.

11. Sequence and schedule of construction, including overall construction schedule.

12. Methods of excavation and backfill.

13. Method of maintaining stability of excavated trenches.

14. Method of monitoring plumbness and deviation of wall.

15. Excavation support system, if any.

16. Any acceptance testing and frequency.

17. Details and location of all necessary construction and expansion joints along the wall.

18. Connection details at the interface of the wall and any adjacent proposed cast in place retaining wall or abutment structure.

19. Details of impermeable membrane connection to abutment in roadway runoff collection system.

#### 636.08 Delivery, Storage and Handling

A. Contractor shall check the material upon delivery to assure that the proper material has been received. A product certification should be provided with each shipment.

B. Material shall be stored above -29° C [-20° F]

C. Contractor shall prevent excessive mud, wet cement, epoxy and like substances that may affix themselves to the material from coming in contact with the material.

D. Material may be laid flat and stored outside for 30 days. For extended storage, material shall be stored in or beneath a trailer or covered with a colored tarpaulin to prevent long-term exposure.

636.09 Wall Excavation The excavation and use as fill disposal of all excavated material shall meet the requirements of Section 203 - Excavation and Embankment, except as modified herein.

636.10 Foundation Preparation The foundation for the structure shall be graded level for a width equal to the length of reinforcement elements plus 1.52 meters [5 ft] or as shown on the plans. Prior to wall construction the foundation shall be compacted with at least 10 passes of a smooth wheel vibratory roller weighing at least 4536 kg [5 ton]. Any foundation soils found to be unsuitable or incapable of sustaining the required compaction shall be removed and replaced with special borrow material. The foundation for the structure shall be approved by the Geotechnical Engineer before erection is started.

A concrete leveling pad shall be constructed as indicated on the submitted plans. The leveling pad shall be cast to the design elevations as shown on the plans. Allowable elevation tolerances are +3mm [0.01 ft] and -6 mm [-0.02 ft] from the design elevations. Placement of wall panels may begin after 24 hours curing time of the concrete leveling pad.

636.11 Wall Erection A field representative from the proprietary wall system being used shall be available, as needed, during the erection of the wall. The services of the representative shall be at no additional cost to the project.

Precast concrete panels shall be placed so that their final position is vertical or battered as shown on the plans. The vendor representative shall specify the required back-batter so that the final position of the wall is vertical. Earth berms at the footing shall be placed to maintain the desired position of panels. For erection, panels are handled by means of lifting devices connected to the upper edge of the panel. Panels should be placed in successive horizontal lifts in the sequence shown on the approved shop drawings as backfill placement proceeds. As backfill material is placed behind the panels, the panels shall be maintained in position by means of temporary wedges or bracing according to the wall supplier's recommendations.

Concrete facing vertical tolerances and horizontal alignment tolerances shall not exceed 6 mm per meter [ $\frac{1}{4}$  in/yd]. During construction, the maximum allowable offset in any panel joint shall be 19 mm [ $\frac{3}{4}$  in]. The overall vertical tolerance of the wall (for top to bottom) shall not exceed 4 mm per meter of wall height.

636.12 Backfill Placement Backfill shall not be placed between November 1st and April 1st. Backfill placement shall closely follow erection of each course of panels. Backfill shall be placed and compacted in such a manner as to avoid any damage or disturbance of the wall materials or misalignment of the facing panels or reinforcing element. Any wall materials,

which become damaged during backfill placement, shall be removed and replaced at the Contractor's expense. The Contractor, at their expense, shall correct any misalignment or distortion of the wall facing panels due to placement of backfill outside the limits of this specification. Prior to the placement of the soil reinforcement, the backfill elevation after compaction shall be at the required elevation of the reinforcements. At each reinforcement level, the backfill shall be placed to the level of the connection. Backfill placement methods near the panels shall assure that no voids exist directly beneath the reinforcing element.

Gravel borrow backfill shall be compacted in accordance with Subsection 203.12 except that the minimum required compaction shall be 95 percent of maximum density as determined by AASHTO T99, Method C or D (with oversize correction, as outlined in Note 7. If 30 percent or more of the backfill material is greater than 19 mm [ $\frac{3}{4}$  in] in size, the acceptance criterion for control of compaction shall be either a minimum of 70 percent of the relative density of the material as determined by ASTM D4253 and D4254, or a method of compaction consisting of at least 4 passes by a heavy roller. Where spread pads support bridge or other structural loads, the top 1.5 m [5.0 ft] below the pad elevation shall be compacted to 100 percent of the maximum density as determined by AASHTO T99, Method C or D (with oversize correction, as outlined in Note 7).

The moisture content (determined in accordance with AASHTO T99, Method C or D) of the backfill material prior to and during compaction shall be uniformly distributed throughout each layer. Backfill materials shall have a placement moisture content less than or equal to the optimum moisture content. Backfill material with a placement moisture content in excess of the optimum moisture content shall be removed and reworked until the moisture content is uniformly acceptable throughout the entire lift.

At each reinforcing level, backfill shall be leveled before placing and bolting the reinforcing. The maximum lift thickness after compaction shall not exceed 300 mm [12 in]. The Contractor shall decrease this lift thickness, if necessary, to obtain the specified density.

Heavy compaction equipment shall not be used to compact backfill within 900 mm [3 ft] of the wall face. Compaction within 900 mm [3.0 ft] of the back face of the wall shall be achieved by at least 3 passes of lightweight mechanical tamper, lightweight roller, or vibratory system. The specified lift thickness shall be adjusted as warranted by the type of compaction equipment actually used. No vehicular equipment shall be operated within 1.0 meter [3.28 ft] of the panels.

The frequency of sampling of the backfill material necessary to assure gradation control throughout construction shall be as directed by the Geotechnical Engineer.

At the end of each day's operation, the Contractor shall slope the least level of the backfill away from the wall facing to rapidly direct runoff away from the wall face. In addition, the Contractor shall not allow surface runoff from adjacent areas to enter the wall construction site.

636.13 Reinforcement Placement Prior to placing the first layer of reinforcements (strips, mats or grids), backfill shall be placed and compacted in accordance with 636.12 - Backfill Placement.

Bending of reinforcements in the horizontal plane that results in a permanent deformation in their alignment shall not be allowed. Gradual bending in the vertical direction that does not result in permanent deformations is allowable.

Cutting of longitudinal or transverse reinforcement bars to avoid conflicts with utility obstructions or piles will not be allowed. A structural connection (yokes) from the wall panel to the reinforcement shall be used whenever it is necessary to avoid cutting or excessive skewing of reinforcement due to pile or utility conflicts.

Soil reinforcements shall be placed normal to the face of the wall, unless otherwise shown on the plans or directed by the Engineer. If skewing of the soil reinforcements is required due to obstructions in the reinforced fill, rotatable bolted connections shall be used and the maximum skew angle shall not exceed 15° from the normal position except in the case of acute corner where redundant reinforcements are used. The tensile capacity of splayed reinforcement shall be reduced by the cosine of the splay angle.

636.14 Method of Measurement Mechanically Stabilized Earth Retaining Wall will be measured by the square meter [square foot] of face area computed using the plan dimensions. No adjustment in the pay quantity will be made if the computed quantity, based on the working drawings, varies from the plan quantity.

Vertical dimension limits will be from the top of leveling pad to the top of the wall facing units, as shown on the plans. The horizontal dimension limits will be from the edges of the facing units at each end of a wall, as shown on the plans. No field measurements will be made unless the Resident specifies, in writing, a change to the limits indicated on the plans.

The wall surface area, as shown on the plans, includes the surface area of nominal panel joint openings and wall penetrations such as pipes and other utilities.

636.15 Basis of Payment The accepted quantity of Mechanically Stabilized Earth Retaining Wall will be paid for at the contract unit price per square meter [square foot]. Payment shall be full compensation for design, fabrication and erection of MSE retaining walls, furnishing all labor, equipment and materials including concrete face panels, fasteners, reinforcing mesh, reinforcing strips, tie strips, hardware, joint fillers, coping, woven drainage geotextile, impervious membrane, select backfill and technical field representative. Cost of cast-in-place concrete for leveling pad will not be paid for separately, but will be considered incidental to the Mechanically Stabilized Earth Retaining Wall.

Excavation, including extra excavation due to unsuitable foundation material, will be measured and paid for under Item 203.20 - Common Excavation. Foundation material and select backfill material will be considered incidental to the Mechanically Stabilized Earth Retaining Walls.

The unit price for Mechanically Stabilized Earth Wall shall include costs for:

1. All design work, preparation of written submittals and plans, revision of submittals, sample submittals and any other necessary preliminary work prior to and after acceptance of the retaining wall by the Geotechnical Engineer.

2. All materials, including transportation, for the MSE walls, including facing panels, MSE reinforcing elements, attachment devices, fasteners, bearing blocks and shims, joint materials, copings, vertical corner elements, concrete masonry, reinforcing steel, crushed stone, select backfill and incidentals.

3. All labor and equipment required to excavate and prepare the wall foundation, form and cast the leveling pad, erect the MSE wall to the lines and grades shown on the plans, place and compact backfill, place and compact the drainage layer, and construct any other items necessary to complete the MSE wall.

4. All temporary sheeting, temporary excavation, and temporary dewatering necessary to perform the other work in this section.

There will be no allowance for excavating and backfilling for the Mechanically Stabilized Earth Retaining Wall beyond the limits shown on the approved submitted plans, except for excavation required to remove unsuitable subsoil in preparation for the foundation.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
636.40 Mechanically Stabilized Earth Retaining Wall	Square meter [square foot]

### SECTION 637 - DUST CONTROL

637.01 Description This work shall consist of controlling dust that results from traffic on the project and the Contractor's operations by applying water and/or calcium chloride as directed by the Resident. In addition to this Special Provision, the requirements of Special Provision 656 and the pertinent Sections of the Standard Specifications will apply.

637.02 Materials The water shall not be salt or brackish and shall be free from oil, acid and injurious alkali or vegetable matter.

The calcium chloride shall conform to Subsection 712.02 except that the requirements for total alkali chloride and impurities shall not apply.

637.03 Sprinkling Water shall be applied by approved methods and with equipment including a tank with a pressure pump and a nozzle-equipped spray bar.

637.04 Calcium Chloride Calcium chloride shall be used when authorized for controlling dust on the roadway under construction and on approved haul roads from the pits to the project

or in the area of dwellings and where dust constitutes a hazard to traffic. Calcium chloride shall be applied by mechanical spreaders or by hand at the rate designated.

637.05 Method of Measurement Water for sprinkling will be measured by the cubic meter [1,000 gal (MG)] in calibrated tanks or distributors or by accurate water meters.

Calcium chloride will be measured for payment by the number of megagrams [tons] satisfactorily applied.

Delivery slips as specified in Section 108.1.3-f will be required except that weight for calcium chloride shall be determined from the weight stated on each bag and the number of bags used.

Water and calcium chloride acceptably applied for the item Dust Control will be measured for payment as one lump sum.

637.06 Basis of Payment Water for sprinkling will be paid for at the contract unit price per cubic meter [MG].

Calcium chloride will be paid for at the contract unit price per megagram [ton].

Water and calcium chloride for the item Dust Control will be paid for at the contract lump sum price. Payment will be full compensation for furnishing and applying water and calcium chloride as required. When no item for Dust Control item or individual items are included in the schedule of items, payment for the work will be considered incidental to the contract.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
637.07 Sprinkling	cubic meter [1000 gallon]
637.08 Calcium Chloride	megagram [Ton]
637.071 Dust Control	Lump Sum

## SECTION 638 - BRIDGE LIGHTING

Reserved

## SECTION 639 - ENGINEERING FACILITIES

639.01 Description This work shall consist of providing, erecting, lighting, equipping and maintaining buildings to be used by the Engineer as field offices or testing laboratories. Upon completion of the work, the buildings and equipment shall remain the property of the Contractor.

639.02 Materials Materials for buildings shall be of good quality customarily used in standard frame house or office trailer construction.

639.03 General The building of the type called for shall be provided before the start of work, and shall remain until work is completed and accepted, unless earlier removal is authorized. The location shall be approved by the Resident.

A fire extinguisher shall be provided in each building or office trailer for electrical and chemical fires and effective on all solvents used in the building.

Walls, roof, floor, windows, and doors shall be tightly constructed to the required area.

Furnishings shall be supplied as called for. Doors shall be equipped with locks and all keys shall be in the possession of the Engineer. Windows shall be equipped with latches so they may be locked on the inside. Window screens and screen doors shall be supplied when necessary.

639.04 Field Offices Field Offices are designated Type A or Type B. Buildings, including trailers, may be provided if they substantially equal or exceed the following requirements. Air conditioning shall be provided in all field offices.

The walls, roof, and floor of the building shall be completely insulated with a minimum insulation value of R-15. Office trailers shall be either new or in very good used condition. The interior walls shall be covered with suitable wall paneling. The entire office trailer shall be for the exclusive use of the Engineer. The office trailer shall be winterized and completely enclosed at the bottom, if the trailer will be used in cold weather.

Testing facilities furnished under this section shall include all facilities for testing as described and shall be available for the exclusive use by the Resident for the duration of the project.

Other types of buildings and facilities may be furnished of equal or better quality.

A public work area will be provided in the field office that shall be designed and constructed so that individuals with disabilities can approach, enter, and exit this area.

At least one accessible route to the field office shall be provided from accessible parking. The accessible route shall comply with the Americans with Disabilities Act Accessibility Guidelines (ADAAG) and this specification.

The minimum clear width of an accessible route shall be 915 mm [36 in] except at doors. The least possible slope shall be used for an accessible route. An accessible route with a running slope greater than 1:20 shall be considered a ramp. Maximum ramp slope is 1:12. The maximum rise for any run of a ramp shall be 760 mm [30 in] and the minimum clear width shall be 915 mm [36 in]. Nowhere shall the cross slope of an accessible route exceed 1:50. Changes in level up to 6 mm [ $\frac{1}{4}$  in] may be vertical and without edge treatment. Changes in level

between 6 mm [ $\frac{1}{4}$  in] and 13 mm [ $\frac{1}{2}$  in] shall be beveled with a slope no greater than 1:2. Ramp floor surfaces shall be stable, firm, and slip-resistant.

Ground floor surfaces along accessible routes and in accessible rooms and spaces including floors, walks, ramps, stairs, and curb ramps, shall be stable, firm, and slip-resistant.

The main door to the public work area shall have a minimum clear opening of 810 mm [32 in] with the door opened 90 degrees, measured between the face of door and the opposite stop. Minimum maneuvering clearances at doors shall be provided. The floor or ground area within the required clearances shall be level and clear.

The handle and other operating devices on accessible doors shall have a shape that is easy to grasp with one hand and does not require tight grasping. Lever-operated mechanisms, push type mechanisms, and U-shaped handles are acceptable designs. Hardware required for accessible door passage shall be mounted no higher than 1220 mm [48 in] above finished floor.

When parking space is designated, then all related requirements will conform to the following: One accessible parking space shall be located on the shortest accessible route of travel from adjacent parking to an accessible entrance.

Level landings shall be provided at bottom and top of each run. The landing shall be at least as wide as the ramp run leading to it with a minimum length of 1525 mm [60 in].

If a ramp run has a rise greater than 150 mm [6 in] or a horizontal projection greater than 1830 [72 in], then it shall have handrails on both sides. Handrails shall have the following features:

- 1) Handrails shall be provided along both sides of ramp segments. The inside handrail on switchback ramps shall always be continuous.
- 2) If handrails are not continuous, they shall extend at least 300 mm [12 in] beyond the top and bottom of the ramp segment and shall be parallel with the floor or ground surface.
- 3) The clear space between the handrail and the wall shall be 40 mm [ $1\frac{1}{2}$  in].
- 4) Gripping surfaces shall be continuous.
- 5) Top of handrail gripping surfaces shall be mounted between 860 [34 in] and 965 mm [38 in] above ramp surfaces.
- 6) Ends of handrails shall be either rounded or returned smoothly to floor, wall, or post.
- 7) Handrails shall not rotate within their fittings.
- 8) The diameter or width of the gripping surfaces of a handrail shall be 32 mm to 40 mm [ $1\frac{1}{4}$  in to  $1\frac{1}{2}$  in], or the shape shall provide an equivalent gripping surface.

Firm and sturdy steps shall also be provided with 180 mm [7 in] maximum riser and 280 mm [11 in] minimum depth, and at least one handrail extending from the top of the steps to a minimum 305 mm [12 in] beyond the bottom of the steps.

The Contractor will make reasonable effort(s) to provide wheelchair accessible toilet facilities when "portable" facilities are provided.

The Contractor shall provide wheelchair accessible toilet facilities when flush type facilities, that is, those with running water, are provided; and the Contractor shall provide wheelchair accessible portable facilities, if used, when the contract duration exceeds two continuous construction seasons.

