

## 2550 TRAFFIC MANAGEMENT SYSTEM

### 2550.1 DESCRIPTION

This work consists of providing and installing Intelligent Transportation System (ITS) and Traffic Management System (TMS) components, including electrical service, for communications, traffic control, surveillance, and motorist information.

#### Acronyms and Definitions

BD-4	TWP (Twisted Pair) Distribution Pedestal (Splice Cabinet)
BD-7	TWP (Twisted Pair) Distribution Pedestal (Splice Cabinet)
DMS	Dynamic Message Sign
EIA	Electronics Industry Association
FC-PC	Field Connector-Physical Contact
FDF	Fiber Distribution Frame
FO	Fiberoptic
JB	Junction Box
LCS	Lane Control Signal
LED	Light Emitting Diode
MM	Multimode
NRTL	Nationally Recognized Testing Laboratory as defined by the US Department of Labor
OTDR	Optical Time Domain Reflectometer
PTZ	Pan Tilt and Zoom
RCS	Ramp Control Signal
RUS	Rural Utilities Service
SM	Singlemode Cable
ST	Straight Tip
TIA	Telecommunication Industry Association
TWP	Twisted Wire Pair
ZDW	Zero Dispersion Wavelength

### 2550.2 MATERIALS

#### A General

Provide materials and equipment and perform work meeting the requirements of the National Electrical Manufacturers Association, the Electronic Industries Association, NRTL, NEC, local codes and ordinances, these specifications, and as required by the contract.

Each component is designed for 10 years of industrial use. Warrant Furnish and Install (F&I) materials and workmanship as well as workmanship on materials paid as

Install items for a minimum of 6 months after completion and acceptance of the contract. The Department may require longer warranty periods for specific items. The Engineer will begin the warranty period on the date all construction obligations of the Contractor are completed as documented by the final completion date on the Certificate of Final Acceptance per 1516, "Acceptance."

During the warranty period, make repairs to all equipment and devices provided and installed during the project. The Engineer will notify the Contractor that a warranted item needs repair. Acknowledge the notification within 24 hours and provide the repair within 48 hours, to the satisfaction of the Engineer.

<b>B Rigid Steel Conduit</b> .....	<b>3801</b>
<b>C Non-Metallic Conduit</b> .....	<b>3803</b>
<b>D Electrical Junction Boxes</b> .....	<b>3838</b>
<b>E Electrical Cable and Conductors</b> .....	<b>3815</b>
<b>E.1 Power Conductors</b> .....	<b>3815</b>
<b>E.2 Loop Detector Conductor</b> .....	<b>3815</b>
<b>E.3 Armored Underground Cables</b> .....	<b>3815</b>
<b>E.4 Signal Control Cable</b> .....	<b>3815</b>
<b>E.5 Loop Detector Lead-in Cable</b> .....	<b>3815</b>
<b>E.6 Telephone Cable</b> .....	<b>3815</b>
<b>F Signal Pedestal</b> .....	<b>3832/Plan</b>

### **2550.3 CONSTRUCTION REQUIREMENTS**

Before starting work, submit a written statement that identifies all subcontractors performing the work contained in this section (2550).

#### **A Cable Installation**

Place conduit and direct buried cables in the same trench only if installing the cable 36 in [900 mm] deep, if adding 6 in [150 mm] of fill, and if installing the conduit on the fill.

##### **A.1 Cable Installed In Conduit**

If pulling cable into conduit by hand or machine, use a limiting device to prevent exceeding the pulling tension specified by the manufacturer.

If pulling cable, apply a material compatible, industry accepted lubricant to the cables to reduce pulling tension. Install each cable with slack in accordance with the manufacturer's recommendations to prevent disconnection or damage from contraction. Do not use damaged cable. Remove abandoned cables from each conduit. Ensure the operating TMS remains active while removing the cables.

## **A.2 Direct Buried Cables**

Trench or plow direct buried cables at least 36 in [900 mm] deep. Install direct burial cable by trenching or by plowing. Install direct burial cable in conduit if it is located under bituminous or concrete surfaces.

Install warning tape meeting the following requirements between 18 in [460 mm] above the cable to 12 in [300 mm] below the surface:

- (1) 3.15 in [80 mm] wide,
- (2) Stretchable,
- (3) Orange, and
- (4) Bears the permanent legend "CAUTION: Mn/DOT CABLE BELOW."

## **A.3 Copper Cable Installation**

Repair Contractor damaged TMS cable as approved by the Engineer.

Do not use buried splices.

Splice telephone cables in BD-4 and BD-7 cabinets with a weather resistant, crimp connector designed to splice three No. 19 conductors.

## **A.4 Fiberoptic Cable Installation**

Use manufacturer-recommended equipment to ensure the cable is not damaged by exceeding the maximum tensile strength and violating the minimum bend radius. Make continuous and steady cable pulls between pull points.

Complete direction changes of fiberoptic cable before entering a HH or other conduit access point. Do not pull fiberoptic cables through HH. This applies to both the horizontal and vertical directions.

Install fiberoptic cable in orange colored split conduit through the HH. Extend the conduit 2in [50 mm] beyond the wall of each HH and seal the conduit to the HH with duct seal.

Splice optical fibers only in outdoor fiber splice enclosures and fiber splice panels. Do not splice between cabinets and splice vaults.

Continuously monitor the tensile load on the cable. Pre-rip the fiber optic cable route to prevent harm to a plowed cable.

Place 6 in [150 mm] of aggregate meeting the requirements of 3149.2.G, "Aggregate Bedding," under cables placed in a trench. Backfill the trench in accordance with 2451, "Structure Excavations and Backfills."

The transition from one elevation to another shall not exceed 1 ft vertical per 5 ft horizontal if installing fiberoptic cable in existing conduits in HH. Re-install existing conduits if necessary to provide the transition for the cable installation, at no additional cost to the Department.

## **B Cabinet Installation**

### **B.1 Two Days Notice**

Notify the Engineer two days before removing an active cabinet from service.

### **B.2 Secure and Seal**

Secure the cabinets to the concrete foundation with anchor rods, nuts, and washers.

Seal the cabinet base to the foundation with a ¼ in × 2 in [6 mm × 50 mm], one piece neoprene gasket.

### **B.3 Conduit**

Install conduits at the center of the cabinet base and extend 3.15 in [80 mm] above the foundation.

## **C Dynamic Message Signs (DMS)**

Provide Dynamic Message Sign (DMS) structures and mounting hardware in accordance with 2564, "Traffic Signs and Devices."

Ensure that the installation of DMS electrical equipment located on the sign structure does not protrude over the walkway, or interfere with moving the walkway safety rail or with opening the sign door.

Install the 120/240 VAC to the sign within one week after installation of the DMS to enable operating the ventilation units.

## **D LCS**

Provide LCS mounting hardware in accordance with 2564, "Traffic Signs and Devices."

## **E Restore Shrubs and Bushes**

Restore shrubs and bushes damaged by Contractor activities in accordance with 1712, "Protection and Restoration of Property."

**F HH**

Make openings in the side of HH water tight with a compound that is compatible for adherence to both the PVC HH and the conduit material.

Fill HH abandoned in sodded areas, with tamped granular material in accordance with 3149.2.E, "Aggregate Backfill." Salvage useable HH covers from abandoned HH. Provide the salvaged HH to the Department's Electrical Services Section.

Secure the Department-provided HH locator ball to an eye bolt with a 1/4 in [6 mm] wide wire wrap. Locate the Department-provided HH locator ball within 1 ft [0.3 m] of the HH cover.

**G RCS**

Cover each installed RCS until starting the system operational test.

**H Conduit**

Install conduit in accordance with 2565.3.D, "Conduit and Fittings," and the following:

**H.1 Conduit on Bridges**

Provide and install deflecting expansion joints meeting NEC requirements.

**H.2 Factory Bends**

Factory bends in conduit 3 in [76 mm] in diameter or greater require a minimum bend radius of 36 in [900 mm].

**H.3 Foundation Locations**

The Engineer will stake the actual locations of the foundations, outside the clear zone, and as far from the paved portion of the roadways as practical.

**I (Blank)**

**J Bonding and Grounding..... 2565.3.J**

Include a ground rod with each foundation.

**J.1 Ground Cable**

Wrap ground cable with green electrical tape in cabinets and HH through which the cable passes.

**J.2 Shield Continuity**

Maintain the electrical continuity of the cable shields while terminating and splicing cables. Install shield bonding meeting the requirements of RUS splicing

Standard PC-2, Section 3.3. Provide bonding connectors meeting the requirements of RUS Specification PE-33 for Cable Shield Connectors. Bond and ground the cable sheaths to a 15 ft  $\times$   $\frac{5}{8}$  in [4.6 m  $\times$  16 mm] diameter ground rod.

## **K Loop Detector Installation**

Install loop detectors as required by the contract and as follows:

### **K1 Loop Detector Conductors**

End loop detector conductors in the near HH. Splice the conductors to the lead-in cable with a soldered butt splice. Wrap the splice with one wrap of electrical tape before placing into the splice encapsulator device.

## **L Fiberoptic System**

### **L.1 (Blank)**

### **L.2 (Blank)**

### **L.3 Outdoor Fiber Splice Enclosure**

Bond each outdoor fiber splice enclosure to the cable armor with a cable clamp and to the closest ground rod with a 1/C No. 6 ground wire and clamp. Provide outdoor fiber splice enclosures with non-oxidizing coating on the connections

### **L.4 Fiber Splice, Patch, Splice/Patch Panel**

Mount the fiber splice, patch, splice/patch panel as required by the contract. Secure the fiberoptic cables and pigtails to the splice, patch, splice/patch panel. Ground the shields by bonding them to the splice, patch, splice/patch panel ground lug.

### **L.5 Fiberoptic Splice Vault**

Place the fiberoptic splice vault on 12 in [300 mm] of filter aggregate in accordance with 3149.2.H, "Coarse Filter Aggregate." Seal and flash test the vault as recommended by the manufacturer.

Coil 60 ft [18 m] of cable for each entrance and exit in each vault containing splices.

## **M CCTV Assembly Installation**

Do not degrade the existing CCTV signals during CCTV Assembly installation.

Orient the lightning rod away from the road at approximately 90 degrees to centerline. Install the horizontal lockout for the pan and tilt unit over the lightning rod

support and set the vertical lockout to 30 degrees above horizontal. Ensure the housing mounting bolts do not hit the pan and tilt unit cover in any tilt position.

#### **2550.4 METHOD OF MEASUREMENT**

The Engineer will only measure items for payment that are completed and accepted.

##### **A Complete Systems**

The Engineer will measure \_\_\_ *System* separately.

##### **B Traffic Management System Components**

The Engineer will measure the various system components by the units of measure required by the contract.

#### **2550.5 BASIS OF PAYMENT**

The Department will:

- (1) Retain 10 percent of the amounts payable on each partial estimate, in accordance with 1906, "Partial Payments."
- (2) Pay for material on hand.
- (3) Pay the remaining percentage retained upon completion of the work as approved by the Engineer.

The contract lump sum price for \_\_\_ *System* includes the cost of providing and installing the system required by the contract, complete in place.

The contract lump sum price for *System Integration* includes the cost of performing the work and incorporating the material required by the contract, into the existing system. The Department will make payments based on the percent of the contract completed, as indicated on the project progress chart. When the Contractor completes 10 percent of the contract as indicated by the chart, the Department will pay 10 percent of the systems integration contract pay item.

The contract unit price for \_\_\_ *Foundation* includes the cost of providing the material and providing and installing the foundation required by the contract.

For cabinet foundations included as part of a larger pad, the cabinet foundation includes the concrete and conduit under and adjacent to the cabinet.

For service foundations included as part of a larger pad, the service foundation includes the concrete, conduit and conductors under and adjacent to the service equipment.

The contract unit prices for TMS contract pay items include the cost of providing and installing each item.

The Department will pay for TMS based on the following schedule:

<b>Item No.:</b>	<b>Item:</b>	<b>Unit:</b>
2550.501	___ System	lump sum
2550.509	Systems Integration	lump sum
2550.511	___ Foundation	each
2550.512	Handholes, Type ___	each
2550.513	Junction Box	each
2550.514	Fiberoptic Splice Vault	each
2550.515	Outdoor Fiber Splice Enclosure	each
2550.516	Buried Cable Sign	each
2550.521	___ in [mm] Rigid Steel Conduit	linear foot [meter]
2550.523	___ in [mm] Non metallic Conduit	linear foot [meter]
2550.524	___ in [mm] Pushed Conduit	linear foot [meter]
2550.531	___ Cable ___ Pr. No. ___	linear foot [meter]
2550.532	___ Cable ___ Conductor No. ___	linear foot [meter]
2550.533	___ Cable ___	linear foot [meter]
2550.534	Fiberoptic Trunk Cable ___ MM ___ SM	linear foot [meter]
2550.535	Armored Fiberoptic Pigtail	each
2550.542	Loop Detector Splice	each
2550.551	Ramp Control Signal, Design ___	each
2550.552	Flasher Signal	each
2550.553	Lane Control Signal	each
2550.561	Closed Circuit Television Assembly	each
2550.562	Dynamic Message Sign, Design ___	each
2550.571	___ Cabinet	each
2550.572	Service ___	each

## **2554 TRAFFIC BARRIERS**

### **2554.1 DESCRIPTION**

This work consists of installing guardrail, barrier, end treatments, transitions, permanent barricades, and other devices that protect or prohibit traffic at the locations shown on the plans or as directed by the Engineer. This work also consists of installing posts and guide posts, and resetting existing barriers.

**2554.2 MATERIALS**

**A Metal Posts**

**A.1 Flanged Channel Sign Post ..... 3401**

**A.2 Structural Metal Posts..... 3406**

**B (Blank)**

**C Wood Posts ..... 3412**

**D Timber Plank, S4S ..... 3426**

**E Wire Rope..... 3381**

**F Steel Beams**

Provide W-beam, thrie-beam rail elements, posts, blocks, soil plates, reducer sections, and end treatments meeting the requirements of *A Guide to Standardized Highway Barrier Hardware*, published by AASHTO, ARTBA, and AGC.

**F.1 Steel Plate Beams ..... 3382**

**F.2 Rub Rail..... 3306**

**G Hardware and Fittings ..... 3381 & 3382**

**H Paints**

Provide paints as required by the contract.

**I (Blank)**

**J Concrete..... 2461**

Provide concrete for anchor blocks and bearing blocks with a compressive strength of at least 2,750 psi [19 MPa] within 14 days. The Department will not require air entrainment.

**K Anchorage Rods ..... 3385**

Anchorage assemblies consist of the anchor and the fittings required to connect the anchor to the end post.

**2554.3 CONSTRUCTION REQUIREMENTS**

**A Excavation and Foundations**

The Contractor may dig post holes by hand or by using mechanical methods. Excavate to the depth necessary to place the rail elements at the specified height above

the ground surface and meeting the requirements for post top and side alignment as shown on the plans. In excavating for anchorages, ensure that anchorages bear on firm, undisturbed earth at the depth shown on the plans.

Use the natural soil at the bottom of the excavation as the foundation of line, guide, and permanent barricade posts. Tamp the natural soil at the bottom of the excavation to provide firm bearing. Found end posts and posts at intermediate guardrail anchorages on concrete bearing blocks. Provide concrete bearing blocks in the dimensions shown on the plans. Firmly install concrete bearing blocks on a foundation prepared as required by the contract.

## **B Installing Posts**

Install posts of the size and type shown on the plans, at the intervals shown on the plans, and to the staked lines. Install posts with post tops from  $\pm\frac{3}{8}$  in [10 mm] of the elevation and grade shown on the plans.

Provide Type A guide posts meeting the following requirements:

- (1)  $5\frac{1}{2}$  in [140 mm] nominal diameter,
- (2) Width from  $4\frac{3}{4}$  in to  $6\frac{1}{4}$  in [120 mm to 160 mm],
- (3) 6 ft [1.8 m] long, and
- (4) Made of treated wood in accordance with 3412, "Wood Guardrail Posts."

Install Type A guide posts with the top of the post 30 in [760 mm] above the shoulder P.I. elevation, unless otherwise indicated on the plans.

Provide flanged channel steel Type B guide posts as culvert markers weighing 2 lb per ft [3.0 kg per m] in the lengths specified in 3401, "Flanged Channel Sign Posts." Install Type B guide posts as shown on the plans.

Mechanically drive posts, if required or allowed by the plans, without damaging the posts.

Install and consolidate backfill materials specified on the plans, to maintain the post plumb and in the correct position.

## **C Installing Barriers**

Install traffic barriers as shown in the plans. Install proprietary barrier items as specified by the manufacturer.

Drill holes in wood posts with the same diameter as the bolts or fittings used. In metal posts, drill holes for bolts or other fittings with a diameter no greater than  $\frac{1}{16}$  in [1.6 mm] of the diameter of the bolt or fitting. Apply two coats of copper naphthenate or another preservative material meeting the requirements of AWWA Standard M4 to

field cuts in treated wood. Allow the first coat to dry for at least 2 h before applying the second coat. The Contractor may leave field bored holes untreated.

Provide bolts no longer than necessary to allow full nut contact after tightening at the overall nominal depth of the assembled parts, plus reasonable allowance as required by the manufacturer for oversize components. In locations of possible vehicle contact, do not allow bolt ends to project beyond the rail contact face. The Contractor may cut off the excess length of bolt to within  $\frac{9}{16}$  in [15 mm] of the nut head.

### **C.1 Wire Rope (Cable Guardrail) Installations**

Except where cable clips are allowed by the manufacturer, wire wrap free ends of wire rope to prevent unraveling.

At intermediate anchorages, space the cables to prevent contact between the separate cables.

Install proprietary high-tension cable barriers as specified by the manufacturer.

### **C.2 Steel Plate Beam Barriers**

Provide steel plate beam barriers including box-beam guardrail, W-beam guardrail, and Thrie-beam guardrail.

If offset blocks are required by the plans or the manufacturer, provide blocks made from treated timber or other material as listed on the Approved/Qualified Products List. Treat field cuts on treated wood in accordance with 2554.3.C, "Installing Barriers."

Install rail and end sections to overlap the adjacent section in the direction of traffic.

Install end treatments as shown on the plans and as staked in the field. Install proprietary end treatments as specified by the manufacturer.

Install the guardrail end treatments and the guardrail concurrently.

### **C.3 Permanent Barricades**

Fabricate permanent barricades as shown in the plans.

## **D Painting and Field Repairs**

Apply two coats of paint as shown on the plans and in accordance with 2479, "Inorganic Zinc-Rich Paint System," to steel above ground and not coated in accordance with 3406, "Structural Metal Fence Posts." Perform other field repairs as recommended by the manufacturer.

## **E Disposal of Surplus Excavated Material**

Dispose of surplus excavated material at no additional cost to the Department and as approved by the Engineer.

### **2554.4 METHOD OF MEASUREMENT**

#### **A Traffic Barriers**

The Engineer will measure traffic barriers of each design by length, to the nearest 1 ft [0.3 m]. The Engineer will measure between the centers of end posts in each continuous section, including transitions. The Engineer will not deduct expansion assemblies from the measurement.

#### **B Permanent Barricades**

The Engineer will measure permanent barricades by length, to the nearest 1 ft [0.3 m] from end to end of the planks of each unit.

#### **C Guide Posts**

The Engineer will measure guide posts by the number of posts placed. The Engineer will separately measure each type as shown on the plans.

#### **D Anchorage Assemblies**

The Engineer will measure anchorage assemblies by the number of assemblies installed.

#### **E End Treatments**

The Engineer will measure end treatments by the number of units of each type installed complete-in-place.

### **2554.5 BASIS OF PAYMENT**

The contract linear foot [meter] price for *Traffic Barrier, Design \_\_\_\_* includes the cost of providing all barrier appurtenances and installing the barrier as shown on the plans, except the Department will separately pay for anchorage assemblies as shown in the plans.

The contract each price for *End Treatment* of each type includes the costs of providing and installing steel plate beam rail, posts, anchorage, offset blocks, hardware, and other related materials.

The Department will pay for traffic barriers and barricades on the basis of the following schedule:

<b>Item No.:</b>	<b>Item:</b>	<b>Unit:</b>
2554.501	Traffic Barrier, Design ____	linear foot [meter]
2554.505	Permanent Barricades	linear foot [meter]
2554.509	Guide Post, Type ____	each
2554.511	Install Traffic Barrier, Design ____	linear foot [meter]
2554.515	Install Guide Post, Type ____	each
2554.521	Anchorage Assembly	each
2554.523	End Treatment, Type ____	each

## 2557 FENCING

### 2557.1 DESCRIPTION

This work consists of constructing fences.

### 2557.2 MATERIALS

On contracts not specifying types of material for metal fencing products, the Contractor may select the type of material. Use the same type of metal fence components on the entire project.

Cap tubular metal posts.

If the contract requires coated metal posts, use the same coating on posts, post supports, rails, gate frames, expansion sleeves, and other hardware items or fittings in accordance with the following:

- (1) Zinc coating with zinc coated fence fabric,
- (2) Aluminum or zinc coating with aluminum coated steel fabric, and
- (3) Vinyl coating with vinyl coated fence fabric.

Provide black vinyl coated posts, hardware, and fabric with a low to medium gloss, unless otherwise shown on the plans.

Use aluminum alloy posts, rails, frames, and other hardware items with aluminum alloy fence fabric.

A brace assembly consists of a single wood or metal brace, installed as a leg brace or as a horizontal brace between two consecutive posts, including the required brace plate or concrete anchor, post anchorages, and guy wires or truss rods. A brace assembly for a chain link fence consists of two brace bars and a truss rod.

**A Fence Wire..... 3376**

**B Fence Gates ..... 3379**

**C Fence Posts**

**C.1 Rolled Steel Posts ..... 3403**

**C.2 Structural Metal Posts..... 3406**

**C.3 Vacant**

**C.4 Treated Wood Posts..... 3413**

**D Hardware and Fittings ..... 3406**

**E Concrete**

Provide concrete in accordance with 2461, "Structural Concrete," Grade B, Type 3 concrete.

**2557.3 CONSTRUCTION REQUIREMENTS**

**A General**

Remove and dispose of brush, trees, and other obstructions that interfere with construction of the fence in accordance with 1405, "Use of Materials Found on the Project," 2101, "Clearing and Grubbing," and 2104.3.C, "Removal Operations." Provide a smooth ground profile at the fence line.

Ensure the bottom of the fence follows the contour of the ground. At small stream crossings, drainage ditches, and other locations where the bottom of the standard size fence cannot conform to the ground contour, construct the fence to span the depression and use extra wire or fabric to close the space below the bottom of the fence, unless otherwise shown on the plans or directed by the Engineer. Provide and install longer posts with intermediate posts, stakes, braces, extra fabric, or wires to span the depression.

Perform field repairs to fence materials as recommended by the manufacturer.

**B Installing Posts, Rails and Braces**

**B.1 General**

Set posts plumb, except set posts perpendicular to the slope of the ground at locations as directed by the Engineer.

Install corner posts, pull posts, end posts, and gate posts at locations shown on the plans or as directed by the Engineer. Provide corner post assemblies at horizontal angle points with deflections greater than 20 degrees. Space pull posts to provide a braced post at points where the following occurs:

- (1) The vertical alignment deflects by greater than 20 degrees,

- (2) The post anchorage is necessary to counteract wire uplift, and
- (3) An abrupt grade change on short runs that cannot be avoided by shaping the ground to a uniform contour.

When driving fence posts, protect the post tops from damage. Remove and replace posts damaged during installation.

Anchor posts placed on concrete walls, curbs, or other concrete structures as shown on the plans.

If placing fence posts in solid rock, set the post at least 12 in [300 mm] into the rock or with the post bottom at the elevation shown on the plans, whichever requires the lesser excavation into the rock. Cut the post bottom to provide the height above the ground surface as shown on the plans. Cut holes in rock to provide a clearance of at least 1 in [25 mm] around the posts. Fill the holes around the posts with grout consisting of one part portland cement, two parts mortar sand, and sufficient water to create the proper consistency. The Contractor may add 0.1 part hydrated lime in the grout.

Place and consolidate concrete around the posts and braces. Allow the concrete to cure for at least 3 calendar days before installing the fence wire.

The Contractor may pour the concrete into prebored holes without forming, if no concrete contamination occurs during placement.

Except as otherwise required for posts and braces set in rock or concrete, backfill the annular space around posts set in prebored holes in layers using selected material from the excavation with each layer thoroughly compacted to produce a rigid post setting. Use other backfill material, if required by the contract.

Dispose of surplus excavated material in low areas along the fence line or as directed by the Engineer. Neatly finish the adjacent area.

## **B.2 Metal Post Installations**

Set posts for chain-link fabric fencing in concrete as shown on the plans. The Contractor may drive line posts if the post lengths provide a post embedment of at least 4 ft [1.2 m] into the ground.

Drive rolled steel line posts.

The Contractor may provide rolled steel end posts, corner posts, and pull posts, including the required braces, with anchor plates and brace plates. Set the posts in dug holes. The Contractor may omit the anchor and brace plates and set the posts and braces in concrete. Backfill excavations around the posts and braces using the excavated material. Thoroughly compact the backfill.

Set rolled steel gate posts in concrete.

Provide and install metal post extensions in the lengths directed by the Engineer at the locations shown on the plans. If post splicing is necessary, use a standard thread and coupling of the same material to thread and join the pipe ends at the splice. Avoid splicing in the exposed upper portion of the post. Provide a suitable plug in the bottom end of each extended post.

### **B.3 Wood Post Installations**

The Contractor may drive posts or set wood posts in prebored holes. Place the larger end of the post in the ground. When driving posts, place the square cut or pointed end in the ground. Except for holes in rock, cut post holes to a diameter providing a clearance of at least 3 in [75 mm] around the post to allow backfill and compaction.

Provide wood braces in accordance with 3413, "Wood Fence Posts (Treated)." Provide wood braces with diameters at the small end equal to the minimum permissible diameter as shown on the plans. Ensure the diameter at the small end does not exceed the top diameter of the smaller adjacent post.

## **C Installing Fence Wire**

Install and pull tight the fence wire as recommended by the manufacturer.

### **C.1 Chain Link Fabric**

Place chain link fabric in continuous runs between corner, end, and gate posts. Install the fabric on the side of line posts that face away from the main road except as otherwise directed by the Engineer. Ensure impacts from snow plowing stress the posts rather than the fasteners.

At ends of chain link fabric, thread a stretcher bar through the fabric loops and use clamps to fasten the bar to the posts as shown on the plans.

Weave pre-bent wire of the same kind as the fabric to make splices in the chain link fabric.

### **C.2 Barbed Wire and Woven Wire**

Unless otherwise directed by the Engineer, place barbed wire and woven wire installed on tangent alignment or on curves no greater than 1 degree on the side of line posts that faces away from the main road. If placing the fence on horizontal curves greater than 1 degree, place the wire on the side of line posts on the outside of the curve. Offset posts at corners to the inside so that the wire will bear against the post.

Fasten fence wire to end, corner, gate, or pull posts before fastening to intermediate line posts. Stretch woven wire to make longitudinal wires taut and to remove 30 percent of the factory fabricated fence crimp.

When required by the plans, cut and splice woven wire at the pull posts to obtain and maintain uniform tension in horizontal wires. The Contractor may use a wire crimping tool to increase the number or depth of tension curves to maintain tension in horizontal wires.

Use wire clips or clamps in accordance with 3376, "Fence Wire," to fasten wires to metal line posts. Use galvanized staples to fasten wires to wood posts. Where the wire loops around end, corner, or pull posts, wrap the wire around the post at least four complete turns.

Use U-shaped wire staples at least 1¾ in [45 mm] long in pine posts and at least 2 in [50 mm] long in cedar posts. The Contractor may use L-shaped staples with serrated, barbed or ring shanks at least 1½ in [38 mm] long.

Diagonally drive U-shaped staples across the wood grain to prevent both points from entering between the same grain. Slope staples upward, against the pull of the wire, in depressions with wire up-lift. Slope staples downward on level ground and over knolls. Staple the wires at corner, end, and pull posts. On line posts, drive the staples to the point that allows movement of the wire. Do not damage the wire while driving the staples.

To splice wire between posts, use an approved splicing sleeve as indicated in 3376, "Fence Wire," or wrap each wire end around the other wire from 4 turns to 6 turns to form a lasting connection. Use a splicing tool in place of hand wrapping to obtain uniformly tight wraps as directed by the Engineer.

If using splicing sleeves on woven wire, maintain the same horizontal distance between vertical wires as in the fabricated wire. If using the wrap method to splice woven wire, allow the two end stay wires to abut each other and enclose the wires within the wrap.

## **D Installing Gates**

Install gates designed to allow locking with a Department-provided padlock and equipped with a padlock keeper at the locations shown on the plans.

## **E Electrical Grounds**

Install electrical grounds consisting of copper coated steel rods with a nominal diameter of at least 5/8 in [15 mm] and a length of at least 8 ft [2.4 m] along each fence line at the staked locations.

Drive ground rods to an elevation flush with the ground surface at points directly below or adjacent to the fence wire. Connect each ground rod to the fence with a solid No. 6 copper wire. Use approved type metal clamps as indicated in 3376, "Fence Wire," to attach the ground wire to the ground rod and to the fence wires to electrically ground each longitudinal fence wire. The Department will not require greater than one connection on woven wire and chain link fabric near the bottom at each ground rod.