In addition to the facilities previously specified in this subsection, each field office shall meet the following minimum requirements:

<u>Description</u>	<u>Quantity</u>	
	Type A	Type B
Floor Area - m <sup>2</sup> (ft <sup>2</sup> )	29 (312)	15 (160)
Inside Wall Height - m (ft)	2.134 (7)	2.134 (7)
Window Area - m <sup>2</sup> (ft <sup>2</sup> )	5.1 (55)	3.3 (35)
Drafting Table Surface Area - m <sup>2</sup> (ft <sup>2</sup> )	1.4 (15)	1.4 (15)
Drafting Stools - each	2	1
Office Desks - each	2	1
Ergonomic Swivel Chairs - each	3	2
Folding Chairs - each	3	2
Lighting Units - each	4	2
Electric Wall Outlets - each	6	3
Wall Closets - each	1	1
Plan Rack for minimum of 6 sets of plans	1	1
Toilet Facility	1	1
Wastebaskets - each	2	1

All windows shall be provided with shades or blinds.

The toilet facility shall be for the exclusive use of State personnel.

The Resident will have the option to reject any furniture or supplies provided to the field office based on general condition.

One hundred ten volt, 60 cycle, continuous electric service shall be supplied for lighting and 15 amp duplex wall outlets. Lighting shall consist of florescent light units with rapid start bulbs located over the work areas for a minimum of 538 lx [50 foot candles] overall.

Drafting surfaces shall be 1000 mm [40 in] above the floor and have shelves beneath. Shelves for plans and rolls shall also be furnished overhead. Drafting stools shall be approximately 700 mm [28 in] high.

Desks shall be single or double pedestal standard office type, and shall be in addition to “built-in” type desks in the office trailer.

Field offices shall be furnished with one four-drawer letter size metal filing cabinet.

Wall closets shall be 525 mm [21 in] wide, 375 mm [15 in] deep, and at least 1200 mm [4 ft] high.

Each office shall be furnished with a broom, dustpan, sweeping compound, trash bags, and with cleaning material for cleaning glass. If the field office is carpeted, then a vacuum cleaner will be provided. The contractor will be responsible for disposing of trash from the field office.

The Contractor shall provide a fully functional desktop copier, capable of copying field books, for the Resident’s use during the project. All maintenance and supplies, except paper, shall be the responsibility of the Contractor.

The Contractor shall provide a water cooler, with hot and cold dispenser, and shall be responsible for supplying bottled water compatible with the water cooler to maintain a constant potable water supply for the duration of the project. All maintenance and supplies shall be the responsibility of the Contractor.

The Contractor shall provide a 4 cubic-foot refrigerator in the field office for the duration of the project.

Each office shall be furnished with a 10-person general-purpose first aid kit. The first aid kit shall be periodically inspected and refilled as necessary.

639.05 Testing Facilities-Soils The building and facilities shall:

a) Be the minimum size and quality as a Field Office, Type B, and placed in an approved location near the project.

b) Have adequate heat and ventilation. The method of heating shall be such that a minimum temperature of 18°C [65°F] can be maintained at all times. Air conditioning shall be provided.

c) Be equipped with a gravity or pressure water system with at least 380 L [100 gal] capacity. The tank shall be piped to a gooseneck faucet at an approved sink within the laboratory. The sink shall have approved outside drainage.

d) Have a bench, 1500 mm long by 600 mm wide, 900 mm [5 ft long by 2 ft wide, 3 ft] above the floor, suitable for supporting a sieve shaker and electric hot plate.

e) Have a chair, and desk or writing table, 1200 x 750 mm [4 ft by 2.5 ft], 750 mm [30 in] above the floor with 2-drawer (minimum) filing cabinet.

f) Have three electric wall outlets; one 15 amp. outlet to be located in the desk area, and two 20 amp. outlets to be located 150 mm (6 in) above the workbench described in d) above.

g) Have 1 stool, 700 mm [28 in] high.

h) Be equipped with the following test equipment and supplies. All equipment and supplies shall be in conformance with revisions of AASHTO T11, AASHTO T27, and AASHTO T191. The Maine Department of Transportation Independent Assurance Sampling and Testing program will be conducted to monitor the precision and accuracy of acceptance tests. All testing equipment shall be of commercial quality and acceptable to the Resident and all equipment determined to be substandard by this testing program shall be replaced. The Contractor shall install and maintain the equipment in good condition at all times.

1. Coarse series shaker: Mechanical shaker having trays with a minimum of 0.129 m<sup>2</sup> [200 in<sup>2</sup>] of surface area or; a manually operated shaker box manufactured to close conformity of the plans available at the MDOT Testing Office. Woven wire sieves conforming to the requirements of AASHTO M92. Sieve sizes 75 mm [3 in], 25 mm [1 in], 19 mm [<sup>3</sup>/<sub>4</sub> in], 12.5 mm [<sup>1</sup>/<sub>2</sub> in] shall be provided for each type of shaker used.

2. Motorized Sieve Shaker with timer, either a combination rocking and tapping action, or rheostat controlled vibrating type. The shaker shall be capable of holding a nest of six 200 mm [8 in] full height sieves and pan.

3. Set of U.S. Standard Brass or Stainless Steel 200 mm [8 in] diameter woven wire sieves conforming to the requirements of AASHTO M92 and the sieves required shall include the following sizes: 25 mm [1 in]; two 19 mm [<sup>3</sup>/<sub>4</sub> in]; 12.5 mm [<sup>1</sup>/<sub>2</sub> in]; 9.5 mm [<sup>3</sup>/<sub>8</sub> in]; 6.3 mm [<sup>1</sup>/<sub>4</sub> in]; 4.75 mm [No. 4]; 2.36 mm [No. 8]; 2.0 mm [No. 10]; two 1.18 mm [No. 16]; 850 μm [No. 20]; 600 μm [No. 30]; 425 μm [No. 40]; 300 μm [No. 50]; 150 μm [No. 100]; two 75 μm [No. 200]; pan and cover

4. Balance: Electric digital 2,000 gram (4.5 lb) minimum capacity, sensitive to 0.1 gram (.0035 oz) and conforming to AASHTO M231 Class G-2.

5. Balance: at least 34 kg [75 pounds] capacity sensitive to 0.02 kg [0.05 lb] conforming to AASHTO M231 Class G100.

6. 2 hot plates, each with two burners 700 to 800 Watt, 3 prong grounded plug, with adjustable control for each burner.

7. 6 Drying Pans: 250 x 375 x 50 mm [10x15x2 in] deep heavy gauge aluminum.

8. Heat Resistant Gloves: Long cuff leather welding gloves.

9. Two D-Handle square end shovels - 240 mm [9½ in] wide.

10. One long handle spade.
11. Two 1.5 x 1.5 m [5x5 ft] imperious vinyl coated nylon canvas for quartering samples.
12. One sample splitter - a stainless steel splitter, conforming to AASHTO T248 paragraph 6.1, with curled safety edges.
13. Miscellaneous small tool and equipment: one 0.45 kg [16 oz] steel hammer; one screwdriver 300 mm [12 in] long with a 10 mm [ $\frac{3}{8}$  in] shaft; two 38 mm [1½ in] paint brushes; three 375 mm [15 in] heavy gauge stainless steel spoons; one brass bristle sieve brush; one 2 m [6 ft] folding rule; one 500 ml. squeeze bottle; one wash bottle (a 3.785 L [1 gal] wide mouth plastic bottle or a 150 x 300 mm [6 in x 12 in] plastic concrete cylinder mold); one floor broom.
14. A 10 person general-purpose first aid kit. The first aid kit shall be periodically inspected and refilled as necessary.

The balances described above in sections h)-4 and h)-5 shall be calibrated by an independent calibration service at a minimum frequency of once per year. A current certification sticker shall be displayed on the balance, and calibration records shall be maintained at the testing facility for Department inspection.

639.08 Heat Heat shall be supplied by the Contractor to maintain an acceptable room temperature during occupancy.

639.09 Telephone The Contractor shall provide three telephone lines and two telephones, touch-tone models in areas where touch-tone service is available, in all field offices for the exclusive use of the State personnel. At least one phone shall be cordless. These telephones shall be on a private line, if available and shall be listed under "State of Maine, Maine Department of Transportation". One telephone line shall have "Call Waiting" installed, if available. Each line shall have jacks installed at each end of the field office. The Contractor shall be responsible for the installation charges and all reinstallation charges following suspended periods. Monthly service and maintenance charges shall be billed by the telephone company directly to the Contractor. During seasonal suspension periods, the telephone company shall be notified to discontinue or suspend the services and the Contractor shall assume all charges. Upon resumption of work, the telephone service shall be reinstated.

The Contractor shall also provide a telephone-answering device in all field offices where a telephone is provided capable of answering calls and recording incoming messages. The Contractor shall be responsible for all maintenance costs for the answering device.

639.10 Method of Measurement Field office and testing facilities will be measured by the unit or lump sum for each building provided, equipped and maintained satisfactorily.

639.11 Basis of Payment The accepted quantity of field office or testing facilities will be paid for at the contract unit price each or lump sum which payment shall be full compensation for furnishing, erecting, equipping, maintaining, furnishing electricity, heating, installing and maintaining toilet facilities and if necessary removing the buildings or office trailers. Payment for testing facilities shall include furnishing all buildings and facilities as required by these specifications for the testing of materials by the State.

Payment for these items will be made in 3 parts; the first payment of ½ to be made after the Contractor has supplied the building or office trailer and it has been approved. The remaining payments shall be made at intervals as follows:

A second payment of ¼ shall be made when one-half of the anticipated work has been completed.

The final payment of the remaining ¼ shall be made upon completion of the work.

Testing facilities, bituminous liquids and Portland cement, will not be paid for directly but all costs will be considered incidental to the various contract items.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
639.18 Field Office, Type A	Each
639.19 Field Office, Type B	Each
639.21 Testing Facilities - Soils	Lump Sum

SECTION 640 - VACANT

SECTION 641 - REST AREA FACILITIES

Reserved

SECTION 642 - STEPS

642.01 Description This work shall consist of the construction of wooden steps, precast concrete steps or cast-in-place concrete steps in accordance with these specifications and in reasonably close conformity with dimensions and designs shown on the plans.

642.02 Materials Materials for the steps shall meet the requirements as specified in the following Sections of Division 700 - Materials:

Exterior Ready Mixed Paint	708.01
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Timber Preservative	708.05
Precast Concrete Units	712.06

Wood shall be well-seasoned spruce or pine, Number 1 dimension lumber. Nails and hardware shall be galvanized.

Precast concrete steps shall conform to the specifications of precast units except as modified herein and shall be of the dimensions detailed on the plans or as otherwise approved. Exposed surfaces shall have a rubbed finish as specified in Section 502.14-d-2.

Cast-in-place concrete steps, shall conform to the requirements of Section 502 - Structural Concrete, Class A.

642.03 Wooden Steps Wooden steps shall be fabricated and fastened in accordance with standard commercial building practices.

After members have been cut to size, the ends shall be soaked in an approved timber preservative. Before assembling the steps, all contact surfaces shall be painted 2 coats of paint, color to be designated. The first coat of paint shall be thinned.

642.04 Precast Concrete Steps Precast concrete steps shall be placed on a compacted gravel bed with horizontal joints level and vertical joints plumb. The foundation shall be prepared in advance of setting the steps by grading and compacting the aggregate subbase to the proper elevation. The steps shall be set with a uniform tread width to match the finish grade of the slope. All remaining excavated areas surrounding the steps shall be filled to the required grade with approved materials and thoroughly tamped.

642.05 Cast-in-place Concrete Steps Cast-in-place concrete steps shall conform to the applicable requirements of Section 502 - Structural Concrete.

642.06 Method of Measurement Wooden steps and precast portland cement concrete steps will be measured by each unit, complete in place and accepted.

Cast-in-place concrete steps will be measured for payment by the cubic meter [cubic yard] in place.

642.07 Basis of Payment The accepted wooden steps will be paid for at the contract unit price each, complete and accepted in place which price shall be full compensation for furnishing all materials, labor and other incidentals necessary to complete the work.

The accepted quantity of precast concrete steps will be paid for at the contract unit price each, complete in place, which price shall be full compensation for furnishing and placing all materials including reinforcing steel.

Excavation and backfill will be measured and paid for as provided in Section 206 - Structural Excavation.

The accepted quantity for cast-in-place concrete steps will be paid for at the unit contract price per cubic meter [cubic yard] complete in place which price shall be full compensation for furnishing and placing all materials including reinforcing steel.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
642.12    Wooden Steps	Each
642.15    Precast Concrete Steps	Each
642.17    Cast-in-place Concrete Steps	cubic meter [Cubic Yard]

### SECTION 643 - TRAFFIC SIGNALS

643.01 Description This work shall consist of furnishing and installing all equipment necessary for the erection and operation of a traffic signal, flashing beacon, temporary traffic signal or modification of a traffic signal, all in reasonably close conformity with the plans.

643.02 General All equipment shall be new unless otherwise specified. Requests for substitution of any specified material shall be submitted in writing with all documentation (specifications, mill certifications, etc.) in order to enable the Department to evaluate the proposal. Substitutes for specified material may be accepted upon approval by the Fabrication Engineer. Functionally, any substitute shall give equal or better service than the specified material. Existing signal equipment to be used shall be cleaned, repainted, and reconditioned as noted on the plans. All equipment, installation of equipment and other incidental work shall conform to the latest applicable provisions of: NEC, MUTCD, NESC, NEMA, and the ITE Standards for traffic control equipment. All work shall be done to the satisfaction of the Resident. The meaning of specific terms shall be as defined in MUTCD, NESC, and the ITE Standards for traffic control equipment.

643.021 Materials Material shall meet the requirements specified in the following Sections of Division 700 - Materials:

Steel Conduit	715.02
Non-metallic Conduit	715.03
Prewired Conduit	715.04
Metallic Junction and Fuse Box	715.05
Secondary Wiring	715.07
Vehicular Signal Indications	718.01
Pedestrian Signal Indications	718.02
Signal Mounting	718.03
Loop Vehicular Detectors	718.04
Microwave Detectors	718.05
Pedestrian Detectors	718.06
Controllers	718.07

Controller Cabinet	718.08
Flasher	718.09
Program Selection	718.10
Contacts and Relays	718.11
Conductors	718.12
Aluminum Supports	720.01
Aluminum Mast Arm and Bracket Arm	720.02
Steel Supports	720.03
Steel Mast Arm and Bracket Arm	720.04
Anchor Bolts	720.07
Wood Utility Pole	720.10

643.022 Paint Aluminum paint shall conform to AASHTO M69, Type II. Green or yellow enamel paint, as indicated on the plans, shall meet or exceed the latest Federal Specification TT-E-489. The color shall match Federal Color Standard Number 14062.

643.023 Design and Fabrication The design and fabrication of traffic signal support structures shall meet the requirements of the current edition of AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals" and interims thereto, except as otherwise indicated within these specifications or on the contract plans. All poles and mast arms shall be designed to withstand the maximum forces generated on the design configuration by the loads specified in Section 3 of the "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals", using the 50-year mean recurrence interval for wind speeds. Minimum design default values for these structures shall be:  $I_r = 1.00$ ;  $C_v = 1.00$ ;  $K_z = 0.94$ ; and  $G = 1.14$ .

All traffic signal structures with mast or bracket arms shall be equipped with an approved damping or energy-absorbing device.

After execution of the contract and before any shop work is commenced, the Contractor shall submit 3 sets of the manufacturer's drawings of all poles proposed to be furnished and erected under this Contract. The drawings shall be of sufficient detail to indicate material and dimensional conformance with these specifications and the contract drawings. Each drawing shall contain a reference to the design criteria and a certification that the design criteria have been met by the poles, mast arms and associated hardware and fittings, as submitted. The certification shall be signed by a Registered Professional Engineer under their official seal.

It is the intent of these specifications that the Contractor shall be fully responsible for the adequacy of the sizes, wall thicknesses, materials and connections of the poles, mast arms and associated hardware and fittings. Approval of the drawings by the Fabrication Engineer will signify only approval of the materials, mounting height(s) and mast arm length(s). Approval of deviations from the contract drawings and/or specifications shall be requested in writing and approved by the Fabrication Engineer before being incorporated in the manufacturer's drawings.

The Contractor shall furnish and install all electrical fittings, pipe, switches, fuses, and such other material necessary to install the equipment properly and securely. All equipment shall

conform to the applicable code and be of first-class workmanship. All electrical fittings shall be complete with weatherproof gaskets.

643.024 Miscellaneous Materials Span wire shall be minimum 7.9 mm [ $5/16$  in] diameter, minimum, 7 strand, extra-high strength, galvanized steel wire. Anchors shall be power installed and sized according to strain and soil conditions. All hardware, such as strandwise feed-thru dead ends, preforming guy grip dead ends and angle thimble-eye bolts, shall be standard pole line hardware.

Guying of poles shall meet the requirements of Grade "B" Construction as defined in the NESC. Guys shall be installed in line with the direction of pull. Anchors shall be power installed so that the centerline of the anchor rod will be within  $10^\circ$  of the line of the guy wire. The holding capacity of the anchor shall be 1.25 times the calculated load on the guy wire. Guy wires shall be utility grade and the maximum working stress shall not exceed half of the maximum ultimate tensile strength of utility grade guy strand. Where bedrock is encountered, rock anchors shall be used.

Pipe standoffs for sidewalk anchors shall be galvanized steel pipe sized according to the offset distance from anchor to pole and shall be fitted with standard guying hardware.

Messenger wire shall be 6 mm [ $1/4$  in] diameter, 7 strand, extra-high strength, galvanized steel wire, unless otherwise specified.

LED lamps shall have a regulated power supply designed to electrically protect the diodes. The lamp shall be watertight and sealed to eliminate contaminants. The lamps shall be capable of operating at ambient air temperatures of  $-40^\circ\text{C}$  [ $-40^\circ\text{F}$ ] to  $+60^\circ\text{C}$  [ $140^\circ\text{F}$ ].

Lamp life shall be a minimum of 100,000 hours of continuous operation. They shall be manufactured using the Allen Gap Technology. Power consumption for 300 mm [12 in] indications including power supply shall not exceed 20w.

643.03 General Installation details will be shown on the plans. The location shown for all equipment and vehicle detectors is approximate; final locations will be determined in the field.

During installation, all heads installed but not operating shall be covered or otherwise concealed from view.

The requirements of certain Sections of this specification may be waived for temporary traffic signals and traffic signal modifications, if so noted on the plans.

643.04 Poles Wood poles shall be placed in the ground to a depth of 20% of their overall length, with a maximum deviation from the vertical of 6 mm in 1500 mm [ $1/4$  inch in 5 ft].

After each wood pole has been set in the ground and plumbed, the space around the pole shall be backfilled with selected earth or sand, free of rocks and other deleterious material,

placed in layers approximately 100 mm [4 in] thick. Each layer shall be moistened and thoroughly compacted.

Strain poles, pedestal poles and mast arm poles shall be erected in a vertical position, with a maximum deviation from the vertical of 6 mm in 1500 mm [ $\frac{1}{4}$  inch in 5 ft] using the leveling nuts provided with the anchor bolts. Once the poles have been plumbed, the top nuts shall be tightened by bringing the nut to a snug tight condition using the full effort of a worker using a spud wrench or compatible tool. After all nuts have been brought to a snug, tight condition, each nut shall be tightened an additional one-third turn, using an impact wrench, torque wrench or large crescent wrench. A minimum of two full threads shall project beyond the outside face of the nut. Nuts and bolts, other than anchor bolts, shall also be tightened by the above procedure.

When foundation and anchor bolts have been installed by others, the Contractor shall verify the anchor bolt dimensions at each location so that bases will be furnished with properly located and sized bolt holes.

Wires in poles shall be supported with a Kellum-type, braided, strain-relief grip attached to a "J" hook mounted inside the pole near the top.

643.05 Loop Detector and Loop Detector Wire Installation The detector unit shall be located in the controller. No more than four loops shall be connected to a single detector amplifier.

Detectors shall be installed according to the manufacturer's recommendation, subject to approval. Each detector shall be supplied complete with comprehensive installation instructions. The pavement slot for wire shall be 50 mm to 75 mm [2 in to 3 in] below the finished surface and not closer than 450 mm [18 in] from the edge of pavement or the curb. The right-angle corners of the pavement slot shall be chamfered to eliminate sharp bends in the loop wires.

Loop detector wire shall be number 14 or number 12 AWG copper conductors drawn through vinyl plastic tubing approximately 6 mm [ $\frac{1}{4}$  in] in diameter. All pulse loop "approach" wiring shall be insulated red and shall be permanently marked "A", "B", "C", or "D", according to the "approach" guidelines in the controller cabinet. All pulse loop "presence" wiring shall be insulated black and shall be permanently marked according to the "presence" guidelines in the controller cabinet. All loop lead-ins shall be of the same conductor with no splicing. The lead-in from the amplifier to the beginning of the loop shall be shielded pairs, as shown on the plans.

All debris and moisture shall be removed from the loop pavement slot before installation of loop wires. The pavement slot shall be filled to the road surface with an approved sealing compound to form a waterproof bond with the pavement after installing the wire loop.

Detector conductors shall not be housed in the same jacket as the signal conductors.

643.06 Microwave Detector Installation The microwave detector shall be installed in accordance with the manufacturer's recommendations. A four-conductor wire shall be installed from the microwave unit to the controller. All angles and adjustment of patterns shall be the responsibility of the Contractor. The detectors shall operate in either pulse or presence mode.

643.07 Span Wire, Messenger Wire, and Guy Wire All span wire, messenger wire, and guy wire installations shall be in conformance with the requirements of the Utility Companies, when installed on Utility Facilities.

All span wires, messenger wires, guy wires, terminal boxes, controller cabinets, or any other metallic surface that might be contacted by people, shall be bonded to ground.

All sidewalk guy wires and slant guy wires installed in a sidewalk area shall be equipped with full-round or half-round guy guards.

643.08 Conduit All conductors under roadways from the controller to the mast arm poles shall be 75 mm [3 in] schedule 80 PVC.

643.09 Service Connection The Contractor shall furnish and install the necessary electrical service as directed by the Utility Company. The Contractor shall make all arrangements for the service connection and be responsible for all charges incurred thereby.

Under no condition shall any equipment, except that shown on the plans, be installed on any Utility Facilities.

Whenever a service connection is to be made, the Contractor shall contact the Utility Company involved and inform them of the location, pole number, and time proposed for the service connection.

The Contractor shall be responsible for all outstanding bills for preliminary work done by the Utility Company during the installation of the traffic signal system, to facilitate the service connection.

A service ground rod shall be installed if the service meter trim is not grounded.

The Contractor shall be responsible for grounding the system to 5 OHMS or less. The grounding shall be performed using a ground meter with reference grounds. All testing will be done in the presence of the Resident.

643.10 Wiring The Contractor shall furnish and install sufficient cable and wire to operate the system properly as shown on the plans and as directed.

The following color code shall be used where possible:

Red Wire	Red, artery
Orange Wire	Yellow, artery

Green Wire	Red, side street
Orange with Tracer	Yellow, side street
Green with Tracer	Green, side street
White and white with tracer	Common for all signals and bond
Blue	All steady burning arrows
Blue with Tracer	Intermittent arrows
Remaining	Detectors and pedestrian signals

The white wire and white wire with tracer shall be used for all common connections and it shall be continuously connected to ground at the controller.

There shall be no wire splices. Connections shall be made on a terminal board inside a watertight galvanized steel or aluminum junction box or in an aerial terminal enclosure with protective cover rated for 600 volts.

Spade type copper terminal ends shall be used to attach all conductors to terminals. All exposed metal parts, including service conduit and the controller cabinet shall be bonded and grounded.

Not more than 3 conductors shall be brought to any one terminal. Terminals shall be mounted to face the cabinet door.

The number and size of conductors required in each cable will be indicated on the plans.

643.11 Vertical Clearance Vertical clearances for vehicular and pedestrian heads shall be in conformity with the MUTCD. All clearances shall be uniform among each type of head or mounting scheme. Clearance for mast arm pole and span wire mounted vehicular heads shall be 4.88 m [16 ft]; clearance for pole mounted vehicular heads shall be 3 m [10 ft]; clearance for pedestrian heads shall be 5.5 m [8 ft] unless otherwise specified. Clearance for span wire mounted flashing beacon heads shall be a minimum of 5.2 m [17 ft] and a maximum of 5.5 m [18 ft].

643.12 Painting All exterior parts of the following equipment shall be delivered to the project finished with green or yellow enamel:

- Vehicular Signal Heads
- Pedestrian Signal Heads
- Pedestrian Push Button Detectors

The outside of the steel controller cabinet shall be painted with aluminum paint.

The Contractor shall apply one coat of green enamel to all existing equipment designated on the plans to be painted. The Contractor shall touch up all scratches on exposed surfaces of new equipment with matching enamel after the equipment has been installed.

All exposed signal parts to be painted shall be cleaned and shall be dry when the paint is applied. No painting shall be done in damp weather nor when the air temperature is below 4°C [40°F], unless otherwise permitted.

The Contractor shall identify recently painted equipment with "Wet Paint" signs, and shall be responsible for all claims for damages resulting from contact with wet paint surfaces.

643.13 Power Factor In the event that the equipment is of such design that the power factor is reduced below the requirement of the Utility Company, the Contractor shall furnish and install, without further charge, all equipment necessary to restore the power factor to a satisfactory percentage. Such equipment shall be accessible and shall not be mounted on the Utility Facilities.

643.14 Field Tests Before acceptance of the work, and in the presence of the Resident, the Contractor shall conduct the following tests on all traffic signal equipment and circuits.

a. Continuity Each circuit shall be tested for continuity.

b. Ground Each circuit shall be tested for grounds.

c. Megger Megger tests at 500 volts DC shall be made on each circuit between the circuit and a ground. The insulation resistance shall not be less than 1000 s [10 megohms] on all circuits, except for inductive loop detector circuits, which shall have an insulation resistance value of not less than 10,000 s [100 megohms].

d. Loop Inductance A loop test meter shall be used to determine that the inductance of the installed loop and lead-in are within the tuning range recommended by the loop detector manufacturer.

e. Functional A functional test shall be made in which it is demonstrated that each part of the system functions as specified.

The functional test for each new or modified traffic signal and flashing beacon shall consist of not less than 10 days of continuous satisfactory operation. If unsatisfactory performance of the system develops, the condition shall be corrected and the test shall be repeated until the 10 days of continuous satisfactory operation is obtained.

The initial operation shall be made between 9:00 A.M. and 2:00 P.M. unless specified otherwise. Before initial operation, all equipment shown on the plans shall be installed and operable.

Initial operation of new or modified traffic signal systems shall be made only after all traffic signal circuits have been thoroughly tested as specified above.

During the test period all costs except electrical energy shall be the Contractor's responsibility.

Functional tests shall start on any working day except Friday or the day preceding a legal holiday.

Shutdown caused by a power interruption shall not constitute discontinuity of the functional test, however, the test shall continue after power is restored.

643.15 Timing The controller shall be timed as noted on the plans. The Contractor shall notify the Resident, at least 1 week in advance, of their intention to initially operate the signals.

At the time of initial operation of the new signals, the Contractor shall provide police protection from the local police department at the Contractor's expense until the Contractor demonstrates to the Resident that the signal operates in conformance with the specification.

643.16 Final Cleaning Up After all work has been completed, the Contractor shall remove all barriers, "Wet Paint" signs, equipment and all debris which has accumulated during the work.

Unless otherwise specified in the plans, the Contractor shall remove and deliver all unused signal equipment and wiring to the State of Maine, Department of Transportation, as directed by the Resident. The Contractor shall notify the State Traffic Engineer (207-624-3620) as to time and date of such delivery. (Deliveries will be accepted Monday through Friday between the hours of 7:00 A.M. and 4:00 P.M. only.) Notification shall precede delivery by a minimum of 24 hours.

643.17 Documents The Contractor shall furnish two operation and maintenance manuals for all controller units, auxiliary equipment, vehicle detector sensor units, control units, and amplifiers. Documents shall be delivered with the controller at the time of testing. Each manual must include, but need not be limited to the following:

- a. An explanation of the theory of operation, including a functional description and a detailed circuit description.
- b. A schematic diagram of each unit. A cabinet wiring diagram including all field wiring and pin locations and designations for all plug type connectors. If any circuit changes are made in the field, the changes shall be noted on the schematic diagrams.
- c. A trouble shooting and preventive maintenance procedure including both field and bench trouble shooting analysis.
- d. A parts list including a pictorial diagram showing the location and identification of each component on the chassis or circuit board.
- e. A drawing of the controller cabinet interior showing the location of all shelves, terminal blocks, relays, timers, loop amplifiers.

In addition, manufacturer's warranties and guarantees for materials shall be delivered to the Resident before acceptance of the project.

643.18 Method of Measurement Traffic signals, traffic signal modifications, interconnect wire, video detection system, traffic signal control system, and flashing beacons will each be measured for payment by the lump sum in place. Temporary traffic signals will be measured for payment by the lump sum, satisfactorily installed, operated, and removed.

Pedestal poles, strain poles, combination poles, and mast arm poles with mast arms will be measured by each unit.

Each loop detector installed, connected to appropriate phases in the controller cabinet, complete and operational will be measured by the unit.

Excavation in solid ledge rock for replacement of wood poles will be measured by the cubic meter [cubic yard]. The depth of measurement will be to the bottom of the pole, and the diameter of measurement will be the pole diameter plus 750 mm [30 in].

643.19 Basis of Payment Traffic signal modifications, traffic signals, interconnect wire and flashing beacons will be paid for at the contract lump sum price, which payment will be full compensation for furnishing and installing all materials, both new and reused, including, but not limited to wood poles, span wire, guys, controllers, vehicular heads, pedestrian heads, flashing beacons, wiring, cable, pole risers, LED lamps, and all appurtenances and incidentals required for a complete functioning installation and for furnishing all tools and labor necessary for completing the installation. Conduits, junction boxes, and foundations will be paid for under Section 626.

Pedestal poles, strain poles, combination poles and mast arm poles with mast arms will be paid for at the contract unit price each which payment shall be full compensation for furnishing and installing all materials, tools and labor necessary to erect the poles.

Payment for temporary traffic signals shall include compensation for the removal of the system upon completion of the work. All materials used for temporary traffic signals will remain the property of the Contractor. Operating the controller by hand will be paid for under Section 629.

Payment will be made for each Loop Detector at contract price, which will be full compensation for materials, labor, and equipment for each loop installed and fully operational.

Traffic signal control system will be paid for at the contract lump sum price, which payment will be full compensation for furnishing and installing all materials, including, but not limited to local intersection traffic signal controller, controller cabinets, on-street master controller, supervisory PC software, and all appurtenances and incidentals required for a complete functioning installation.

Video detection system will be paid for at the contract lump sum price, which payment will be full compensation for furnishing and installing all materials, including, but not limited to video processing unit, video cameras, supervisory PC software, and all appurtenances and incidentals required for a complete functioning installation.

Payment for excavation of solid ledge rock for the placement of wood poles will be made under Section 206.07.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
643.60 Flashing Beacon at:	Lump Sum
643.71 Traffic Signal Modification:	Lump Sum
643.72 Temporary Traffic Signal:	Lump Sum
643.80 Traffic Signals at:	Lump Sum
643.81 Traffic Signal Control System	Lump Sum
643.83 Video Detection System	Lump Sum
643.86 Traffic Signal Loop Detector	Each
643.90 Interconnect Wire Between:	Lump Sum
643.91 Mast Arm Pole	Each
643.92 Pedestal Pole	Each
643.93 Strain Pole	Each
643.94 Dual Purpose Pole	Each

#### SECTION 644 - GLARE BARRIER

Reserved

#### SECTION 645 - HIGHWAY SIGNING

645.01 Description This work shall consist of furnishing and installing new signs, sign supports, delineators, and breakaway devices and removing, relocating and/or modifying existing signs and sign supports, in accordance with these specifications and in reasonably close conformity with the plans.

645.02 General All equipment shall be new unless otherwise specified. Requests for substitution of any specified material shall be submitted in writing with all documentation (specifications, mill certifications, etc.) in order to enable the Department to evaluate the proposal. Substitutes for specified material may be accepted, upon approval of the Fabrication Engineer. Substitutes shall give equal or better service than the specified material. Where an existing system is to be modified, the existing material shall be removed, upgraded, or disposed of as directed by the contract documents.

645.021 Materials Materials shall meet the requirements specified in the following Sections of Division 700 - Materials:

Reflective Sheeting	719.01
Demountable High Intensity Reflectorized Letters, Numerals, Symbols and Borders	719.02
Aluminum Extrusions	719.03
Aluminum Sheets	719.04
Plywood	719.05
Demountable Reflectorized Delineators	719.06
Assembly Hardware	719.07
Aluminum Supports	720.01
Steel Supports	720.03
Steel H-beam Poles	720.06
Anchor Bolts	720.07
U-Channel Posts	720.08
Wood Sign Posts	720.12

Paint for the edge and back of plywood and field coat paint for wood sign posts shall be an exterior grade dark green enamel conforming to Federal Specifications TT-P-71b.

645.022 Sign Layout Drawings The Contractor shall submit 3 sets of sign-face, layout-detail, and scale drawings. Fabrication of the signs shall not begin until the Contractor has received approval of these drawings. The drawings shall contain complete detailed information and dimensions. One set of drawings will be returned to the Contractor, who will submit corrected drawings, if required. The drawings shall be detailed using the same units used on the plans.