Install electrical grounds in the following locations:

- (1) On each fence line at the point of crossing beneath an electric power line.
- (2) Two grounds at each pedestrian gate, one on each side of the gate opening, as close to the gate posts as practicable.
- (3) Additional grounds on each fence line to maintain spacing between grounds of 1,500 ft [450 m] on fences with metal posts and 1,000 ft [300 m] on fences with wood posts.
- (4) At least one electrical ground on each separate section of fence. The Department defines a separate section of fence as a run with unbroken electrical continuity.
- (5) On each separate section of fence, uniformly space electrical grounds and locate a ground within a distance from each end no greater than half of the desired maximum spacing interval.

## **2557.4 METHOD OF MEASUREMENT**

### **A Wire Fence**

The Engineer will separately measure fence of each design by length along the bottom of the fence, from center to center of end posts, excluding the lengths of gates as measured between gate posts.

### **B Brace Assemblies**

The Engineer will separately measure wood or metal brace assemblies by the number of each kind constructed complete-in-place, regardless of length, design, or anchorage.

### **C Electrical Grounds**

The Engineer will measure electrical grounds by the number of ground rods and connections provided and installed complete-in-place.

### **D Gates**

The Engineer will measure gates by the number of individual units constructed complete-in-place.

## E Metal Post Extensions

The Engineer will measure metal post extensions by length of extensions, based on the difference between the standard driven post length and the actual post length as installed.

### 2557.5 BASIS OF PAYMENT

The contract each price for *Metal Brace Assembly* includes the cost of the brace plate or concrete anchor, post anchorages, and guy wires or truss rods.

The contract each price for *Electrical Ground* at includes the cost of the ground wire and connectors.

The Department will include the cost of removing and disposing of brush, tree, and obstructions with relevant contract unit prices for fence construction, unless the contract provides specific pay items for the work. The Department will include the cost of providing and installing longer fence posts, intermediate posts, stakes, braces, extra fabric, or wires as required with relevant contract unit prices for fence construction, unless the contract includes specific contract pay items for the work.

The Department will pay for fencing on the basis of the following schedule:

<b>Item No.:</b>	<b>Item:</b>	<b>Unit:</b>
2557.501	Wire Fence, Design ____	linear foot [meter]
2557.516	Pedestrian Gate	each
2557.517	Vehicular Gate	each
2557.519	Metal Post Extensions	linear foot [meter]
2557.521	Wood Brace Assembly	each
2557.522	Metal Brace Assembly	each
2557.523	Metal Brace Assembly (Chain Link Fence)	each
2557.527	Electrical Ground	each

## 2564 TRAFFIC SIGNS AND DEVICES

### 2564.1 DESCRIPTION

This work consists of fabricating, packaging, and delivering, or installing traffic signs and devices.

## **2564.2 MATERIALS**

### **A General**

Provide electrical material and equipment meeting the requirements of 2545.2, "Electrical Lighting Systems, Materials." If the Department specifies a particular material (fixture, device, or component), the Contractor may use an alternate material, equal to or better than the material specified, provided the Contractor obtains the written approval of the Engineer before incorporating the alternate material into the work.

### **B Structural Steel**

Fabricate structural steel posts and trusses from steel meeting the requirements of 3306, "Low-Carbon Structural Steel," unless otherwise required by the contract.

Provide structural bolts, nuts, and washers meeting the requirements of 3391.2.B, "High Strength Structural Steel Bolts," and 3392, "Galvanized Hardware."

Provide bolt anchorages as specified in the contract or if not specified, as approved by the Engineer.

### **C Concrete (Mix 3Y43) ..... 2461**

### **D Reinforcement Bars ..... 3301**

All reinforcement bars shall be as indicated in the contract and shall be epoxy coated.

### **E Spiral Reinforcement..... 3305**

### **F Signs and Markers ..... 3352**

Fabricate sign panels in accordance with the following, unless otherwise required by the contract. Types of sign panels, route markers, and overlays contained in this section (2564) are referenced in the Traffic Engineering Manual, the Standard Signs Manual, or both.

Provide sheet aluminum sign base material for Type C, Type D, Type Overlay sign panels, delineators, markers, and Type OH sign panels on sign supports in accordance with 3352.2.A.1.a, "Sheet Aluminum," except provide non-reflectORIZED lexon-black, flexible plastic sign-base material for cylinder-style delineators.

Provide extruded aluminum sign base material in accordance with 3352.2.A.1.b, "Extruded Aluminum, Bolted Type," covered with 0.063 in [1,600 μm] sheet aluminum meeting the requirements of 3352.2.A.1.a, "Sheet Aluminum." for Type A, Type EA, Type EO, and Type OH sign panels on panel mounting posts. Provide  $\frac{3}{16}$  in [5 mm] aluminum alloy pull-through rivets as fasteners to attach the sheet

aluminum to the extruded panel. Tightly butt the sheet aluminum vertically and rivet to the extruded panel on centers no greater than 12 in [300 mm] vertically and horizontally. Rivet the edges and corners of each sheet. Do not place rivets within 1 in [25 mm] of the extruded panel joints. After attaching the sheet, ensure the sheet aluminum is free of waviness.

Provide sign face material for sign panels, delineators, and markers of reflective sheeting, meeting the requirements of 3352.2.A.2.e, "Sign Sheeting Type IX," for Type IX or 3352.2.A.2.f, "Sign Sheeting Type XI," for Type XI, unless otherwise specified in this section (2564).

For W11-1, W11-2, S1-1, S4-3, and S5-1 standard signs, provide reflective sheeting sign face material meeting the requirements of 3352.2.A.2.e, "Sign Sheeting Type IX," for Type IX FL fluorescent yellow-green, or 3352.2.A.2.f, "Sign Sheeting Type XI," for Type XI FL fluorescent yellow-green.

Provide sign face material of the same type and color of fluorescent sheeting material for W16-7p, W16-9p, W20-100P, and W13-1 standard signs as used on W11-1, W11-2, S1-1, S4-3, and S5-1 standard signs, when used together.

Provide reflective sheeting sign face material meeting the requirements of 3352.2.A.2.e, "Sign Sheeting Type IX," for Type IX FL fluorescent yellow or 3352.2.A.2.f, "Sign Sheeting Type XI," for Type XI FL fluorescent yellow for warning signs, yellow markers, yellow delineators, the yellow background on sign panels, and the yellow background on Sign Panels Type Overlay.

For the sign face material on the M1-5A Route Marker and the M1-5B Type Overlay, obtain the gold color with a screen-processed color using a transparent gold paint. Obtain the blue color with a screen-processed color using transparent blue paint. Ensure the overlap of the blue and gold screen-processed colors does not exceed  $\frac{3}{32}$  in [3 mm].

Provide white reflective sheeting for sign face material meeting the requirements of 3352.2.A.2.e, "Sign Sheeting Type IX," for Type IX or 3352.2.A.2.f, "Sign Sheeting Type XI," for Type XI on sign panels with a brown background.

For yellow sign face material for cylinder style delineators, provide reflective sheeting meeting the requirements of 3352.2.A.2.a, "Sign Sheeting Type III," for Type III MT.

For white sign face material for cylinder-style delineators, provide reflective sheeting meeting the requirements of 3352.2.A.2.b, "Sign Sheeting Type V," for Type V, or 3352.2.A.2.d, "Sign Sheeting Type VIII," for Type VIII.

Provide non-reflectorized black or yellow sign face material for X4-2 Hazard Markers as required by the contract.

Provide non-reflectorized red or black sign face material for X4-11 End of Roadway Markers as required by the contract.

Provide reflective sheeting meeting the requirements of 3352.2.A.2.e, "Sign Sheeting Type IX," for Type IX or 3352.2.A.2.f, "Sign Sheeting Type XI," for Type XI, for the following applications:

- (1) Sign legend material for sign panels except for sign panels with brown sheeting,
- (2) Numerals on M1-5A Route Markers and M1-5B Type Overlays,
- (3) Delineators and markers, and
- (4) Colors other than yellow on warning signs.

For sign panels with brown sheeting, provide sign legend material with brown (1179) Electronic Cuttable (EC) film produced by the same manufacturer that fabricates reflective sheeting meeting the requirements of 3352.2.A.2.e, "Sign Sheeting Type IX," for Type IX or 3352.2.A.2.f, "Sign Sheeting Type XI," for Type XI. If splicing is required to apply brown EC film on sign panels, provide vertical butt splices spaced so splices do not occur through letters or arrows. Before applying the brown EC film to the sign face material, perform the following:

- (1) Cut and weed-out the legend and border from the brown EC film as shown on the sign panel details in the contract. Do not cut and weed-out the brown EC film covered by Sign Panels Type Overlay;
- (2) Apply the weeded brown EC film to the white, reflective sheeting sign-face material; and
- (3) Apply the brown EC film "corner" pieces located outside the border that fill in the square corners of the sign panel.

Screen the sign legend material for colors other than black in accordance with 3352.2.A.5.c, "Screen Processed Painted Legend." Provide sign legend material for black legends in accordance with 3352.2.A.5.c, "Screen Processed Painted Legend," or 3352.2.A.5.d, "Pigmented Plastic Film Legend."

**G Anchor Rods..... 3385**  
**H Flanged Channel Sign Posts..... 3401**

**2564.3 CONSTRUCTION REQUIREMENTS**

**A General**

Fabricate and install traffic signs and devices in accordance with the MN MUTCD for Streets and Highways and the AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals*.

Do not perform work on the project until underground utilities are located in accordance with 1507, "Utility Property and Service." Replace electrical cable damaged due to Contractor-negligence at no additional cost to the Department. Replace damaged electrical cable from terminal point to terminal point.

Construct electrical systems or conduit systems for conveying electrical cables and conductors, or portions of electrical cables and conductors, as required by the contract, in accordance with 1702, "Permits, Licenses, and Taxes," and 2545.3, "Electrical Lighting Systems, Construction Requirements."

Sign locations and post lengths indicated in the contract are approximate. The Engineer will make the final determination of sign locations and the required post lengths for Type A and Type OH Signs in the field. The Contractor shall determine the required post lengths for all other signs.

If refurbishing signs with legends that are pertinent to traffic, do not extend the down-time for the sign beyond the eight-hour period from 8:00 a.m. to 4:00 p.m., unless providing a replacement sign at no additional cost to the Department.

If, in the opinion of the Engineer, the message on a sign panel is not pertinent to existing traffic, delay installation of the sign panel until the message becomes pertinent or install the sign and place an effective cover over the non-pertinent message. Provide opaque covers that do not hold moisture against the sign face. The Engineer will not approve burlap as an effective cover for reflective signs. Install the sign panel with the cover and the Department will assume responsibility for maintaining and removing the cover after the Engineer accepts the work.

Unless the Contractor arranges to reclaim cover material, the material will become the Department's property upon final acceptance of the work. Cover, maintain, and uncover sign panels with non-pertinent messages at no additional cost to the Department.

The Department considers removal and replacement of existing guardrail for the convenience of the Contractor as incidental work.

Replace topsoil, sodded, and seeded areas disturbed by the work and dispose of excess excavated materials as approved by the Engineer.

## **B Concrete Structures**

Produce concrete for footings in accordance with the requirements for Grade Y, Type 3 concrete as specified in 2461, "Structural Concrete."

Provide a rubbed-surface finish on exposed concrete surfaces.

Do not install sign posts on concrete footings until the concrete has cured for a minimum of seven days.

### **B.1 Concrete Footings**

If the Engineer approves, the Contractor may use either spread footings or drilled-shaft footings as a substitute.

Construct footings as required by the contract. The Department will only pay for the planned design quantity for each footing at the contract unit price, except for Department required design changes.

If the contract requires drilled shaft footings, the Contractor may submit an alternate design for approval by the Engineer with the understanding that, if approved, the Department will not adjust the contract quantities or unit prices. If the Engineer approves the alternate design, the Contractor may proceed.

Provide design details for alternate drilled shaft footing designs in accordance with one of the following:

- (1) Use a constant diameter shaft at least 6 in [153 mm] greater than the diagonal dimension of the column base plate. Use the planned longitudinal reinforcement bars without bending. Use either spiral reinforcement or tie bars spaced at 6 in [153 mm] centers for the full length of the shaft, or
- (2) Install a horizontal construction joint at the bottom of the tapered section of the shaft about 6 ft [1.8 m] below the top. Before placing new concrete above the construction joint, coat the surface of the in-place concrete with a Department-approved bonding agent. Lap vertical reinforcement bars a length equal to 40 times the diameter of the reinforcement bar used.

Construct footings in accordance with 2401.3, "Concrete Bridge Construction, Construction Requirements," except as modified by 2564.3.B.2, "Median Barrier Footing."

The Contractor may use undisturbed earth to form concrete placement if the soil is stable enough, as determined by the Engineer, to allow concrete placement and the Contractor takes precautions to prevent contamination of the concrete.

## **B.2 Median Barrier Footing**

Provide NMC conduit and fittings to connect to the non-metallic conduit in adjacent median barrier as detailed on the plans and the special provisions.

Provide a surface finish and color that matches the adjacent median barrier.

## **C Sign Support**

Provide and install a sign support as required by the contract, current AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals*, and this subsection (2564.3.C).

Provide concrete footings as required by the contract. Determine the reinforcement steel and the anchor rods as required by the contract.

Provide and install an overhead sign identification plate in accordance with 2564.3.P, "Overhead Sign Identification Plate."

## **D Overhead Sign Structure Repair**

Repair an existing overhead sign structure in accordance with the 2123, "Equipment Rental," and the following:

Contact the Department's Structural Metals Inspection Unit (DSMIU) to schedule inspection of sign structures. Perform the inspection before removing the sign structure from storage, or after salvaging the structure.

Correct the following conditions, if encountered, as determined by the DSMIU:

- (1) Rusted or missing nuts, bolts or washers,
- (2) Defective shop and field splices on main chord angles,
- (3) Missing welds,
- (4) Cracking welds or structural elements,
- (5) Section loss on post base plate,
- (6) Flame gouges on base plate or at bolt holes,
- (7) Cracks around post handhole,
- (8) Zinc coating loss or deterioration, and
- (9) Rusting.

Perform repairs in accordance with 2471, "Structural Metals."

Verify that each locking pin fits completely into the locking pin hole in the handrail hinge, while the handrail is in the raised position. For locking pins that do not fit, drill out the handrail hinge to make a proper fit. Repair damage to galvanized surfaces in accordance with 2471.3.L.1, "Galvanizing."

After completing the repairs and before installation, obtain reinspection by the DSMIU.

### **E Structural Steel**

Manufacture and fabricate structural steel in accordance with 2471, "Structural Metals," and the additional requirements and limitations specified in this subsection (2564.3.E).

Provide shop drawings for overhead sign structures and for Type A sign structures in accordance with 2471.3.B, "Shop Detail Drawings."

Assemble the truss sections and posts in the shop before galvanizing. Check truss sections and posts for straightness, alignment and dimensions and correct any variations. Correct warpage from galvanizing before installing structural steel.

Ensure main chord angles for overhead sign structures that are at least ½ in [13 mm] thick, meet a Charpy V-notch impact strength requirement of 15 ft•lb [20 N•m] at 40 °F [5 °C].

Drill or mechanically cut overhead sign post base plate anchor rod holes.

Lubricate the threads of nuts before installation. Use the following minimum torque values:

<b>Anchor Rod Diameter</b>	<b>Torque</b>
2 in [51 mm]	300 ft•lb [400 N•m]
2¼ in [57 mm]	375 ft•lb [500 N•m]
2½ in [64 mm]	450 ft•lb [600 N•m]
2¾ in [70 mm]	550 ft•lb [750 N•m]
3 in [76 mm]	700 ft•lb [950 N•m]

Mar the threads of the anchor bolts in accordance with 2402.3.H, "Setting Anchor Bolts."

Unless otherwise required by the contract, provide and install galvanized structural steel posts (H-Pile) as footings for Type A signs in accordance with 2452, "Piling," 2471, "Structural Metals," and the following:

- (1) Construct footings as required by the contract;
- (2) The Department will allow use of a 14 ft [4.3 m] H-Pile post instead of welding a 2 ft [0.6 m] stub post to the 12 ft [3.7 m] H-Pile;
- (3) Obtain a bearing capacity from 12 ton [107 kN] to 14 ton [125 kN] for each H-Pile in accordance with 2452, "Piling;"

- (4) Splice additional length of H-Pile in accordance with 2452, "Piling," and drive to the bearing capacity required in 2452.3.C, "Equipment for Driving," if the driven length of H-Pile specified in the contract fails to reach bearing capacity;
- (5) Repair damage to galvanized surfaces in accordance with 2471, "Structural Metals," before back filling.

## **F Flanged Channel Sign Posts**

### **F.1 Furnish Flanged Channel Sign Post**

Fabricate, package, and deliver flanged channel sign posts in accordance with 3352, "Signs, Delineators, and Markers," 3401, "Flanged Channel Sign Posts," this section (2564), and the following:

- (1) Band posts of the same weight [mass] and length with banding material, in lots of no more than 20 posts per bundle;
- (2) Label each bundle with the following:
  - (2.1) Post weight per foot [mass per meter],
  - (2.2) Contractor's name,
  - (2.3) Project number,
  - (2.4) Source of the material, and
  - (2.5) Supplier's name;
- (3) Deliver the posts to the Department as required by the contract;
- (4) Give the Engineer at least three working days notice; and
- (5) Deposit posts as directed by Department personnel.

The Engineer will reject material with damage detected during unloading. The Department will perform final inspection and acceptance of the posts within 14 calendar days after the date of delivery to the Department.

### **F.2 Furnish and Install Flanged Channel Sign Posts**

Install the posts plumb above ground, located and oriented as directed by the Engineer. Remove and replace posts that are bent or damaged and considered unacceptable by the Engineer, at no additional cost to the Department.

Set posts firmly in the ground. After driving, ensure the top of the post has the same cross-sectional dimensions as the post body.

If mounting a delineator on a bridge rail, provide and install a bracket as required by the contract in lieu of a conventional steel post.

Install posts in surfaced medians or sidewalks as detailed on the plans or in the special provisions.

## **G Modify Post**

Do not splice Type A sign post sections below the friction fuse.

Extend Type A sign posts, located above the friction fuse, and panel mounting posts by welding a new or salvaged section of the same size to an existing post in accordance with 2471, "Structural Metals."

The Contractor may extend S4 × 7.7 [S100 × 11] panel mounting posts by bolt splicing as required by the contract and in accordance with 2471, "Structural Metals." Galvanize post extensions in accordance with 2471, "Structural Metals."

If shortening posts, dispose of removed sections in accordance with 2104, "Removing Pavement and Miscellaneous Structures."

The Contractor may use thermal cutting in accordance with 2471, "Structural Metals." Repair galvanized areas marred by cutting or welding in accordance with 2471, "Structural Metals."

## **H Sign Panels**

Type Overlays are separate panels mounted on the face of signs to form a part of the legend. Attach Type Overlays to the sign panels with rivets spaced 12 in [300 mm] on centers except at the edges. Attach the edges of each Type Overlay with rivets spaced no greater than 6 in [150 mm] on centers. Do not install rivets within 1 in [25 mm] of extruded panel joints.

Fabricate the sign panels in accordance with the standard sign drawings in the Standard Signs Manual or as required by the contract. For sign panels detailed in the contract, provide sign panel layouts with the following characteristics:

- (1) The vertical dimension given is for the legend component having the largest vertical dimension in the particular line of copy. Other legend components are centered on the larger legend component unless indicated otherwise.
- (2) The horizontal dimensions given within the sign panel are to the tenth of an inch and are cumulative representing the distance from the left edge of panel to the extreme left edge of the legend component.
- (3) The position of an arrow is measured in degrees counterclockwise from a right horizontal reference line. The abbreviation MOD used in the sign panel recap = Modified.

Screen a fabrication sticker with the following information:

- (1) Company name and address,
- (2) The twelve months of the year in numeric order, and
- (3) The last two digits of the current year and the following four years.

Affix the sticker to the backside of each new Type C single-post installation and Type D sign panels in the lower right corner of the sign panel, when facing the back of the sign panel. For installations of at least two posts for Type C sign panels, install the sticker at the bottom center of the sign panel. Indicate the month and year of fabrication of the sign panel on the sticker using one of the following methods:

- (1) Punch-out the fabrication month and year of the sign panel on the completed sticker; or
- (2) Block out the month and year of fabrication on the screen before applying the black ink so that the month and year of fabrication will not be displayed.

Provide a full-size mockup of the sticker, measuring 3 in × 1½ in [75 mm × 40 mm] with a black legend on a white, reflectorized background, to the Engineer for approval.

Attach extruded sign panels to sign posts or panel mounting posts with new post clips and torque each post clip to 12 ft•lb to 14 ft•lb [16 N•m to 19 N•m].

Package, deliver, store, and install sign panels in accordance with 1607, "Handling Materials," 3352, "Signs, Delineators, and Markers," and the retroreflective sheeting manufacturer's recommendations.

For furnished and installed signs or sign panels, affix a Department-provided warning sticker to the backside of each sign panel directly above the fabrication sticker. Warning stickers are available at the Department's Transportation District Office specified in the Contract. The Transportation District's contact person and phone number are specified in the Contract. Give the Transportation District's contact person thirty calendar days advance notice before picking up the stickers.

For sign panels the Contractor furnishes but does not install, group sign panels by type and then size. Ensure each package only contains the sign panels for a specific location and no more than 20 sign panels per package. Label each package with the following:

- (1) Sign number,
- (2) Contractor's name,
- (3) Project number,
- (4) Material source,
- (5) Supplier's name,
- (6) Quantity of sign panels, and
- (7) The delivery location required by the contract.

Provide notice at least 3 working days to the Department's sign shop personnel before delivery of sign panels to the Department.

Deposit sign panels as directed by Department personnel. The Engineer will reject sign panels with damage detected during unloading. The Department will perform final inspection and acceptance of sign panels within 14 calendar days of the date of delivery to the Department.

## **I (Blank)**

## **J Saw Sign Panels**

Saw-cut extruded aluminum sign panels and ensure the resulting panel edge is smooth. Dispose of excess material in accordance with 2104, "Removing Pavement and Miscellaneous Structures."

## **K Sign Panel Overlay Type \_\_\_**

Provide and install overlay panels, including legends, on existing extruded aluminum sign panels. Attach the overlay sheets to the extruded panel with  $\frac{3}{16}$  in [5 mm] aluminum alloy, pull-through rivets.

Use 0.063 in [1600  $\mu$ m] aluminum sign base material for overlay sheets in accordance with 3352.2.A.1.a, "Sheet Aluminum."

Use reflective sheeting sign face material in accordance with 3352.2.A.2.e, "Sign Sheeting Type IX," or 3352.2.A.2.f, "Sign Sheeting Type XI," except for the following:

- (1) For a yellow background on sign panel overlays, use reflective sheeting as specified by 3352.2.A.2.e, "Sign Sheeting Type IX," FL fluorescent yellow, or 3352.2.A.2.f, "Sign Sheeting Type XI," FL fluorescent yellow, and
- (2) For a brown background, use white reflective sheeting as specified by 3352.2.A.2.e, "Sign Sheeting Type IX," or 3352.2.A.2.f, "Sign Sheeting Type XI."

Use sign legend material as specified by 3352.2.A.2.e, "Sign Sheeting Type IX," or 3352.2.A.2.f, "Sign Sheeting Type XI" for the sign face material on each sign panel, except for the following:

- (1) Use brown (1179), electronic Cuttable (EC) film produced by the same manufacturer that fabricates the reflective sheeting specified by 3352.2.A.2.e, "Sign Sheeting Type IX," or 3352.2.A.2.f, "Sign Sheeting Type XI," for sign legend material on sign panel overlays with brown sheeting; and
- (3) If brown EC film for sign panel overlays requires splicing, make splices vertical and butt spliced and spaced so splices do not occur through letters or arrows.

Before applying the brown EC film to sign face material, perform the following:

- (1) Cut and weed-out legends and borders specified on the sign panel overlay details in the contract from the brown EC film. Do not cut and weed-out the brown EC film that will be covered by sign panels Type Overlay.
- (2) Apply the weeded brown EC film to the white reflective sheeting sign face material.
- (3) Apply the brown EC film "corner" pieces, located outside the border that fill in the square corners of the sign panel overlay.

Use direct-applied sign legend material in accordance with 3352.2.A.5.c, "Screen Processed Painted Legend," or 3352.2.A.5.d, "Pigmented Plastic Film Legend" for black legends. Remove demountable legends on existing sign panels and dispose of them in accordance with 2104, "Removing Pavement and Miscellaneous Structures."

Tightly butt the overlay sheets vertically and rivet to the existing panel on 12 in [300 mm] vertical and horizontal centers. Rivet the edges and corners of each overlay sheet. Do not place rivets within 1 in [25 mm] of the extruded panel joints. Attach overlay sheets to the existing panel so sheets are free of waviness.

Remove in-place post clips and attach overlaid, extruded sign panels to sign posts or panel mounting posts with new post clips. Torque each post clip from 12 ft•lb to 14 ft•lb [16 N•m to 19 N•m] when attaching all extruded sign panels to posts.

#### **L Install Sign Panel Type \_\_**

Install a salvaged or Department-provided sign panel, as required by the contract and the following:

- (1) Install Type A and Type OH sign panels using new post clips;
- (2) Install Type EA and Type EO sign panels with new flanged channel posts and post clips;
- (3) Torque each post clip from 12 ft•lb to 14 ft•lb [16 N•m to 19 N•m] when attaching extruded sign panels to posts.
- (4) Install Type C and Type D sign panels with new nuts, bolts, and washers; and
- (5) Use new sign bracket assemblies as shown on the plans for Type OH sign panels installed on sign supports.

#### **M Install Sign Type \_\_**

Install Type A signs on breakaway supports at the locations required by the contract. Install salvaged or Department-provided Type A sign panels using new post clips. Torque each post clip from 12 ft•lb to 14 ft•lb [16 N•m to 19 N•m] when attaching all extruded sign panels to posts. Completed installations shall be in accordance with the contract and details shown on the plans. Provide and install a new friction fuse consisting of a friction fuse plate and hinge plate, new bolts, nuts,

and washers on each post. Repair damaged galvanized surfaces in accordance with 2471, "Structural Metals."

Provide and install a new sign structure for Type C and Type D signs and install salvaged sign panels as required by the contract, using new nuts, bolts, and washers. Install salvaged sign panels to the mounting heights as shown on the plans.

Install each mast arm mounted, Type D signs at the locations shown on the plans, to the Engineer's satisfaction, and in accordance with the "Structural Details For Signal Mast Arm Mounted Signs" specified in the Standard Signs Manual, page 105A. If the materials specified in the Standard Signs Manual, page 105A are no longer available, provide each mast arm mounted Type D sign panel with a mounting system approved by the Department. Obtain approval for the mounting system by submitting product specifications and strength calculations that demonstrate compliance with the current AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals*. Address submittals to the Fabrication Methods Engineer, Mn/DOT Office of Bridges and Structures, Mail Stop 610, 3485 Hadley Avenue North, Oakdale, Minnesota 55128.

Provide new flanged channel posts for Type EA and Type EO sign panels, and install salvaged sign panels with new post clips as required by the contract. Torque each post clip to 12 ft•lb to 14 ft•lb [16 N•m to 19 N•m].

Install Type OH sign structures obtained by salvage or from storage on new concrete footings in accordance with the torque requirements specified by 2564.3.E, "Structural Steel," and as required by the contract.

Remove, provide, and replace the following with new components:

- (1) Safety chains and components of safety chain snap assemblies,
- (2) Safety rail locking pins, and
- (3) Chains welded to the locking pin heads (one chain/locking pin).

Dispose of removed items in accordance with 2104, "Removing Pavement and Miscellaneous Structures."

Verify that each locking pin fits in the locking pin hole in the handrail hinge while the handrail is in the raised position. Drill out the handrail hinge to make a proper fit for locking pins that do not fit. Repair damaged galvanized surfaces in accordance with 2471.3.L.1, "Galvanizing."

## **N Sign Legend Revision**

Revise sign legends of existing sign panels as required by the contract and the following:

- (1) Clean the sign faces with a mild detergent and water solution before installing the new sign legend;
- (2) Use reflective sheeting for new legends in accordance with 3352.2.A.2.e, "Sign Sheeting Type IX" or 3352.2.A.2.f, "Sign Sheeting Type XI," on Type A, Type EA, Type EO and Type OH sign panels; and
- (3) Use direct-applied, non-reflectorized sign legend material in accordance with 3352.2.A.5.c, "Screen Processed Painted Legend," or 3352.2.A.5.d, "Pigmented Plastic Film Legend" for black legends.

## **O (Blank)**

### **P Overhead Sign Identification Plate**

Provide and install an overhead sign identification plate for each overhead sign installed as required by the contract. Provide a plate that incorporates the overhead sign number directly below the sign panel shown on the plan layout and as required by the contract.

For post mounted signs, strap-mount the plate on the overhead sign post as required by the contract. Install the plate on the right-hand post. Determine the right-hand post by looking in the direction of traffic flow. If signs face both directions of travel on a single structure, provide two plates. Install the plate 6 ft [1.8 m] above the base plate elevation facing traffic.

For bridge-mounted, Type OH signs with sign lighting, install the overhead sign identification plate 6 ft [1.9 m] above the edge of the pavement on the feed point identification plate delineator post specified by 2545.3.J.4, "Feed Point Identification Plate."

For bridge-mounted, Type OH signs without sign lighting, install the plate on a 2 lb/ft [3 kg/m] delineator post in accordance with 3401, "Flanged Channel Sign Posts." Install the plate and post as close to the bridge as possible and behind the guardrail. If no guardrail is in place, install the plate and post at least 12 ft [3.7 m] outside the edge of shoulder or face of curb. Install the plate so the bottom is 6 ft [1.8 m] above the edge of pavement.

### **Q Extend Walkway Support**

Extend each walkway support on existing Type OH sign structures as required by the contract.

### **R Friction Fuse**

Provide and install a friction fuse on each existing Type A sign post as required by the contract and the following:

- (1) Remove the in-place friction fuse, consisting of a friction fuse plate and a hinge plate, and in-place mounting hardware, and dispose of these items in accordance with 2104, "Removing Pavement and Miscellaneous Structures;"
- (2) Provide and install a new friction fuse consisting of a friction fuse plate and a hinge plate, new bolts, nuts, and washers on each post as required by the contract; and
- (3) Repair damaged galvanized surfaces in accordance with 2471.3.L.1, "Galvanizing."

## **S Keeper Plate**

Provide and install a keeper plate on each existing Type A sign post as required by the contract.

Verify sign post dimensions in the field. Immediately before installing keeper plates, clean the base connection plate to remove grit, dirt, and deleterious material. Reinstall the post in accordance with base connection bolting procedures shown on the plans. Replace missing, damaged, or rusty bolts, nuts, and washers.

## **T Traffic Control**

Provide signs for traffic control meeting the requirements of the Standard Signs Manual. Provide barricades meeting the requirements of Mn/DOT Standard Plate 8000. Provide all other traffic control devices in accordance with the MN MUTCD. Install nylon washer spacers between the temporary traffic construction sign panels and the in-place sign panels.

Provide Traffic Control Devices (TCDs) as required by the contract and MN MUTCD.

Install TCDs in accordance with the MN MUTCD, before beginning work. Maintain TCDs while in place and remove them if not required.

## **U Scheduling of Work**

Schedule work in accordance with the following requirements:

- (1) Ensure one of the following signs is in service at all times for each exit:
  - (1.1) The Exit sign in the gore, or
  - (1.2) The Exit direction sign just in advance of the gore;
- (2) Provide at least one directional sign, either an advance guide sign or an "Exit" directional sign, in service at all times for each exit; and
- (3) Do not remove sign structures until approved by the Engineer. The Engineer's approval for removing an existing sign is contingent upon

compliance with Items 1 and 2 above and upon completion of a constructed, functional replacement sign.

## **V Delineators and Markers**

Fabricate delineators and markers in accordance with the standard sign drawings in the Standard Signs Manual, the Traffic Engineering Manual, or as required by the contract. Provide and install the tubular or flanged channel sign post, mounting bracket, or strap mounting hardware, and attach the delineator or marker with mounting hardware required by the contract.

## **W Safety Cable**

To assemble and attach safety cables as shown on the plans for Type OH signs with walkways and no sign lighting, provide and install brackets, aircraft cable, and hardware as shown on the plans.

## **2564.4 METHOD OF MEASUREMENT**

### **A General**

The Engineer will individually measure each of the following items; modify post, install sign panel Type \_\_, sign legend revision, overhead sign identification plate, extend walkway support, friction fuse, and keeper plate.

### **B Concrete Structures**

#### **B.1 Concrete Footings**

The Engineer will measure concrete footings for Type OH signs by volume based on the dimensions required by the contract. The Engineer will not deduct the volume of metal reinforcement, anchorages, and conduit. The Engineer will measure anchorage assemblies separately.

#### **B.2 Median Barrier Footing**

The Engineer will measure median barrier footings by volume based on the dimensions required by the contract. The Engineer will not deduct the volume of metal reinforcement, anchorages, and conduit. The Engineer will measure anchorage assemblies separately.

### **C Sign Support**

The Engineer will measure a sign support as a complete unit including concrete footings and overhead sign identification plates.

## **D Overhead Sign Structure Repair**

The Engineer will measure overhead sign structure repair by the number of hours required to complete the repair, including use and operation of equipment, travel time inside the project limits, and work and materials involved.

## **E Structural Steel**

The Engineer will measure the following structural steel items:

- (1) Trusses for overhead signs (Design B);
- (2) Posts for overhead signs (Design B);
- (3) Walkway supports for overhead signs (Design B);
- (4) Walkway grating for overhead signs (Design B);
- (5) Panel mounting posts for overhead signs (Design B);
- (6) Trusses for overhead signs (Bridge Mounted); and
- (7) Posts and H-piles for Type A signs.

The Engineer will measure structural steel items separately by the computed weight [mass] of structural steel incorporated in each item in accordance with the measurement provisions of 2402.4.A, "Weight," as modified by the following:

- (1) The weight [mass] measurement for Design B overhead sign trusses includes the following:
  - (1.1) Structural members of the truss,
  - (1.2) The lower chord juncture plate,
  - (1.3) Cap plates,
  - (1.4) Tie plates,
  - (1.5) Collar,
  - (1.6) Panel mounting posts,
  - (1.7) Walkway grating,
  - (1.8) Walkway supports,
  - (1.9) Safety rail, and
  - (1.10) Fixture mounting channel.
- (2) The weight [mass] measurement for Design B overhead sign posts includes the following:
  - (2.1) Posts,
  - (2.2) The base juncture plate,
  - (2.3) Lower chord juncture post plate,
  - (2.4) Gusset plates,
  - (2.5) Baseplate,
  - (2.6) Overhead sign identification plate, and

(2.7) The anchorage assembly.

(3) The weight [mass] measurement for Bridge Mounted overhead sign trusses includes the following:

(3.1) The structural members of the truss,

(3.2) The panel mounting posts,

(3.3) Walkway grating,

(3.4) Walkway supports,

(3.5) Safety rail, and

(3.6) Fixture mounting channels.

(4) The Engineer will base the computed weight [mass] on the quantity tables in the contract;

(5) The Engineer will not measure bolts, nuts, rivets, washers, and shims used in the fabrication and erection of signs, and will not apply the provisions of 2402.4.A, "Weight," that provide a percent increase in weight [mass].

## **F Flanged Channel Sign Posts**

The Engineer will measure flanged channel sign posts by the computed weight [mass] for each post size provided.

## **G Sign Panels**

The Engineer will measure each type of sign panel by area based on the nominal dimensions of the sign panels. All signs are considered rectangular for the purpose of measurement except that the Engineer will measure triangular shaped sign panels as the actual area of the triangle. The Engineer will not make deductions for rounded corners.

## **H Saw Sign Panels**

The Engineer will measure sawing of extruded sign panels by the length of the saw cut.

## **I Sign Panel Overlay Type \_\_**

The Engineer will measure sign panel overlays by the area and type of sign panels overlaid.

## **J Install Sign Type \_\_**

The Engineer will measure each type of sign by the number of complete units in place in accordance with 2564.3.M, "Install Sign Type \_\_."

## **K Delineators and Markers**

The Engineer will measure delineators and markers by the number of each type of complete units provided and installed. A complete unit consists of the following as specified by the Standard Signs Manual, Traffic Engineering Manual, or as required by the contract:

- (1) Delineator or marker panel,
- (2) Tubular or flanged channel sign post,
- (3) Mounting bracket or strap mounting hardware,
- (4) Delineator or marker panel mounting hardware.

### **2564.5 BASIS OF PAYMENT**

The Department will pay for traffic signs and devices at the contract unit price per unit of measure.

The contract cubic yard [cubic meter] price for *Concrete Footings* includes the cost of constructing the footings, replacing topsoil and sodded areas disturbed by the operations, and disposing excess excavated material as approved by the Engineer. The Department will include the cost of excavation for concrete structures with other relevant contract unit prices except for the following:

- (1) The Department will pay for the volume of excavation required 12 in [300 mm] below the bottom of the concrete structure, measured as actual material removed, within the limitations set forth in 2451.4.A, "Structure Excavation," as extra work.
- (2) The Department will pay for Class R excavation that is encountered and cannot be avoided by adjustment of the concrete structure location as extra work.

The Department will include the cost of reinforcement bars with other relevant contract unit prices.

The contract pound [kilogram] price for *Structural Steel* (Design B, Posts for OH Signs) includes the cost of anchorage assemblies.

The contract unit price, each, for *Median Barrier Footing* includes the cost of constructing the footing in place as shown on the plans. The Department will include the cost of excavation for concrete structures with other relevant contract unit prices except for the following:

- (1) The Department will pay for the volume of excavation required 12 in [300 mm] below the bottom of the concrete structure, measured as actual

material removed, within the limitations set forth in 2451.4.A, "Structure Excavation," as extra work.

- (2) The Department will pay for Class R excavation that is encountered and cannot be avoided by adjustment of the concrete structure location as extra work.

The Department will include the cost of reinforcement bars with other relevant contract unit prices.

The contract unit price, each, for *Sign Support* includes the cost of providing and installing the sign support, concrete footings, and overhead sign identification plate.

The contract man-hour price for *Overhead Sign Structure Repair* includes the cost of performing the work as required by the contract, except that the contract each price for *Install Sign Type OH* will include the cost of the crane work and materials required to position and block the truss up off the ground. Overhead sign structure repair is exempt from 1903, "Compensation for Increased or Decreased Quantities." The Department will not make a unit price adjustment for overhead sign structure repair in the event of a quantity underrun or overrun.

The contract pound [kilogram] price for *Structural Steel* includes the cost of providing and erecting the structural steel items as required by the contract including the cost of providing and installing posts in surfaced medians or sidewalks. The contract pound [kilogram] price for *Structural Steel* also includes the cost of manufacturing, packaging, and delivering flanged channel sign posts as required by the contract.

The contract unit price, each, for *Modify Post* includes the cost of modifying each post as required by the contract.

The contract square foot [square meter] price for *Sign Panels Type C* and *Type D* includes the cost of providing and installing the tubular or flanged channel sign posts, stringers, brackets, and attachment angles or strap mounting hardware for sign panel attachment.

The contract square foot [square meter] price for *Sign Panels Type EA* and *Type EO* includes the cost of providing and installing the flanged channel sign posts.

The contract square foot [square meter] price for *Sign Panels Type A* includes the cost of the hardware required to assemble the panel sections and to attach the assembled sign panels to the sign posts.

The contract square foot [square meter] price for *Sign Panels Type OH* includes the cost of the hardware required to assemble the panel sections and attach the assembled sign panels to the panel mountings posts or the sign support.

The Department will include the cost of torquing post clips with the applicable pay items for traffic signs and devices.

The contract each price for *Install Sign Panel Type C* and *Type D* includes the cost of screening and installing fabrication stickers and installing warning stickers.

The contract unit price, each, for *Furnish Sign Panels Type \_\_\_* includes the cost of providing and delivering the sign panels as required by the contract.

The contract linear foot [linear meter] price for *Saw Sign Panel Type \_\_\_* includes the cost of sawing sign panels as required by the contract.

The contract square foot [square meter] price for *Sign Panel Overlay Type \_\_\_* includes the cost of removing and reinstalling the existing sign panel, and providing, installing, and torquing new post clips, except the contract square foot [square meter] price for *Sign Panels Type Overlays* includes the cost of providing and installing new type overlays.

The contract unit price, each, for *Install Sign Panel Type \_\_\_* includes the cost of installing each sign panel as required by the contract.

The contract unit price, each, for *Install Sign Type \_\_\_* includes the cost of installing each sign as required by the contract. The contract unit price for *Install Sign Type OH* includes the cost of safety chains and components of safety chain snap assemblies, safety rail locking pins, and chains welded to the locking pin heads.

The Department will pay for posts and concrete footings or H-Pile footings for Type A signs, and the footings for Type OH signs separately. The Department will pay for posts and H-Piles for Type A signs under Structural Steel Posts for Type A signs. The Department will pay for the anchorage assembly(ies) under Structural Steel Posts for Type OH Signs (Design B). The Department will pay for concrete footing(s) for Type OH signs under Concrete Footings (Type Spread or Shaft) or median barrier footing(s).

The contract unit price, each, for *Sign Legend Revision* includes the cost of revising each sign panel as specified in the contract.

The contract unit price, each, for *Overhead Sign Identification Plate* includes the cost of providing and installing each overhead sign identification plate as required by the contract.

The contract unit price, each, for *Extend Walkway Support* includes the cost of extending each walkway support as required by the contract.

The contract unit price, each, for *Friction Fuse* includes the cost of removing an in place friction fuse, and providing and installing a new friction fuse as required by the contract.

The contract unit price, each, for *Keeper Plate* includes the cost of providing and installing a new keeper plate as required by the contract.

The contract unit price, each, for delineators and markers includes the cost of providing and installing each delineator and marker as required by the contract.

The Department will pay for traffic signs and devices on the basis of the following schedule:

<b>Item No.:</b>	<b>Item:</b>	<b>Unit:</b>
2564.511	Concrete Footings Type ____	cubic yard [cubic meter]
2564.513	Median Barrier Footing	each
2564.515	Sign Support	each
2564.518	Overhead Sign Structure Repair	man-hour
2564.522	Structural Steel - (Specify Item & Use)	pound [kilogram]
2564.524	Modify Post	each
2564.531	Sign Panels Type ____	square foot [square meter]
2564.533	Furnish Sign Panels Type ____	square foot [square meter]
2564.534	Saw Sign Panel Type ____	linear foot [meter]
2564.535	Sign Panel Overlay Type ____	square foot [square meter]
2564.536	Install Sign Panel Type ____	each
2564.537	Install Sign Type ____	each
2564.538	Sign Legend Revision	each
2564.539	Overhead Sign Identification Plate	each
2564.540	Extend Walkway Support	each
2564.541	Friction Fuse	each
2564.542	Keeper Plate	each
2564.550	Delineator, Type ____	each
2564.551	Reference Post Marker	each
2564.552	Hazard Marker X4-2	each
2564.553	Clearance Marker X4-4	each
2564.554	Snowplow Marker X4-5	each
2564.555	End of Roadway Marker X4-11	each

## 2565 TRAFFIC CONTROL SIGNALS

## **2565.1 DESCRIPTION**

### **A General**

This work consists of providing and installing materials and electrical equipment, or installing Department-provided materials and electrical equipment, or both to provide a complete, operating traffic signal system.

This work also consists of providing the following as required by the contract:

- (1) Revised traffic signal systems,
- (2) Wood pole span wire traffic signal systems,
- (3) Automatic Traffic Recorder (ATR) systems,
- (4) Temporary bridge signal systems,
- (5) Conduit systems,
- (6) Detection systems,
- (7) Materials for future signal systems,
- (8) Interconnection systems,
- (9) Flasher systems, and
- (10) Emergency Vehicle Pre-emption (EVP) systems, or a combination.

### **B Definitions**

Refer to the ITE, the MN MUTCD, 1101, "Abbreviations," and 1103, "Definitions," for the definitions of words and phrases pertaining to traffic control signal systems and related work. Refer to NEMA Standards Publication for "Traffic Control Systems" for the definitions of words and phrases in conjunction with traffic signal control equipment and controller units.

Refer to the NEC, Article 100 for the definition of the term "Listed."

Use a National Recognized Testing Laboratory (NRTL) as defined by the U.S. Department of Labor. Ensure the testing laboratory is listed by OSHA in its scope of recognition for the tests conducted as required by this section.

Use the definitions in these referenced publications unless otherwise defined in these Standard Specifications or the contract.

## **2565.2 MATERIALS**

### **A General**

#### **A.1 Regulations and Code**

Provide electrical equipment meeting relevant standards and requirements from the following references:

- (1) NEMA;
- (2) Underwriters' Laboratories, Inc. (UL); or
- (3) The Electronic Industries Alliance (EIA).

Provide materials, electrical equipment, and workmanship meeting the standards in the current editions of the following references:

- (1) NEC,
- (2) ASTM,
- (3) ANSI,
- (4) ITE,
- (5) MN MUTCD, and
- (6) Relevant local laws and ordinances.

Provide copper electrical conductors. Provide wire sizes for electrical conductors based on the American Wire Gauge (AWG).

### **A.2 Materials and Electrical Equipment List**

Within 15 calendar days following the Award of Contract date, submit a list of Contractor-provided materials and electrical equipment to the Engineer. Include in the list, the name of the manufacturer, size, and the location where the item is obtained.

Within 15 calendar days following the contract approval-notice mailing date, provide evidence in writing to the Engineer, that orders are placed for signal system components required on the project.

### **A.3 Material Samples for Testing**

Provide samples of materials for testing and inspection. The Engineer may accept materials on the basis of the manufacturer's certification that material was sampled, tested, and inspected for compliance with the contract requirements. The Department reserves the right to accept or reject material on the basis of its own tests and inspections.

### **A.4 Tests**

Perform the tests necessary to demonstrate that the materials, electrical equipment, and the installation of these items meet the requirements of the contract, at no additional cost to the Department.

Provide instruments, apparatus, tools, materials, and labor necessary to perform the required tests, at no additional cost to the Department. Instruments, apparatus, tools, and materials for performing tests will remain the property of the Contractor after completion of the tests.

### **A.5 Warranties, Guarantees, and Instruction Sheets**

Provide new materials and electrical equipment with warranties and guarantees.

For materials and electrical equipment, submit manufacturers' warranties and guarantees, instruction sheets, and parts lists, to the Engineer before final acceptance of the project or if requested by the Engineer.

Warrant and guarantee that materials and equipment provided to the project are free of defects in materials and workmanship in accordance with the following:

- (1) Turn over warranties and guarantees, offered by the material and electrical equipment manufacturer as a customary trade practice, to the Department. Name the Department as the obligee on manufacturers' warranties and guarantees;
- (2) Warrant and guarantee in-service operation of materials and electrical equipment for one year. The one-year in-service warranty period begins when the Contractor "turns-on" the traffic control signal system, except the one-year period for materials and electrical equipment components placed into operation after the "turn-on" of the traffic control signal system begins on the date the materials and electrical equipment are initially, individually placed in service. The Department defines "turn-on" as the time the complete traffic control signal system meets the installation and operational requirements of the contract and is placed in automatic operation.

Replace or correct materials and electrical equipment the Engineer finds defective within the one-year in-service warranty period at no additional cost to the Department.

The warranty and guarantee requirements of this section do not apply to parts of materials and electrical equipment that the Engineer determines were subject to misuse, negligence, or accident and not the fault of the Contractor.

### **A.6 Mn/DOT Approved/Qualified Products Lists**

Access traffic signal system materials listed on the Approved/Qualified Products List.

**B Conduit and Accessories**

**B.1 Rigid Steel Conduit (RSC) and Conduit Fittings ..... 3801**  
**B.2 Intermediate Metal Conduit (IMC) and Conduit Fittings ..... 3802**  
**B.3 Non-Metallic Conduit (NMC) and Conduit Fittings..... 3803**  
**B.4 Conduit Expansion Fittings ..... 3839**

**C Handholes**

Only use Department-approved handholes listed on the Approved/Qualified Products List under “Signals.”

**D Electrical Junction Boxes ..... 3838**

**E Concrete..... 2411**

**E.1 General**

Provide Mix No. 3Y43 concrete for mast arm pole foundations and light standard foundations.

Provide Mix No. 3A32 concrete for the following:

- (1) Ground-mount cabinet foundations (for cabinets),
- (2) Equipment pad foundations,
- (3) Pedestrian push button station foundations,
- (4) Flasher pedestal foundations, and
- (5) New sidewalk construction or sidewalk replacement.

Provide concrete meeting the requirements for Type 3, Grade A concrete if the contract does not require a specific mix designation.

Construct or replace concrete pavement or base, removed for trenching or construction operations, with Mix No. 3Y43 high early-strength concrete.

Provide plastic curing blankets in accordance with 3756, “Plastic Curing Blankets.”

**F Anchor Rods..... 3385**

**F.1 Traffic Signal Pedestals and Mast Arm Pole Standards**

Provide anchor rods, nuts, and washers for traffic signal pedestals and mast arm pole standards as required by the contract.

## **F.2 Traffic Signal Cabinets**

For traffic signal cabinets, provide anchor rods and nuts in accordance with 3385, "Anchor Rods," for Type A anchor rods. Provide anchor rods with the tops stamped AB36. The Engineer will not accept blue-top bolt identification in lieu of stamped anchor rods. Provide anchor rods with a diameter of  $\frac{3}{4}$  in  $\times$  19 in,  $\pm 0.50$  in [19 mm  $\times$  483 mm,  $\pm 13$  mm] long before bending a 2 in [51 mm] ell on one end. Thread the opposite end of each anchor rod with at least 4 in [102 mm] of thread. Hot-dip galvanize each anchor rod full length in accordance with 3392, "Galvanized Hardware." Provide stainless steel washers 2 in [51 mm] in diameter in accordance with 3385, "Anchor Rods."

## **F.3 Signal Service Cabinets (Type SSB)**

For Type SSB signal service cabinets, provide anchor rods and nuts in accordance with 3385, "Anchor Rods," for Type A anchor rods. Provide anchor rods with the tops stamped AB36. Do not provide blue top-bolt identification. Provide anchor rods with a diameter of  $\frac{3}{4}$  in [19 mm]  $\times$  19 in [483 mm]  $\pm 0.50$  in [13 mm] long before bending a 2 in [51 mm] ell on one end. Provide anchor rods with at least 4 in [102 mm] of thread. Hot-dip galvanize each anchor rod length in accordance with 3392, "Galvanized Hardware." Provide stainless steel washers 2 in [51 mm] in diameter in accordance with 3385, "Anchor Rods."

## **F.4 Anti-seize Lubricant**

Apply brush-on anti-seize lubricant to threaded portions of signal system components before assembly. Apply brush-on lubricant to the following threaded assemblies:

- (1) Mast arm pole standard anchor rods above concrete foundations,
- (2) Mast arm pole to transformer base bolts,
- (3) Traffic signal cabinet anchor rods above concrete foundations,
- (4) Signal service cabinet anchor rods above concrete foundations,
- (5) Pedestal anchor rods above concrete foundations,
- (6) Pedestal shaft and pedestal base,
- (7) Pedestal reinforcing collars,
- (8) Pedestal shaft caps,
- (9) Pedestal base cover bolt and nut,
- (10) Blind threaded inserts, or rivet nuts,
- (11) Threaded hub and flange pole adaptor,
- (12) Bolt on hub and flange,
- (13) Straight and angle mount plumbizers, and
- (14) Signal bracketing.

<b>G</b>	<b>Electrical Cables and Conductors .....</b>	<b>3815</b>
<b>H</b>	<b>Mast Arm Pole Standards and Luminaires .....</b>	<b>3831</b>
<b>I</b>	<b>Emergency Vehicle Preemption (EVP) .....</b>	<b>3814</b>
<b>J</b>	<b>Traffic Signal Pedestal.....</b>	<b>3832</b>
<b>K</b>	<b>Vehicle Signal Faces .....</b>	<b>3834</b>
<b>L</b>	<b>Pedestrian Signal Faces .....</b>	<b>3835</b>
<b>M</b>	<b>Wood Poles .....</b>	<b>3840</b>
<b>N</b>	<b>Service Equipment.....</b>	<b>3837</b>
<b>O</b>	<b>(Blank)</b>	
<b>P</b>	<b>Pedestrian Push Buttons and Signs .....</b>	<b>3833</b>
<b>Q</b>	<b>Signs .....</b>	<b>2564</b>

Provide pedestal-mounted, pole shaft-mounted, or mast arm-mounted signs of the size required by the contract, and fabricated in accordance with the Standard Sign Manual and 3352, "Signs, Delineators, and Markers."

**R Traffic Signal Cabinet and Control Equipment**

Provide the traffic signal cabinet, or other pad-mounted cabinet and control equipment, as required by the contract.

**S Miscellaneous Materials**

If the contract does not specify requirements for materials and electrical equipment, provide the materials and equipment as approved by the Engineer.

**T Bent Pipe Monotube Signal Bridges**

Fabricate bent pipe monotube signal bridges as required by the contract and in accordance with 2471, "Structural Metals."

**U Concrete Walks and Pedestrian Curb Ramps**

Construct 4-inch [102 mm] thick concrete walks around traffic signal bases in accordance with 2521, "Walks," and as required by the contract. If in a curb section, concrete walks may include pedestrian curb ramps. Construct pedestrian curb ramps, if shown on the plans, in accordance with the Department Standard Plate No. 7036.

**V Terminal Blocks**

Provide terminal blocks consisting of a one-piece phenolic molding with 12 double-point terminals, with strap screw contacts for size 10-32 binder head screws. Provide barriers between terminals at least ½ in [13 mm] high. Ensure the holes for the binder head screws do not extend through the plastic. Provide terminal blocks with slots that fit the spade lugs for terminating conductors. Ensure each terminal block meets the 600 V requirements of NEMA. Provide terminal blocks that are NRTL Listed as compliant with the requirements of UL XCFR2.GuideInfo — Terminal Blocks.

**W Pole Base Connectors**

Only use pole base connectors, pins, sockets, and hand crimp tools listed on the Approved/Qualified Products List under “Signals.”

**X Loop Detector Sealant Material**

Only use loop detector sealant material listed on the Approved/Qualified Products List under “Signals.”

**Y Loop Detector Splices**

Only use loop detector splice encapsulation kits listed on the Approved/Qualified Products List under “Signals.”

**2565.3 CONSTRUCTION REQUIREMENTS****A General**

The locations shown on the plans for component parts, including pedestrian curb ramps, are approximate. The Engineer will establish the exact locations of component parts including pedestrian curb ramps.

Keep highways, streets, and roads open to traffic during construction in accordance with 1404, “Maintenance of Traffic.” Protect openings or uncompleted work that may cause a hazard to vehicle or pedestrian traffic in accordance with 1707, “Public Convenience and Safety.”

**A.1 Compliance with Electrical Codes and Standards**

Perform work meeting the requirements of the NEC, the Minnesota Department of Labor and Industry, Board of Electricity, and state laws and local ordinances governing electrical installations.

## **A.2 Permits and Inspections**

Obtain the necessary permits and inspections at no additional cost to the Department.

Perform work in conjunction with construction of electrical systems or conduit systems for conveying electrical cables and conductors as required by the contract and in accordance with 1702, "Permits, Licenses, and Taxes." Obtain a permit for the performance of this work, including the installation of conduits, in accordance with the Minnesota Electrical Act.

## **A.3 Utility Property and Service ..... 1507**

Meet the minimum clearance requirements, determined by the electrical utility company, for overhead electrical lines to other overhead structures and equipment operations.

## **B Existing Electrical Systems**

Maintain existing electrical systems, including traffic signals, ATRs, flasher systems, and street lighting, or Department-approved temporary replacements, in effective operation during the progress of new work, except if the Engineer directs, or the contract requires turn-offs. Notify the Engineer at least 48 h before scheduled turn-offs and before performing work on existing electrical systems. Do not turn off existing traffic signal systems without the Engineer's approval and the Engineer's presence.

Unless otherwise required by the contract, the Department will continue maintenance during the performance of work on existing electrical systems. The Department will provide electrical energy for operation and repair or replace component parts of existing electrical systems, damaged by public traffic or natural causes.

During authorized work suspension, the Department will maintain existing traffic signal cabinets and control equipment and will maintain existing traffic control signal systems, unless otherwise required by the contract.

If Contractor operations cause damage, promptly repair or replace damaged component parts of existing electrical systems in accordance with relevant specifications for new construction of the damaged component, at no additional cost to the Department. If the Contractor fails to perform the repairs or replacements, the Department will perform the work and deduct repair or replacement costs from money due to the Contractor.

## **C Excavation and Backfill**

Provide excavation and backfill for the installation of concrete foundations, cable, conduit, handholes, and other items shown on the plans in accordance with 2451, "Structure Excavations and Backfills." Do not excavate trenches for conduit and holes for concrete foundations and handholes wider than necessary. Install concrete foundations, conduit, and handholes as soon as possible following excavation. Place excavation material in locations that will not cause damage or obstruct vehicle or pedestrian traffic, or interfere with surface drainage.

Locate trenching at the distance from the edge of the pavement, back of curbing, or edge of surfaced shoulders as required by the contract or directed by the Engineer. Ensure the distance the pavement, curbing, or surfaced shoulders does not cause damage to these improvements. Construct the trench with uniform alignment for accurate referencing of the underground installation.

At locations scheduled for guardrail, utilities, cable, or other below-ground structures, modify locations to prevent damage to the cable or conduit during installation of other components. Before installation, coordinate with and obtain approval from the Engineer for modified locations. Replace cables damaged by Contractor operations due to lack of coordination with the Engineer and lack of the Engineer's approval of the location, at no additional cost to the Department.

If trenching and excavation operations require the removal of concrete pavement or concrete sidewalk, cut the concrete with a concrete saw to a depth of at least 35 percent of the thickness of the concrete along the removal lines before breaking and removing, or remove the concrete to existing joints.