645.023 Support Structures The design, materials and fabrication of sign support structures and foundations shall meet the requirements of the current edition of AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals" and interims thereto, except as otherwise indicated within these specifications or on the plans. Beam mounted signs and their supports shall be designed using wind speeds as determined from the 25-year mean recurrence interval isotach map. Minimum design default values for these structures shall be:  $I_r = 0.87$ ;  $C_v = 0.93$ ;  $K_z = 0.87$ ; and  $G = 1.14$ . Bridge, cantilever, and butterfly sign supports and associated signs and hardware shall be designed using the wind speeds as determined from the 50 year mean recurrence interval isotach map, as contained in the above referenced AASHTO Specifications. Minimum design default values for these structures shall be:  $I_r = 1.00$ ;  $C_v = 1.00$ ;  $K_z = 0.94$ ; and  $G = 1.14$ . For sign supports mounted on bridge structures and approaches to bridge structures, the mounting height shall be measured as the distance of the mounted sign(s) center of gravity to one of the following:

For bridges over bodies of water: above the prevailing water level or, in the case of tidal waters, above mean high tide.

For overpass structures: above the lower roadway level.

For approach ramps: above the average adjacent ground level, if said ground level is more than 3 m [10 ft] below the base of the structure.

All cantilever and butterfly type sign support structures shall be equipped with an approved damping or energy-absorbing device.

For aluminum construction, welding shall conform to the current edition of AWS Structural Welding Code, Aluminum, D1.2 for aluminum construction.

After execution of the contract and before any shop work has commenced, the Contractor shall submit 3 sets of drawings, and computations if prescribed below, of all sign supports proposed to be furnished and erected under this contract. The drawings shall be of sufficient detail to indicate material and/or dimensional conformance with these specifications and the contract drawings and, in the case of bridge, cantilever and butterfly type sign supports, shall be sufficiently detailed to show all structural significant details.

Approval for deviations from the contract drawings and/or specifications shall be requested in writing and shall be approved by the Fabrication Engineer before being incorporated in the manufacturer's drawings. Requests for substitution of all specified material shall be submitted in writing, with full documentation (specifications, mill certification, etc.) enabling the Department to evaluate the proposal.

Sign support structures and anchor bolts shall meet the requirements specified in Section 720 as well as the current edition of AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals".

A Certificate of Compliance shall be provided for all material in accordance with the requirements of the General Statement of Division 700 - Materials.

a. Beam Mounted Signs The beams for beam-mounted signs shall be of the size, material and shape designated in the contract documents. The Contractor shall be fully responsible for the adequacy and design of any structural details not shown on the plans, and each drawing shall contain a reference to the design criteria and a certification by a Professional Engineer registered in accordance with the State of Maine regulations, over their official stamp, that said design criteria have been met by all parts of the structure designed and/or detailed by the Contractor. Approval of the drawings will signify only approval of the size, material and length of the beam.

b. Bridge, Cantilever, and Butterfly Type Sign Supports The Contractor shall be responsible for the design of the support structure including its foundation. Foundation design shall follow requirements of Section 645.024 - Bridge, Cantilever, and Butterfly Support Structure Foundations, as well as this Section.

Signs shall be placed on the support structure such that the bottom edges are aligned while accommodating the minimum height requirement. The Contractor shall use the Contract Drawings in order to determine the approximate horizontal placement of signs.

Installation shall be in accordance with Section 645.06 - Installation of Type I Signs. The structure and foundation shall be designed to accommodate a minimum of 1.5 times the sign area on each structure as shown on the contract documents. This additional theoretical sign load shall be computed by: Increasing the sign lengths an additional 25% and increasing sign height by an additional 25% while maintaining the approximate prescribed sign center line locations, height from roadway and bottom edge alignment.

Bridge type structures shall be designed using either a tri-chord or four-chord truss structure as the overhead member. Each of the two upright members supporting the bridge type overhead truss member shall consist of a minimum of two vertical legs. A four chord truss configuration shall be required if the contract documents specify placing signs on both sides of the overhead structure (two way traffic beneath structure). Cantilever and butterfly type structures shall be designed using either a tri-chord or four-chord overhead truss member. The upright member of a cantilever or butterfly-type support structure shall have a maximum horizontal deflection of  $L/40$ , where  $L$  is the length of upright member, as determined from design loads calculated in accordance with the AASHTO "Standard Specification for Structural Supports for Highway Signs, Luminaires and Traffic Signals".

The base plates of uprights for all types of support structures shall have heavy hex leveling nut with 2 hardened flat washers. The distance between the bottom of the base plates to the top of the foundations shall not exceed twice the diameter of the anchor bolts. Grout, or other materials, shall not be placed between base plates and the top of foundations. In addition to the required detail drawings, the Contractor shall submit 3 copies of the design computations, including fatigue considerations, in accordance with Section 11, Fatigue Design, in the AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals", and interims thereto, for the entire structure. Erection lifting points shall be clearly depicted on the shop drawing.

The computations shall be sufficiently detailed to allow the Engineer to check and approve the computations. Computer printouts will not be accepted unless they meet the above criteria. All plans and design calculations, sign support structure and foundation, shall be signed by a Professional Engineer registered in accordance with the State of Maine regulations. Approval will be based on the applicable provisions of Section 105.7 - Working Drawings.

Overhead sign panel mounting devices shall be designed accommodating the requirements of appropriate sign panel tilting included in this specification. The design of this assembly shall include fastening sign panels directly to steel or aluminum members as further described in Section 719.07, as well as other applicable Sections, plans and specifications.

c. Bridge Overpass Mounted Sign Supports Overpass mounted sign supports shall be constructed to the configuration and sizes and of the material shown on the contract documents. Approval will be based on the applicable provisions of Section 105.7 - Working Drawings. Fastening sign panels directly to steel or aluminum members shall be as described in Section 719.07, as well as other applicable Sections, plans and specifications.

d. Breakaway Supports for Sign Supports Breakaway supports for sign supports will be required only for those locations indicated on the contract plans. Breakaway supports, approved by the Resident, using load-concentrating couplings shall be supplied for use at all locations designated as breakaway. Breakaway Support Certification of both breakaway and structural adequacy shall be provided by the Manufacturer. Design calculations or test data of production samples to support certification shall be provided. Breakaway support components shall provide the same or greater structural strength as the support post or pole utilizing the breakaway device. On multi-pole sign supports designated as breakaway, each pole shall be equipped with breakaway hinges immediately below the lower edge of the sign. Hinges relying on the friction between the hinge and the pole face for transmitting the design moment will not be accepted for use. Breakaway devices are subject to the applicable provisions of Section 721.

645.024 Bridge, Cantilever and Butterfly Support Structure Foundations The Contractor may select a foundation system meeting the design criteria of Section 13 of the current edition of AASHTO “Standard Specifications for Structural Supports for Highway Sign, Luminaries and Traffic Signals”, unless otherwise specified by the Department. Geotechnical design of the foundations shall be in accordance with Section 13 of the afore-mentioned AASHTO code. The design criteria for the resistance of drilled caisson and spread footing foundations against overturning, sliding and bearing capacity failure shall meet the requirements of Section 4 of the current edition of AASHTO “Standard Specifications for Highway Bridges”. The structural design of foundations shall meet the requirements of the current edition of AASHTO “Standard Specifications for Highway Bridges”. The Contractor shall submit to the Fabrication Engineer for approval, detailed plans and calculations, prepared by a licensed Professional Engineer, of the proposed sign foundation. Construction of the foundation shall not commence until the Department has approved the foundation design.

For estimating and bidding purposes, in the absence of boring samples and standard penetration tests, or the actual determination of soil properties at the proposed footing location, the Department will accept an assumed allowable soil bearing pressure of 72 kPa [1.5 kips/ft<sup>2</sup>] for the design of the footing. The actual, existing, soil classification, analysis and footing design shall be determined by the Contractor’s qualified firm or person by use of hollow stem auger boring samples. All costs associated with the work required to sample, classify and analyze the soil, design the footing and prepare submittals shall be incidental to related Contract items. All unsuitable material (peat, organic material, material that has been dumped, etc.) within the limits of a footing must be removed at the direction of the Resident and the shaft depth of drilled caissons shall be increased to bear on suitable material. Concrete for the footing shall be placed immediately after excavation to prevent water from collecting in the excavated area. The structural design of foundations shall meet the requirements of the current edition of AASHTO “Standard Specifications for Highway Bridges”. Concrete shall be Class LP in accordance with Section 502 - Structural Concrete. Drilled shaft foundation holes, except in ledge, shall be excavated by auger method to the neat line of the outside dimensions of the footing without disturbing the soil around or below the proposed footing. Precast foundations shall not be permitted. In areas where rock or ledge is encountered above the proposed bottom of footing, the Contractor will have the option of removing rock and placing the footing at the design depth shown on the Contractor’s Working Drawings, or constructing a grouted rock-anchored

foundation system. This rock-anchored system shall be designed by the Contractor and approved by the Department. Back fill for pedestal foundations shall be granular borrow for underwater back fill meeting the requirements of Section 703.20 - Gravel Borrow, of the Standard Specification. The granular borrow shall be placed in layers not exceeding 150 mm [6 in] in depth before compaction. Each layer of back fill shall be thoroughly compacted by use of power tampers to at least 95% of the maximum density as measured in the field per AASHTO T191 or by an approved method using calibrated nuclear device. All back filling and compacting shall be in accordance with the applicable provisions of Section 206, of the Standard Specifications. The Contractor shall submit 3 copies of all foundation design work, structural and geotechnical, together with computations and plans used for design purposes, as specified in Section 645.023.

645.03 Classification of Signs Sign sizes, color and legend designs shall conform to these specifications, the plans, and MUTCD requirements. The signs are classed according to the intended use as follows:

a. Type I guide signs shall consist of high intensity, reflectorized sheeting or reflectorized, demountable letters, numerals, symbols and border mounted on a high intensity, reflective sheeting background adhered to a sign panel constructed of extruded aluminum planks.

b. Type I regulatory, warning, and route marker assembly signs shall consist of high intensity, reflective sheeting letters, numerals, symbols, and border on a high intensity, reflective sheeting background adhered to a sign panel constructed of sheet aluminum.

c. Type II guide signs shall consist of engineering grade, reflective sheeting letters, numerals, symbols and border on an engineering grade, reflective sheeting background attached to a sign panel constructed of plywood.

d. Type II regulatory, warning and route marker assembly signs shall consist of engineering grade reflective sheeting letters, numerals, symbols and border on an engineering grade reflective sheeting background adhered to a sign panel constructed of sheet aluminum or plywood.

645.04 Fabrication of Type I Guide Signs

a. Panels The panels for this type sign shall be shop-fabricated from aluminum planks to the sizes designated on the approved shop drawings. Cut edges shall be true, smooth, and free from burrs or ragged breaks. Flame cutting will not be permitted. Bolt holes may be drilled to finished size or punched to finished size, provided the diameter of the punched hole is at least twice the thickness of the metal being punched.

Fabrication of extruded aluminum sign planks, including punching or drilling holes and cutting to length, shall be completed before the metal degreasing and the application of the reflective sheeting. The bolts required for fastening the extruded aluminum planks together

shall conform to the designs used in standard commercial processes for the type of extruded aluminum panels to be used as approved.

All route shields shall be on an overlay aluminum sheet of 2 mm [0.080 in] minimum thickness and shall be in full color with reflective background; they shall not have demountable numerals and borders.

**b. Reflective Sheeting** The high intensity or engineering grade reflective sheeting shall be applied to the extruded aluminum plank in accordance with the current recommendations of the sheeting Manufacturer.

The reflective sheeting shall cover the complete panel and shall not be trimmed to conform to the border. The reflective sheeting shall overlap into the side recess of the individual planks. There shall be no paint applied to the sign panels. The surface of all completed sign panels shall be flat and free of defects. Extruded aluminum molding shall be placed on the edges of the extruded panels, as shown on the plans.

**c. Text** The design of upper and lower case letters, numerals and symbols, and the arrangement and spacing of texts shall be as provided on the plans and in conformance with the MUTCD and Standard Highway Signs.

Text for Guide Signs shall be composed of demountable letters, numerals, symbols, and borders and shall be high-intensity, reflective sheeting. The demountable text shall be applied to the panels by use of aluminum pop rivets, in accordance with standard commercial processes, as approved. All demountable letters, numerals, symbols, and borders shall be the same manufacturer's make for the entire project. Cutout high-intensity, reflective sheeting text shall be applied to the sign panel with a pre-coated, adhesive backing.

#### 645.041 Fabrication of Type I Regulatory, Warning and Route Marker Assembly Signs and Type II Sheet Aluminum Regulatory, Warning and Route Marker Assembly Signs

**a. Panels** Sheet aluminum sign panels shall be shop-fabricated to the size shown on the plans. The corners shall be rounded to the indicated radius where shown.

Bolt holes may be drilled or punched to finished size provided the diameter of the punched hole is at least twice the thickness of the metal being punched. Cut edges shall be true, smooth, and free from burrs or ragged breaks. Flame cutting will not be permitted. Punching or drilling of holes and cutting to size shall be completed before metal degreasing and the application of reflective sheeting.

**b. Reflective Sheeting** The high intensity or engineering grade reflective sheeting shall be applied to the sheet aluminum sign panels in accordance with the current recommendations of the sheeting Manufacturer. The reflective sheeting colors shall conform to the MUTCD standard highway sign colors for each type of sign. Surface of all panels shall be flat and free from defects.

c. Text The text for regulatory, warning, confirmation and route marker assembly signs shall be composed of: High intensity or engineering grade, reflective sheeting letters, numerals, symbols and borders; or the silver letters may be formed by applying transparent ink to the reflective sheeting background where the silk screen process is used; or other methods to form the text may be used, when approved in advance.

645.042 Fabrication of Type II Guide Signs and Type II Plywood, Regulatory, Warning and Route Marker Assembly Signs

a. Panels Fabrication of all sign panels from high-density, overlaid plywood shall be performed in a uniform manner. All fabrication, including cutting, drilling, and edge routing, shall be completed prior to painting and application of reflective sheeting to the high-density, overlaid plywood. Panels shall be cut to size and shall be plywood. Panels shall be cut to size and shall be free of warping, open checks, open splits, open joints, open cracks, loose knots and other defects resulting from fabrication. Corners shall be left square. The surface of all sign panels shall be flat.

The edge and back of the plywood shall be painted with an exterior grade dark green paint.

b. Blanks Sign blanks shall be cut to shape using a saw blade that does not tear plywood grain. Holes shall be clean-cut and uniform. All cracks, open checks, open splits and other defects occurring on the edge surfaces shall be filled with a synthetic wood filler and sanded smooth prior to sealing and painting. The sign blank edges shall be sealed using an approved sealer/primer. The edges shall then be painted with an exterior grade, dark green paint.

The surface shall not be painted before application of reflective sheeting. Before applying reflective sheeting, dirt or wax shall be removed by one of the following methods:

1. The surface shall be buffed lightly with solvent-soaked steel wool, fine or medium, using organic solvents, such as lacquer thinner, xylol, heptane, benzene or naphtha, and wiped dry with clean cloths.
2. The panel shall be sanded lightly with fine-grade paper, cleaned with solvent, and wiped dry using clean cloths.

c. Reflective Sheeting The engineering grade reflective sheeting shall be applied directly to the cleaned high-density surface in accordance with the recommendations of the reflective sheeting manufacturer.

d. Text The text for regulatory, warning, confirmation and route marker assembly signs shall be composed of cutout, engineering-grade reflective sheeting letters, numerals, symbols and borders or the silver letters may be formed by applying transparent ink to the reflective sheeting background where the silk screen process is used. Other methods to form the text may be used when approved in advance.

The design of the letters, numerals, and symbols, the spacing of the text and the size and spacing of the border shall conform to the MUTCD and Standard Highway Signs.

645.06 Installation of Type I Signs The sign locations shown on the plans are approximate; exact locations will be determined in the field by the Resident. Signs stockpiled before erection shall be stored in a vertical position and completely covered to avoid staining, weathering, and dirt accumulation.

a. Sign Supports Poles for single and multiple support roadside signs shall be erected plumb, using the leveling nuts supplied with the anchor bolts. When signs are supported by more than one pole, all poles shall be carefully aligned to avoid warping of the sign panel.

Bridge, butterfly and cantilever type sign supports and their foundations shall be constructed, assembled and erected, in accordance with the manufacturer's details, as approved. All horizontal supports spanning the roadway shall be level and shall have permanent camber as described in Section 10 of the current edition of AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals", and interims thereto. If, at any time after their erection, bridge, butterfly or cantilever type sign supports are to remain for a period in excess of 72 hours without the sign(s) for which they were designed being in place, suitable vibration damping devices, approved by the Resident, shall be installed until such time as the sign(s) can be erected.

Bridge-mounted sign supports shall be fabricated and assembled in accordance with the details as shown on the contract drawings and with Section 504. Additionally, if required to be painted, bridge-mounted sign supports shall be painted in accordance with Section 506

Where aluminum surfaces are in contact with concrete or dissimilar metals, the contacting surface shall be thoroughly coated with an approved, aluminum impregnated caulking compound or the surfaces shall be separated by another approved material. Before signs are attached, aluminum sign supports shall be cleaned of all dirt and discoloration using methods recommended by the manufacturer.

b. Sign Panels Extruded aluminum planks for sign panels shall be bolted together, as indicated on the plans. Extruded aluminum molding shall be placed on the edges of the extruded panels. Sign panels shall be attached to the posts to provide the vertical and horizontal clearances from the roadway as indicated on the plans. Sign panels on overhead structures shall provide a minimum clearance of 5.2 m [17 ft] to the roadway surface. Sign panels on bridge-mounted sign supports shall be installed with the bottom edge of the sign approximately 100 mm [4 in] above the bottom of the bridge beam.