Backfill excavations around the installed concrete foundations, conduit, and handholes. Use backfill material similar to adjacent soils and compact backfill material to the same density. Avoid placing stones immediately adjacent to conduits or direct-buried cable during backfill placement. If required by the contract, or directed by the Engineer, use granular material in designated layers or portions of the backfill provided in accordance with 2451, "Structure Excavations and Backfills." Restore the following to the original condition required by the contract, to the Engineer's satisfaction, and at no additional cost to the Department:

- (1) Roadway surfacing, including concrete pavement, bituminous surface, or gravel surface,
- (2) Sidewalks,
- (3) Curbs and gutters,
- (4) Sod, and
- (5) Railways.

Remove and dispose of surplus material from excavation and backfill outside the right-of-way in accordance with 2104.3.D.3, "Disposal outside Right of Way."

## **D Conduit and Fittings**

### **D.1 General**

Provide conduit and fittings of the type and size required by the contract. The Contractor may install conduit and fittings of a larger size than specified. If the contract does not specify the size of conduit, provide conduit at least  $\frac{3}{4}$  in [21 mm] and sized so the area occupied by the electrical cables and conductors does not exceed 40 percent of the internal cross-sectional area of the conduit for rigid steel conduit or 35 percent for non-metallic conduit.

Install conduit in accordance with the NEC. In a single conduit run, provide conduit of the same size and type, continuous from outlet to outlet. The Contractor may incorporate special conduit fittings for pulling electrical cables and conductors or making short radius bends, as necessary, in the run.

The Engineer will reject damaged conduit with sharp kinks or reduced cross sections.

Preserve conduit from damage and provide for installation into the system. Rigidly support conduit that will be encased in concrete or masonry in position during casting.

Install electrical cables and conductors in conduit, unless otherwise required by the contract.

### **D.2 Conduit Placement**

Install conduit in a straight run to enter handholes and foundations in line with the general direction of the conduit run.

#### **D.2.a Above Ground**

Secure conduit attached above ground to wood poles with U-shaped two-hole pipe straps meeting the requirements of the current edition of the NEC and spaced no more than 4 ft [1.2 m] apart.

Secure conduit attached above ground to metal poles with at least  $\frac{3}{4}$  in [19 mm] wide stainless steel banding, spaced no more than 5 ft [1.5 m] apart.

Support conduit within 3 ft [900 mm] of each termination or fitting.

Install expansion devices at each structure expansion joint as required by the contract, or directed by the Engineer.

Secure conduit, attached above ground to cabinets, bridges, and other structures as required by the contract and to the Engineer's satisfaction.

### **D.2.b Underground**

Place conduit using the trenching method, except the Engineer may direct the conduit placement under existing pavement by directional boring, or other Engineer-approved method. If using a method other than trenching and a distortion greater than  $\frac{1}{4}$  in [6 mm] is created in the existing roadway surface, remove the distortion and restore the roadway to the original condition at no additional cost to the Department.

Except under existing pavements, place High Density Polyethylene (HDPE) continuous length conduit by trenching, vibratory plow, or other method approved by the Engineer.

If plowing HDPE conduit, provide a vibratory plow with a feed blade that is capable of performing the following:

- (1) Breaks the ground,
- (2) Places the conduit to a predetermined depth,
- (3) Guides the conduit into the bottom of the break through the guide blade chute so that little or no stress is placed on the conduit during installation to avoid damage,
- (4) Does not pull the conduit in place, and
- (5) Closes the break in the ground.

Do not use HDPE continuous length conduit between concrete foundations and the nearest handhole.

Do not use the trenching method, or push conduit with a pneumatic compaction tool to place conduit under existing concrete, bituminous surfaces, or railways unless approved by the Engineer. If using the trenching method to place conduit below existing roadway pavements submit details and description of the planned method of trenching construction, including traffic control and restoration of the roadway to its original condition, to the Engineer for approval before starting work. Grout the voids that result from abandoned, augering or boring operations through a roadbed at no additional cost to the Department and as approved by the Engineer.

If placing conduit underground below new or reconstructed roadway surface areas or sidewalk, use the trenching method to place the conduit and backfill before placing new roadway surfaces or new sidewalk, as approved by the Engineer.

Place underground conduit at least 18 in [450 mm] below the surface of a ground area and at least 24 in [600 mm] below roadway surfaces. Place underground conduit

under railroad tracks at least 42 in [1.10 m] below the bottom of railroad ties, or as required by the Railroad Company.

If approved by the Engineer, the Contractor may change conduit runs required by the contract to avoid underground obstructions.

If placing underground conduit using the trenching method, place conduit to a uniform depth below the surface of the adjacent ground line or finished roadway. Do not place conduit before the Engineer inspects the trench.

Provide underground conduit runs with provisions for draining moisture. Slope horizontal conduit runs to drain at a rate of at least 0.25 percent, or 3 in per 100 ft [75 mm per 30.5 m]. To drain the low points, not including the open ends of conduit runs, install a standard tee conduit fitting and nipples, at least 6 in [150 mm] long. Extend the fitting and nipple into a hole 24 in × 24 in [600 mm × 600 mm] deep. Backfill the hole with crushed rock or Department-approved granular material.

Position conduit, terminating in handholes or concrete foundations, so the conduit extends inside the handholes, pole bases, cabinet bases, or structure bases by 2 in [50 mm] to 3 in [75 mm]. Slope the conduit toward the access opening. Slope the conduit out of the foundation, toward the handhole opening for drainage.

Locate conduit couplings at least 6 in [150 mm] from the structure surface.

Place conduit entering existing concrete foundations by sawing and breaking the concrete so conduit enters the foundation below the adjacent ground surface and projects from 1 in to 2 in [25 mm to 50 mm] above the top of the foundation and inside the pole shaft or cabinet base. Return the foundation to its original condition by patching with concrete as approved by the Engineer.

Thread conduit, stubbed out of a concrete foundation for future use if installing RSC or IMC. Cap stubbed conduit on the open ends with standard pipe caps or PVC caps, based on the type of conduit. Extend conduit from 18 in to 24 in [450 mm to 600 mm] out of the concrete foundation in the direction shown on the plans or as directed by the Engineer.

Following installation of cables and conductors, seal the open ends of conduit entering cabinets or pole foundations, using paraffin or other Engineer-approved sealing compound.

### **D.3 Conduit Bends**

Provide conduit bends, except factory bends, with a radius of at least six times the nominal diameter of the conduit. Make conduit bends without damaging the conduit and without reducing the internal diameter of the conduit.

For bends in conduit runs, provide the minimum radius necessary, but do not exceed 360 degrees of bend per run between handholes, foundations, or both.

#### **D.4 Rigid Steel Conduit and Intermediate Metal Conduit**

##### **D.4.a Joints**

Thread the ends of the conduit and use a standard threaded conduit coupling to join standard length conduit. If cutting standard length conduit, thread and ream the ends to remove burrs and rough edges.

Conduit ends, joined by coupling, must butt or come together for the full circumference of the conduit to provide an electrical bonding and grounding connection for the length of the conduit run.

Paint coating on conduit damaged by handling or installing with rust preventative paint as approved by the Engineer.

##### **D.4.b Open Ends**

Thread and cap the open ends of conduit in handholes and conduit extending above concrete foundations with standard conduit caps, or other method approved by the Engineer, until wiring installation. Install a grounding-type insulated threaded conduit bushing on the open ends when caps are removed. Provide bushings in accordance with the UL 467 for grounding and bonding equipment. Provide a lug compatible with a No. 6 copper bonding conductor and consisting of stainless steel, copper, brass, bronze, or integral to the bushing. Cover the lug and copper bonding conductor at each bushing with a corrosion inhibiting compound.

Cap the open ends of conduit that terminates on the side of wood poles or other structures with weatherhead entrance fittings.

##### **D.4.c Existing Conduit**

Clean and blow-out existing underground conduit, incorporated into a new or revised electrical system, with compressed air before placing new electrical cables and conductors. Replace old grounding bushings and ground wire in existing handholes to maintain a continuously grounded system.

If placing new handholes in existing conduit runs, cut the conduit and extend it into the new handhole as approved by the Engineer. Thread the open ends of conduits, fit conduit with grounding-type insulated threaded conduit bushings, and bond and ground the conduit.

## **D.5 Rigid PVC Conduit**

### **D.5.a Joints**

Trim the inside and outside of cut ends of rigid PVC conduit to remove rough edges. Use standard sized couplings or rigid PVC conduit with an attached preformed coupling. Clean rigid PVC conduit sections with a joint cleaner and cement joints with a PVC cement. Allow the PVC cement to set for 6 h before pulling conduit through a directional-bored channel. Conduit ends must butt or come together for the full circumference of the conduit. Use long-line couplings to join conduit sections if placing rigid PVC conduit under existing roadway surfaces.

### **D.5.b Open Ends**

Immediately cap or plug the open ends of rigid PVC conduit to prevent the entrance of moisture until the installation of the electrical cables and conductors. Before installing electrical cables and conductors, provide rigid PVC conduit with standard PVC conduit bell ends and bell ends for HDPE, continuous length conduit to prevent damage to the electrical cables and conductors.

Cap or plug the open ends of rigid PVC conduit, not containing electrical conductors, using standard sized PVC conduit caps or plugs.

### **D.5.c Conduit Encasement**

If the contract requires use of the trenching method for rigid PVC conduit, place in granular or concrete encasement. For granular encased rigid PVC conduit, ensure the bottom and sides of the trench are free of sharp irregularities before placing conduit. Backfill the first 6 in [150 mm] of the trench with granular material meeting the requirements of 3149, "Granular Material." For concrete encased rigid PVC conduit, extend the trench width 3 in [75 mm] from each side of the conduit. Provide Mix No. 3A32 concrete, or an equivalent, and encase the conduit 3 in [75 mm] on each side.

## **D.6 Conduit Attached to a Bridge**

Mount and attach conduit to a bridge as required by the contract and as approved by the Engineer. Provide conduit supports and space the supports as required by the NEC. Use hangers or pipe clamps, approved by the Engineer before installation, to support conduit. Attach hangers or pipe clamps using two-unit threaded bolt anchorages meeting the requirements of the contract or, if not specified, approved by the Engineer. Provide and install hardware that allows removal of the hanger or pipe clamp and permits conduit expansion and contraction.

Provide expansion fittings in conduit runs attached to bridges, as required by the NEC or directed by the Engineer. Provide electrically continuous RSC or IMC

conduit runs with expansion fittings using a copper bonding jumper with the ampacity required by the NEC. Provide a bonding jumper internal to the expansion fitting.

## **E Handholes**

Install handholes as required by the contract and as approved by the Engineer. The Contractor may install additional handholes at no additional cost to the Department.

Set the tops of handholes so the cover is 1 in [25 mm] below grade, except in sidewalk areas, set the cover flush, or as directed by the Engineer.

To facilitate drainage, set handholes on a compacted aggregate drain bed, 3 ft [1 m] in diameter or square, and 12 in [300 mm] deep, using coarse filter aggregate in accordance with 3149.2.H, "Coarse Filter Aggregate."

Backfill handholes after installing the frame casting and cover.

Drill conduit holes into the side walls of handholes no more than 1 inch larger than the size conduit being installed.

Remove excess material inside of existing handholes that are to be used in the new system.

After handhole and conduit installation at each handhole location, make the sidewalls inside handholes watertight by patching with concrete for pre-cast concrete handholes, or material-compatible caulking compound, or other sealing material, compatible with PVC and other type handholes, to the Engineer's satisfaction.

For placing pre-cast concrete handholes with Type HD or other metal frame and cover, in areas not surfaced with concrete, support handholes with concrete to the Engineer's satisfaction. If required by the contract, support other type handholes with metal frames and covers with concrete.

## **F Concrete Foundations**

### **F.1 General**

Except for portions of concrete foundations that extend into solid rock, use forming tubes or wood forms with the following characteristics to construct concrete foundations in accordance with 2411, "Minor Concrete Structures":

- (1) Of the size and shape required by the contract,
- (2) With an ordinary surface finish in accordance with 2401.3.F, "Finish of Concrete," on all sides, 6 in [150 mm] below the adjacent ground line, and
- (3) Floated smooth top with beveled or chamfered edges.

If soil conditions allow, the Engineer may approve casting of foundations with rigid and securely braced forms or tubes only on the upper portion of the foundation. Brace entering conduits, anchor rods, ground rod electrodes, and other equipment in position and at the height necessary until the concrete cures. Do not remove forms until the concrete cures.

Use portable vibrators and hand spading to consolidate the concrete to form a smooth, dense surface free of air or water blisters.

If unstable foundation conditions are encountered, the Contractor may alter concrete foundation construction to secure a stable foundation, as approved by the Engineer. If obstructions such as solid rock are encountered that prevent concrete foundation construction as planned, the Contractor may adjust the foundation dimensions as required by the contract, or directed by the Engineer, to provide a stable foundation.

Form the exposed concrete above the adjacent ground line, sidewalk, or paved area to present a neat appearance.

## **F.2 Anchor Rods**

Place the anchor rods in pole foundations in a rigid cage to maintain alignment while pouring the concrete as approved by the Engineer. Provide anchor rod cages designed without welding or tack welding on the anchor rods. The Engineer will reject anchor rods with welding or tack welding. Provide a template for the anchor rod projections. Leave the template in place until the concrete is cured. Do not begin work on the concrete foundation until the Engineer approves the anchor rods. The Engineer will reject foundations if anchor rods are improperly aligned after the concrete cures. Do not enlarge bolt holes in transformer bases to allow for shifted anchorages.

## **G Loop Detectors**

### **G.1 General**

Provide preformed rigid PVC or saw-cut inductive loop detectors as required by the contract. Install complete loop detectors with the following:

- (1) An electrical conductor embedded loop or group of loops installed in the roadway as required by the contract, and
- (2) A loop detector lead-in cable to the traffic signal cabinet or other cabinet,

## **G.2 Installation**

### **G.2.a Preformed Rigid PVC Loop Detector**

Provide loop detectors encased in rigid PVC conduit in accordance with Standard Plate 8132.

### **G.2.b. Saw-Cut Loop Detectors**

Provide saw-cut loop detectors in accordance with Standard Plate 8130.

The Engineer may make minor adjustments to the size or shape of the loop detector in the field at no additional cost to the Department.

Make an individual saw cut from each loop detector to the conduit leading to the handhole.

## **G.3 Loop Detector Test Report**

Submit three copies of a signed and dated loop detector test report to the Engineer. Include the following information in the report for each loop detector and lead-in cable system provided and installed as required by the contract:

- (1) Project numbers, intersection, and location identification,
- (2) Loop detector number shown on the plans,
- (3) Width and length dimensions of the loop detector, in inches, as installed,
- (4) Number of turns of wire in loop detector as installed,
- (5) Meet the following continuity test results for each detector circuit as tested at two locations:
  - (5.1) Less than 0.5  $\Omega$ , from lead to lead for loop detectors, as measured at the handhole or junction box before splicing the loop detector lead-in cable,
  - (5.2) Less than 5  $\Omega$  for loop detector and lead-in cable systems at the intersection traffic signal cabinet after splicing the handhole or junction box, and
  - (5.3) An ohm reading at the intersection traffic signal cabinet greater than the ohm reading measured at the loop detector adjacent handhole or junction box.
- (6) Inductance test results from 50 $\mu$ H to 900 $\mu$ H for each loop detector and lead-in cable system, and
- (7) Insulation resistance test results of at least 100 M $\Omega$  as performed at 500 VDC between one loop detector lead-in cable conductor and the "Equipment Ground Bus" in the cabinet.

Perform the continuity test, inductance test, and insulation resistance test at the intersection traffic signal cabinet before terminating the loop detector lead-in cable conductors on the terminal facilities. Perform loop detector tests in the Engineer's presence at no additional cost to the Department.

The Engineer will distribute the three final loop detector test reports for the intersection as follows:

- (1) The original to the official project file,
- (2) One copy to the traffic signal cabinet, and
- (3) One copy to the Department's Electrical Services Unit or maintaining agency.

Provide the electrical instruments, apparatus, tools, and labor to perform the required loop detector tests on each loop detector and lead-in cable system. Electrical instruments, apparatus, and tools remain the Contractor's property after the tests are completed.

If a loop detector or lead-in cable system fails any of the loop detector tests, replace parts or the entire loop detector and lead-in cable system at no additional cost to the Department as directed by the Engineer. Repeat and record the loop detector tests for the "revised" loop detector and lead-in cable system.

Each loop detector and lead-in cable system must pass the loop detector tests and must be operational as approved by the Engineer. Regardless of the test results, the Department may test each loop detector and lead-in cable system with their own test equipment.

## **H Bonding and Grounding**

Provide bonding, grounding, ground-rod electrodes, grounding electrode conductors, and grounding connections in accordance with NEC.

Provide ground rod electrodes with the following characteristics:

- (1) At least  $\frac{5}{8}$  in [16 mm] in diameter by 15 ft [4.6 m] long,
- (2) Single piece,
- (3) Non-threaded,
- (4) Copper clad, and
- (5) NRTL listed as meeting the requirements of UL 467.

Form a continuous bonded and grounded system using the following mechanically and electrically secure components:

- (1) Metal conduit,
- (2) Metal traffic signal pedestals,

- (3) Mast arm pole standards,
- (4) Light standards,
- (5) Service equipment,
- (6) Metal junction boxes,
- (7) Down guys,
- (8) Span wire,
- (9) Microwave and sonic detector units, and
- (10) Cabinets.

Provide copper bonding and grounding conductor, at least No. 6 AWG stranded, and insulated green. Provide grounding of the system and neutral at the service point, as required by the NEC, except provide at least No. 6 AWG stranded, and insulated green grounding electrode conductor.

Use a brass, bronze, or stainless steel bolt at least  $\frac{3}{16}$  in [5 mm] in diameter installed in the lower part of the shaft or base to attach the grounding and bonding jumper to metal traffic signal pedestals, mast arm pole standards, and light standards. Do not use a solder or sheet metal strap connection.

Use an NRTL-listed, reusable screw-type, active clamping ground lug with a tang that connects to the  $\frac{5}{16}$  in [8 mm] signal pole base grounding stud to attach the No. 6 AWG stranded, insulated green grounding conductor to metal traffic signal pedestals and mast arm pole standards to the signal pole base.

Terminate the No. 6 AWG stranded, insulated green conductor on the "Equipment Ground Bus." Ground the "Equipment Ground Bus" to the signal service ground rod electrode with at least No. 6 AWG stranded, insulated green grounding electrode conductor.

Provide and connect a No. 6 AWG stranded, insulated green equipment grounding conductor from the "Equipment Ground Bus" in the traffic signal cabinet or other type cabinet to the ground bus of the service equipment and to each incoming conduit grounding bushing lug or each incoming No. 6 AWG stranded, insulated green conductor.

Drive ground rod electrodes at service points and locations required by the contract. Install ground rod electrodes and grounding connections in accordance with the NEC. Place the ground rod electrode for PA85, PA90, and PA100 signal poles in the nearest hand hole adjacent to the signal pole foundation as required by the contract. Provide pedestal foundations with a ground rod electrode placed inside the pedestal foundation slightly off center in the pedestal foundation as required by the contract before casting the concrete foundation. Ground the signal poles by bonding together the No. 6 AWG, stranded, insulated green grounding conductor that runs from the traffic signal cabinet to the ground rod electrode and through to the pole

base. Install the ground rod electrode in the handhole with the top of the ground rod 3 in [75 mm] below the bottom of the handhole cover as required by the contract.

If installing the ground rod electrode in concrete foundations, install the top of the ground rod electrode from 2 in [50 mm] to 3 in [75 mm] above the foundation. Bond the service equipment to the ground rod electrode.

Use exothermic welding or other methods required by the contract to bond ground rod electrodes to the No. 6 AWG stranded, insulated green grounding conductor coming from the traffic signal cabinet and running to the signal pole base.

If not installing a bonded, grounded, continuous rigid steel conduit system, use a No. 6 AWG standard and insulated green grounding electrode conductor to bond metal poles, pedestals, cabinets, and other structures requiring a ground rod electrode to the ground rod electrode as required by the contract. Attach one end of the bonding jumper to the lower part of the pole, pedestal, cabinet, or structure shaft or base. Use a grounding connection to attach the other end of the bonding jumper to the ground rod electrode as specified in the contract.

If bonding and grounding in non-metallic conduit systems, install a No. 6 green stranded equipment grounding conductor with all electrical circuits. If installing non-metallic conduit for future use, the Contractor may omit the equipment grounding conductor.

In addition to the required bonding and grounding jumper and required threaded grounding conduit bushings on open ends of new conduit, provide and install new bonding and grounding jumpers and new threaded grounding conduit bushings on open ends of in-place conduit at the in-place locations as directed by the Engineer.

Apply an oxide inhibiting agent to all No. 6 grounding connections after assembly and final connection.

## **I (Blank)**

## **J Wiring**

### **J.1 General**

Install electrical cables, conductors, and electrical wiring in accordance with the NEC.

Use insulated spade lugs or pole base connectors for terminal connections of conductors.

Tape the ends of un-terminated spare electrical conductors to exclude moisture.

Leave 3 ft [1 m] of slack cable in each handhole through which a run of cable passes.

Leave 24 in [600 mm] of slack cable in each mast arm pole base, light standard base, and traffic signal pedestal base.

Install unmetere service conductors in a separate conduit system from all other conductors. Run conductors of a branch circuit in a single conduit.

Continuously run electrical cables and conductors without splices from the terminal appliances in the traffic signal cabinet to the pole base connectors, terminal blocks, or other terminal appliances.

Continuously install loop detector lead-in cable without splices or terminals from the loop detector conductor and lead-in cable splice to the traffic signal cabinet or other type cabinet.

Continuously install interconnect cable between cabinets without splices. Run the cable in straight lines with a minimum number of bends in the cable run.

Provide the size and quantity of conductors in each cable and the number of cables in a given conduit run as shown on the plans. The Engineer will not require additional spares.

Wire the electrical system in accordance with the field wiring diagram shown in the plans. Identify cables as shown on the field wiring diagram in all handholes, junction boxes, traffic signal pedestal bases, mast arm pole bases, light standard bases, and cabinets. Except for the individual conductors terminated at the cabinet fuse panels, wrap white vinyl adhesive tape around the cable to identify cables and conductors. Handwrite labels with a black permanent marker as approved by the Engineer or use a label maker suitable for use in wet locations. Wrap the labels from a label maker around the cable in one complete revolution with minimum  $\frac{1}{10}$  in overlap.

Place machine printed labels, embossed plastic labels, vinyl adhesive pre-printed labels, or sleeve type labels around each conductor to identify the individual conductors terminated at the cabinet fuse panels. Place labels on each cable terminated at the terminal appliances located inside the traffic signal cabinet (i.e. RED 2 1, YEL 2 1, GRN 2 1, RLTA 5 1, YLTA 5 1, GLTA 5 1, RRTA 4 1, YRTA 4 1, GRTA 4 1, DWK P6 1, WLK P6 1, etc., or the like, indicating the signal indication and the signal face number). Apply the label within 3 in [75 mm] of the terminal point. Provide an identification strip for terminal blocks in traffic signal pedestal bases and pole bases as part of the terminal block. Each conductor shall be identified in a similar manner as above to label the signal indication it serves.

Using a black permanent marker, label both sides of pole base connectors with signal face number.

## **J.2 Underground Wiring**

To avoid damaging the cable and conductor insulation, hand pull electrical cables and conductors through rigid steel conduit. Clean the conduit at the time of installation. Tape the ends of electrical cables and conductors to exclude moisture until spliced or terminated.

Hand pull cables and conductors through rigid PVC conduit without splitting or damaging the rigid PVC conduit due to "pull rope abrasion". Replace the damaged portion of the rigid PVC conduit as approved by the Engineer.

Use the trenching method or a vibratory plow to direct bury interconnect cable not placed in conduit to a depth of at least 36 in [915 mm], except where required to enter a handhole. If the contract requires the interconnect cable to enter a handhole, install the cable in the side of the handhole from 6 in to 8 in [150 mm to 200 mm] above the bottom of the handhole. Maintain the a depth of at least 36 in [915 mm] within 2 ft to 3 ft [600 mm to 915 mm] of the handhole.

If plowing direct buried interconnect cable, provide a vibratory plow with a feed blade that is capable of performing the following:

- (1) Breaks the ground,
- (2) Places the cable to a predetermined depth,
- (3) Guides the cable into the bottom of the break through the guide blade chute so that little or no stress is placed on the cable during installation to avoid damage,
- (4) Does not pull the cable in place, and
- (5) Closes the break in the ground.

Submit the plowing method to the Engineer for approval before installing the cable.

Place plastic warning tape meeting the following characteristics at least 18 in [460 mm] above the interconnect cable or conduit containing the interconnect cable and at least 12 in [300 mm] below the surface:

- (1) 3 in [75 mm] wide,
- (2) Permanent orange,
- (3) Stretchable,
- (4) Non-biodegradable, and
- (5) Imprinted with the inscription, "CAUTION – Mn/DOT COMMUNICATION CABLE BELOW"

Place any direct buried cable that enters or exits handholes in an electrical conduit sleeve at least 3 ft [915 mm] long.

### **J.3 Cabinet Field Lead Wiring**

Do not cut a field lead entering a cabinet shorter than the farthest terminal in the cabinet. After completing field connections to the cabinet terminal, dress and band together the field leads to provide an orderly arrangement within the cabinet.

### **J.4 Splices**

Do not splice unless required by the contract or approved by the Engineer. If required by the contract or approved by the Engineer, only splice in handholes, control cabinets, junction boxes, or in bases of poles. Do not splice underground cable unless specifically required by the contract. Use an approved epoxy splice kit for underground cable splices as required by the contract.

Provide electrical splices for conductors and cables as required by the contract. Waterproof conductor and cable splices. Electrically and mechanically secure splices without solder, except loop detector splices. Use split bolt connectors or other connector types with splices as specified in the contract. Do not use pressure spring type connectors. Splice loop detector as specified in the contract.

Unless otherwise required by the contract, use self-fusing electrical insulation putty tape to tape insulate spliced conductors, except grounding wires, to a thickness of at least 1.5 times that of the original insulation. Apply two layers of protective plastic electrical tape over the self-fusing electrical insulation putty tape and extend at least 1 in [25 mm] over the regular conductor insulation. Use waterproof electrical coating to waterproof the entire splice.

If required by the contract for a temporary system, provide NRTL listed connectors designed to prevent direct contact between the aluminum and copper conductors for splices between aluminum and copper conductors. Provide NRTL listed terminals for use with aluminum wire for terminals used on aluminum conductors. Tighten the connections to the manufacturer recommended torque.

### **J.5 Terminal Blocks**

Where required by the Contract, provide each mast arm pole base, traffic signal pedestal base, light standard base, and other bases with vehicle and pedestrian signal indications or pedestrian signal indications with a NRTL listed terminal block for terminating field conductors and traffic signal conductors.

The terminal blocks, screws, and spade lugs in each base shall be covered with an approved electrical insulating coating. Provide Pole Base Terminal Block Coatings listed on the Approved/Qualified Products List under "Signals."

Remove the white plastic marking strip from the terminal block before applying the approved electrical insulating coating. After coating the terminal block, reinstall the white plastic marking strip.

Install terminal blocks in bases so that the terminal block screws face the door opening and are accessible.

### **J.6 Aboveground Wiring**

For electrical cables and conductors installed above ground, except where run on overhead span wire, use one of the following methods:

- (1) Conduit attached to wood poles, metal poles, cabinets, or other structures; or
- (2) Inside metal poles, pedestals, cabinets, or other structures.

Provide slack of 5 percent of the span length when installing overhead span wire.

When installing electrical cables and conductors on span wire, using straps with spacing less than 18 in [450 mm] for lacing. Provide weather-resistant, black nylon, non-metallic straps with a loop tensile strength of at least 250 lb [113.4 kg]. Submit the non-metallic straps to the Engineer for approval before installation.

### **J.7 Pole Base Connectors**

If required by the contract, provide mast arm pole bases, traffic signal pedestal bases, light standard bases, and other bases with vehicle and pedestrian signal indications or pedestrian signal indications with Department-approved pole base connectors for terminating field conductors and traffic signal conductors. Use a Department-approved hand crimp tool to install pole base connectors as specified in the contract.

### **K Service Equipment Installation**

Install service equipment in accordance with the NEC and local laws and ordinances governing service equipment installations.

Refer to the plans for the approximate location of service points. The Engineer or the power company will determine the exact location of service points.

Install signal service cabinets as specified in the contract.

When installing service equipment on a wood pole, install the meter socket directly above the service disconnect. Terminate risers near the top of the wood pole or structure. Cap risers with a weatherhead to prevent the entrance of water. Extend power conductors beyond the weatherhead with an additional 4 ft length for a drip loop, to allow the power company to connect to the power conductors from the source

of power. The power company will perform connections at no additional cost to the Contractor, unless otherwise specified in the contract.

For installation on a mounting bracket assembly, locate the meter socket and disconnecting means as specified in the contract.

Provide lugs for terminating conductors sized for the associated conductors. Do not trim strands of conductors to fit into undersized lugs.

Arrange for the power connection with the power company.

## **L Vehicle and Pedestrian Signal Face Installation**

### **L.1 Pedestal Mounted (With Signal Bracketing)**

Mount vehicle and pedestrian signal faces on top of traffic signal pedestals as required by the contract. Install symmetrically arranged and securely assembled pedestal mounted assemblies plumb and level. Provide for internal wiring within the pedestal shaft signal brackets and pipe fittings.