Sign panels mounted over the roadway shall tilt in the direction of the approaching traffic in such a manner that the angle between the sign face and the roadway grade, at the sign location shall be  $85^{\circ} \pm 3^{\circ}$ .

Ground-mounted signs located 1.2 m to 9 m [4 ft to 30 ft] from the edge of shoulder shall form an angle of  $93^{\circ}$  between the approach roadway and the sign.

Signs located more than 9 m [30 ft] from the edge of the shoulder shall form an angle between the approach roadway and the sign face equal to  $87^{\circ} - 1^{\circ}$  for each additional 3 m beyond 9 m [10 ft beyond 30 ft].

Unless otherwise shown on the plans, or designated by the Resident, a minimum lateral clearance of 1.2 m [4 ft] shall be provided between the edge of the shoulder and the edge of any sign panel.

The elevation of the bottom edge of guide sign panels shall be 2.1 m [7 ft] above the elevation of the edge of the traveled way, at the sign location, or in case of a curb section, 2.1 m [7 ft] above the elevation of the outer edge of the roadway, unless authorized otherwise.

Signs located 9 m [30 ft] or more from the edge of traveled way shall be 1.5 m [5 ft] above the elevation of the edge of shoulder.

In the event that a second sign is to be placed under the main sign, the elevation of the bottom edge of the principal sign shall be a minimum of 2.4 m [8 ft] above the outer edge of the traveled way, or a minimum of 2.4 m [8 ft] above the edge of the traveled way, in curbed sections; the bottom edge of the second sign must be at least 1.5 m [5 ft] above the edge of the traveled way.

The elevation of the bottom edge of the regulatory, warning and route marker sign panels shall be 1.8 m [6 ft] above the elevation of the edge of the pavement, or edge of roadway in curbed sections, at the sign location. The elevation of the bottom edge of these sign panels above the elevation of the edge of the pavement on all crossing or connecting roadways shall be 1.5 m [5 ft] in rural areas or 2.1 m [7 ft] in urban areas. Field conditions may require some variation in elevations, as directed.

Each sign shall have at least two fasteners connecting it to the sign poles, except signs of 300 mm [1 foot] or less in height may have one fastener.

645.061 Installation of Type II Signs The exact sign locations will be determined in the field. Signs stockpiled before erection shall be stored in a vertical position and completely covered to avoid staining, weathering, and dirt accumulation.

a. Sign Supports Support posts for Type II signs shall be U-channel posts weighing 3.7 kg/m [2½ pounds per foot] for signs of less than 0.58 m<sup>2</sup> [6.24 ft<sup>2</sup>] in area, 100 by 100 mm [4 in by 4 in] wood posts or two U-channel posts weighing 3.7 kg/m [2½ lb/ft] for signs of area 0.59 m<sup>2</sup> to 0.84 m<sup>2</sup> [6.24 ft<sup>2</sup> to 9 ft<sup>2</sup>], 100 mm by 150 mm [4 in by 6 in] wood posts for signs of area 0.85 m<sup>2</sup> to 1.49 m<sup>2</sup> [9 ft<sup>2</sup> to 16 ft<sup>2</sup>], and 150 mm by 150 mm [6 in by 6 in] wood posts for signs of area over 1.49 m<sup>2</sup> [16 ft<sup>2</sup>]. All signs 1500 mm [60 in] wide or wider shall be mounted on two wood posts. Wood posts shall be set to a depth of 1.2 m [4 ft]. U-channel posts shall be set to a minimum depth of 760 mm [30 inches]. Leading signs less than 0.84 m<sup>2</sup> [9 ft<sup>2</sup>] on the apex of islands will be installed on U-channel posts. When it is necessary to set sign posts in bedrock, holes shall be excavated to the required depth and

size at the locations indicated on the plans. The excavated material will be satisfactorily disposed of, as directed, and the posts set to the required depth.

When installing pressure-treated sign posts, the cut end of the posts shall not be buried in the ground.

Backfilling around the posts shall be with excavated material unless the excavated material is considered unsatisfactory, in which case the backfill shall be granular material conforming to the requirements of Section 703.19 - Granular Borrow. Backfill shall be thoroughly tamped in layers not exceeding 200 mm [8 in] in depth.

When directed, the area around the posts shall be loamed and seeded in accordance with the applicable provisions of Section 615 and Section 618.

The Contractor shall be responsible for and shall repair all damage to underground drainage structures, utilities, or lighting conduits encountered during placing the posts.

b. Mounting Type II signs shall be mounted using assembly hardware specified in Section 719.07.

645.062 Installation of Delineators Posts for delineators shall be erected so that posts and assemblies will be plumb. All posts, which are bent or otherwise damaged, shall be removed and properly replaced. Posts shall be driven 1200 mm [4 ft] from the outside edge of shoulder, 1200 mm [4 ft] from the face of curb and 1200 mm [4 ft] from the normal edge of shoulder in guardrail sections. A suitable driving cap shall be used and after driving, the top of the post shall have substantially the same cross sectional dimensions as the body of the post.

When bedrock is encountered in erecting posts, the depth to be drilled into the rock shall be determined by the Resident.

After the posts are driven, delineators shall be mounted 1200 mm [4 ft] above the elevation of the edge of the traveled way. In the event that a delineator is required to be installed on a bridge structure, it shall be installed by use of a bracket as shown on the plans.

645.063 Installation of Breakaway Devices Breakaway devices shall be installed at locations indicated on the plans by an approved method. Each sign and pole shall be carefully demounted for reinstallation at the same or at a new location. Manufacturer's installation information shall be provided on the project.

If required, poles shall be cut in such a manner that no rough edges will remain. No flame cutting will be permitted. Cut edges on steel poles shall be painted in accordance with Section 645.07.

Existing foundations shall be modified for attachment of the breakaway device as shown on the plans or approved.

Breakaway devices shall be attached to new foundations in accordance with the recommendations of the breakaway device manufacturer and as approved.

645.07 Demounting and Reinstalling Existing Signs and Poles Signs and poles designated to be demounted and not designated to be reinstalled, except those designated to be demounted by others, shall be delivered to the Resident.

Existing sign panels, poles, foundations, and sign hardware, damaged because of the Contractor's operations shall be replaced or repaired by the Contractor to the satisfaction of the Resident.

New or relocated regulatory, warning, confirmation or route marker assembly signs shall be installed the same working day as the corresponding existing signs are demounted. All new or relocated guide signs shall be installed within two working days of the time the corresponding existing sign is demounted. Before the Contractor demounts any regulatory or warning sign, they shall erect a similar easel mounted sign at a designated location. The Contractor shall maintain this temporary sign in place until the permanent sign is installed.

Existing signs and poles shall be reinstalled in accordance with the applicable requirements for installing new signs and poles.

Relocated steel posts and clamps shall be field painted two coats after the posts have been erected. The first coat shall be a zinc-dust primer paint meeting Federal Specification TT-P-641B Type II. The second coat shall be bright aluminum paint, aluminum-dust Type II, Class 3 brightness, meeting Federal Specification TT-A-468 with a minimum of 0.24 kg/L [2 lb/gal], with vehicle meeting or exceeding Federal Specification TT-V-109. Scratches shall be touched up after the erection of the sign panels. The touchup shall be with both primer and finish coat. Sign pole surfaces to be painted shall be cleaned and dry when the paint is applied. No painting shall be done in damp weather nor when the air temperature is below 4°C [40°F].

645.08 Method of Measurement Demount Signs, Demount Poles, Reinstall Signs, and Reinstall Poles will be measured by each unit.

Bridge, cantilever and butterfly type sign supports, including the foundations, support structures and sign panels, complete in place, as called for on the plans, will be measured by each unit.

Bridge Overpass-Mounted Guide Signs, including supports, will be measured by each unit in place.

Breakaway devices (1 per pole) shall be measured by the unit complete in place and accepted.

The area of roadside guide signs, regulatory, warning, confirmation and route marker assembly signs of the respective types, will be measured by the area in square meters [square

feet], computed to nearest hundredth of a square meter [0.01 ft<sup>2</sup>], as determined by the overall height multiplied by the overall width.

Aluminum poles for roadside guide signs, Type I will be measured by the number of units of each diameter, complete in place. Steel H-beam poles will be measured for payment by the kilogram [lb], determined from the nominal weight per meter [ft] for each size and the lengths as indicated on the plans.

Demountable reflectorized delineators will be measured by the number of units of each type in place.

645.09 Basis of Payment The accepted demounted signs and demounted poles will be paid for at the contract unit price each for the respective item specified. Such price will be full compensation for delivering signs and poles not to be reinstalled to a site designated by the Resident, and all other incidentals necessary to complete the work.

The accepted reinstalled signs or reinstalled poles will be paid for at the contract unit price each. Such price will be full compensation for furnishing new hardware, when required, and all incidentals necessary to complete the installations. All signs or poles designated to be reinstalled that are damaged by the Contractor shall be replaced by the Contractor with new signs or poles conforming to the applicable Specifications at no additional cost to the State.

The accepted bridge, cantilever and butterfly type sign supports will be paid for at the contract lump sum price for the respective items. Such price will be full compensation for the signs, support structures, foundations, and incidentals necessary to complete the work.

The accepted guide signs-overpass mounted, will be paid for at the contract lump sum price for the respective items, which price will be full compensation for the signs, supports and incidentals necessary to complete the work.

The accepted roadside guide signs and regulatory, warning, confirmation, and route marker assembly signs will be paid for at the contract unit price per square meter [ft<sup>2</sup>]. Such payment will be full compensation for furnishing and installing signs, assembly hardware, and all incidentals necessary to complete the work.

The accepted aluminum poles will be paid for at the contract unit price each for the specified diameter, complete in place.

The accepted demountable reflectorized delineators will be paid for at the contract unit price each for the type specified, which payment will be full compensation for delineator and post or bridge rail mounting, complete in place.

Payment for breakaway devices shall be full compensation for furnishing and installing the device, all required pole cutting, for adapting the pole to the breakaway device, for adapting the concrete base to the breakaway device and all other incidentals necessary to complete the work. Separate payment will be made at the respective contract unit prices for demounting and

reinstalling the signs and the poles at multi-pole installations. At single-pole installations, separate payment will be made at the respective contract unit prices for demounting and reinstalling the poles only.

The accepted quantity of steel H-beam poles will be paid for at the contract unit price per kilogram [lb], complete in place as shown on the plans or as designated.

Furnishing and installing posts for Type II signs, including earth excavation and backfilling, furnishing and placing assembly hardware, backfilling material, loam, seed and other incidentals, will not be paid for directly but will be considered incidental to the cost of the signs they support.

Excavating rock will be paid for as provided in Section 206.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
645.103 Demount Guide Sign	Each
645.106 Demount Regulatory, Warning, Confirmation and Route Marker Assembly Sign	Each
645.108 Demount Pole	Each
645.113 Reinstall Guide Sign	Each
645.116 Reinstall Regulatory, Warning, Confirmation and Route Marker Assembly Sign	Each
645.118 Reinstall Pole	Each
645.12 Overhead Guide Sign: (STA X + XXX)	Lump Sum
645.13 Bridge Overpass-Mounted Guide Sign: (STA X + XXX) (Left/Right XX)	Lump Sum
645.14 Special Work No.: _____	Lump Sum
645.15 Cantilever Guide Sign: (STA X + XXX)	Lump Sum
645.161 Breakaway Device Single Pole	Each
645.162 Breakaway Device Multi Pole	Each
645.251 Roadside Guide Signs, Type I	square meter [Square Foot]
645.261 Bridge Guide Sign, Type I	square meter [Square Foot]
645.271 Regulatory, Warning, Confirmation and Route Assembly Sign, Type I	square meter [Square Foot]
645.281 125 mm [5 Inches] Aluminum Pole	Each
645.282 150 mm [6 Inches] Aluminum Pole	Each
645.283 175 mm [7 Inches] Aluminum Pole	Each
645.284 200 mm [8 Inches] Aluminum Pole	Each
645.285 250 mm [10 Inches] Aluminum Pole	Each
645.286 300 mm [12 Inches] Aluminum Pole	Each
645.289 Steel H-Beam Poles	kilograms [Pounds]
645.291 Roadside Guide Signs Type II	square meter [Square Foot]

645.292	Regulatory, Warning, Confirmation and Route Marker Assembly Signs Type II	square meter [Square Foot]
645.301	Demountable Reflectorized Delineator, Single	Each
645.302	Demountable Reflectorized Delineator, Double	Each

SECTION 646 through 651 VACANT

SECTION 652 - MAINTENANCE OF TRAFFIC

652.1 Description This work shall consist of furnishing, installing, maintaining and removing traffic control devices necessary to provide reasonable protection for motorists, pedestrians and construction workers in accordance with these Specifications, the applicable provisions of Section 105.4.5 - Special Detours, and the plans.

Traffic control devices include signs, signals, lighting devices, markings, barricades, channelizing, and hand signaling devices, traffic officers, and flaggers.

652.2 Materials All traffic control devices shall conform to the requirements of Part VI of the latest edition of the MUTCD, and NCHRP 350 guidelines.

All signs shall be fabricated with high intensity retroreflective sheeting conforming to Section 719.01. All barricades, drums, and vertical panel markers shall be fabricated with high intensity orange and white retroreflective sheeting conforming to Section 719.01.

Construction signs shall be fabricated from materials that are flat, free from defects, retroreflectorized, and of sufficient strength to withstand deflections using a wind speed of 130 km/hr [80 miles/hr].

All barricades, cones, drums, and construction signs may be constructed from new or recycled plastic.

652.2.2 Signs Only signs with symbol messages conforming to the design of the Manual of Uniform Traffic Control Devices shall be used unless the Resident approves the substitution of word messages.

652.2.3 Flashing Arrow Board The flashing arrow board shall consist of at least 15 hooded amber sealed beam lamps arranged to present 4 horizontal messages; left arrow, right arrow, double arrow, and light bar only. In the three arrow signals, the second light from the arrow point shall not operate. The arrow shall be mounted on at least a 1200 mm by 2400 mm [4 ft by 8 ft] flat black board with the bottom of the sign approximately 2100 mm [7 ft] above ground.

Circuitry shall be solid state. The arrow board shall be equipped with a manual control and a solid state photocell control to reduce intensity a minimum of 50% when ambient light falls below 54 lx [5 foot candles].

Each flashing light shall use Lamp No. 4412 A, sealed beam par 46, 8800 candlepower with a flash rate of not less than 25 per minute, dwell time 50% per cycle.

Power for the flashing arrow board shall be from either a self-contained generator unit of sufficient power to operate the lamps at their rated output, or commercial power if available.

The flashing arrow board with generator and independent power drive shall be mounted on a pneumatic-tired trailer vehicle or other suitable support for hauling to various locations as directed.

652.2.4 Other Devices Vertical panel markers shall be orange and white striped, 200 mm wide by 600 mm high [8 in wide by 24 in high]. On the Interstate System, vertical panel markers shall be orange and white striped, 300 mm wide by 900 mm high [12 in wide by 36 in high].

Cones shall be orange in color, at least 710 mm [28 in] high, and retroreflectorized. Retroreflection shall be provided by a white band of retroreflective sheeting conforming to Section 719.01, 150 mm [6 in] wide, no more than 75 mm to 100 mm [3 in to 4 in] from the top of the cone, and a 100 mm [4 in] wide white band at least 50 mm [2 in] below the 150 mm [6 in] band.

Drums shall be of plastic or other yielding material, and shall be approximately 900 mm [36 in] high and a minimum of 450 mm [18 in] in diameter. There shall be at least two retroreflectorized orange and at least two retroreflectorized white stripes at least 100 mm [4 in] wide on each drum. Metal drums shall not be used.

Warning lights and battery operated flashing and steady burn lights shall conform to the requirements Section 712.23 - Flashing Lights.

STOP/SLOW paddles shall be the primary and preferred hand-signaling device. Flags shall be limited to emergencies. The paddle shall have an octagonal shape and be at least 450 mm [18 in] wide with letters at least 150 mm [6 in] high and should be fabricated from light semi-rigid material.

Type I barricades shall be 600 mm minimum, 2400 mm maximum [2 ft minimum, 8 ft maximum] in length with a 200 mm [8 in] wide rail mounted 900 mm [3 ft] minimum above the ground. Type II barricades shall be 600 mm [2 ft] in length with two 200 mm [8 in] wide rails, and the top rail shall be mounted 900 mm [3 ft] minimum above the roadway. Type III barricades shall be 2400 mm [8 ft] in length with three 200 mm [8 in] wide rails, and the top rail shall be mounted 1500 mm [5 ft] minimum above the roadway.

The cross members of all barricades shall be of 13 mm [ $\frac{1}{2}$  in] or 16 mm [ $\frac{5}{8}$  in] thick plywood or other lightweight rigid material such as plastic, fiberglass or fiberwood as approved by the Resident. The predominant color for supports and other barricade components shall be white, except that unpainted galvanized metal or aluminum components may be used.

The portable message sign shall be a Winko-matic, or an approved equal. The sign message shall have a minimum of three lines and eight characters per line. It shall have a minimum clear visibility of 275 m [900 ft]. The changeability of the sign message shall be done with so-called, LED technology. The sign shall be lighted from above and below the message for night use. The sign shall be mounted on a heavy duty trailer. The trailer shall have leveling jacks and a 50 mm [2 in] ball hitch. The sign shall have capability of being raised to a minimum of 2 m [7 ft] above the trailer, measured for the bottom of the sign. It shall be capable of being rotated 360° with respect to the trailer. The sign shall be solar powered. The controller shall be a high performance laptop computer with LCD display. It shall have a standard 72 Keyboard. The controller shall have the capability of a minimum 200 messages with a minimum 150 preprogrammed commonly used messages and 50 user created messages. It shall be enclosed in a weather proof cabinet on the trailer. The sign shall have the capability of flashing the message. There shall be a battery back-up power source in the event of failure.

## CONSTRUCTION REQUIREMENTS

652.3.1 Responsibility of the Department The Department will provide Project traffic requirements such as allowable lane or road closures, minimum temporary lane widths, work zone speed limits, timing limitations, and allowable special detours and temporary structures. No revisions to these requirements will be permitted unless the Contractor can thoroughly demonstrate an overall benefit to the public and a Contract Modification is approved.

652.3.2 Responsibility of the Contractor The Contractor shall provide continuous and effective traffic control and management for the Project that is appropriate to the construction means, methods, and sequencing allowed by the Contract and selected by the Contractor.

652.3.3 Submittal of Traffic Control Plan The Contractor shall submit, at or before the Preconstruction Meeting, a Traffic Control Plan (TCP) that provides the following information to the Department:

a. The name, telephone number, and other contact numbers (cellular phone, pager, if any) of the Contractor's employee (the "Responsible Person") with overall responsibility for following the TCP, and who is empowered to immediately resolve any traffic control deficiencies or issues.

b. Proposed construction phasing or sequencing that reasonably minimizes traffic impacts. The Contractor shall conduct the Work such that traffic delays do not exceed 5 minutes unless longer periods are authorized by the Department. The Contractor shall provide advance signing to warn motorists of expected traffic backups or queues.

c. A written narrative and/or plan explaining how traffic and pedestrians will be moved through the Project Limits, including transitions during the change from one phase of construction to the next, as applicable.

d. Temporary traffic control treatments at all intersections with roads, rail crossings, businesses, parking lots, pedestrian ways, bike paths, trails, residences, garages, farms, and other access points, as applicable.

e. A list of all certified flaggers to be used on the Project, together with the number of flaggers which will be used for each type of operation that flagging is needed. If the Contractor is using a flagging Subcontractor, then the name and address of the Subcontractor may be provided instead of a list of flaggers.

f. A procedure for notifying the Resident, local emergency officials, and local government officials (including the name and phone numbers of such officials) whenever significant traffic impacts are anticipated or occur. For a related provision, see Section 105.2.2 - Project Specific Emergency Planning.

g. A description of any special detours including provisions for constructing, maintaining, signing, and removing the detour or detours, including all temporary bridges and accessory features and complete restoration of the impacted land.

h. The maximum length of requested contiguous lane closure. The Contractor shall not close excessive lengths of traffic lane to avoid moving traffic control devices.

i. The proposed temporary roadway surface conditions and treatments. The Contractor shall provide an adequate roadway surface at all times; taking into account traffic speed, volume, and duration.

j. The coordination of appropriate temporary items (drainage, concrete barriers, barrier end treatments, impact attenuators, and traffic signals) with the TCP.

The Department will review the TCP for completeness and conformity with Federal requirements, Contract provisions, the current edition of the MUTCD, and Department policy and procedures. No review or comment by the Department, or any failure to review or comment, shall operate to absolve the contractor of its responsibility to design and implement the plan in accordance with the Contract, or to shift any responsibility to the Department. If the TCP is determined by the Department to be operationally ineffective, the Contractor shall submit modifications of the TCP to the Department for review, and shall implement these changes at no additional cost to the Contract. Nothing in this Section shall negate the Contractor's obligations set forth in Section 110 - Indemnification, Bonding, and Insurance.

652.3.4 General Prior to starting any work on any part of the project adjacent to or being used by the traveling public, the Contractor shall install the appropriate traffic control devices in accordance with the plans, specifications and the latest edition of Manual of Uniform Traffic Control Devices, Part VI. The Contractor shall continuously maintain the traffic control devices

in their proper position, and they shall be kept clean, legible and in good repair throughout the duration of the work. If notified that the traffic control devices are not in place or not properly maintained, the Contractor may be ordered to immediately suspend work until all deficiencies are corrected.

No equipment or vehicles of the Contractor, their subcontractors, or employees engaged in work on this contract shall be parked or stopped on lanes carrying traffic, or on lanes or shoulders adjacent to lanes carrying traffic, at any time, except as required by ongoing work operations. Contractor equipment or vehicles shall never be used to stop, block, or channelize traffic.

The Contractor shall not store material or park equipment within 4.6 m [15 ft] of the edge of the established travel lanes. Equipment parked overnight between 4.6 and 9.1 m [15 and 30 ft] of the edge of the travel lane shall be placed behind positive barriers if feasible, or clearly marked by channelizing devices or other reflective devices.

Channelization devices shall include Vertical Panel Markers, Barricades, Cones, and Drums. These devices shall be installed and maintained at the spacing determined by the MUTCD through the work area.

Channelization devices consisting of barricades or drums, at a maximum spacing of 15 m [50 ft], shall be used in guardrail areas when neither the existing guardrail nor the new guardrail is in place. The Contractor shall not remove guardrail until absolutely necessary for construction operations in that area. The guardrail shall be replaced as soon as possible thereafter.

All excavation areas adjacent to the roadway shall be channelized continuously in both directions for the length of the project in all areas where the centerline strip is not effective in accordance with the latest edition of the MUTCD.

Where the roadway is adjacent to an area being excavated, a minimum 600 mm [2 ft] shoulder should be maintained and the effective slope of the earth excavation beyond the 600 mm [2 ft] shoulder shall not be steeper than a 1½ horizontal to 1 vertical. The effective slope of rock excavation shall not be steeper than 1 horizontal to 1 vertical beyond the 600 mm [2 ft] shoulder. In the case of cuts over 1.5 m [5 ft] deep, an earth berm or other approved barrier shall be placed between the travel lane and the excavated area. In this instance, travel speeds shall be limited by specific advisory signing to 20 miles per hour in all cases. When excavation does not leave sufficient usable widths to maintain two-way traffic as provided in Section 105.4 - Maintenance of Work, one-lane traffic controlled by a traffic signal or continuous flagging may be considered. Closely spaced vertical panels, drums or other channelizing devices shall be used on any of these types of areas that are left exposed for short durations.

When paving operations or shoulder grading leave a 75 mm [3 in] or less exposed vertical face at the edge of the traveled way, channelization devices shall be placed 0.61 m [2 ft] outside the edge of the pavement at intervals not exceeding 183 m [600 ft] and a 1.2 m by 1.2 m [48 in by 48 in] W8-9 Low Shoulder sign shall be placed at a maximum spacing of 0.80 km [½ mile].

When paving operations or shoulder grading leave greater than a 75 mm [3 in] exposed vertical face at the edge of the traveled way, the Contractor shall place shoulder material for a width of at least 1.2 m [4 ft] to meet the pavement grade, and place channelizing devices as above, before the lane is opened to traffic.

Special Detours and temporary structures, if used, shall meet applicable AASHTO standards, including curve radii and grade.

652.3.5 Installation of Traffic Control Devices Signs shall be erected on temporary sign supports approved crashworthy devices in conformance with NCHRP 350 requirements so that the bottom of the sign is either 1) 300 mm [12 in] or 2) greater than 1.5 m [5 ft] above the traveled way. Post-mounted signs shall be erected so the bottom of the sign is no less than 1500 mm [5 ft] above the traveled way, and 2100 mm [7 ft] above the traveled way in business, commercial, and residential areas. Signs must be erected so that the sign face is in a true vertical position. All signs shall be placed so that they are not obstructed in any manner and immediately modified to ensure proper visibility if obstructed. Signs may be mounted lower or higher to fit the situation when authorized by the Resident. Cones shall be either weighted or nailed. Tires will not be allowed as weights.

Vertical panel markers shall be mounted with the top at least 1200 mm [4 ft] above the traveled way.

Drums shall not be weighted on the top. Drain holes shall be provided to prevent water from accumulating in the drums. Drums may be weighted with up to 150 mm [6 in] of loose dry sand.

The Contractor shall operate and maintain the flashing arrow board unit and trailer and shall continuously supply fuel and lubrication for dependable service during the life of the contract. The units shall remain in continuous night and day service at locations designated until the Resident designates a new location or discontinuance of service.

The Contractor shall maintain the devices in proper position and clean them as necessary. Maintenance shall include the covering and uncovering of all signs when no longer applicable (even if for a very short duration). The sign shall be considered adequately covered when no part of the sign face is visible either around or through the covering.

The Contractor shall replace damaged traffic control devices with devices of acceptable quality, as directed by the Resident.

652.3.6 Traffic Control The Contractor shall provide a minimum roadway width of 6.7 m [22 ft] for two-way traffic and 3.4 m [11 ft] for one-way traffic. The existing travelway width shall be maintained to the maximum extent practical. Vertical panel markers, drums, cones, or striping shall be used to clearly delineate the roadway through the construction area. Two-way traffic operation shall be provided at all times that the Contractor is not working on the project. One-way traffic shall be controlled through work areas by flaggers, utilizing radios, field telephones, or other means of direct communication.

The traffic control devices shall be moved or removed as the work progresses to assure compatibility between the uses of the traffic control devices and the traffic flow. Traffic control devices that become unnecessary shall be immediately removed from use.

Pavement markings shall be altered as required to conform to the existing traffic flow pattern. Repainting of pavement marking line, if required to maintain the effectiveness of the line, shall be considered maintenance of traffic control devices. No separate payment will be made. Inappropriate existing pavement markings shall be removed whenever traffic is rerouted, and temporary construction pavement markings shall be placed. Obliteration and removal of non-applicable markings and placement of temporary construction pavement markings shall be considered maintenance of traffic control devices and will be paid for under the appropriate Contract item. Traffic changes shall not be made unless there is sufficient time, equipment, materials, and personnel available to complete the change properly before the end of the workday. This provision will not be required when traffic is rerouted for brief periods during daylight hours and the route can be clearly defined by channelizing devices, or flaggers, or both.

652.4 Flaggers The Contractor shall furnish flaggers as required by the TCP or as otherwise specified by the Resident. All flaggers must have successfully completed a flagger test approved by the Department, and administered by a Department-approved Flagger-Certifier. All flaggers must carry an official certification card with them while flagging. Flaggers shall wear a vest, shirt, or jacket that is orange, yellow, yellow-green, or fluorescent versions of these colors, together with a hardhat with reflectivity. For nighttime conditions, similar outside garments shall be retroreflectorized, and shall be visible at a minimum distance of 300 m [1000 ft]. Lighted hand signal equipment shall be used, and the flagger station illuminated as needed, to assure visibility.

Flagger stations shall be located far enough in advance of the workspace so that approaching road users will have sufficient distance to stop before entering the workspace. While flagging, the flagger should stand either on the shoulder adjacent to the traffic being controlled, or in the closed lane. At a spot obstruction, the flagger may stand on the shoulder opposite the closed sections to operate effectively. Under no circumstances shall the flagger stand in the lane being used by moving traffic or have their back to oncoming traffic. The flagger should be clearly visible to approaching traffic at all times and should have a clear escape route.

When conditions do not allow for proper approach sight distance of a flagger or storage space for waiting vehicles, additional flaggers shall be used at the rear of the backlogged traffic or at a point where approaching vehicles have adequate stopping sight distance to the rear of the backlogged traffic. All flagger stations shall be signed, even when in close proximity. The signs shall be removed or covered when flagger operations are not in place, even if it is for a very short duration.

Flaggers shall be provided 10 minute breaks every two hours, and a lunch period away from the workstation. The Contractor shall furnish sufficient spare trained flaggers to provide continuous flagging during required or necessary breaks and during lunch periods.

652.41 Traffic Officers Traffic officers will be uniformed police officers.

652.5 Warning Lights Warning lights shall be installed at locations designated by the Resident before any work is done on the portions of roadway being used by traffic. Upon installation, all warning lights shall remain in continuous operation during the life of the project, unless otherwise authorized by the Resident.

When a suitable 120-volt AC power service source is available within 150 m [500 ft] of the designated warning light location, power operated flashing lights shall be installed. Two alternately flashing lamps shall be mounted approximately 600 mm [24 in] above the sign, spaced approximately 600 mm [24 in] apart.

When a suitable 120-volt AC power service source is not available, battery operated flashing lights may be erected. Four flashing lamps shall be mounted approximately 150 mm [6 in] above the sign, spaced approximately 300 mm [12 in] apart.

The power service connections shall be installed to the satisfaction of both the power company and the Resident. The Contractor shall make all necessary arrangements for the power service connections and be responsible for all charges incurred thereby, including power charges. The Contractor shall also be responsible for all outstanding bills from the electric power company for preliminary work done by the electric company for the power service connection.

When batteries are required for battery operated flashing lights, they shall be provided and replaced by the Contractor as necessary.

652.6 Night Work When work is scheduled during the hours of dusk or darkness, the Contractor shall provide and maintain lighting on all equipment and at all work stations.

The lighting facilities shall be capable of providing light of sufficient intensity (20 foot-candle, minimum) to permit good workmanship, safety and proper inspection at all times. The lighting shall be cut off and arranged on stanchions at a height that will provide perimeter lighting for each piece of equipment and will not interfere with traffic, including commercial vehicles, approaching the work site from either direction.

The Contractor shall have available portable floodlights for special areas.

The Contractor shall utilize padding, shielding or other insulation of mechanical and electrical equipment, if necessary, to minimize noise, and shall provide sufficient fuel, spare lamps, generators, etc. to maintain lighting of the work site.

The Contractor shall submit a lighting plan at the Preconstruction Conference, showing the type and location of lights to be used for night work. The Resident may require modifications be made to the lighting set up in actual field conditions.

The Contractor shall furnish approved signs reading "Construction Vehicle - Keep Back" to be used on trucks hauling to the project when such signs are deemed necessary by the Resident. The signs shall be a minimum of 750 mm by 1500 mm [30 in by 60 in], Black and Orange,

Type III FP-85. The older type “Construction Vehicle - Do Not Follow” signs may be used until the end of their service life.

All vehicles used on the project shall be equipped with amber flashing lights, visible from both front and rear, or by means of single, approved type, revolving, flashing or strobe lights mounted so as to be visible 360°. The vehicle flashing system shall be in continuous operation while the vehicle is on any part of the project.

Payment for lighting, vehicle mounted signs and other costs accrued because of night work will not be made directly but will be considered incidental to the related contract items.

652.7 Method of Measurement Signs and panel markers will be measured by the square meter [square foot] for all signs authorized and installed. Flashing arrow boards, portable-changeable message signs, and flashing and steady burn lights, will be measured by each unit authorized and installed on the project. Barricades, drums, and cones will be measured by each unit authorized. No additional payment will be made for devices that require replacement due to poor condition or inadequate retroreflectivity.

The accepted quantity of traffic officer and flagger time will be the number of hours the designated station is occupied. The number of hours authorized for payment will be measured to the nearest ¼ hour.

Maintenance of traffic control devices will be measured by the calendar day or as one lump sum for all authorized and installed traffic control devices.

Warning lights will be measured by the group of lights furnished.

652.8 Basis of Payment The accepted quantity of signs and panel markers will be paid for at the contract unit price per square meter [square foot]. Such payment will be full compensation for furnishing and installing all signs, sign supports, and all incidentals necessary to complete the installation of the signs.

The accepted quantity of flashing arrow boards, portable-changeable message signs, barricades, battery operated flashing and steady burn lights, drums, and cones will be paid for at the contract unit price each for the actual number of devices authorized, furnished, and installed. Such payment shall be full compensation for all incidentals necessary to install and maintain the respective devices.

#### 652.8.1 Maintenance of Traffic Control Devices

652.8.1.1 Payment by Calendar Day Maintenance of Traffic Control Devices will be paid for at the contract unit price per calendar day for each calendar day that the Contractor maintains traffic as specified herein. Such payment will be full compensation for moving devices as many times as necessary; for replacing devices damaged, lost, or stolen; and for cleaning, maintaining, and removing all devices used for traffic control, including replacing temporary pavement marking lines.

The contract unit price per calendar day for Maintenance of Traffic Control Devices shall be full payment each day for such maintenance, encompassing all areas of the contract, regardless of whether or not the work areas or projects are geographically separated.