Place a pedestal mounted vehicle signal face directly above the pedestal slipfitter collar. Attach with a bracket to the top of the vehicle signal face and to the pedestal shaft.

### **L.2 Vertical Pole Shaft Mounted (With Signal Bracketing)**

Mount vehicle and pedestrian signal faces on a vertical pole shaft if shown on the plans. Provide threaded 1½-inch [38 mm] half-couplings capable of receiving threaded 1½-inch [38 mm] signal brackets and provide for internal wiring within the vertical pole shaft. Weld the half-couplings into the vertical pole shaft 10 ft [3 m] above the pole foundation. Position threaded couplings on the vertical pole shaft as specified in the contract.

Mount vehicle pedestrian signal faces as shown on the plans. Provide plumb, securely assembled pole mounted assemblies that allow for internal wiring within the vertical pole shaft, signal brackets, and pipe fittings.

### **L.3 Vertical Pole Mounted (With Angle Mount Plumbizer)**

Use angle mount plumbizers to plumb the vehicle and pedestrian signal faces mounted on vertical pole shafts.

Attach two vehicle signal sections below the mount. Attach the remaining vehicle signal sections above the mount. Fasten the two signal sections below the mount and the signal sections above the mount together and to the mount as specified in the contract to prevent the assemblies from loosening due to vibration.

Mount the pedestrian indication below the mount as specified in the contract.

Fasten the two signal sections below the mount and the signal sections above the mount together and to the mount as specified in the contract. Use signal head mounting spacers if attaching four sections or five sections at the mount.

#### **L.4 Pedestal Mounted (With Two Vehicle Straight Mount Plumbizers)**

Use a straight mount plumbizer to mount vehicle and pedestrian signal faces plumb on pedestal shafts. Mount signal sections below the mount and the remaining vehicle signal sections above the mount. Fasten the two signal sections below the mount and the signal sections above the mount together and to the mount as specified in the contract. Use a universal hub to attach the straight mount plumbizer to the pedestal shaft. Using the manufacturer's specific installation tool, attach the universal hub to the pedestal shaft in accordance to the manufacturer's instructions. Install a PVC wireway between the universal hub and the entrance of the straight mount plumbizer.

Mount the pedestrian indication below the straight mount plumbizer as specified in the contract. Use a universal hub to attach the straight mount plumbizer to the pedestal shaft. Using the manufacturer's specific installation tool, attach the universal hub to the pedestal shaft in accordance with the manufacturer's instructions. Install a PVC wire way between the universal hub and the entrance of the straight mount plumbizer.

Fasten the two signal sections below the mount and the signal sections above the mount together and to the mount as specified in the contract. Use signal head mounting spacers if attaching four sections or five sections at the mount.

#### **L.5 Mast Arm Mounted (With Straight and Angle Mount Plumbizer)**

Use angle mount plumbizers to mount vehicle signal faces on traffic signal mast arms at the extended end of the mast arm. Use straight mount plumbizers to mount vehicle signal faces at the mid arm position of the mast arm. Mount two signal sections below the mount and the remaining signal sections above the mount.

Fasten the two signal sections below the mount and the signal sections above the mount together and to the mount as specified in the contract. Use signal head mounting spacers if attaching four sections or five sections at the mount.

Provide vertical clearance from the bottom of the signal heads, including the background shields, to the pavement from 17 ft [5.18 m] to 19 ft [5.79 m].

#### **L.6 Bagging**

Use "gunnysacks" or other material approved by the Engineer to bag vehicle and pedestrian signal faces after installation and until traffic control signal activation to

indicate that the traffic control signal is not in operation. Maintain bagging as approved by the Engineer.

### **L.7 Anti-Seize Lubricant**

Brush an anti-seize lubricant onto the threaded portions of signal bracketing, pipe fittings, mounting hardware, and angle and straight mount plumbizer threaded nipples before installation.

### **M Wood Pole Installation**

Place wood poles in the ground to a depth equal to 20 percent of the pole length. Excavate 8 in [200 mm] larger than the diameter of the base of the pole and keep free from loose material. Hoist the pole into place without damage. Plumb and rake as directed by the Engineer. Provide backfill utilizing Selected Material as specified in 2451, "Structure Excavations and Backfills," and place in 8 inch (200 mm) or less lifts. Moisten and compact each lift. Place the wood pole so that a void area does not display between the wood pole and backfill at the ground plane when placed under load.

### **N Traffic Signal Pedestal Installation**

Use U-shaped, galvanized, metal shims to plumb traffic signal pedestals as approved by the Engineer. Bolt traffic signal pedestals to the cast-in-place anchor rods of the concrete foundations. Place the pedestal access door 180 degrees from the roadway centerline.

### **O (Blank)**

### **P Mast Arm Pole Standard Installation**

Hoist mast arm pole standards into position without damage. Use two nuts and washers on each anchor rod to plumb the mast arm pole standards and to vertically position the pole face opposite the arm. Do not enlarge or alter holes in the base plate to accommodate misaligned anchorages.

Use the following procedure to install mast arm pole standards on anchor rods:

- (1) Clean exposed part of anchor rods with a wire brush or equivalent.
- (2) Ensure clean anchor rods and that nuts spin freely along the entire length of all anchor rods.
- (3) Lubricate anchor rod threads with brush-on anti-seize compound.
- (4) Install and level heavy hex leveling nuts.
- (5) Install first set of washers, place base or pole to anchor rod cluster, install second set of washers.
- (6) Install and hand tighten heavy hex top nuts.

- (7) Using “full force” and a standard wrench, or a few impacts of an impact wrench, tighten top nuts.
- (8) Using “full force” and a standard wrench, tighten leveling nuts.
- (9) Mark positions of top nuts in relation to its adjacent bolt. Tighten top nuts an additional one-sixth turn beyond tightening achieved in Steps 6 and 7.
- (10) After 48 h, with the entire mast arm pole standard completely assembled and installed, check the tightness of the nuts. Follow step 7, step 8, and step 9 for additional tightening.

Place the transformer base access door 180 degrees from the mast arm.

Install mast arms, brackets, and other attachments to the vertical pole shaft without damage.

Repair and restore damaged areas to original condition as specified in the contract or as approved by the Engineer.

## **Q Sign Installation**

### **Q.1 Pedestal or Pole Shaft Mounted**

Provide each pedestal or pole shaft mounted sign with two standard sign mounting bracket assemblies using a stainless steel band at least  $\frac{3}{4}$  in [19 mm] wide. Mount on the pedestal or pole shaft at the height as directed by the Engineer. Drill and tap shaft and mount signs as directed and as approved by the Engineer. Mount pedestal and pole shaft signs with a clearance of at least 7 ft [2.13 m] from the bottom of the sign to the finished walking surface or ground surface at the base of the pole.

### **Q.2 Mast Arm Mounted**

Provide each mast arm mounted sign with mast arm mounting bracket assemblies in accordance with the mast arm sign mounting details in the Standard Signs Manual, Detail 105A, and mounted at the specified location on the mast arm as approved by the Engineer.

### **Q.3 Sign Post Mounted**

Use U-channel sign posts to mount sign post mounted sign panels in accordance with the contract.

## **R Cabinet Installation**

Securely bolt pad mounted cabinets to the concrete as approved by the Engineer.

Install rubber gasket sections, Department or Contractor provided, between the bottom of the aluminum cabinet base and the concrete foundation. Leave a  $\frac{1}{2}$  in [13 mm] gap in the gasket for water drainage.

## **S Emergency Vehicle Preemption (EVP) Installation**

Install EVP detectors and EVP confirmatory indicator light atop traffic signal mast arms and, if required by the contract, atop traffic signal pedestal shafts in accordance with the following:

- (1) Install the detector, confirmatory indicator light, wiring, and connections in accordance with manufacturer's instructions.
- (2) Inform the Engineer of obstructions in line with the detector before installation.
- (3) Attach the detector and confirmatory indicator light to the traffic signal mast arm or traffic signal pedestal shaft to the satisfaction of the Engineer.
- (4) Provide any extension hardware with the same outside diameter as the traffic signal bracketing framework, and use a reducer conduit fitting to attach the detector and indicator light assembly to the traffic signal mast arm.
- (5) Paint extension hardware the same color as the traffic signal mast arm. Do not paint the detector and confirmatory indicator light assembly.
- (6) Securely tighten hardware.
- (7) Install and mount the detector and confirmatory indicator to ensure the watertight integrity of the assembly.
- (8) Provide a 6 in [150 mm] vertical separation between the detector and confirmatory indicator light combination.
- (9) Install the detector shield tube with the drain hole at the bottom.
- (10) Do not splice detector cables from the EVP detector on the mast arm to the traffic signal cabinet.
- (11) Mark the detector cable in the traffic signal cabinet with its street and direction association.
- (12) Make one-way or two-way EVP detectors and one-way or two-way EVP indicator lights operational when the signal system is initially turned on.
- (13) Ensure each approach of the intersection detects an approaching Emergency Vehicle at a minimum distance of 1800 feet [548.6 m].

## **T Painting**

Paint metal structures and metal components of traffic control signal systems with finish coat paint if required by the contract and in accordance with 2478, "Organic Zinc-Rich Paint System," and the following:

- (1) Apply exterior, dark green meeting the requirements of 3532, "Exterior Polyurethane Paint," on the traffic signal pedestal bases and mast arm pole standard transformer bases.

- (2) Apply sign yellow baking and Air Dry meeting the requirements of 3532, "Exterior Polyurethane Paint," on cast aluminum vehicle and pedestrian signal indication housings, mast arm pole standard vertical pole shafts, traffic signal pedestal shafts, pedestal slipfitter collars, pedestal reinforcing collars (wind collars), all signal brackets and pipe fittings, and pedestrian push button stations.
- (3) For the first two coats, apply aluminum paint meeting the requirements of 3533, "Aluminum Polyurethane Paint," to steel cabinets, traffic signal mast arms, luminaire vertical pole shaft extensions, and luminaire mast arms.
- (4) Apply dull non-reflective black on aluminum visors, aluminum directional louvers, aluminum background shields, and aluminum vehicle and inside and outside pedestrian signal indication housing doors.

As an alternative to field painting, the Contractor may use equivalent manufacturer's shop coat paint and field touch-up any damaged finish as approved by the Engineer. If a manufacturer's shop coat paint is accepted or specified in the contract, make every effort during installation to protect the factory applied finish. Repair and restore damage to the finish as approved by the Engineer.

Provide mast arm pole standards painted at the manufacturer. Remove any protective wrap provided by the manufacturer during shipping immediately after receipt of the shipment on the project. Protect the factory applied finish when erecting the painted mast arm pole. Provide a collar for handling the pole made of a material that will protect the painted finish of the pole. Except for touch-up painting, do not field paint the mast arm pole standards. Use touch up paint provided by the manufacturer to repair and restore nicks, scratches, paint chips, or other damage to the finish as approved by the Engineer.

Do not field paint unpainted aluminum components of a signal system.

## **U Existing Materials and Electrical Equipment**

### **U.1 Removing and Salvaging**

Remove and salvage electrical systems in accordance with 2104, "Removing Pavement and Miscellaneous Structures," and as specified in the contract at locations required by the contract or directed by the Engineer. Do not damage the removed and salvaged materials and electrical equipment during removal.

Take ownership of materials and electrical equipment of an existing electrical system required to be removed but not salvaged and dispose of the materials and equipment outside the right-of-way, subject to 2104.3.D.3, "Disposal outside Right of Way," and as specified in the contract.

## **U.2 Reinstalling**

Where installing salvaged materials and electrical equipment at new locations, provide and install materials required to complete the new installation.

If the Engineer determines that existing materials and electrical equipment are unsatisfactory for reuse, replace the unsatisfactory material with new materials and electrical equipment. The cost of the new material and equipment will be paid for as extra work in accordance with 1402, "Contract Revisions."

## **U.3 Stockpiling**

The Contractor may stockpile materials and electrical equipment of an existing electrical system required to be removed and not reused on the project until its removal outside the right-of-way. Stockpile as approved by the Engineer.

## **V Field Testing**

Before completing the work, perform a functional test demonstrating to the Engineer that the traffic signal components are fully functional. Do not activate the traffic control signal until completion of all field tests and the Engineer approves the results.

Before final acceptance, provide the Engineer manufacturers' warranties, instructions, and wiring diagrams of the materials and electrical equipment provided to the project.

## **W Activating Signals**

Before activating traffic control signal systems, aim vehicle and pedestrian signal faces as directed by the Engineer. Notify the Engineer at least 48 h before the scheduled traffic signal activation.

Department personnel will activate the traffic control signal system unless otherwise directed by the Engineer. Provide assistance at the time of the turn on to ensure the traffic control signal system is operating correctly and safely. Provide parts and labor to correct malfunctioning components of the traffic control signal system. This requirement does not include Department-provided material and components, except if damaged by the Contractor. Do not activate the signal system before the Engineer approves the operational signal system and its components, including the emergency vehicle preemption and the traffic control interconnection.

Do not turn the signal system ON, OFF, or in flashing mode unless approved by and in the presence of the Engineer.

**X Restoration and Cleanup**

Replace or repair sidewalks, curbs, gutters, pavements, base materials, sod, or plants damaged or removed during the Contractor's operations as approved by the Engineer. Maintain reconstruction work as approved by the Engineer until final acceptance.

**2565.4 METHOD OF MEASUREMENT**

The Engineer will measure the new traffic control signal system as an integral unit complete in place and operating. The Department considers the complete installation at one intersection as one unit.

**2565.5 BASIS OF PAYMENT**

The Department will pay for new traffic control signal systems on the basis of the following schedule:

<b>Item No:</b>	<b>Item:</b>	<b>Unit:</b>
2565.511	Traffic Control Signal System	Signal System

**2571 PLANT INSTALLATION AND ESTABLISHMENT**

**2571.1 DESCRIPTION**

This work consists of providing, planting, and establishing trees, shrubs, vines, and perennials of the species, variety, grade, size, or age, and root category specified for the locations shown on the plans, including planting or transplanting plants provided by the Department.

Perform this work in accordance with the current edition of the Inspection and Contract Administration Manual for Mn/DOT Landscape Projects (ICAMMLP).

**2571.2 MATERIALS**

**A Nursery Plant Stock..... 3861**

Provide plants of the species shown on the plans in the variety, grade, and size, or age indicated.

**A.1 Investigations and Supply of Planting Stock and Materials**

By submitting a proposal and accepting award of the contract in accordance with 1205, "Examination of Proposal Package and Site of Work," the Contractor assures

familiarity with the project site and contract documents, commitments from suppliers, and delivery of the plant stock and materials required to complete the contract.

## **A.2 Plant Stock and Materials Documentation**

Provide the following plant stock and materials documentation:

- (1) At or before the preconstruction conference, provide the Engineer with a Mn/DOT-preliminary *Certificate of Compliance for Plant Stock, Landscape Materials, and Equipment* (copy of form provided in the current edition of ICAMMLP).
- (2) At least one week before plant stock delivery to the project, provide the Engineer with the following:
  - (2.1) A copy of a valid nursery stock, dealer or grower certificate, registered with the Minnesota Department of Agriculture (MDA), a current nursery certificate or license from a state or provincial Department of Agriculture for each plant stock supplier, or both;
  - (2.2) A copy of the most recent *Certificate of Nursery Inspection* for each plant stock supplier;
  - (2.3) Documentation certifying that plant material shipped from out-of-state nursery vendors subject to state and federal quarantines, is free of currently regulated pests, including Emerald Ash Borers, and Gypsy Moths. To determine if Minnesota vendors are subject to quarantines, call the MDA Supervisor of Nursery Inspection and Export Certification at (651) 201-6388; and
  - (2.4) An updated *Certificate of Compliance*, signed by the Contractor's authorized representative.
- (3) Upon delivery of plant stock and materials to the project, provide the Engineer with the following:
  - (3.1) Bills of lading or shipping documents for plant stock and landscape materials delivered to the project, and
  - (3.2) An updated and signed *Certificate of Compliance*, if necessary, to reflect deviations from the original *Certificate of Compliance* documentation submitted at or before the preconstruction conference.
- (4) As a condition for authorization of payments, provide the Engineer with vendor invoices or billing statements for plant stock and materials used on the project.

The Engineer will consider work performed with plant stock, materials, or equipment that was misrepresented in the documentation, as unauthorized work.

If the Contractor does not provide the documentation required by this section, the Engineer may consider subsequent work unauthorized and the Department may assess a daily charge of \$200.00, on a calendar day basis, until the Contractor achieves compliance.

### **A.3 Substitutions**

The Engineer may allow substitutions in accordance with 1605, "Substitute Materials." Before requesting substitutions, provide written documentation that plants shown on the plans are not available in quantities to fulfill the contract requirements from the individual suppliers on the *Partial List of Nursery Dealers and Growers* in the most current edition of the ICAMMLP. The Engineer, in consultation with the project designer, may authorize specific substitute plants or may extend the contract time to ensure availability of the plants shown on the plans. Provide substitutions equal to or better than the initially specified materials.

### **B Department Furnished Stock and Transplant Stock**

Obtain Department provided stock and transplant stock from sources shown on the plans or specified by the special provisions.

### **C Incidental Materials and Work**

The Department considers incidental materials and work, specified, non-specified, replacement, or miscellaneous, to include materials and work that are incidental to payment for the individual plant installation contract items and for which the Department does not make direct payment.

#### **C.1 Specified Incidental Materials and Work**

Supply, install, and maintain incidental materials as required for plant installation and establishment in accordance with the special provisions, plans, and standard planting details.

#### **C.2 Non-specified Incidental Materials and Work**

Supply, install, and maintain non-specified incidental materials for plant installation and establishment success in accordance with product labeling, manufacturer's instructions, and applicable laws, regulations and ordinances.

#### **C.3 Replacement Materials and Work**

Provide materials and work to replace unacceptable or missing plants, materials, and incidental items in accordance with the special provisions, plans, and standard planting details. Provide replacement materials and work that is equal to or better than the initially specified materials and work.

#### **C.4 Miscellaneous Incidental Materials, Equipment and Work**

Miscellaneous incidental materials, equipment, and work include the following:

- (1) Mobilization,
- (2) Traffic control,
- (3) Protection and restoration of vegetation and property,
- (4) Layout and staking,
- (5) Soil cultivation,
- (6) Compost,
- (7) Mulch,
- (8) Rodent protection,
- (9) Staking and guying,
- (10) Seedling shelters,
- (11) Temporary erosion control,
- (12) Mowing,
- (13) Application of herbicides, insecticides, fungicides, and water and
- (14) Other materials, equipment, and work necessary to install, maintain, and establish plants as shown on the plans and in a healthy, vigorous, and weed-free condition.

### **2571.3 CONSTRUCTION REQUIREMENTS**

#### **A General**

##### **A.1 Landscape Specialist**

Provide a Landscape Specialist, certified by the Department, to perform or supervise plant installation and establishment work. Provide documentation of the Certified Landscape Specialist at or before the preconstruction conference. Landscape specialists may obtain certification by completing the one-day Department Landscape Project Inspection and Administration Training Class and passing a test administered by the Department's Landscape Architecture and Forestry Units. Full certification is valid for 3 years. Landscape Specialists may obtain provisional certification for 1 year by passing a test without completing the training class.

##### **A.2 Notices by Contractor**

Notify the Engineer at least 3 calendar days before planned deliveries of initial and replacement planting stock to the project to allow for inspection scheduling. Notify the Engineer at least 24 hours before beginning or changing distinct operations. Include the following in the notice:

- (1) The project number,
- (2) Engineer's name,

- (3) Notification date,
- (4) Intended dates and times for the operations, and
- (5) The planned locations of work.

Provide notifications in writing, using confirmable e-mail, or facsimile transmissions.

### **A.3 Unauthorized Work and Penalties for Non-compliant Operations**

The Engineer will consider work performed as follows to be unauthorized work:

- (1) Without required and acceptable documentation and notifications,
- (2) Without supervision by a certified landscape specialist,
- (3) Without conducting required and acceptable competency tests, or
- (4) In conflict with the working hours of 1803, "Prosecution of Work."

In the case of non-compliant operations, the Department may assess a daily charge of \$200.00, on a calendar day basis, until the Contractor achieves compliance.

### **A.4 Required Equipment**

Provide equipment meeting the requirements of 1805, "Methods and Equipment," and with the following available on the project at all times:

- (1) At least one portable compaction tester capable of measuring compaction in the soil to at least 18 in [450 mm] deep,
- (2) At least one soil recovery probe for assessment of soil moisture conditions, and
- (3) At least one tree caliper with measurement readings in inches.

### **B Preconstruction Work**

Preconstruction work includes:

- (1) Attending a preconstruction conference,
- (2) Submitting preconstruction documentation,
- (3) Mobilizing equipment and supplies to the project,
- (4) Protecting existing vegetation, resources, and property in accordance with the plans, special provisions, and 1712, "Protection and Restoration of Property," 2031, "Field Office and Laboratory," 2557, "Fencing," and 2572, "Protection and Restoration of Vegetation."

### **C Staking Planting Holes and Beds**

Stake the exact locations and layouts for the Engineer's approval.

To remedy unanticipated, localized problems and seasonal conditions that may hinder plant establishment, the Contractor may request the Engineer's approval to

perform the following in accordance with the standard planting details and options shown on the plans:

- (1) Relocate plantings,
- (2) Make plant substitutions, or
- (3) Modify soil or drainage characteristics.

Locate plantings to provide the following:

- (1) A clear sight distance of at least 1,200 ft [360 m] in front of traffic signs and extending 50 ft [15 m] beyond the signs; and
- (2) Clear zones and safety sight corners and lines shown on the plans free of plants.

## **D Preparing Planting Holes and Planting Beds**

To prevent site compaction and damage, do not work in planting holes and bed areas if the soil moisture is greater than field capacity.

### **D.1 Utilities**

Before cultivating soil or excavating holes on the project, meet the requirements of 1507, "Utility Property and Service."

The Contractor may request the Engineer's approval to relocate plantings to avoid unanticipated conflicts with utilities.

### **D.2 Weed Control and Soil Cultivation**

Apply herbicide to actively growing vegetation beginning in spring or fall. Before cultivating individual planting holes and bed areas, kill turf and weed growth within the limits of planting areas that will receive mulch in accordance with the following:

- (1) Mow existing vegetation to at least 3 in [75 mm] at least one week before spraying herbicide. Remove the cuttings. Allow the vegetation to re-grow to a height from 4 in to 8 in [100 mm to 200 mm] before applying the herbicide.
- (2) At least three days before applying herbicide, submit to the Engineer, labels of the intended herbicides and a copy of a valid MN Pesticide Applicator License, including Category A and Category J.
- (3) Spray and kill turf and weeds, including the top growth and roots, only within designated areas using a non-selective, non-residual post emergent herbicide containing 41 percent glyphosate as the active ingredient. Ensure personnel, licensed by the MDA and experienced in the use of chemical pesticides perform the work in accordance with the manufacturer's instructions and recommendations. Apply the herbicide to dry foliage on actively growing

vegetation. Apply the herbicide in August or early September before the fall or spring Plant Installation Period (PIP) as required by the contract. If an August or September application is not possible for the spring PIP, apply the herbicide in late April or early May. If precipitation occurs within 6 hours after applying herbicide, reapply herbicide as needed to achieve 100 percent kill.

- (4) Before beginning soil cultivation work, schedule and perform a Competency Test to the satisfaction of the Engineer. The Engineer considers a satisfactory Competency Test one that demonstrates acceptable soil cultivation, incorporation of soil additives, compaction levels, and soil drainage in one planting bed area and one individual tree planting area.
- (5) Before placing soil additives as shown on the plans, use a spading machine to deep cultivate the planting hole and bed areas by loosening the soil to at least 12 in [300 mm] deep and a compaction level of no more than 200 psi [1,400 kPa] to this depth, as measured from the finished grade elevation of the soil. The Engineer may approve other equipment to address site constraints, if requested by the Contractor. For hydraulic spade-type, machine-moved tree-transplanting, the Engineer will not require planting hole cultivation, other than loosening the soil outside the soil-ball perimeter in accordance with the standard planting details shown on the plans.
- (6) Unless otherwise shown on the plans, add 4 in [100 mm] of Grade 2 compost, in accordance with 3890, "Compost" and other soil additives shown on the plans or as requested by the Contractor and approved by the Engineer, over the cultivated planting hole and bed areas and use a spading machine to incorporate it to a depth of at least 12 in [300 mm], as measured from the finished grade elevation of the soil.
- (7) Use a compaction tester to ensure compaction in the planting hole and bed areas does not exceed 200 psi [1,400 kPa] to a depth of at least 16 in [400 mm]. If Contractor-operations result in zones of hardpan or excessively compacted soil, repeat deep cultivation or de-compact the subsoil in accordance with 2105.3.H, "Finishing Operations," specifically the requirements for turf establishment areas, at no additional cost to the Department.
- (8) Ensure drainage in the planting hole and bed areas. For suspected drainage problems, perform a percolation test by filling a 16 in [400 mm] deep planting hole with water and measuring the time it takes the water to drain from the hole. The Engineer considers adequate drainage equal to or greater than a percolation rate of  $\frac{1}{2}$  in/h [12 mm/h]. If drainage does not meet these requirements, request approval from the Engineer to relocate or delete affected planting locations or proceed with Extra Work using one or a

combination of the planting details for poorly drained soils, as shown on the plans.

- (9) Apply temporary erosion control measures in accordance with the NPDES permit, SWPPP notes, and 2573, "Storm Water Management." The Contractor may use Type 6 wood chip mulch at a depth no more than 1 in [25 mm] for temporary erosion control in prepared planting bed areas.

### **D.3 Wet Soils, Rock, and Debris**

If the Contractor encounters excessively wet soils, bedrock, or excessive quantities of boulders and construction debris, the Contractor may request the Engineer's approval to relocate or delete plantings, or modify soil or drainage characteristics in accordance with the alternative options in the standard planting details shown on the plans.

### **E Delivery and Storage of Plants**

Before installation, the Engineer will provide for inspection and acceptance of plant stock delivered to the project in accordance with the current edition of the ICAMMLP and 3861, "Plant Stock."

Install plant stock on the day of delivery to the project unless using temporary storage methods. Before installation, keep the roots of plants completely covered with a moisture-holding material consisting of wood chips, straw, sawdust, moss, or soil. Keep the moisture-holding material continuously moist and protect it from drying winds, direct sunlight, excessive heat, freezing, low humidity, inadequate ventilation, and animal or human harm. The Engineer will consider plants with damage that occurred or was discovered during temporary storage, unacceptable. Do not store plants from one planting season to the next.

#### **E.1 Pruning — Top Growth and Roots**

Immediately before planting, prune the roots of bare-root plants, except seedlings, and the top growth of deciduous plants. Cut-back broken or badly bruised roots and dry root tips to sound, healthy tissue. Prune to remove dead, rubbing, damaged, diseased, and suckering branches, and to improve plant symmetry, structure, and vigor. Prune coniferous trees and shrubs only to remove damaged growth or a competing leader.

Prune in accordance with the horticultural practices specified in the current edition of the ICAMMLP and the standard planting details on the plans.

Do not prune oak trees during the oak wilt season from April through July, to prevent the spread of oak wilt disease. Immediately treat accidental cuts or wounds to

oaks with a wound dressing in accordance with the standard planting details shown on the plans. Keep wound-dressing material on the project during the oak wilt season.

## **E.2 Buried Root Flares**

The Engineer will consider container-grown and balled and burlapped plant stock unacceptable if provided with more than 4 in [100 mm] of soil depth above the root flare. The Engineer may accept plants provided with no more than 4 in [100 mm] excess soil above the root flare if the excess soil can be removed without damaging the root system of the plants.

## **E.3 Excessive Roots**

Reject containerized or balled and burlapped plants with roots extending at least 4 in [100 mm] beyond the container or burlap.

## **F Installation of Plants**

### **F1 General**

Before proceeding with plant installation work, schedule and perform a competency test demonstrating acceptable plant installation methods to the Engineer's satisfaction and in accordance with the plans and standard planting details, for each plant pay item and root category on the project. The Engineer considers a satisfactory competency test to be one that demonstrates acceptable handling of plants, digging of holes and beds, and installation of plants, initial watering, installation of protection materials and mulching.

Before digging planting holes, rake temporary erosion control wood chip mulch off prepared planting areas to prevent wood chip contamination of the planting soil in the holes.

The Contractor may re-spread wood chip mulch formerly used as temporary erosion control around plants to a depth no greater than 1 in [25 mm] following plant installation, if newly provided and acceptable Type 6 mulch is applied over the top to the depth shown on the standard planting details in the plans.

Dig planting holes to the configuration and minimum dimensions shown in the standard planting details on the plans. If the soil moisture is greater than field capacity, do not work in planting holes and beds.

Ensure drainage in the planting hole and bed areas. For a suspected drainage problem, perform a percolation test by filling a 16 in [400 mm] deep planting hole with water and measuring the time it takes the water to drain from the hole. The Engineer considers adequate drainage equal to or greater than a percolation rate of ½ in/h [12 mm/h]. If drainage does not meet these requirements, request approval

from the Engineer to relocate or delete affected planting locations or proceed with extra work using one or a combination of the planting details for poorly drained soils as shown on the plans.

## **F.2 Individual Plant Stock Types and Installation Requirements**

Install plants in accordance with the steps and requirements in the standard planting details shown on the plans and specific to each plant stock type.