652.8.1.2 Payment by Lump Sum Maintenance of Traffic Control Devices will be paid at the contract lump sum price. Such payment will be full compensation all days that the Contractor maintains traffic as specified herein, and for moving devices as many times as necessary; for replacing devices damaged, lost, or stolen; and for cleaning, maintaining, and removing all devices used for traffic control, including replacing temporary pavement marking lines.

The contract lump sum price for Maintenance of Traffic Control Devices shall be full compensation for all days for such maintenance, encompassing all areas of the contract, regardless of whether or not the work areas or projects are geographically separated.

652.8.2 Other Items The accepted quantities of flagger hours will be paid for at the contract unit price per hour for each flagging station occupied, with no additional payment for overtime. The contract unit price shall be full compensation for hiring, transporting, equipping, supervising, and the payment of flaggers and all overhead and incidentals necessary to complete the work.

The accepted quantities of traffic officer hours will be paid for at the contract unit price per hour for each station occupied, with no additional payment for overtime. This price shall be full compensation for supplying uniformed officers with police cruisers, and all incidentals necessary to complete the work; including transportation, equipment, and supervision.

The accepted quantities of warning lights will be paid for at the contract unit price, per group, complete in place including the necessary power, and remaining in operation during active work of the project or as otherwise directed. Upon completion of the work, the lamps, fixtures, and the framework required to properly mount the lamps shall remain the property of the Contractor.

Payment for temporary pavement marking lines and pavement marking removal will be made under the respective pay item in Section 627 - Pavement Markings.

Payment for temporary traffic signals will be made under Section 643 - Traffic Signals.

There will be no payment made under the pay items in Section 652 - Maintenance of Traffic, for devices furnished or maintenance work required after the expiration of the adjusted total contract time.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
652.30 Flashing Arrow	Each

652.31	Type I Barricade	Each
652.311	Type II Barricade	Each
652.312	Type III Barricades	Each
652.32	Battery Operated Light	Each
652.33	Drum	Each
652.34	Cone	Each
652.35	Construction Signs	square meter [Square Foot]
652.36	Maintenance of Traffic Control Devices	Calendar Day
652.361	Maintenance of Traffic Control Devices	Lump Sum
652.37	Warning Lights	Group
652.38	Flaggers	Hour
652.381	Traffic Officers	Hour
652.41	Portable-Changeable Message Sign	Each

### SECTION 653 - POLYSTYRENE PLASTIC INSULATION

653.01 Description This work shall consist of furnishing and installing a polystyrene plastic insulating layer at locations designated on the plans in accordance with these specifications.

653.02 General Insulating material shall be extruded polystyrene insulating board conforming to the requirements of AASHTO M230.

Pegs shall be hard wood, approximately 150 mm by 6 mm [6 in by ¼ in] round, pointed on one end.

653.03 Preparation of Foundation The insulating boards shall be placed on a compacted layer of granular material graded to a tolerance of 13 mm [½ in] above or below the required grade and cross section. The surface shall be free of rocks that would cause damage to the insulating boards. The type and thickness of the granular material will be as shown on the plans.

653.04 Placing Insulating Boards The insulating boards shall be secured to the ground with pegs placed at each corner or where directed by the Resident, and driven flush with the surface of the insulating board. Joints between the insulating boards shall be staggered. The openings in all joint shall be kept to a minimum.

653.05 Placing Backfill After the insulating boards have been placed, granular material shall be placed using care to avoid pushing or puncturing the boards. The depth of the first layer of aggregate subbase sand shall not be less than 150 mm [6 in] loose measure. The aggregate subbase sand shall be spread with a crawler type bulldozer of not more than 390 kg/m<sup>2</sup> [80 lb/ft<sup>2</sup>] ground contact pressure or with other approved equipment but not supported directly on the insulating boards. Trucks and other heavy construction equipment shall not be operated directly on the insulating boards. The type and thickness of granular material will be shown on the plans.

653.06 Compaction Compaction of the first layer of aggregate subbase sand shall be by vibratory methods to the satisfaction of the Resident. After the first layer has been compacted, normal construction practices may be followed providing no loads are placed on the area which produce more than 390 kg/m<sup>2</sup> [80 lb/ft<sup>2</sup>] ground contact pressure.

653.07 Protection of Polystyrene Since gasoline, oil, heat, and sunlight will damage polystyrene, all precautions shall be taken to prevent them from damaging the insulating board. The insulating boards shall not be stored in sunlight for more than one day.

653.08 Method of Measurement Polystyrene plastic insulation will be measured by the square meter [square yard] in place.

653.09 Basis of Payment The accepted quantities of polystyrene plastic insulation will be paid for at the contract unit price per square meter [square yard] complete in place. Payment shall be full compensation for and for furnishing and placing the insulating boards of pegs.

Payment will be made under:

	<u>Pay Item</u>	<u>Pay Unit</u>
653.20	25 mm [1 in] Polystyrene Plastic Insulation	square meter [Square Yard]
653.21	38 mm [1½ in] Polystyrene Plastic Insulation	square meter [Square Yard]
653.22	50 mm [2 in] Polystyrene Plastic Insulation	square meter [Square Yard]
653.23	75 mm [3 in] Polystyrene Plastic Insulation	square meter [Square Yard]

SECTION 654 - VACANT

SECTION 655 - ELECTRICAL WORK

Reserved

SECTION 656 - TEMPORARY SOIL EROSION AND WATER POLLUTION CONTROL

656.1 Responsibility of the Contractor-Prepare and Follow Plan The Contractor shall provide continuous and effective temporary soil erosion and water pollution control for the Project that is appropriate to the construction means, methods and sequencing allowed by the Contract and selected by the Contractor. To do so, the Contractor shall prepare and submit a Soil Erosion and Water Pollution Control Plan (SEWPCP) and properly implement its approved SEWPCP. The Contractor shall have its SEWPCP approved, perform a preconstruction field review, and install and certify initial controls before commencing any Work, which could disturb soils or impact water quality.

If the Contractor properly implements its approved SEWPCP, then (1) any Work required in excess of that required by the SEWPCP will be Extra Work, (2) any Delay resulting from any such excess Work will be analyzed in accordance with Section 109.5 - Adjustments for Delay, and (3) the Contractor will not be responsible for damages relating to insufficient soil erosion and water pollution control including the cost of all environmental enforcement actions, penalties, or monetary settlements assessed any environmental regulatory entity and all costs incurred by or through the Department.

If the Contractor fails to prepare, submit, or seek approval of a SEWPCP or fails to properly implement its approved SEWPCP, then (1) the Department may suspend all Work, (2) the Department may withhold all Progress Payments or any portion thereof until the Contractor remedies all deficiencies; (3) the Department may remedy deficiencies with Departmental or contracted forces and deduct the cost thereof from payments otherwise due the Contractor; (4) any delay resulting from such failure or non-compliance will be a Non-excusable Delay; and (5) the Contractor will be responsible for all damages arising from or related to such failure or non-compliance including the cost of all environmental enforcement actions, penalties, or monetary settlements assessed by any environmental regulatory entity and all costs incurred by or through the Department including legal and consulting fees.

656.2 Submittal and Approval of the SEWPCP Within 21 calendar days of Contract Execution, the Contractor must submit two copies of its SEWPCP to the Resident.

Within 14 days of receipt, the Department will determine if the SEWPCP is in accordance with the Contract requirements and (1) notify the Contractor that its SEWPCP is approved or (2) return it for any needed revisions. If returned for revision, the Contractor must resubmit two copies of its revised SEWPCP as provided above within 7 days and the Department will have 7 days from receipt of the revised plan to notify the Contractor whether its SEWPCP is approved or again requires revision. Additional iterations will occur in a like manner until the Department approves the Contractor's SEWPCP. The Contractor must have its SEWPCP approved and implemented before commencing any Work, which could disturb soils or impact water quality.

## SEWPCP REQUIREMENTS

656.3.1 Qualifications of Preparer The preparer of the SEWPCP must be knowledgeable and experienced in erosion and pollution control and must (1) be a "DEP Certified Contractor" as designated by the Maine Department of Environmental Protection (MDEP), or (2) be licensed in Maine as a Professional Engineer, Landscape Architect, or Soil Scientist.

656.3.2 Standards The SEWPCP must be in accordance with all applicable laws, rules, regulations, permit requirements and conditions, this specification, all other contractual provisions, and the latest version of Department's "Best Management Practices for Erosion & Sedimentation Control" (the "BMP Manual"). In the event of conflicting provisions, the SEWPCP must utilize the more restrictive requirements. If the Work could disturb soils in the watersheds of any sensitive waterbodies identified in the Contract Documents or listed in Appendix A of the BMP Manual, then the SEWPCP must be in accordance with the higher

standards for soil erosion and water pollution contained in Section II (B) - "Guidelines for Sensitive Waterbodies" of the BMP Manual.

656.3.3 General SEWPCP Elements In addition to other requirements provided for or referenced in this specification, the SEWPCP must include the following elements.

- a. The name and qualifications of the person preparing the SEWPCP.
- b. The name of the on-site person, the "Environmental Coordinator", responsible for implementation of the SEWPCP, who must be the Prime Contractor's Superintendent or other supervisory employee with the authority to immediately remedy any deficient controls, with their phone number and emergency number (personal cellular phone or pager).
- c. The schedule and sequence of all activities that involve soil disturbance including work on sites outside the right-of-way such as borrow pit operations, haul roads, staging areas, equipment storage sites, mixing plants, and waste disposal sites including expansion of existing sites.
- d. Incorporation of permanent erosion control features into the project at the earliest practicable time.
- e. Identification of steep slopes and highly erodible soils, with the method and frequency of soil stabilization.
- f. Emergency procedures for storms, including availability of Materials and procedures and time frames for corrective action if controls fail.
- g. A discussion of how the SEWPCP meets or exceeds the Standards and Commitments contained in Section II of the BMP Manual.
- h. Type and location of all temporary erosion and sedimentation control measures. Temporary winter stabilization must be used between November 1 and April 1, or outside of said time period if the ground is frozen or snow covered. Temporary winter stabilization involves, at a minimum, covering all disturbed soils with some method other than using unanchored hay or straw mulch. Such other methods may include the use of Erosion Control Mix or other covers that are not susceptible to erosion or wind movement. If temporary winter stabilization practices are used, spring procedures for permanent stabilization shall also be described in the SEWPCP.
- i. Mulching type and frequency of application for disturbed soil areas.
- j. Location and frequency of application of temporary seeding.
- k. Description of all dust control procedures for roadways, haul roads, work areas, and all other contractor activities.

l. Location and method of temporary sediment control for existing and proposed catch basins and all other drainage inlet and outlet areas.

m. Describe all in-stream work, with timing and plans for temporary stream diversions and cofferdams.

n. Describe the design, location, and plans for sedimentation basins used for dewatering cofferdams.

o. Inspection and maintenance schedules for all erosion and water pollution control measures - temporary and permanent - including the method, frequency and disposal location for sediment removal.

p. Temporary erosion control features for any designated mitigation site that is specified in the Contract.

q. Procedures for removal of temporary erosion and pollution controls.

656.3.4 Water Pollution Control Requirements In addition to other requirements provided for or referenced in this specification, the SEWPCP must include all of the following requirements applicable to water pollution control.

a. The Contractor must comply with the applicable federal, state, and local laws, and regulations relating to prevention and abatement of water pollution.

b. Except as allowed by an approved permit or otherwise authorized by the Department in writing, pollutants and construction debris including excavated material, aggregate, residue from cleaning, sandblasting, or painting, cement mixtures, chemicals, fuels, lubricants, bitumens, raw sewage, wood chips, and other debris shall not be discharged into waterbodies, wetlands, or natural or man-made channels leading thereto and such materials shall not be located alongside waterbodies, wetlands, or such channels such that it will be washed away by high water or runoff.

c. Construction operations in waterbodies or wetlands shall be restricted to the construction limits shown on the plans and to those areas that must be entered for the construction of temporary or permanent structures, except as allowed by approved permit or otherwise authorized by the Department in writing.

d. Mechanized equipment shall not be operated in waterbodies or wetlands, except as allowed by approved permit or otherwise authorized by the Department in writing.

e. Upon completion of the work, waterbodies or wetlands shall be promptly cleared of all falsework, piling, debris or other obstructions caused by the construction operations, except as otherwise authorized by the Department in writing.

f. Spill Prevention. If the Work includes the handling, use, or storage of petroleum products or hazardous Matter/Substances including the on site fueling of Equipment, the SEWPCP must include a Spill Prevention Control and Countermeasure Plan (SPCCP). At a minimum, the SPCCP must include:

1. The name and emergency response numbers (telephone number, cellular phone and pager numbers, if applicable) of the Contractor's representative responsible for spill prevention and response;

2. General description and location of (1) handling, transfer, storage, and containment facilities of such products or hazardous Matter/Substances ("activities and facilities") and (2) potential receptors of such products or hazardous Matter/Substances including oceans, lakes, ponds, rivers, streams, wetlands, and sand and gravel aquifers ("sensitive resources") including the distances between said activities and facilities and said sensitive resources;

3. Description of preventative measures to be used to minimize the possibility of a spill including Equipment and/or Materials to be used to prevent discharges including containment and diversionary structures, inspections and personnel training;

4. A contingency response plan to be implemented if spill should occur including a list of emergency phone/pager numbers including the Contractor's representative, MDEP Spill Response, the Resident, and local police and fire authorities, a list of emergency response equipment and locations and a description of the capabilities of the equipment, a description of the general response and clean up protocols by product or Matter/Substances and an overview of the verbal and written notification procedures for federal, state and local officials. For a related provision, see 105.2.2 - "Project Specific Emergency Planning".

For a related provision, see Section 105.8.3 - "Wetland and Waterbody Impacts".

656.3.5 Material Requirements Unless otherwise approved by the Department, the Contractor must use temporary erosion control Materials contained on the Department's Preapproved List of Erosion Control Materials if such a list is established, the Department's latest BMP Manual, or Section 717 - Roadside Improvement Materials.

656.3.6 Construction Requirements In addition to other requirements provided for or referenced in this specification, the SEWPCP must include all of the following requirements applicable during construction.

a. The Contractor shall install and maintain all temporary erosion control Materials in accordance with the manufacturer's recommendations, or the Department's latest BMP's or Standard Specifications where applicable.

b. The Contractor shall perform in-stream work during low flow conditions, except as allowed by a specific Permit requirement. During in-stream work, the Contractor shall

maintain water flow at all times except in ponded water or where specifically authorized. The Contractor, to the maximum extent practicable, shall place pipes in dry conditions.

c. The Contractor, to the maximum extent practicable, shall install temporary and permanent erosion control measures prior to conducting clearing and grubbing operations. The Contractor shall not conduct clearing operations within any protected vegetative buffer area indicated in the plans, notes, or special provisions. The Contractor shall limit excavation, borrow and embankment operations commensurate with its capability and progress in keeping the finish grading, mulching, seeding, and other such temporary and permanent erosion control measures current in accordance with its schedule. Should seasonal limitations make such coordination impractical, temporary erosion control measures shall be provided immediately.

d. The Contractor shall not work in a wetland, except as allowed by a specific permit provision. All equipment which must work in a wetland shall travel and work on platforms or mats that protect vegetation which the Department has designated to remain. The Contractor shall not store or stockpile materials in a wetland. The Contractor shall contain and immediately remove from the wetland or waterbody any debris generated by the Work

e. The Contractor shall not place uncured concrete directly into a waterbody. The Contractor shall not wash tools, forms, or other items in or adjacent to a waterbody or wetland.

f. The Contractor shall contain all demolition debris (including debris from wearing surface removal, saw cut slurry, dust, etc.) and shall not allow it to discharge to any resource. All demolition debris shall be disposed of in accordance with Section 202.03 - Removing Existing Superstructure, Structural Concrete, Railings, Curbs, Sidewalks and Bridges. The Contractor shall dispose of debris in accordance with the Maine Solid Waste Law, Title 38 M.R.S.A., Section 1301 et. seq. Containment and disposal of demolition debris shall be addressed in the Contractor's SEWPCP.

g. The Contractor shall air dry all treated lumber for at least 21 days before use. All treated timber surfaces shall be exposed during air-drying.

h. The Contractor shall place all permanent seeding in accordance with Section 618 - Seeding unless the Contract states otherwise. The Contractor shall state what additional measures they will employ for soil stabilization between November 1<sup>st</sup> and April 1<sup>st</sup>.

i. The Contractor shall not remove rocks from below the normal high water line of any wetland, great pond, river, stream, or brook, except to the extent necessary for completion of the Work and as allowed by environmental permits. The Contractor shall not work below the high water line of a great pond, river, stream, or brook during periods of elevated water, except as necessary to protect work in progress or for emergency flood control and as allowed by environmental permits.

j. During periods of approved suspension, the Contractor shall inspect and maintain temporary and permanent erosion controls in accordance with its approved SEWPCP.

k. All sites of disturbed soil outside the right-of-way such as haul roads, staging areas, Equipment storage sites, mixing plants, and waste disposal sites including expansion of existing sites shall be graded smooth, loamed, seeded, and mulched upon completion of the work. For a related provision, see Section 105.8.6 - Pit Requirements.