### **G Watering**

During the PIP, provide watering equipment and forces on the project capable of completely watering plants as often as necessary to maintain soil moisture in the root zones.

Within 2 hours of installation, saturate the backfill soil of each plant with water. After settling, provide additional backfill to fill in the voids.

### **H Mulch**

Before placing mulch, fine grade and level the planting bed soils with hand tools. Place mulch material in accordance with the standard planting detail shown on the plans no more than seven days after plant installation. The Engineer will consider placement of mulch, contaminated with soil or other materials and not complying with the requirements of 3882, "Mulch Materials," unacceptable. Remove unacceptable mulch from the project.

### **I Protection of Installed Trees**

Use protective materials to ensure the healthy growth and survival of installed trees.

#### **I.1 Staking and Guying**

Unless staking and guying is shown on the plans, only stake and guy trees if necessary to maintain the trees in a plumb condition. The following circumstances may warrant staking and guying:

- (1) Excessive soil moisture,
- (2) Light-textured soil,
- (3) Steep slopes,
- (4) Exposure to excessive wind, and
- (5) The likelihood of vandalism.

Install staking and guying in accordance with the standard planting details shown on the plans.

Remove staking and guying within 1 year of initial installation.

## **I.2 Rodent Protection**

Place rodent protection around deciduous, pine, and larch trees in accordance with the standard planting details shown on the plans.

## **I.3 Tree Painting**

Paint trees in accordance with the standard planting details shown on the plans.

## **I.4 Seedling Tree Shelters**

Install seedling tree shelters in accordance with the standard planting details shown on the plans.

## **J Cleanup and Restoration Work**

Perform the following cleanup and restoration work on an ongoing basis and as the final step of the initial planting operations:

- (1) Remove excess materials, rocks and debris from the project;
- (2) Repair turf in disturbed areas with seed mixes as shown on the plans or to match in-place turf;
  - (2.1) Immediately before sowing seed or laying sod, prepare soil as specified in 2575.3.B, "Grading Preparations Prior to Seeding;"
  - (2.2) Uniformly broadcast a Type 4 natural base fertilizer, as specified by 3881.2.B.4, "Type 4 — Natural Based Fertilizer," that provides nitrogen at an application rate of 43 lb/acre;
  - (2.3) Lay sod, or uniformly broadcast seed at 1.5 times the rate specified in Table 2575-1, "Seed Mixture Application Rates." Provide seed in accordance with the requirements of 3876, "Seed" and perform seeding in accordance with Table 2575-2, "Season of Planting;"
  - (2.4) Rake and firm seeded areas to ensure seed contact with the soil;
  - (2.5) Broadcast or disc anchor Type 1 mulch in all seeded areas;
- (3) Install erosion control measures to prevent erosion.

## **K Plant Establishment Period**

### **K.1 Establishment Period**

A Plant Establishment Period (PEP) of at least 2 calendar years begins on the date that initial planting operations on the project are completed and continues until final acceptance of the project, unless otherwise shown on the plans.

## **K.2 Establishment Work**

Keep plants in a healthy growing condition in accordance with the current edition of the ICAMMLP throughout the establishment period and submit Mn/DOT *Landscape Contractor Scouting Reports* in accordance with item 1 of 2571.3.K.2.a, "All Plants." Perform plant establishment work throughout the growing seasons from April through October and as necessary during the dormant seasons from November through March. The Engineer may perform random inspections throughout the PEP to verify compliance. The Engineer will consider the Contractor non-compliant if the Contractor does not maintain plants throughout the PEP and does not submit scouting reports.

The Department may assess a daily charge of \$200.00 for non-compliance, on a calendar day basis, until the Contractor achieves compliance.

### **K.2.a All Plants**

In plant establishment work, perform the following:

- (1) Scout to assess the condition of the plants and the planting site and factors that may influence plant health, vigor, and establishment success. Scout these conditions at least every two weeks during the growing season and at least every month during the dormant season;
- (2) Submit a written scouting report to the Engineer via e-mail by the 1<sup>st</sup> and 15<sup>th</sup> of each month during the growing season from April to October and by the 1<sup>st</sup> of each month during the dormant season from November to March. The Engineer will use the report-frequency and content to assess plant establishment compliance. The report may include scanned copies of the plan sheets with the Contractor notes, copies of the report form found in the current edition of the ICAMMLP, or both. Include the following in the report:
  - (2.1) The project number;
  - (2.2) Engineer's name;
  - (2.3) Name of Contractor's responsible scout or representative;
  - (2.4) Dates work was performed;
  - (2.5) Work locations;
  - (2.6) Work completed;
  - (2.7) Prevailing weather conditions;
  - (2.8) Soil moisture assessments;
  - (2.9) Insect, animal, vehicular, weather, or other damage;
  - (2.10) Disease problems;
  - (2.11) Treatment recommendations' and

- (2.12) Assessment of overall plant conditions including weed competition and control.
- (3) Maintain soil moisture in accordance with 2571.3.G, "Watering" and the watering guidelines of the standard planting details shown on the plans;
- (4) Repair, adjust, or replace staking and guying, mulch material, planting soil, rodent protection, seedling tree shelters, tree paint, and other incidental items in accordance with the plans;
- (5) Maintain healthy, vigorous plants, free of harmful insects, fungus, and disease;
- (6) Remove dead, dying, and unsightly plants. Provide and install replacement plants in accordance with 2571.2.K.2.b, "Replacement Requirements;"
- (7) Maintain plants in a plumb condition at the planting depth shown on the planting details in the plans;
- (8) Maintain planting areas in a weed-free condition as follows:
  - (8.1) Remove weeds, top growth and roots, within the mulch limits by hand pulling. Pre-water mulched areas to ensure weed top growth and roots are entirely removed. Ensure weeding operations do not contaminate the mulch or project with weed seed, weed-laden soil or propagating weed parts. Remove State and County-regulated noxious weeds to at least 3 ft [900 mm] beyond the mulch limits. Remove weed parts or weed-laden material from the project to avoid the spread of weed infestations;
  - (8.2) Do not spray chemicals for weed control in mulched planting areas during the PEP. The Contractor may apply a non-selective, non-residual post-emergent herbicide containing 41 percent glyphosate, as the active ingredient with a surfactant on a spot treatment basis with a brush or wick applicator. The Contractor may also apply a broad-spectrum dichlobenil based granular, pre-emergent herbicide in accordance with product labeling and manufacturer's recommendations;
  - (8.3) Do not weed whip or weed clip as weed control;
  - (8.4) Mow turf bands around the mulch limits at least 3 ft [900 mm] beyond the limits and at least 4 in [100 mm] high if the turf height exceeds 9 in [230 mm] adjacent to mulched planting areas;
  - (8.5) Mow turf areas installed as part of the project when the growth exceeds 18 in [500 mm] high. Mow turf from 6 in [150 mm] to 12 in [300 mm] high. Control State and County-listed noxious weeds;
- (9) Prune to remove dead, rubbing, damaged or diseased branches, unwanted suckers, and to improve plant form and structure;

- (10) Prevent or repair rutting and other damage that may lead to soil erosion and weed infestation;
- (11) Perform plant establishment operations consistent with plant care and horticultural practices detailed in the current edition of the ICAMMLP; and
- (12) Remove excess material, obsolete temporary erosion control devices, rocks, and debris from the project.

### **K.2.b Replacement Requirements**

Within the first year of the 2-year PEP, determine which plants need replacing. Replace dead, defective, or missing plants and incidental materials in accordance with initial installation requirements, including plants lost due to accidents, vandalism, theft, rodent damage, damage caused by the Contractor, or if ordered by the Engineer, at no additional cost to the Department. Conduct plant replacement operations during the month of May within the first year of the PEP. At least one week before plant replacement, submit a summary report of proposed plant replacements to the Engineer. Include by attachment, copies of plan sheets with the proposed replacement quantities and locations identified and a Mn/DOT *Certificate of Compliance for Plant Stock, Landscape Material, and Equipment*, in the report. Using brightly colored paint, mark on site plants requiring replacement.

Provide replacement plants and incidental materials that are equal to or better than the initial material required by the contract.

If less than a full year remains in the PEP, do not replace plants unless the PEP is extended by a supplemental agreement or change order to provide at least one full year of establishment care.

## **L Acceptance of Work**

For acceptance at full payment, ensure each plant meets the *Criteria For Accepting Plant Size* shown in the current edition of the ICAMMLP.

### **L.1 Acceptance of Preconstruction Work**

The Engineer will accept the preconstruction work after the Contractor secures commitments for required materials, submits a Mn/DOT *Certificate of Compliance for Plant Stock, Landscape Materials, and Equipment*, participates in a preconstruction conference, obtains the Engineer's approval for the progress schedule, moves equipment and supplies to the project, and provides protection for existing plants.

### **L.2 Acceptance of Preparation of Planting Holes and Beds**

For the Engineer's acceptance of preparation of planting holes and beds, complete a competency test, other specified staking, initial weed control, soil cultivation including incorporation of additives, and temporary erosion control work.

### **L.3 Acceptance of Initial Planting Operation**

The Engineer will provisionally accept initial planting operations based on the following:

- (1) Plant stock acceptance,
- (2) Completion of a competency test,
- (3) Installation of individual plants, and
- (4) All incidental material and work items shown in the initial planting operations chapter of the current edition of the ICAMMLP, including initial but not limited to watering, tree protection materials, mulching, proper drainage, pruning, staking and guying, tree painting, fertilizing, erosion control, seeding and clean up.

### **L.4 Final Acceptance**

As a condition for terminating the PEP and conducting the final inspection, the Engineer may require the Contractor to bring the plant establishment work into compliance.

On or about the date of termination of the PEP, the Engineer will perform a final inspection of the project.

The Engineer will determine which plants to accept for payment at the contract unit price, at a reduced payment, or with no payment.

Upon final acceptance, the Engineer will not require further Contractor-care of plantings.

The Engineer will make final acceptance at the completion of the two-year PEP and based on a final inspection of the completed project.

#### **2571.4 METHOD OF MEASUREMENT**

The Engineer will measure plants separately by the number of acceptable plants for each contract item in accordance with 2571.5.G, "Payment Schedule."

#### **2571.5 BASIS OF PAYMENT**

The Department will make payment for plant installation and establishment at a percentage of the contract unit price per item unit of measure for all costs relating to furnishing, installing, and maintaining, the required plants and associated incidental materials as specified and shown on the plans.

The Engineer may require additional materials and work beyond that specified or shown in the contract. The Department will make payment for the additional materials and work as extra work.

The Department may make full payment, reduced payment or no payment of no more than the maximum eligible partial payment percentage at any payment phase (initial, interim, final) based on the performance of the Contractor (see Payment Checklist in the current edition of the ICAMMLP).

## **A Full Payment**

The Department will make full payment of 100 percent of the contract unit price for each plant the Engineer considers acceptable, upon inspection, if the Contractor fully achieves all Payment Criteria as defined in the Payment Checklist in the current edition of the ICAMMLP.

## **B Reduced or No Payments**

The Department will make a reduced payment or no payment of the contract unit prices for each plant if the Contractor does not achieve all Payment Criteria, as defined in the Payment Checklist in the current edition of the ICAMMLP.

## **C Initial Payment**

The Department will make partial payment up to 70 percent of the contract unit price for each plant for completion of the following work:

### **C.1 Preconstruction Work**

The Department will pay no more than 10 percent of the contract unit price for each plant with the completion and acceptance of preconstruction work as defined in the *Preconstruction Work Checklist* in the current edition of the ICAMMLP.

### **C.2 Preparation of Planting Holes and Beds**

The Department will pay no more than 15 percent of the contract unit price for each plant with the completion and acceptance of preparation of planting holes and beds work as defined in the *Preparation of Planting Holes and Beds Checklist* in the current edition of the ICAMMLP.

### **C.3 Initial Planting Operations**

The Department will pay no more than 45 percent of the contract unit price for each plant with the completion and acceptance of initial planting operations work as defined in the *Initial Planting Operations Checklist* in the current edition of the ICAMMLP.

## **D Interim Payment**

At the end of the first calendar year of the PEP, and after completion and acceptance of the Contractor's work and continuous compliance with the plant establishment requirements as defined by the *Plant Establishment-Year One Checklist*

in the current edition of the ICAMMLP, the Engineer may authorize no more than 15 percent of the contract unit price for each plant.

### **E Final Payment**

The Department will make final payment after final inspection and acceptance of the completed project at the end of the PEP. The Engineer may authorize no more than 15 percent of the contract unit price for each plant as defined by the *Plant Establishment Year 2 Checklist* in the current edition of the ICAMMLP. The total final payment includes the Plant Establishment Year 2 payment, assessments and reduced payments, if any, and bonus payment, if eligible.

The Department will not pay for replacement plants, unless authorized by the Engineer.

The Department may continue to withhold any percentage of initial and interim payments from the final payment.

The Department will not reimburse any assessments charged during the contract period at the final payment. If the final voucher shows that the total of initial and interim payments made exceeds the total amount due the Contractor, promptly refund the Department for the overpayment.

### **F Bonus Payment**

When 90 percent or more of all plants installed within the initial plant installation period (PIP) and related contract operations have been continuously acceptable throughout the contract period, the Department will make a bonus payment of 10 percent of the total final contract unit price for plant installation and establishment.

The Department considers replacement plants, replaced during the initial PIP, to be initially installed plants. Replacement plants made during the PEP are not eligible for bonuses.

### **G Payment Schedule**

The Department will pay for plant installation and establishment on the basis of the following schedule:

<b>Item No.</b>	<b>Item</b>	<b>Unit</b>
2571.501	Coniferous tree (size & root category)	tree
2571.502	Deciduous tree (size & root category)	tree
2571.503	Ornamental tree (size & root category)	tree
2571.504	Coniferous shrub (size & root category)	shrub
2571.505	Deciduous shrub (size & root category)	shrub
2571.506	Vine (age or size & root category)	vine

<b>Item No.</b>	<b>Item</b>	<b>Unit</b>
2571.507	Perennial (age or size & root category)	plant
2571.510	Iron Sulfate	pound (kilogram)
2571.511	Iron Sulfate	ton (metric ton)
2571.512	Activated Charcoal	pound (kilogram)
2571.513	Activated Charcoal	ton (metric ton)
2571.514	Plant Hormones	gallon (liter)
2571.515	Hydrophilic Polymers	pound (kilogram)
2571.516	Mycorrhizal Inoculum	pound (kilogram)
2571.541	Transplant tree (spade size*)	tree
2571.544	Transplant shrub	shrub
2571.546	Transplant vine	vine
2571.547	Transplant perennial	plant

NOTE: State Root Category: Seedling, Bare Root, Machine Moved, Container Grown, Balled and Burlapped

\* Spade size: 42 in [1.1 m], 60 in [1.5 m], 78 in [1.9 m], 85 in [2.1 m], 90 in [2.3 m].

## **2572 PROTECTION AND RESTORATION OF VEGETATION**

### **2572.1 DESCRIPTION**

This work consists of protecting and preserving vegetation from damage and restoring vegetation damaged by the Contractor's operations.

### **2572.2 MATERIALS**

**A Plant Materials.....2571 and 2575**

#### **B Temporary Fence**

Provide temporary fence meeting the following characteristics and requirements:

- (1) At least 4 ft [1.2 m] high,
- (2) Conspicuous in color (see Standard Detail Sheet for Protection and Restoration of Vegetation), and
- (3) Commercially available snow fence or other fencing material approved by the Engineer.

**C Water .....2571.2.C.4**  
**D Sandy Loam Topsoil ..... 3877**  
**E Tree Growth Retardant (TGR)**

Provide the TGR paclobutrazol or an equal approved by the Engineer.

**2572.3 CONSTRUCTION REQUIREMENTS**

**A Protecting and Preserving**

Protect and preserve the following:

- (1) Specimen trees,
- (2) Threatened and endangered plants listed on the Federal and state threatened and endangered species list,
- (3) Vegetation as required by the contract,
- (4) Trees, brush, and natural scenic elements within the right-of-way and outside the limits of clearing and grubbing in accordance with 2101.3, "Clearing and Grubbing, Construction Requirements," and
- (5) Other vegetation as directed by the Engineer.

Do not place temporary structures, store material, or conduct unnecessary construction activities within 25¼ ft [8 m] outside of the dripline of trees designated for preservation, unless otherwise approved by the Engineer.

Do not place temporary structures or store material, including common borrow and topsoil, outside of the construction limits in areas designated for preservation, as required by the contract or as approved by the Engineer.

Do not place or leave waste material on the project, including bituminous and concrete waste that would interfere with performing the requirements of 2105.3.C, "Preparation of Embankment Foundation," or 2575, "Establishing Turf and Controlling Erosion." The Department defines concrete waste as excess material not used on the project, including material created from grinding rumble strips. Dispose of excess material in accordance with 2104.3.D, "Disposal of Material and Debris."

**A.1 Temporary Fence**

Place temporary fences to protect vegetation before starting construction. Place temporary fence at the construction limits and at other locations adjacent to vegetation designated for preservation as required by the contract or as approved by the Engineer. The Department will provide tree protection signs. Place tree protection signs in accordance with the following:

- (1) Along the temporary fence at 50 ft [15.25 m] intervals,

- (2) At least two signs per fence, or
- (3) As directed by the Engineer.

Do not remove the fence until all work is completed or until approved by the Engineer.

Ensure the fence prevents traffic movement and the placement of temporary facilities, equipment, stockpiles, and supplies from harming the vegetation.

### **A.2 Clean Root Cutting**

Cleanly cut tree roots at the construction limits as required by the contract or as directed by the Engineer.

Immediately and cleanly cut damaged and exposed roots. Cut back damaged roots of trees designated for protection to sound healthy tissue and immediately place topsoil over the exposed roots. Immediately cover root ends exposed by excavation activities with 6 in [150 mm] of topsoil as measured outward from the cut root ends. Limit cutting to a minimum depth necessary for construction. Use a vibratory plow, or other approved root cutter in accordance with the Standard Detail Sheet for Protection and Restoration of Vegetation, before excavation.

### **A.3 Watering**

Water root-damaged trees during the growing season that root damage occurs, and water specified trees if required by the contract or directed by the Engineer. Maintain adequate but not excessive soil moisture by saturating the soil within the undisturbed portion of the dripline of impacted or identified trees to a depth of 20 in [500 mm]. Use a soil recovery probe to check the soil moisture to a depth of 20 in [500 mm], and adjust the intervals and frequency of watering in accordance with prevailing moisture and weather conditions.

### **A.4 Sandy Loam Topsoil**

Place sandy loam topsoil instead of common borrow fill within the dripline of specimen trees as required by the contract or as directed by the Engineer.

Place the topsoil to avoid over-compaction as approved by the Engineer. Establish turf consistent with the adjacent areas as approved by the Engineer.

### **A.5 Utility Construction**

Bore under roots of trees designated for preservation for utility installations within the tree protection zone in accordance with the following:

<b>Table 2572-1 Tree Protection Zone</b>
--

<b>Tree diameter at 4.5 ft [1.4 m] above ground, in [mm]</b>	<b>Minimum distance from face of tree trunk, ft [m]</b>	<b>Minimum depth of tunnel, ft [m]</b>
<2 [50]	2 [0.6]	2 [0.6]
2–4 [51–100]	4 [1.2]	2.5 [0.75]
>4–9 [101–225]	6 [1.8]	2.5 [0.75]
>9–14 [226–350]	10 [3.0]	3 [0.9]
>14–19 [351–480]	12 [3.6]	3.25 [1.0]
>19 [480]	15 [4.8]	4 [1.2]

Do not perform open trenching within the tree protection zone.

## **A.6 Blank**

## **A.7 Pruning**

Provide an arborist certified by the International Society of Arboriculture to prune trees as required by the contract or as directed by the Engineer in accordance with 2571.3.E.1, “Pruning – Top Growth and Roots.” Ensure the arborist removes dead, broken, rubbing branches, and limbs that may interfere with the existing and proposed structures.

## **A.8 Destroyed or Disfigured Vegetation**

Restore vegetation designated on the plans for preservation that is damaged or disfigured by the Contractor’s operations at no additional cost to the Department. Restore the damaged vegetation to a condition equal to what existed before the damage. The Engineer may assess damages against the Contractor for damage to vegetation not restored to the previous condition. The Engineer will assess the value of damages to trees and landscaping at not less than the appraisal damages as specified in the Council of Tree and Landscape Appraisers *Guide for Plant Appraisal*. The Engineer will determine and assess damages of other vegetation.

## **A.9 Oak Trees**

Avoid wounding of oak trees during April, May, June, and July to prevent the spread of oak wilt. If the Engineer determines that work must take place near oak trees during those months, immediately treat resulting wounds with a wound dressing material consisting of latex paint or shellac. Blend paint colors with the bark color. Maintain a supply of approved wound dressing on the project at all times during this period.

## **A.10 Tree Growth Retardant (TGR)**

Provide an arborist certified by the International Society of Arboriculture to treat trees with the TGR as required by the contract or as directed by the Engineer. Ensure

the arborist applies the TGR paclobutrazol as a basal drench or soil injection and in accordance with the label directions. Provide the Engineer with the product label and material safety data sheet for the product used.

**A.11 (Blank)**

**A.12 Other Vegetation Protection Measures**

Provide other vegetation protection measures including root system bridging, compaction reduction, aeration, irrigation systems, J-barriers for specimen tree protection, and retaining walls as required by the contract or as directed by the Engineer.

**B Ash Trees (Emerald Ash Borer Compliance).....2101.3.D.4**

**C Plant Installation..... 2571**

**D Disposal of Material and Debris .....2104.3.D**

**2572.4 METHOD OF MEASUREMENT**

**A Temporary Fence**

The Engineer will measure temporary fence placed, maintained, and removed by length along the bottom of the fence between end posts.

**B Clean Root Cutting**

The Engineer will measure clean root cutting by length along the plow line. The Engineer will determine the beginning and ending points for clean root cutting as the intersection of the construction limit and the dripline of the tree or brush or in accordance with lines shown on the plans.

**C Water**

The Engineer will measure water by volume used to protect and restore vegetation. The Engineer will not measure water otherwise used in performing the work, such as for maintenance of sod.

**D Sandy Loam Topsoil**

The Engineer will measure sandy loam topsoil by compacted volume provided and placed.

**E Pruning**

The Engineer will measure pruning by the hours of actual pruning work.

**F Tree Growth Retardant (TGR)**

The Engineer will measure TGR by volume of material applied for the size of the tree treated. The Engineer will determine the volume of TGR required by the diameter at breast height (DBH) of each tree treated. DBH is defined as 4.5 ft [1.4 m] above ground level. The Engineer will use a diameter tape measure to measure DBH.

**2572.5 BASIS OF PAYMENT**

The Department will include the cost of the following with other relevant contract items:

- (1) Boring under roots in the tree protection zone, dressing of wounds, and disposal of material and debris, and
- (2) Pruning made necessary to allow for the Contractor's operations or to remedy damage caused by the Contractor's operations.

The Department will pay for protection and restoration of vegetation based on the following unit prices, in the absence of contract unit prices:

<b>Table 2572-2 Protection and Restoration of Vegetation Items</b>	
<b>Item</b>	<b>Unit Price</b>
Temporary fence	\$2.50 per ft [\$8.00 per m]
Clean root cutting	\$3.50 per ft [\$11.50 per m]
Water	\$3.00 per 100 gal [\$8.00 per L]
Sandy loam fill	\$7.65 per cu. yd [\$10.00 per cu. m]
Prune trees	\$75.00 per h
Tree growth retardant	\$8.00 per diameter in [\$3.15 per diameter cm]

The Department will pay for protection and restoration of vegetation on the basis of the following schedule:

<b>Item No.:</b>	<b>Item:</b>	<b>Unit:</b>
2572.501	Temporary Fence	linear foot [meter]
2572.502	Clean Root Cutting	linear foot [meter]
2572.503	Water	gallon [liter]
2572.504	Sandy Loam Fill	cubic yard [cubic meter]
2572.505	Prune Trees	hour
2572.506	Tree Growth Retardant	gallon [liter]

**2573 STORM WATER MANAGEMENT**

### **2573.1 DESCRIPTION**

This work consists of managing storm water runoff and project related water discharges to minimize sediment pollution and managing the discharges associated with dewatering and basin draining activities.

### **2573.2 MATERIALS**

<b>A (Blank)</b>	
<b>B Water Treatment .....</b>	<b>3875</b>
<b>C Bale Barriers .....</b>	<b>3882</b>
<b>D Silt Fence .....</b>	<b>3886</b>
<b>E Flotation Silt Curtain .....</b>	<b>3887</b>
<b>F Temporary Slope Drain.....</b>	<b>3892</b>
<b>G Sandbags.....</b>	<b>3893</b>
<b>H Sediment Control Log .....</b>	<b>3897</b>
<b>I Flocculants.....</b>	<b>3898</b>
<b>J Filter Berm .....</b>	<b>3874</b>

### **2573.3 CONSTRUCTION REQUIREMENTS**

#### **A General**

Schedule, construct, maintain or install temporary sediment control and storm water management measures as required by the contract and in accordance with the permits required for the project.

Adjust the installation location of temporary storm water management and sediment control devices as shown on the plans to better accommodate the actual field conditions and increase the effectiveness of a device.

#### **A.1 Erosion Control Supervisor**

Provide an Erosion Control Supervisor with a valid Minnesota Construction Site Management certification, authorized to represent the Contractor on matters pertaining to the NPDES construction storm water permit compliance, and available to the work site within 24 hours of an initial disturbance to final stabilization. The following list describes the duties of the Erosion Control Supervisor:

- (1) Implements the quality control program,

- (2) Ensures proper installation and maintenance of all erosion and sediment control Best Management Practices BMPs,
- (3) Implements the erosion and sediment control schedule,
- (4) Coordinates the work of subcontractors to ensure the full execution of erosion and sediment control measures for each operation and stage of work,
- (5) Oversees the work of subcontractors to ensure the subcontractors undertake erosion and sediment preventive measures at each stage of the work,
- (6) Prepares the required weekly erosion control schedule and inspections with the dates and times,
- (7) Attends construction meetings to discuss the erosion control schedule and inspections,
- (8) Prepares the erosion and sediment control Site Management Plans as required by the contract or as directed by the Engineer,
- (9) Provides for erosion and sediment control methods for temporary work not shown on the plans,
- (10) Amends the SWPPP to document changes,
- (11) Ensures acquisition of and compliance with applicable permits for borrow pits, dewatering, and temporary work in rivers, lakes and streams,
- (12) Ensures the full installation of erosion and sediment control work before suspension of the work,
- (13) Coordinates with federal, state, and local regulatory agencies on resolution of erosion and sediment control issues resulting from the work,
- (14) Ensures that proper cleanup occurs from vehicle tracking on paved surfaces, locations where sediment leaves the right-of-way, or both, and
- (15) Ensures the certification of installers for operations in accordance with 2573.2.A.2, "Certified Installers."

## **A.2 Certified Installers**

Provide a certified installer to install or to direct installations of erosion or sediment control practices and for the following:

- (1) Seeding,
- (2) Sodding,
- (3) Mulching,
- (4) Silt fence or other perimeter sediment control device installations,
- (5) Rolled Erosion Control Products (RECP) installation,
- (6) Hydraulic Erosion Control Product installation,
- (7) Silt curtain installation,
- (8) Ditch check installation, and
- (9) Compost installation.

Provide at least one installer with a valid Minnesota Inspector or Installer Certification at the time of installation.

If the Contractor fails to provide the required certified installers, the Engineer may reject the work as unauthorized work in accordance with 1512, "Unacceptable and Unauthorized Work."

### **A.3 Areas of Environmental Sensitivity**

Schedule and phase construction in and around Areas of Environmental Sensitivity (AES) to minimize the potential of sediment entering into these areas. Use measures such as hand clearing and grubbing, limiting bare soil exposure time, expediting construction activities, and immediately establishing final vegetation to minimize sediment loss potential.

### **A.4 Construction of Temporary Sediment Basins and Traps**

Construct temporary sediment basins concurrently with the start of soil disturbing activities. Direct storm water run off from localized watershed to the basins. Mulch, seed, or both, the exposed side slopes of the basins meeting the requirements of the NPDES permit or within 14 calendar days.

### **A.5 Temporary Perimeter Sediment Control Measures**

Install sediment control measures down gradient before, or in conjunction, with soil disturbing activities.

Recover sediment, restore property to the pre-existing conditions for loss of sediment off the project, or both at no additional cost to the Department

### **A.6 Dewatering and Pumping**

Obtain permits in accordance with 1701, "Laws to be Observed," and 1702, "Permits, Licenses, and Taxes," for dewatering and pumping operations. Provide a water treatment plan for turbid or sediment laden water. Submit the water treatment plan to the Engineer before pumping. Do not begin work until the Engineer approves the water treatment plan. The Contractor may include use of sediment traps, vegetative filter strips, flocculants, or other water treatments in accordance with 3875, "Water Treatments," in the water treatment plan.

Protect the discharge location of the dewatering process from erosion. Unless otherwise required by the contract, provide and install the BMPs to control erosion and suspended sediment during the dewatering or pumping operation.

### **A.7 Suspension of Grading**

Shape exposed soil and incorporate temporary and permanent erosion control measures as approved by the Engineer before suspending grading operations.

## **A.8 Related Work**

Control drainage and erosion on the work related to the Project including: haul roads, temporary construction, waste disposal sites, plant and storage locations, and borrow pits other than commercially operated sources. Maintain the area, shape the area to allow storm runoff with minimum erosion, replace topsoil, and establish vegetative cover on areas where the potential for pollution has been increased due to the Contractor's operations. Waste disposal sites, borrow pit areas or other related work located outside of the Right-of-Way may require separate permits.

## **B Installation of Silt Fence**

### **B.1 Type PA Preassembled**

Install preassembled silt fence with attached wooden stakes in small areas less than  $\frac{1}{4}$  acre [0.6 ha]. Pound stakes at least 1.5 ft [0.5 m] into the ground. Install the geotextile with the salvaged edge on top. Place the bottom edge of the geotextile into a trench 6 in [150 mm] deep and 6 in [150 mm] wide. Backfill and tamp the trench for compaction.

### **B.2 Type MS Machine Sliced**

Mechanically install the geotextile with the salvaged edge on top. Place the geotextile directly behind the soil-slicing blade as it works to achieve consistent placement and depth. Do not plow soil if using the slicing method. Roll the wheels of a tractor or skid steer on each side of the geotextile at least 2 times to compact the soil immediately next to the geotextile

Install posts adjacent to the back face of the geotextile with the studs facing away from the geotextile fabric. Secure each post by inserting three plastic zip ties through the geotextile.

### **B.3 Type HI Hand Installed**

Install the geotextile by hand in areas inaccessible by a machine. Install the bottom 8 in [200 mm] to 12 in [300 mm] of the geotextile in accordance with one of the following methods:

- (1) Placed the geotextile into a trench 6 in [150 mm] deep and 6 in [150 mm] wide with the bottom edge of the geotextile wrapping back up to the soil surface. Backfill and tamp the trench for compaction, or

- (2) In areas where soils prohibit hand trenching, place the geotextile on the ground on the front face and covered with crushed rock or p-gravel at least 12 in [300 mm] wide and 6 in [150 mm] high to provide for as a filter.

Install posts adjacent to the back face of the geotextile with the studs facing away from the geotextile fabric. Insert three plastic zip ties to secure it to each post.

#### **B.4 Type SD Super Duty**

Place the bottom edge of the geotextile from 4 in [100 mm] to 6 in [150 mm] underneath the face of the median barrier exposed to direct storm water runoff. Place the median barriers end to end to minimize the gap between each barrier. Attach the geotextile to the face of the barrier with wire or plastic zip ties and tie to each eyelet on the barrier.

#### **B.5 Type TB Turbidity Barrier**

Use turbidity barriers to isolate the work zone from the watercourse. Install the turbidity barrier as close to the work area as possible but at no point in expected water depths greater than 3 ft [0.9 m] deep. Do not trench the geotextile into the watercourse. Anchor at least a 1 ft [0.3 m] flap folded upgradient with sandbags in accordance with 3893, "Sandbags," to seal the bottom edge. In the top edge, insert a steel support cable into a 2 in [50 mm] double stitch sleeve and fastened to steel fence posts in accordance with 3403, "Hot-Rolled Steel Fence Posts."

Install posts adjacent to the back face of the geotextile with the studs facing away from the geotextile fabric. Secure each post by inserting three plastic zip ties through the geotextile.

Before removing the turbidity barrier, remove and dispose of material not originally in the isolation zone in a location approved by the Engineer.

### **C Installation of Bale Barriers**

Trench bales into the ground 4 in [100 mm] and stake with two wood stakes. Provide the stakes in a length that allows the placement of the stake so the top of the stakes remains flush with the top of the bale when embedded into the ground at least 10 in [250 mm].

### **D Sandbag Installation**

Install sandbags on a level contour. Sandbags installed a minimum of 6 ft [2 m] back from the toe of the slope to allow ponding, and to provide room for sediment storage. Stack sandbags at least three bags high. Butt ends of bags tightly together and overlap butt joints of rows beneath with each successive row. Stack bags in trapezoidal shape with respect to the side profile.

## **E Filter Berm Installation**

### **E.1 Compost, Slash Mulch**

Install filter berms along the contour of the slope and perpendicular to sheet flow. Install the filter berms so the beginning and end of the installation points slightly up the slope to create a “J” shape at each end to contain runoff from above and prevent it from flowing around the ends of the berm. For slopes that receive runoff from above, place a filter berm at the top of the slope to control the velocity of the flow running onto the slope, and to spread the runoff out into sheet flow. On slopes 1:3 (V:H) or steeper the Contractor may place a number of filter berms at regular intervals down the slope.

If installing in ditches, install perpendicular to the ditch gradient such that the top of the berm in the middle of the ditch is lower in elevation than the bottom of the terminating points on the ditch sideslopes.

Upon formation, immediately seed compost filter berms.

### **E.2 Rock Weeper**

Line the bottom of the rock weeper with a Type IV geotextile in accordance with 3733, “Geotextiles.” Provide a rock weeper with side profile that forms a triangle with 1:6 (V:H) slopes on both the front and back slopes. Install coarse filter aggregate in accordance with 3149, “Granular Material,” on the front half of the triangle with a 1:6 (V:H) slope to a height of 1½ ft [0.5 m]. Install Class I riprap in accordance with 3601, “Riprap Material,” on the back half of the triangular section. Construct the center cross-section of the weeper to place the center point of the rock weeper 4 in [100 mm] lower than the end points of the weeper at the ditch side slopes.

### **E.3 Topsoil**

Use topsoil filter berm as a temporary perimeter control BMP. Construct a topsoil berm using topsoil salvaged from the project. Immediately following formation, stabilize the berm with seed and mulch or an equivalent approved by the Engineer. Spread the topsoil used for the berm back across the site before the final stabilization process occurs.

### **E.4 Slash Mulch/Temporary Fence System**

Provide the temporary fence in accordance with 2572.3, “Protection and Restoration of Vegetation, Construction Requirements.” Install perpendicular to flow along the contours. Install a Slash Mulch Filter Berm in accordance with 3874, “Filter Berm,” on the upgradient toe of the temporary fence.

## **F Sediment Control Log Installation**

### **F.1 Straw, Wood Fiber, and Coir**

Logs will require a shallow trench for effectiveness contain no gaps between the log and the soil. Backfill and compact the upgradient side of the sediment control log with soil. Stake logs through the back half of the log at a 45 degree angle with the top of the stake pointed upstream. If using more than one sediment control log for length, overlap the ends 6 in [150 mm] and stake both ends.

### **F.2 Wood Chip, Compost, and Rock**

Place logs on smooth, prepped soils with no gaps between log and soil. Install logs along contours with ends turned up slope in a J-hook manner.

### **F.3 Sediment Control Log/Erosion Control Blanket System**

Install Type 3 Erosion Control Blanket (ECB) in accordance with 3885, "Rolled Erosion Control Products," on bare soils and perpendicular to the ditch flow with the leading edge exposed to flow buried in a trench 4 in [100 mm] deep and 4 in [100 mm] wide. Backfill and compact the trench. Staple the ECB at spacing no greater than 1 ft [0.3 m] on center, with staples meeting the following requirements:

- (1) U shaped,
- (2) At least 11 gage steel wire,
- (3) 1 in [25 mm] span width, and
- (4) Length from 6 in to 8 in [150 mm to 150 mm].

Install a Wood Fiber Sediment Control Log in accordance with 3897, "Sediment Control Log," on top of the ECB and anchored with wood stakes. Stake the log with wood stakes meeting the following requirements:

- (1) At least 1 in  $\times$  2 in [25 mm  $\times$  50 mm] nominal,
- (2) 16 in [400 mm] long,
- (3) Pointed end, and
- (4) Spaced at 1 ft [0.3 m] intervals.

Drive the stakes through the back half of the log at a 45 degree angle. Point the top of the stake upstream. If using more than one sediment control log for length, overlap the ends 6 in [150 mm] and stake both ends.

### **F.4 Sediment Control Log/Erosion Control Blanket/Flocculant System**

Install a Wood Fiber Sediment Control Log/Type 3 Erosion Control Blanket System in accordance with 2573.3.F.3, "Sediment Control Log/Erosion Control Blanket System." Before applying Granular Flocculant in accordance with 3898, "Flocculants," obtain a soil sample from the project location. Analyze the soil sample

to reference determine which flocculant to apply to each log. Initially apply 2 oz [56 g] of anionic or neutrally-charged flocculant over the log where water will flow and 1 oz [28 g] of flocculant on ECB on each side of the sediment control log. Reapply flocculant after every rainfall event of at least  $\frac{1}{2}$  in [12 mm]. The Contractor may substitute other proprietary turbidity reducing agents as approved by the Engineer.

### **F.5 Sediment Control Log/Silt Fence System**

Install Silt Fence Type Machine Sliced in accordance with 2573.3.B.2, "Type MS Machine Sliced." Place a Wood Fiber Sediment Control Log in accordance with 3897, "Sediment Control Log," along the upgradient toe of the silt fence. Allow the log to work, unstaked, as a pre-filter to the silt fence. If using more than one sediment control log for length, overlap the ends 6 in [150 mm].

### **G Rock Check**

Install class II riprap on top of a Type IV geotextile liner in accordance with 3733, "Geotextiles." Configure riprap in a trapezoidal-shaped berm with respect to the side profile. Construct the center cross-section so that the center point of the rock check is 4 in [100 mm] lower than the end points of the rock check at the ditch side slopes.

### **H Rock Weeper/Erosion Control Blanket/Flocculant System**

Install Rock Weeper Filter Berm per 2573.3.E.2, "Rock Weeper." Install Type 3 Wood Fiber Erosion Control Blanket (ECB) in accordance with 3885, "Rolled Erosion Control Products," on top of the berm perpendicular to the direction of flow. Staple the leading edge at intervals no greater than 1 ft [0.3 m]. Hold down the opposing edge with stones or staples. Apply granular flocculant in accordance with 3898, "Flocculants," at a rate of 3.5 oz [100 g] over the center portion of the ECB where the water will flow over. Perform flocculant application during construction activities and after every rainfall event of at least  $\frac{1}{2}$  in [12 mm]. The Contractor may substitute other proprietary turbidity reducing agents as approved by the Engineer.

### **I Flotation Silt Curtain Installation**

Provide a flotation silt curtain meeting the following requirements and characteristics:

- (1) Contains connecting devices at each end so that sections can be joined together,
- (2) Contains connecting devices designed to prevent silt from permeating through the connection and at the specified strength to prevent ripping out, and

(3) Installation shall reach the bottom of the water body.

### **I.1 Still Water**

Secure both ends of a Light Duty Floating Silt Curtain in accordance with 3887, "Flotation Silt Curtain," to land with steel fence posts in accordance with 3403, "Hot-Rolled Steel Fence Posts," and extend the curtain at a 45 degree angle from both ends. Anchor the curtain in the waterway with at least 40 lb [18 kg] at intervals no greater than 100 ft [30 m] along the length of the curtain. Mark each anchor with a buoy in navigable waters. Keep the curtain as tight to the work area or shoreline as possible not to exceed one-fourth of a stream width.

### **I.2 Moving Water**

Secure both ends of a Heavy Duty Floating Silt Curtain in accordance with 3887, "Flotation Silt Curtain," to land with steel fence posts in accordance with 3403, "Hot-Rolled Steel Fence Posts," and extend the curtain at a 45 degree angle from both ends. Anchor the curtain in the waterway with at least 300 lb [136 kg] anchors at intervals no greater than 50 ft [14.2 m] along the length of the curtain. Mark each anchor with a buoy in navigable waters. Keep the curtain as tight to the work area or shoreline as possible not to exceed one-fourth of a stream width.

### **J (Blank)**

### **K Construction Exit Controls**

The following list ranks exit controls from lowest to highest protection:

- (1) Slash mulch,
- (2) Crushed,
- (3) Temporary paving,
- (4) Reinforced geotextile,
- (5) Sheet pads,
- (6) Floating road,
- (7) Timber pad,
- (8) Rumble pad, and
- (9) Wash-off.

Use construction exit control BMPs at exit locations to minimize vehicle tracking of sediment from the project onto paved surfaces. Install BMPs during the initial phase of the project.

Select construction exit BMP based on soil type, time of year, and nature of construction activity. Used materials generated by the project as construction exit controls whenever possible. Maintain exit controls during the project.

Clean paved streets at the end of each working day, or more frequently as necessary to provide safety to the traveling public.

## **L Culvert End Controls**

Provide culvert end protection consisting of the BMPs and devices for preventing sedimentation into and through underground drainage culverts. Culvert end protection applies to median drains, centerline culverts, box culverts, and entrance culverts.

Protect culvert inlet ends with sediment capture devices before soil disturbing activities that would result in sediment laden storm water runoff entering the culvert. Protect culvert outlet ends with energy dissipation devices, transition devices, or both to reduce erosion and sediment loss while reducing the velocity of water exiting culvert. Leave installed devices in place for as long as the culvert is functioning. Maintain devices until the Contract is completed.

Prevent or minimize the potential for unsafe, flooding, or siltation problems. Clean out devices regularly. Provide devices with emergency overflow features to reduce the flooding potential. Place devices in a manner that does not create driving hazards or obstructions. Remove sediment deposited in, or plugging, drainage systems at no additional cost to the Department.

## **M Storm Drain Inlet Protection**

Provide the Engineer with an inlet staging protection plan, including each BMP needed to protect all given inlets throughout the work. Implement BMPs and devices to prevent passage of sediments into and through underground drainage systems. Protect storm drain inlets, including manholes, catch basins, curb inlets, and other drop type inlets constructed for the ingress of surface water runoff into underground drainage systems.

Protect storm drain inlets with sediment capture devices before soil disturbing activities that result in sediment laden storm water runoff entering the inlet. Provide effective storm drain inlet protection until the completion of paving or stabilizing of sources with potential for discharging to an inlet.

Prevent or minimize the potential for unsafe flooding or siltation problems. Regularly clean out devices and provide devices with an emergency overflow to reduce the flooding potential. Place devices without creating driving hazards or obstructions.

## **N Flocculants**

Do not apply flocculants directly to public waters (i.e. lakes, wetlands, streams). Apply flocculants within containment areas and rigorously agitate the area. Before applying a flocculant, test the pH and temperature of the storm water. Apply

flocculant within the manufacturer's specified ranges. Allow from 15 min to 20 min retention time for the chemical reaction for clay size particles to settle, ensuring that the discharge of the treated water is visually the same as the receiving water.

### **O.1 Liquid Flocculant**

Hydraulically apply liquid flocculant over the surface of the water to be treated. Dilute the liquid flocculant concentrate to form a stock solution. Apply the stock solution at the manufacturer recommended rate to yield 1 ppm in the final treated water volume.

### **O.2 Flocculant Sock**

Securely anchor the flocculant sock in an area where the water to be treated will flow over the sock. Do not leave flocculant socks in standing, stagnant water.

### **O.3 Granular Flocculant**

Mix granular based flocculant with water in a tank to form a stock solution. Hydraulically apply the stock solution at the manufacturer's recommended rate to yield 1 ppm in the final treated water volume.

## **P Maintenance**

### **P.1 General**

Keep all devices functioning properly and maintained in accordance with the Contract or required permit. Repair or replace plugged, torn, displaced, damaged, or nonfunctioning devices within 24 h of discovery or as soon as practicable as approved by the Engineer.

### **P.2 Temporary Sediment Control Devices**

Remove sediment from devices such as bale barriers, silt fences, ditch checks, sediment control logs, and perimeter controls when the sediment reaches one-third of the height of the device and reshape the area as shown on the plans. Replace non-functional devices and devices damaged by sediment removal. Perform sediment removal within 24 h of discovery or as soon as field conditions allow access. The Department will consider the cost of sediment removal as included in the relevant contract unit price for each temporary sediment control device and will make no separate payment for this work.

### **P.3 Filter Berms**

Remove accumulated sediment or install a new berm when sediment reaches one-third of the berm height. Expand, enlarge, or augment the filter berm with additional

erosion and sediment control practices if concentrated flows bypass or breach the berm. Add filter material to maintain the dimensions of the berm.

#### **P.4 Sediment Control Log Erosion Control Blanket/Flocculant System**

Following initial application of 2 oz [57 g] of flocculant, reapply 2 oz [57 g] of flocculant after every rainfall event of at least ½ in [13 mm].

#### **P.5 Rock Weeper/Erosion Control Blanket/Flocculant System**

Remove sediment from device when it reaches one-third of the height of the system. Apply an additional 3.5 oz [100 g] of flocculant on top of blanket after every rainfall of at least ½ in [13 mm].

#### **P.6 Sediment Basins and Traps**

Drain the basin and remove the sediment when the depth of sediment collected in the basin reaches 50 percent of the height of the riser or 50 percent of the storage volume. Complete drainage and removal within 72 h of discovery or as soon as field conditions allow access. Remove sediment to the original designed or excavated grade or as necessary to restore the function of the device.

Clean out and shape temporary sedimentation basins intended for use as permanent water quality management basins as shown on the plans.

#### **P.7 Storm Drain Inlet Protection Devices**

Clean, remove sediment, or replace storm drain inlet protection devices on a routine basis to ensure the full functionality of the devices for the next rainstorm event.

#### **P.8 Culvert End Protection Devices**

Clean, remove sediment, or replace culvert end protection devices on a routine basis to ensure the full functionality of the devices for the next rainstorm event.

#### **Q Removal of Temporary Devices**

Remove temporary sediment control devices after completing the work unless otherwise required by the contract or directed by the Engineer. All removed materials become the property of the Contractor.

Spread accumulated sediment to form a suitable surface for turf establishment or dispose of the sediment. Shape the area to permit natural drainage as approved by the Engineer.

Remove the silt curtain upon completion of work. Do not allow re-suspension of sediment or loss of trash and oil into the water during the silt curtain removal.

**R Workmanship Rework Schedule**

To qualify for payment, correct unacceptable workmanship when the quality falls below the threshold level in accordance with Table 2573-1, “Temporary Sediment Control: Corrective Action” and prevent reoccurrences of unacceptable work.

<b>Table 2573-1 Temporary Sediment Control: Corrective Actions</b>	
<b>Item</b>	<b>Corrective Action Required</b>
Silt fence	Improper geotextile used
	Insufficient geotextile embedment
	Insufficient compaction of soil
	Soil turned over, loosened, or both due to inadequate equipment for sliced type
	Inadequate fastenings
	Incorrect post spacing
Bale barriers	Not notched in
	Not properly staked into the ground
Filter berms	Damaged or compacted by equipment
	Berm breached or bypassed
Floating silt curtain	Curtain not anchored on land
	Curtain not weighted sufficiently in water
Ditch checks	Sediment control logs not properly trenched, staked, or both
	Not stapled properly for blanket and sediment control log system
	Water flows around the end rather than over the middle
	Incorrect spacing of checks
Perimeter controls	No geotextile used for rock weeper system or rock checks
	Incorrect BMP for location
	Not properly J-hooked at termination points
	Not placed along contours
Storm drain inlet protection	Inlet opening unprotected.
	Emergency overflow not provided where required
	Device not cleaned out
Sediment control logs	Not staked properly resulting in undermining or movement of logs
	Log ends not overlapped when more than one is needed in a line

**2573.4 METHOD OF MEASUREMENT**

**A Bale Barriers**

The Engineer will measure the bale barriers by the length installed.

### **B Silt Fence**

The Engineer will measure silt fence along the base of the fence from outside to outside of the end posts for each section of fence.

### **C Sandbag Barriers**

The Engineer will measure sandbag barriers by surface area based on actual measurement taken along the length of the barrier times its height. If the Contractor installed more than one thickness of sandbags the Engineer will measure the surface area of each layer of thickness and add it to the quantity.

### **D Flotation Silt Curtain**

The Engineer will measure flotation silt curtain by length installed.

### **E Sediment Traps**

The Engineer will measure sediment trap quantities by volume for basin excavation and construction. The Engineer will measure excavation by volume of the material in its original position. The Engineer will measure overflow devices separately.

### **F Temporary Slope Drains**

The Engineer will measure temporary slope drains by length installed. The Engineer will measure materials used to provide an outlet separately.

### **G Sediment Removal**

The Engineer will measure sediment removal by the number of hours of actual equipment working time in accordance with 2123.4, "Equipment Rental, Method of Measurement." The Department will not adjust the contract unit price based on the consistency of the sediment removed.

### **H Sediment Control Logs**

The Engineer will measure straw, wood fiber, coir, wood chip, compost, and rock sediment control logs by the length installed.

The Engineer will measure sediment control log/erosion control blanket/flocculant systems by each unit provided.

The Engineer will measure sediment control log/silt fence system by the length installed.

## **I Rock Check**

The Engineer will measure rock checks by the volume based on field measurement.

## **J Culvert End Controls**

The Engineer will measure culvert end controls by each by measuring the number of individual culvert ends protected throughout the work regardless of the type or number of devices used at each culvert end.

## **K Storm Drain Inlet Protection**

The Engineer will measure storm drain inlet protection by the number of individual inlets protected over the life of the contract regardless of the types of number of devices used at each storm drain inlet.

## **L Flocculants**

The Engineer will measure liquid flocculant by the volume of liquid flocculant concentrate used. The Engineer will not include the water used to dilute the concentrate in the measurement for liquid flocculant.

The Engineer will measure flocculant sock by each sock provided.

The Engineer will measure granular flocculant by the weight used and placed. The Engineer will not include the water used to dissolve and dilute the granular flocculant in the measurement for granular flocculant.

## **M Filter Berm**

The Engineer will measure compost and slash mulch by the loose volume upon acceptable installation based on actual field measurement.

The Engineer will measure rock weeper system and filter berm safety fence system by the length installed.

The Engineer will measure topsoil berm by volume after compaction in its final configuration after the temporary stabilization BMPs and based on actual field measurement.

## **N Construction Exit Controls**

The Engineer will measure construction exit controls by the lump sum including the cost of protecting each exit over the life of the contract regardless of types or quantities.

## **2573.5 BASIS OF PAYMENT**

The contract unit prices for storm water management will include the cost to complete the work, maintenance, and removal as required by the contract.

### **A General**

Upon installation of temporary sediment control devices, the Department may provide partial payment of temporary sediment control devices no greater than 80 percent of the contract unit price for each relevant pay item unless otherwise required by the contract. If providing partial payment, the Department will pay the remaining percentage after the Contractor removes the devices.

### **B Storm Drain Inlet Protection**

The contract unit price for the inlet protection devices contract item includes the cost of removing and disposing of trapped sediment in inlet protection devices or sediment deposited in or plugging drainage systems protected by the devices.

#### **B.1 Partial Payments**

The Department will pay for *Storm Drain Inlet Protection* in partial payment amounts in accordance with the following:

- (1) Initial installation, 25 percent of payment,
- (2) Maintenance during first half of contract period, 25 percent of payment, and
- (3) Maintenance during last half of contract period and removal of devices, 50 percent of payment.

#### **B.2 Deductions**

The Department will deduct from monies owed to the Contractor for each improperly installed or maintained storm drain inlet protection and for each drain where the Contractor failed to remove sediments in accordance with 1512, "Unacceptable and Unauthorized Work."

### **C Culvert End Controls**

The contract unit price for the culvert protection controls contract item includes the cost of removing and disposing of trapped sediment in culvert end controls or sediment deposited in or plugging drainage systems protected by these controls.

#### **C.1 Partial Payments**

The Department will provide partial payments for culvert end controls in accordance with the following:

- (1) Initial installation, 25 percent of payment,

- (2) Maintenance during first half of contract period, 25 percent of payment, and
- (3) Maintenance during last half of contract period and removal of devices, 50 percent of payment.

## **C.2 Deductions**

The Department will deduct from monies owed to the Contractor for each improperly installed or maintained culvert end controls and for each culvert end control where the Contractor failed to remove sediments in accordance with 1512, "Unacceptable and Unauthorized Work."

## **D Silt Fence**

### **D.1 Partial Payments**

The Department will pay for *Silt Fence Type* \_\_\_\_ in accordance with the following:

- (1) Initial installation, 50 percent of payment, and
- (2) Removal of the devices 50 percent of payment.

### **D.2 Deductions**

The Department will deduct from monies owed to the Contractor for each section of silt fence not maintained at discharge points or where damaged by the public or the Contractor in accordance with 1512, "Unacceptable and Unauthorized Work."

## **E Water Treatments**

The lump sum price for *Water Treatments* includes the cost of labor, development of water treatment plan, equipment, materials, monitoring, outfall scour protection, treatment, supervision complete in-place, pumping, setting up tanks, maintenance, protection of trees, repair and replacement of damaged sections, removal of sediment deposits, and removal of erosion protection and sediment control systems after final stabilization.

## **F Construction Exit Controls**

The Department will pay by lump sum for installation, maintenance, and removal of construction exit controls upon successful completion of the project if specified in the plans.

## **G Sediment Traps**

The Department will compensate the Contractor for the cost of sediment removal and the cost of spreading, hauling, and disposing of the material within the right of way on an equipment rental hourly basis in accordance with 2123, "Equipment Rental."

## H Erosion Control Supervisor

If the contract contains a contract item for *Erosion Control Supervisor*, the Department will provide partial payment no greater than 50 percent of the contract lump sum price for *Erosion Control Supervisor* upon satisfactory completion of either half the allowable project working days or half the anticipated project duration time as approved by the Engineer. If providing partial payment, the Department will pay the remaining percentage upon performance of duties as approved by the Engineer and completion of the work.

### H.1 Deductions

The Department will deduct \$1,000 per calendar day from monies owed to the Contractor for failure to provide a certified erosion control supervisor or failure to perform erosion control supervisor duties.

## I Pay Items

The Department will pay for temporary sediment control items on the basis of the following schedule:

<b>Item No.:</b>	<b>Item:</b>	<b>Unit:</b>
2573.501	Water Treatments	lump sum
2573.501	Bale Barrier	cubic yard [cubic meter]
2573.502	Silt Fence, Type ____	linear foot [meter]
2573.504	Sandbag Barrier	square foot [square meter]
2573.505	Floatation Silt Curtain, Type ____	linear foot [meter]
2573.506	Sediment Trap Excavation	cubic yard [cubic meter]
2573.515	Filter Berm ____	linear foot [meter]
2573.516	Filter Berm ____	cubic yard [cubic meter]
2573.520	Sediment Removal, Backhoe	hours
2573.530	Storm Drain Inlet Protection	each
2573.531	Storm Drain Inlet Protection	lump sum
2573.533	Sediment Control Log ____	linear foot [meter]
2573.534	Sediment Control Log ____	each
2573.537	Rock Check	cubic yard [cubic meter]
2573.538	Rock Weeper/Erosion Control Blanket Flocculant System	each
2573.539	Stabilized Construction Exit	lump sum
2573.541	Liquid Flocculant	gallon [cubic meter]
2573.542	Flocculant Sock	each
2573.543	Granular Flocculant	pound [kilogram]
2573.550	Erosion Control Supervisor	lump sum
2573.560	Culvert End Controls	each
2573.561	Culvert End Controls	lump sum

## 2574 SOIL PREPARATION

### 2574.1 DESCRIPTION

This work consists of providing temporary shaping and grading, and preparing the soil for permanent turf establishment to reduce the risk of soil erosion. Temporary shaping and grading includes directing water flow and smooth rough grading to install temporary erosion control materials. Preparing the soil for permanent turf includes soil tilling and soil additives.

### 2574.2 MATERIALS

<b>A Lime .....</b>	<b>3879</b>
<b>B Topsoil Borrow.....</b>	<b>3877</b>
<b>C Fertilizer .....</b>	<b>3881</b>
<b>D Compost.....</b>	<b>3890</b>
<b>E Soil and Root Additives .....</b>	<b>3896</b>

### 2574.3 CONSTRUCTION REQUIREMENTS

#### A General

Prepare the soil to minimize soil erosion and to provide a media for plant and root establishment. Place topsoil to the depths as shown on the plans. Perform soil preparation operations for permanent seed and sod and for temporary conditions.

#### A.1 Smooth Rough Grading

Perform smooth rough grading when installing temporary erosion control materials in locations where the final topsoil grade has not been established or during the topsoil placement before soil bed preparation operations. Smooth rough grading removes clods of soil greater than 3 in [75 mm] in diameter and ruts, erosion rills, or washouts deeper than 3 in [75 mm]. Remove rocks and other debris larger than 3 in [75 mm] during this operation.

#### A.2 Soil Tracking

After establishing final grade with topsoil placement and before turf establishment, perform soil tracking on slopes 1:2 (V:H) and steeper. Perform soil tracking to reduce runoff velocity, to increase infiltration, and to reduce erosion. To perform soil tracking, create horizontal grooves on an exposed slope using a

stair-stepping procedure or run tracked construction equipment up and down the slope to roughen the surface and to increase the relief of a bare soil surface. Perform the stair-stepping procedure parallel to the contour of the land.

### **A.3 Soil Bed Preparation**

Immediately before sowing the seed or placing sod, prepare the soil surface to provide a smooth, moist, and evenly textured foundation. Complete the tilling after applying soil amendments to the soil. Use cultivating equipment such as disks, harrows, field diggers, or tillers capable of loosening the soil to a depth of at least 3 in [75 mm] on all areas except for slopes steeper than 1:2 (V:H). Till the soil surface to remove track imprints from wheeled or tracked equipment. Operate cultivating equipment on slopes at right angles to the direction of surface drainage. Soil clods, lumps, and tillage ridges 3 in [75 mm] high may remain in place for seeding operations. Soil clods, lumps and tillage ridges 1.5 inch (40 mm) high may remain in place for sodding operations. Multiple passes of the equipment may be needed to meet these requirements.