## IMPLEMENTATION OF SEWPCP

656.4.1 Preconstruction Field Review Before commencing any Work, that could disturb soils or impact water quality, the preparer of the SEWPCP and the Environmental Coordinator must field review the project. The Contractor shall provide the Department at least three days prior notice of this review.

656.4.2 Preconstruction Installation of Controls/Certification Before commencing any Work, which could disturb soils or impact water quality, initial soil erosion and water pollution controls must be installed in compliance with the Contractor's SEWPCP and the Environmental Coordinator must so certify to the Department in writing.

656.4.3 Follow Plan Until Acceptance of the Work, the Contractor must continuously provide soil erosion and water pollution controls in compliance with its approved SEWPCP as amended, if necessary, and in compliance with Section 656.4.5 - Additional Measures/Amendment of SEWPCP.

656.4.4 Inspection and Record Keeping The Environmental Coordinator must inspect and monitor all controls for the duration of the project and keep a written log. This log must include daily on-site precipitation and air temperature, as well as the performance, failure, and any corrective action for all controls in place. The log must be updated at least weekly and after all significant storm runoff and flood events. The Environmental Coordinator must make this log available to the Department upon request. The Contractor will retain the log for three years after the completion of the project.

656.4.5 Additional Measures/Amendment of SEWPCP If there exists observable evidence of erosion or sedimentation despite the installation of all controls in compliance with the Contractor's approved SEWPCP, then the Contractor must undertake such additional measures as are necessary to stop such erosion and prevent further erosion or sedimentation. Observable evidence of erosion or sedimentation includes visible sheet, rill, or gully erosion, discoloration of water by suspended particles, areas of sediment accumulation, slumping of banks, deposition of soil, and visible dust. Such additional measures must be undertaken within 24 hours and completed within 48 hours from the time such evidence is observed, unless otherwise authorized by the Department. Within 7 days of that time, the Contractor must submit an amendment to its SEWPCP setting forth the apparent cause of the erosion or sedimentation and the additional measures undertaken and that will continue to be undertaken. If the Contractor complies with the requirements of this Section, all additional measures and the amendment of the SEWPCP

will be Extra Work and any Delay resulting from the additional measures will be analyzed in accordance with Section 109.5 - Adjustments for Delay.

656.4.6 Duration of Contractor's Responsibility The Contractor shall provide temporary soil erosion and water pollution controls in compliance with its SEWPCP and maintain all permanent control features until Acceptance of the Work. Once final surface treatments are established, the Contractor is responsible for removal of all temporary sedimentation control practices such as silt fence. Notwithstanding the preceding sentence, all work needed to remedy damage to properly installed and maintained permanent control features caused by a weather-related Uncontrollable Event shall be Extra Work.

## PAYMENT

656.5.1 If Pay Item 656.75 Provided If the Schedule of Items contains Pay Item 656.75 for Temporary Soil Erosion and Water Pollution Control, payment will be made on a Lump Sum basis, payment of which will constitute full and complete compensation for all labor, equipment, materials, inspection, professional services, and incidentals necessary to prepare, submit, obtain approval of, and properly implement the Contractor's SEWPCP. The Lump Sum will be payable in installments as follows: 10% of the Lump Sum once the final SEWPCP is approved and the initial soil erosion and water pollution controls are in place and certified by the Contractor, with the 90% balance to be paid as the Work progresses at a rate proportional to the percentage completion of the Contract.

Failure by the Contractor to comply with its SEWPCP and/or failure to implement additional measures will result in a reduction in payment, computed by reducing the 90% balance (a) by the number of days deficient divided by the number of days from start of work to project completion or (b) \$100 for each day deficient, whichever is greater. Payment may be further adjusted as provided in Section 656.1 - Responsibility of the Contractor - Prepare and Follow Plan.

Cofferdams and related temporary soil erosion and water pollution controls are incidental to the Pay Item 656.75, unless a specific pay item for cofferdams is included in the Schedule of Items. If a specific pay item for cofferdams is included, then related temporary soil erosion and water pollution controls, including inspection and maintenance, are incidental to the pay item for cofferdams.

656.5.2 If No Pay Item If Pay Item 656.75 is not provided in the Schedule of Items, then the cost related thereto shall be Incidental to the Contract.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
656.75 Temporary Soil Erosion and Water Pollution Control	Lump Sum

## SECTION 657 - REHABILITATION OF PITS

657.01 Description This work shall consist of grading and treating the surface of pit areas in accordance with these specifications and as directed.

657.02 Materials Materials shall meet the requirements specified in the following Sections of Division 700 - Materials:

Fertilizer	717.01
Agricultural Ground Limestone	717.02
Seed	717.03

Seed shall be in accordance with the provisions for Method No. 2. When used for the rehabilitation of areas except loam and sod fields, the following seed shall be added to each 45 kg [100 lb] of the seed mixture: 2 kg [5 lb] of Orchard Grass, 2 kg [5 lb] of Bird's Foot Trefoil, and 2 kg [5 lb] of Ladino Clover.

657.03 Grading Upon the completion of excavating the pit, the Contractor shall grade the pit area compatible with the surroundings. Strippings shall be redistributed over the pit area as directed.

The area where granular material is exposed shall be graded to a slope of 1 vertical to 1 horizontal or flatter. The areas of all non-granular slopes shall be graded to a slope of 1 vertical to 2 horizontal or flatter. Tree stumps, roots, and other debris shall be covered. The areas of pits of solid or broken ledge rock shall be trimmed of loose rock and the bottom of the pit graded to be compatible with the surroundings.

Wherever ponds are left within the pit, a slope of 1 vertical to 4 horizontal to or flatter, shall extend into the water at least 5 m [16 ft] to assure that the pond will not be a hazard to the public.

657.04 Surface Treatment After completion of the grading and distribution of the strippings, the ground surface shall be fertilized and seeded as directed.

Fertilizing and seeding shall be done in accordance with the procedures of Section 618 - Seeding, Method Number 2 except for the added seed mixture to be used when required. The seed shall be applied at the rate of 1.8 kg [4 lb] of seed mixture per unit.

Mulching shall be applied in accordance with Section 619 - Mulch.

657.05 Method of Measurement Seeding pits will be measured by the 100 m<sup>2</sup> [1,000 ft<sup>2</sup>] unit of land seeded, measured along the slope of the ground from the extremities of seeded area, except as noted in Section 657.06 - Basis of Payment.

657.06 Basis of Payment The accepted quantity of seeding pits will be paid for at the contract price per unit, which price shall be full compensation for furnishing and applying

agricultural ground limestone, fertilizer, and the designated type seed at the specified rate, and for tilling the soil to implant the seed.

Cost of grading of slopes and bottoms of pits, grading of stripping piles over the pit and grading of all other pit areas distributed by the Contractor under this project shall be considered incidental to the various contract items and no additional payment will be made.

Mulching, when called for, will be paid for under Section 619 - Mulch.

When the bid schedule does not contain an estimated quantity for Seeding Pits, the work, equipment and materials required to meet the requirements of Section 657 - Rehabilitation of Pits and Section 619 - Mulch will not be paid for directly but will be considered incidental to the other contract items.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
657.24    Seeding Pits	Unit

#### SECTION 658 - ACRYLIC LATEX COLOR FINISH

658.01 Description This work shall consist of applying a color finish to asphaltic or portland cement concrete surfaces designated on the plans for median strips, islands, and certain crosswalks, color-coated with an acrylic latex finish system.

658.02 Materials The color finish shall be a green acrylic latex emulsion type, containing only inert mineral pigment colorants, fade-resistant for exterior use. The color coating shall contain insoluble mineral fillers suitable for uniform application, tack free, and shall show no deterioration due to temperature, salts, moisture, and ultraviolet rays of sun for a period of at least one year.

Only materials on the following list of approved acrylic latex coating shall be used.

#### PREQUALIFIED ACRYLIC COLOR FINISH SYSTEMS

Company Name:	California Prod. Corp. Cambridge, MA	Nova Sport USA Framingham, MA	A. D. Rossi St. Johnsbury, VT	Touraine Paints, Inc. Everett, MA
Product:	Fortified Plexipave (Ready to Use) Light Green	NS501 Grass Green	Elite - Color Light Green	Tru-Flex TRC 81 Green
Dilution:	No Dilution	1 to 1		1 to 1
Pavement Surf. Temp. °C [°F]				
Min	10 [50] and rising	10 [50] and rising	10 [50] and rising	10 [50] and rising
Max	60 [140]	60 [140]	60 [140]	60 [140]

658.03 Surface Preparation The bituminous or portland cement concrete shall be carefully laid, free of depressions and ridges and at the pitch or grade shown on the plans to provide flow of water from the surface. The pavement shall be free of all loose dirt, dust particles, grease, oil, or any other contaminant. Grease and oils shall be removed by a detergent wash, flushed with water, and followed by high-pressure water, air broom, or hand sweep.

The surface course of bituminous concrete pavement shall be a tight mix of thoroughly compacted material. The pavement shall be placed a minimum of 7 days before the application of the coating.

The surface of portland cement concrete pavement shall be a medium broom finish. New concrete must cure a minimum of 30 days before application of coating. The concrete surface shall be first washed with phosphoric acid solution [8 part water to 1 part acid], then coated with a tie-coat before the green finish coat can be applied.

The surface shall be accepted by the Resident and the coating subcontractor before the application of the color coating.

The Contractor shall add sand to the acrylic latex in the crosswalk area as directed by the Resident.

658.04 Application of Color Coating The coating shall be applied according to the Manufacturer's recommendations, which can be found in the technical bulletin of the product.

The paint shall be stored in an area where freezing or overheating will not occur.

The acrylic coatings are waterborne and cannot cure in cold temperatures or when subject to moisture. Care shall be taken not to apply coatings when rain is forecast or sudden drop in temperature is expected.

Two coats shall be applied over the area in a thickness sufficient to give uniform texture, appearance, and color, per Manufacturer's recommendation. The second coat shall not be applied until the first coat is completely dried to touch and the Manufacturer's minimum time is requirement for top coating has elapsed.

No color coating shall be allowed to run, drop, or otherwise color adjacent areas.

If the Contractor elects to apply the coating after the above date, the Contractor is responsible for the performance of the coating. In this case, the payment will be withheld until the following spring.

658.05 Method of Measurement Acrylic Latex Color Finish will be measured by the square meter [square yard] of surface sealed, measured parallel to the surface. Furnishing and adding sand at designated locations will be incidental.

658.06 Basis of Payment The accepted quantity of Acrylic Latex Color Finish will be paid for at the contract unit price per square yard complete in place, including furnishing, and adding sand, where required.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
658.20 Acrylic Latex Color Finish	square meter [Square Yard]

#### SECTION 659 - MOBILIZATION

659.01 Description When this item is listed as a Pay Item in the Bid, it shall consist of preparatory work and operations including, but not limited to those necessary to the movement of personnel, equipment, supplies and incidentals to the project site; and for all other work and operations which must be performed or costs incurred prior to beginning work on the various items on the project site.

659.02 Basis of Payment Partial payments will be made in accordance with Section 108.2.3 Mobilization

The total sum of payments under this item shall not exceed the original Contract amount bid regardless of the fact that the Contractor may shut down their work on the Project or move equipment away from the Project and then back again.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
659.10 Mobilization	Lump Sum

#### SECTION 660 - ON-THE-JOB TRAINING

660.01 Description As part of the Contractor's equal employment opportunity affirmative action program, the primary objective on-the-job training shall be to train and upgrade minorities and women toward journey worker status.

660.02 Requirements Contractors, where seasonal workforce for the preceding year did not meet craft tradesperson goals of 6.9 percent for women and 0.05 percent for minorities in skilled and semi-skilled areas, and a Laborer level of 10 percent for women and 0.05 percent for minorities, shall: (a) provide on-the-job training (OJT) aimed at developing full journey workers in the types of trades or job classifications involved on a Contract; and (b) when a Contractor has complied with the above cited women and minority employment goals, no further training is required provided the numbers remain at or above the given percentages. The

method for determining company-wide compliance shall be the actual hours worked by women and minorities during the preceding season from April 1<sup>st</sup> through November 15<sup>th</sup> annually. Such record shall be provided to the Department's OJT and Contract Compliance Consultant at time of award. Contractors in compliance with craft goals shall no longer be required to provide training provided the workforce does not fall below the required levels. If it does, Contractors shall begin training in accordance with Section 660.

Total training hours will be the amount listed in the Schedule of Items.

If OJT is required, then the Contractor shall complete and forward to the Department's OJT and Contract Compliance Consultant the Letter of Intent, along with the OJT Registration form including the Workforce Breakdown form, prior to commencing any project work. The Contractor shall submit the Registration/Enrollment form to the OJT and Consultant indicating each classification to be used in the course of meeting this requirement.

Training classifications shall be distributed among work classifications needed by a Contractor in the skilled and semi-skilled craft levels identified on the Letter of Intent.

The Contractor shall receive credit only when the Department's representative has approved the program. For this reason, Contractors are reminded to register candidates at the onset of the Project work in order to guarantee the maximum training time for the enrollee to complete their program. Contractors will be reimbursed for such hours as are approved.

The Contractor shall make every effort to enroll minority and women trainees (e.g., by conducting systematic and direct recruitment through public and private sources likely to yield minority and women trainees) to the extent that such persons are available within a reasonable area of recruitment. The Contractor shall be responsible for demonstrating the steps taken in pursuance thereof, before determination as to whether the Contractor is in compliance. If, in accordance with Section 660 - On-The-Job-Training, the Contractor is acting affirmatively and has achieved the semi-skilled and skilled craft employment goals of 6.9 percent women and 0.05 percent minorities, and 10 percent for women, and 0.05 percent for minorities in unskilled classes, then the Contractor will have no further training obligation for the periods that the levels are maintained. If the Contractor falls below these standards, it shall immediately reinstate an Affirmative Action Program to increase the employment and retention of women and minorities.

Trainees shall not be enrolled in a classification in which they have successfully completed a training course leading to journey worker status, or for which they have held employment as a journey worker. No contractor shall enroll trainees who possess post secondary degrees, certification, or diploma without first securing written approval. Only individuals with non-construction oriented credentials, except those who are upgraded will be considered. Upgrades from semi-skilled to skilled crafts is acceptable but must be approved by the Department or its representative.

The minimum length and type of training for each classification will be as established in the training program selected by the Contractor and approved by the Department or its

representative. Nothing in this Section limits a Contractor to only the curriculum found in the OJT Manual. The Department will consider a training curriculum if it likely to meet the equal employment opportunity obligations that bring women and minorities into the industry and retain them. By design, it will lead to qualifying the average trainee for journey worker status in the classification used. Contractors are encouraged to examine training opportunities, which fit their need.

Contractors whose OJT hours are waived, may establish a training obligation to a subcontractor. Section 660 shall be included in all contracts to subcontractors. Subcontractors are expected to comply with craft goals. As with other Sections applied to a sub, the Contractor retains obligations accordingly.

If training is required, the Contractor shall maintain records, and furnish the Department or its representative with documentation of each trainee's progress using the Weekly OJT Evaluation form.

660.03 Method of Measurement The OJT item will be by the number of hours worked according to the approved training program. At enrollment, trainees shall be paid at least 75 percent of the average wage paid for craftspeople in the stated classification on the project. Provided a trainee achieves the objectives of the program, the Contractor must provide incremental wage increases to each enrollee as they progress in their program. By completion, a trainee is expected to earn a comparable wage to that of other journeyed workers, employed by the contractor in this classification.

660.04 Basis of Payment The OJT shall be at the contract unit price per hour. Payment will be made even though the Contractor received additional training program funds from other sources, provided such other source does not specifically prohibit the Contractor from receiving other payment. No payment shall be made to the Contractor, if the Department determines the Contractor failed to provide the required training, or if able, the contractor did not hire the trainee as a tradesperson when their program is completed. The Department shall work with any contractor whose efforts have been deemed not consistent with the spirit or intent of the Program.

The Contractor shall begin training at the onset of employment for the trade classification. Trainees are expected to remain in status as long as training opportunities exist in the work classification, or until the training program is completed. Provided the Contractor has Department approval, training may be conducted off-site. Verification of training hours shall be determined for credit on off-site work by either: 1) the weekly training report, or 2) the Contractor's usual daily/weekly time card. The Contractor will have fulfilled the responsibilities by specifically providing the maximum training opportunity as required in this Special Provision.

When the Department determines the Contractor has not complied with this Section, the number of training hours remaining to be completed for each training hour required will be multiplied by the prevailing wage rate plus fringes for that particular trainee's classification. The resulting figure shall be deducted from any monies due the Contractor, as determined by the

Resident. The Department shall move within ten days of the ruling to advise the Contractor, in writing, so a corrective action plan may be developed in order to avoid similar future findings. If subsequent efforts fail, sanctions may be imposed

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
660.21 On-The-Job Training	Hour