### **A.4 Subsoiling**

Perform subsoiling after placing the topsoil to reduce soil compaction in the following areas:

- (1) Where the subsoil has been compacted by equipment operations,
- (2) Staging areas,
- (3) Where the plans show turf establishment, and
- (4) Infiltration areas.

Perform subsoiling in one direction on the contours perpendicular to the flow of water. Use a multi-shanked, parallelogram implement to create channels. Do not use disc cultivators, chisel plows, or spring-loaded equipment to perform subsoiling. Space the grid channels from 12 in to 36 in [300 mm to 910 mm] apart except as shown on the plans. Create channels at least 20 in [500 mm] deep or as shown on the plans. For saturated soil, delay subsoiling operations until soil dries to at least field capacity.

Observe a minimum setback as directed by the Engineer for the following subsoiling exceptions:

- (1) Slopes steeper than 1:3 (V:H),
- (2) Areas within the dripline of existing trees,
- (3) Over utilities within 30 in [750 mm] of the surface,
- (4) Where trenching or drainage lines are installed,
- (5) Where compaction is required by design (abutments, footings, or inslopes),  
and

(6) Inaccessible slopes.

## **B Infiltration, Filtration, and Bioretention Areas**

Construct sites after stabilizing contributing drainage areas. Stabilize areas draining to infiltration sites. Prevent sediment laden runoff from entering infiltration site during construction. Use light tracked equipment to excavate, grade, shape, and place soil loosely as shown on the plans. Minimize tracking and compacting over the infiltration areas. Place excavated material to prevent the material from re-entering the basin during the work. Subsoil infiltration basins before placing topsoil borrow type A or B in accordance with 3877, "Topsoil Borrow."

## **C Topsoil**

Stockpile existing topsoil on the project site or at a suitable location approved by the Engineer. Test stockpiled topsoil in accordance with the testing procedures for soil fertility in 3877, "Topsoil Borrow." Complete the testing at least 1 month before placement. Use these test results to determine pH adjustments and fertilizer, soil additives, and compost needs for plant establishment. The Engineer will determine adjustments to the existing topsoil for plant establishment based on the test results.

Obtain the Engineer's approval for topsoil borrow sources. Before blending individual components to create topsoil borrow material, verify that each component meets the specification requirements. If shown on the plans, screen and pulverize topsoil borrow material. Test topsoil borrow material in accordance with the testing procedures for soil fertility in 3877, "Topsoil Borrow." Complete the testing before delivery and placement. Use these test results to determine pH adjustments and fertilizer, conditioner, and compost needs for plant establishment.

## **D Applying Soil Amendments**

Do not place commercial fertilizer, liming material, and soil additives on frozen ground or snow. Apply fertilizers and conditions after cessation of the runoff from spring snowmelt.

Use mechanical spreading devices to uniformly apply fertilizers, compost, liming materials, and additives at the rates required by the contract before placing seed or sod. Till the soil at least once within 24 hours of placing fertilizer, compost, lime, or additives. Perform seeding no later than 48 hours after fertilizing.

The Department based the lime application rates on 1,000 lb Effective Neutralizing Power (ENP) per ton [500 kg ENP per tonne] of agricultural liming material. Adjust the actual lime application rate to meet the above rate.

The Contractor may use Grade 1 compost instead of commercial fertilizer, as approved by the Engineer. Apply the compost at an equivalent nutrient application rate to the rate for commercial fertilizer shown on the plans.

**E Acceptance of Work**

Notify the Engineer at least 24 h before beginning and changing soil preparation operations. Till and mix soil amendments into the soil before seeding operations. The Engineer will reject soil preparation not verified by inspection as unauthorized work in accordance with 1512, "Unacceptable and Unauthorized Work."

The Engineer will accept an infiltration, filtration, or bioretention area after a double ring infiltrometer test (ASTM D3385) demonstrates an acceptable percolation rate in accordance with 3877, "Topsoil Borrow."

**F Workmanship Rework Schedule**

The Engineer may require corrective action for the conditions indicated in Table 2574-1 for the work to qualify for payment.

<b>Table 2574-1 Required Corrective Action</b>		
<b>Item</b>	<b>Corrective Action Required if</b>	<b>Corrective Action</b>
Fertilizer and lime	Incorrect rate of application	Reapply at adjusted rate to meet require rate.
	Not uniform placement	Reapply on areas missed.
	Not incorporated properly	Re-till the soil.
Compost	Incorrect rate of application	Reapply at adjusted rate to meet require rate.
	Not uniform placement	Reapply on areas missed.
	Rutting of slopes with equipment	Re-till the soil.
Topsoil and topsoil borrow materials	Inadequate soil loosening or preparation	Re-till the soil.

Correct the quality of work for soil placement necessary for approval by the Engineer at no additional cost to the Department. Dispose of nonconforming materials in accordance with 1608, Unacceptable Materials."

#### **2574.4 METHOD OF MEASUREMENT**

##### **A Fertilizer**

The Engineer will measure fertilizer by the weight of each type applied. If the Contractor provides fertilizer with different type than as shown on the plans, the Engineer will adjust the application rate of the fertilizer provided to meet the equivalent type proportions of the fertilizer shown on the plans.

##### **B Lime**

The Engineer will measure agricultural lime by weight applied.

##### **C Soil and Root Additives**

The Engineer will measure soil and root additives by the weight or volume applied.

##### **D Compost**

The Engineer will measure Grade 1 compost by weight applied.

The Engineer will measure Grade 2 compost by loose volume.

##### **E Topsoil Borrow**

The Engineer will measure topsoil borrow material by volume and as loose volume as required by the contract.

##### **F Subsoiling**

The Engineer will measure subsoiling by area.

##### **G Soil Tracking**

The Engineer will measure soil tracking by area.

##### **H Soil Bed Preparation**

The Engineer will measure soil bed preparation by area.

#### **2574.5 BASIS OF PAYMENT**

For items of work not included in the schedule of contract pay items, the Department will pay unit prices as shown in the special provisions for the relevant items of work.

The Department will pay for soil preparation on the basis of the following schedule:

<b>Item No.:</b>	<b>Item:</b>	<b>Unit:</b>
2574.508	Fertilizer, Type ____	pound [kilogram]
2574.510	Iron Sulfate	pound [kilogram]
2574.511	Iron Sulfate	ton [metric ton]
2574.512	Activated Charcoal	pound [kilogram]
2574.513	Activated Charcoal	ton [metric ton]
2574.514	Plant Hormones	gallon [liter]
2574.515	Hydrophilic Polymers	pound [kilogram]
2574.516	Mycorrhizal Inoculum	pound [kilogram]
2574.550	Compost, Grade 2 and Grade 3	cubic yard [cubic meter]
2574.551	Compost, Grade 1	ton [metric ton]
2574.575	Subsoiling	acre [hectare]
2574.525	Topsoil Borrow	cubic yard [cubic meter]
2574.576	Lime	pound [kilogram]
2574.578	Soil Bed Preparation	acre [hectare]

## **2575 ESTABLISHING TURF AND CONTROLLING EROSION**

### **2575.1 DESCRIPTION**

This work consists of applying temporary soil covers and establishing a perennial ground cover to reduce the risk of soil erosion.

Temporary soil covers include mulch, establishment of an annual vegetative cover, erosion control blanket and hydraulic soil stabilizers. Establishment of a perennial vegetative cover includes seeding, sodding, mulching, and any other specified work.

### **2575.2 MATERIALS**

**A Seed ..... 3876**

<b>B (Blank)</b>	
<b>C Sod.....</b>	<b>3878</b>
<b>D (Blank)</b>	
<b>E (Blank)</b>	
<b>F Mulch .....</b>	<b>3882</b>
<b>G Rolled Erosion Control Products .....</b>	<b>3885</b>
<b>H (Blank)</b>	
<b>I Hydraulic Erosion Control Products .....</b>	<b>3884</b>

### **2575.3 CONSTRUCTION REQUIREMENTS**

#### **A General**

Minimize soil erosion and prevent damage from sedimentation by using the Best Management Practices (BMP) to cover bare soils in temporary and permanent conditions. Use temporary erosion control BMP's, including limiting the amount of exposed erodible soils and providing for proper exposed soil stabilization for slopes, ditches, storm drain and culvert outlets, and storm water discharge points from erosion. Use permanent erosion control BMP's to provide the final stabilization of exposed slopes. Properly prepare soils in accordance to 2574, "Soil Preparation."

#### **A.1 Erodible Surface**

Erodible surface potential starts when construction activities disturb the natural vegetation or topsoil. Erodible surface potential ends at completion of finishing and turf establishment. In order to expedite this process the Department will withhold [\$3000 per acre{\$4200 per ha] from the Contractor for areas open to erosion The Engineer will determine the areas open to erosion before approving each partial payment. Areas open to erosion will not include the roadway embankment area.

#### **A.2 Exposed Soil Stabilization**

Use rapid stabilization methods to temporarily stabilize disturbed areas within 200 ft [61 m] of surface water and in Areas of Environmental Sensitivity (AES).s. Use temporary seed mixtures and/or mulch or hydraulic erosion control products to stabilize other disturbed areas. Schedule, construct, or install stabilization measures on exposed soil areas as shown on the plans or as required by the permit.

#### **A.3 Growing Seasons**

Schedule and install temporary and permanent seed or sod in areas at the optimum growing time for proper turf establishment

**A.3.a Seeding Dates**

Plant seed mixtures during the seasons of planting for the various seed mixtures in accordance with Table 2575-:

<b>Table 2575-1 Season of Planting</b>		
<b>Seed Mixture Number</b>	<b>Spring</b>	<b>Fall</b>
21-112	—	Aug. 1 – Oct. 1
21-111	May 1 – Aug. 1	—
22-111, 22-112*	April 1 – July 20.	July 20 – Oct. 20
25-121, 25-131, 25-141, 25-151*	April 1 – June 1	July 20 – Sept. 20
25-142*	April 1 – Sept. 1	—
Any mix beginning with a 3	April 15 – July 20	Sept. 20 – Oct. 20
* For the portion of Minnesota north of, and including TH 2, plant seed mixtures 22-111 to 25-142 from April 15 to September 20.		

Adjustments to growing dates may be modified by no more than 10 calendar days by the Engineer based on weather conditions. Provide temporary stabilization when outside the season of planting dates of the specified permanent seed mixture.

**A.3b Sodding dates**

Sod growing days are any calendar day exclusive of the days from November 1 to April 15. These dates may be adjusted if requested in writing and approved by the Engineer by no more than 15 calendar days, to shorten the excluded periods when conditions are favorable to active growth, or to lengthen the excluded period when conditions for establishment are unfavorable.

Sodding from June 10 to August 10 will require more frequent watering.

**A.4 Winter Season**

During the winter season, perform erosion control operations to protect the site through the end of the spring snowmelt season. Such practices include dormant seeding and sodding, snow seeding and mulching, and frozen ground mulching. Both dormant seeding and sodding are performed during the early winter season. Early winter season is the period when soil temperatures will not allow seeds to germinate and when normal plant rooting will not occur.

## B Placing Seed

Store the seed from time of purchase until installation at 50° F (10 °C) and 50 percent humidity. Protect the seed from moisture until sowing. Do not use wet or moldy seed.

Sow the seed uniformly at the adjusted bulk rate of application for each mixture. Adjust the bulk seeding rate needed to achieve the required PLS rate for the mixture in accordance with 3876, "Seed" and the following formulas:

$$(1) \text{ Bulk Application, lb [kg]} = \frac{PLS, lb[kg]}{\% PLS}$$

$$(2) \% PLS = \% \text{ germination} \times \% \text{ purity}$$

Immediately after seeding cultipack the seedbed to provide seed to soil contact. Do not broadcast seed with wind velocities greater than 15 mph [25 km/h].

### B.1 Temporary Seeding

Perform temporary seeding on graded areas with topsoil and unable to receive permanent seeding or slopes and topsoil berms left idle for longer than 1 month. Use cover crop and mid-term stabilization seed mixtures as shown in 3876, "Seed", Table 3876-1 for temporary seeding.

Prepare the soil in accordance with 2574.3.A and 2574.3.B, except for stockpile and berms where no soil preparation is needed.

### B.2 Seeding Turf Mixes

Mechanically sow or hydraulically apply seed mixture numbers from 21-111 to 25-151 adjusted bulk application rate of each mixture Only use hand operated mechanical spreaders on areas too small for or inaccessible by the specified equipment.

If using an agricultural type seed drill, operate the drill in a general direction at right angles to the direction of surface drainage and sow the seed shall to a depth no greater than  $\frac{3}{8}$  in [10 mm]. Sow small seed species, including timothy, alfalfa, white clover, and red clover, through the grass seed attachment separate from other seeds.

### B.3 Seeding Native Mixes

Seed native mixes (any mix beginning with a number 3) with a native seed drill, a drop type seeder, or a hydro seeder at the adjusted bulk application rate of each mixture. Use a drill capable of accurately metering the types of seed planted and capable of maintaining a uniform mixture of seeds during drilling. Use a drill with disk furrow openers and a packer assembly to compact the soil directly over the drill

row Seed native mixes in rows spaced no greater than 8 in [200 mm] apart. Place seeds to a final planting depth from  $\frac{1}{8}$  in [3 mm] to  $\frac{3}{8}$  in [10 mm]. Perform drill seeding at a right angle to surface drainage. A drop type seeder equipped with a separate seed box for the fluffy seed and a soil packer assembly may be used in lieu of a drill with disc openers Use a cyclone or spinner type seeder on areas no greater than 1 acre [0.4 ha] or on areas inaccessible to other equipment, as approved by the Engineer.

#### **B.4 Hydroseeding**

Use a hydroseeder capable of continuous agitation action to uniformly distribute the seed over the area. Add a 50 lb [22.5 kg] 3884.2.C, "Type Hydraulic Mulch", as a tracer for each 500 gal [1.9 cu. m] of water in the hydroseeder tank. Use flood type nozzles and Manufactures' recommended water volume. Once the seed has been added to the tank mixture a one hour time limit is set for spreading the mixture on the soil. Once the one hour is passed the excess mixture must be discarded. Do not hydroseed with wind velocities greater than 15 mph [25 km/h].

#### **B.5 Interseeding**

Perform interseeding if seeding into temporarily mulched areas or if drilling additional seed into previously seeded areas. Use an interseeding drill containing trash rippers and at least one box fine seed and at least one box for larger seeds or fluffy seeds. Operate the drill to slice through the vegetative mat and make a furrow 1 in [25 mm] wide and from  $\frac{3}{8}$  in [10 mm] to 1 in [25 mm] deep in the underlying soil. Place seeds in the furrows through the drill seed disk openings. Drop the seed onto the ground surface from the fine seed box. Place the large or fluffy seed to a final planting depth from  $\frac{1}{4}$  in [6 mm] to  $\frac{3}{8}$  in [10 mm].

#### **B.6 Permanent Seeding into Temporarily Mulched/Blanketed Areas**

Permanently seed areas previously temporarily mulched. Without performing additional tillage or site prep work, the Contractor may use an interseeding drill to drill seed directly into temporarily mulched or temporarily seeded areas. In lieu of using an interseeding drill, the Contractor may lightly disc the mulched areas before seeding. Apply fertilizer within 24 h before interseeding or light disking. Leave the existing cover in place as serve as mulch.

Permanently seed into areas temporary blanketed using the hydroseeding application as mentioned above. Hydroseed into the installed blanket with the nozzle 6 feet [2m] from blanket, forcing the seed and water through the blanket.

#### **B.7 Winter Seeding**

Dormant seed after October 20 and when soil temperatures 1 in [25 mm] below surface are no greater than 40 °F [4 °C].

Perform snow seeding over the top of snow allowing the seed to melt through the snow to the soil and germinate upon warm up in the spring.

### **C Applying Mulch**

Mechanically spread mulch to provide a uniform distribution over all exposed soil at the application rate to provide 90 percent uniform soil coverage. If non-uniform distribution occurs, re-mulch areas or remove the excess coverage.

Do not operate mulch-blowing equipment on slopes steeper than 1:2.5 (V:H) or on slopes that will rut the soil surface. Use blower attachments to apply the mulch without traversing the slopes. Do not mulch with wind velocities greater than 15 mph [25 km/h].

Areas within 10 ft [3 m] of the shoulder immediately mulch, and anchor the mulch in a continuous operation after seeding. If traffic or wind dislodges the seed or mulch due to delays in the continuous operation, reseed and remulch the affected areas.

Areas outside 10 ft [3 m] of the shoulder shall be mulched within 24 hr after seeding.

#### **C.1 Temporary Mulching**

Perform temporary mulching on contiguous areas of 2.0 acres [0.8 Ha] and greater to protect the site during non-seeding periods from erosion. If the requirements of 2575.3.M, "Rapid Stabilization" do not apply, perform temporary mulching in accordance with this section.

#### **C.2 Type 1, Type 3, Type 7, and Type 8 Mulch**

Use blower equipment to place Type 1, Type 3, Type 7, and Type 8 mulch at a target application rate of 2 ton per acre [4.5 tonne per ha]. Apply the mulch at an actual rate as directed by the Engineer to match varying material or project conditions. Apply the mulch to ensure visibility of 10 percent of the soil surface through the mulched areas.

#### **C.3 Type 5 Mulch**

Apply Type 5 mulch at a rate of 80 cu. yd per acre [150 cu. m per ha] as specified in the plans as an erosion control material.

#### **c.4 Type 6 Mulch**

Apply Type 6 mulch at the rate shown on the plans or special provisions.

### **c.5 Type 9 Mulch**

Apply Type 9 mulch at a rate required by the contract. Before placing mulch, uniformly compact and smooth the foundation, cover the foundation with 6 mil [150 µm] plastic sheeting, and uniformly spread the aggregate mulch to the thickness shown on the plans without harming the foundation. Level the finished aggregate surface flush with adjacent areas.

### **C.6 Winter Mulching**

Perform frozen ground mulching on bare frozen soils. Place 3882, Type 5, Type 6, and Type 9 mulch materials with no modifications to meet the requirements of frozen ground mulching. Place 3882, Type 1, Type 3, Type 7, or Type 8 mulch materials with the following modifications to meet frozen ground mulching:

At temperatures above 20 °F ( -6 °C) use 3884, Type Natural Tackifier, in lieu of disc anchoring

At temperatures below 20 °F ( -6 °C) delay mulching until ground is snow covered and perform snow mulching.

Perform snow mulching at any time over the top of snow. No disc anchoring is required. Apply Snow mulching prior to or during a snowfall event.

### **D Disk Anchoring**

Anchor Type 1, Type 3, Type 7, and Type 8 mulches with a disk anchoring tool as required by the contract immediately after placement unless otherwise approved by the Engineer.

Punch the mulch into the soil to a depth from 2 in [50 mm] to 3 in [75 mm]. Space the blades and discs on the anchoring tool no greater than 8 in [200 mm] apart .Use Hydraulic Erosion Control Products to anchor the mulch in lieu of disc anchoring, in areas inaccessible by disc equipment.

### **E Hydraulic Erosion Control Products**

#### **E.1 Type Tackifier**

Use natural tackifiers alone, as an additive to other soil stabilizers, or as an overspray on mulched areas.

##### **G.1.a Type Natural Tackifier**

Use the manufacturer's recommended rate of application and mix ratios based on use, site conditions, and time of year. Allow from 9 to 12 hours of dry time before subject to rain. Uniformly distribute the tackifier over the target area.

### **E.1.b Type Synthetic Tackifier**

Dilute synthetic tackifier at a rate of 10 parts water to 1 part polymer and apply to the soil at a rate of 1,200 gal per acre [220 kg per ha].

### **E.1.c Type Polyacrylamide (PAM)**

Do not use polyacrylamide (PAM) on pure sand or gravel without fine silts or clays. Do not apply PAM over snow cover or to slopes that flow directly into a wetland or state waters. Apply PAM as recommended by the manufacturer.

Provide certification of the following:

- (1) Percent of pure PAM present by weight,
- (2) Percent activity,
- (3) Average molecular weight, and
- (4) Charge density of the PAM.

Provide a material safety data sheet for prepackaged PAM. The Contractor may include PAM as a part of a polymer stabilized fiber matrix. Apply PAM in its pure form on slopes and channels at a rate no greater than 200 lb per acre [224 kg per ha], and no later than 4 hours prior to rain.

## **E.2 Type Hydraulic Compost Matrix**

Apply hydraulic compost matrix with hydraulic spray equipment in a water-slurry mixture. The tank must have jet or mechanical agitation for mixing. The dry material application rate is 3,000 lb per acre [3,363 kg per ha]. Use the water to bale ratio as recommended by the manufacturer

## **E.3 Type Hydraulic Mulch**

Apply hydraulic mulch with hydraulic spray equipment in a water-slurry at the rate of 2,100 lb per acre [2,353 kg per ha]. Use the water to bale ratio as recommended by the manufacturer. Increase the application rate and percent tackifier to roughened soils for complete coverage. The Engineer may inspect the tank loading and spray application, to verify that the applied materials meet the manufacturers recommendations and the soil is 100 percent covered.

## **E.4 Type Stabilized Fiber Matrix**

Do not field mix additives or components for stabilized fiber matrix, as this mulch is a pre-manufactured matrix. Provide stabilized fiber matrix at the manufactures recommended application rate and no later than 48 hours prior to rain

## **E.5 Type Bonded Fiber Matrix (BFM)**

Apply BFM with hydraulic spray equipment by a manufacturer's certified applicator. Perform seeding as a separate operation before applying the BFM. The Contractor may apply seed and BFM in a single operation in small or inaccessible areas as approved by the Engineer. Apply BFM at a rate from 3,000 lb per acre to 4,200 lb per acre [3,300 kg per ha to 4,620 kg per ha] based on site characteristics as shown on the plans. Use the water to bale ratio recommended by the manufacturer. Apply the BFM from at least two opposing directions and obtain continuous ground coverage. If applying BFM at rates of at least 3,500 lb per acre [3,850 kg per ha], apply the BFM in two stages using one half of the material in each stage. Allow the first stage application to dewater before applying the second stage. Do not use BFM in water bearing soils or by itself in ditch bottoms carrying concentrated flows.

### **E.6 Type Fiber Reinforced Matrix (FRM)**

Apply FRM with hydraulic spray equipment by a manufacturer's certified applicator. Perform seeding as a separate operation before applying the FRM. Apply at a rate of 3,900 lb per acre [4372 kg/ha] based on site characteristics as shown on the plans. Use the water to bale ratio recommended by the manufacturer.

## **F Placing Sod**

Before delivering sod to the work site, prepare the soil in accordance with 2574.3.A, "Soil Preparation, Construction Requirements, General," to avoid delays in placing the sod. Place sod as shown on the plans and in accordance with this section.

Use straw or hydromulch to stabilize exposed areas shown on the plan until installation of sod is within the specified growing dates.

Reseed or remulch damaged areas adjacent to the sod within 5 working days after completing the sod placement and rolling or tamping operations.

### **F.1 Slopes**

Place sod strips starting at the bottom of the slope and progressing upward with long edges parallel to the contour. Stagger joints alternately without space between. Secure the sod to the slope with wire staples or another anchor system approved by the Engineer as per Table 3885-5 spaced no greater than 2 ft [0.61 m] apart. At the tops of slopes steeper than 1:4 (V:H), trench the sod 3 in [75 mm] into the topsoil.

Use shingling along the sides of the strips of sod to place sod on slopes steeper than 1:2 (V:H) and overlap the upper piece by at least 3 in [75 mm]. Use wire staples to secure sod on the slope at 16 in [406 mm] intervals. Shingle the sod so water will flow over the sod from one roll of sod to the next. Trench 3 in [75 mm] of sod into the topsoil on the uppermost strip of sod.

## **F.2 Ditches**

In ditch bottoms and other areas with expected concentrated water flow, place the sod parallel to the direction of water flow in the main channel. Shingle sod overlapping the ends by at least 4 in [100 mm] and the edges by at least 3 inches [75 mm]. Trench 3 in [75 mm] of sod into the topsoil on the uppermost strip of sod on side-slopes steeper than 1:4 (V:H).

In ditch bottoms with high flow velocities, overlay shingled sod with jute, a biodegradable netting, or chain link fence. Use stakes or staples to secure the jute, netting, or fence to the sod. The jute, biodegradable netting, or the chain link fence will not require removal after maintenance period.

## **F.3 Winter Sodding**

Perform dormant sodding, on slopes, in ditches, and at least **10 ft [3 m]** from the shoulder between November 1 and soil freeze-up meeting the following conditions:

- (1) The Engineer authorizes dormant sodding,
- (2) Provide Soil Preparation for sod,
- (3) Stake or staple the sod on slopes and in ditches,
- (4) Water the sod to saturation immediately after placement, and
- (5) Water the sod a second time unless the sod receives 1 in [25 mm] of rain or 6 inches [150 mm] of snow from 7 calendar days to 10 calendar days after placement.

Do not dormant sod in areas shown with Salt Tolerant Sod (3878) or within 10 ft [3 m] from the shoulder, including areas next to boulevards and areas receiving salt encrusted snow and ice from winter deicing operations. Temporary stabilize these areas with mulch or Erosion Control Blanket.

## **G Placing Rolled Erosion Control Products**

### **G.1 Erosion Control Netting**

If placing netting in ditch bottoms, flumes, and other areas with expected concentrated water flows, roll out the netting flat and parallel to the direction of water flow. If placing netting on slopes, roll out netting flat and parallel or perpendicular to the direction of water flow. Shingle and overlap the edges of adjacent strips perpendicular to direction of water flow from 2 in [50 mm] to 4 in [100 mm]

Drive wire staples vertically into the soil to secure the netting. Do not stretch the netting before stapling. Place staples 3 ft [1 m] apart along the ends and edges of each strip. Place additional rows of staples 3 ft [1 m] apart and parallel to the edge row of staples to prevent the distance between adjacent rows from exceeding 3 ft [1 m].

Within the rows, place staples 3 ft [1 m] apart. Create a sawtooth pattern with the placement of staples in adjacent rows.

## G.2 Erosion Control Blankets

Place the blankets within 24 h after sowing of the seed on that area. Roll out or lay the blankets with netting on top. If using blankets with netting on two sides, place the side of the blanket with the majority of thread stitching on the bottom. Roll out blankets flat and parallel or perpendicular to the direction of water flow. Evenly spread the blankets without stretching, allowing the fibers to come in direct contact with the soil over the entire area. Shingle and overlap the edges parallel to water flow by at least 4 in [102 mm]. Shingle and overlap the edges perpendicular to water flow by at least 7 in [178 mm]. Staple overlaps on slopes at 1½ ft [0.5 m] intervals, see Table 3885-5.

At the tops of slopes and at the beginning of each blanket in ditch bottoms, bury the upgrade end of the blanket in a check slot 6 in [150 mm] deep. Insert the blanket end to the full depth of the check slot. Backfill and compact the check slot. For slopes longer than 100 ft [30 m], dig a second check slot perpendicular to the slope gradient one-third of the slope length measured from the bottom of the slope. Place the blanket to the full depth of the check slot. Backfill, and compact the check slot. Staple blankets with the number of staples in accordance with Table 2575-2:

<b>Table 2575-2 Stapling of Blankets</b>	
<b>Slope (V:H)</b>	<b>Minimum Number of Staples per <i>sq. yd [sq. m]</i></b>
Flatter than 1:2	1.2 [1.0]
1:2 – 1:1	1.7 [1.4]
Channel or ditch applications	3.5 [2.9]

## G.3 Placing Turf Reinforcement Mats

Shape and prepare the site by in accordance to 2574 Provide turf reinforcement mat meeting the requirements of the class as shown on the plans. Soil fill turf reinforcement mats.

Install the mat, half the seed, fertilize, place topsoil, and place the Type 3 erosion control blanket in one continuous operation. Roll out or lay the mat parallel to the direction of water flow. Evenly spread the mat without stretching, allowing the fibers to come in direct contact with the soil over the entire area. Bury and staple the beginning edge of each mat in a check slot 6 in [150 mm] wide by 6 in [150 mm] deep. Overlap adjacent strip edges by at least 4 in [102 mm]. Staple the mat at a uniform density of 3.5 staples per sq. yd [2.9 staples per sq. m].

Directly seed and fertilize with the amounts as shown on the plans. Soil fill with 3877.2.B, "Type B Topsoil Borrow" or as an alternative 3890.2.B, "Grade 2 Compost", to a depth from ½ in [12 mm] to 1 in [25 mm]. If equipment must operate on the mat use only rubber tired type. No tracked equipment or sharp turns are allowed on the mat. Smooth out soil to just expose the top netting of the matrix. Provide 3885, type 3erosion control blanket and install in accordance with 2575.3.G.2, "Erosion Control Blankets" on top of the seeded topsoil to prevent erosion

#### **G.4 Winter Blankets**

Install 3885, erosion control blankets over frozen ground and use the appropriate anchors in as shown in Table 3885-5.

#### **H Shoulder Mulch Overspray**

Perform shoulder mulch overspray by spraying 3884, Tackifier over seeded and mulched areas on a strip 3 feet [0.9 m] wide immediately abutting a gravel or paved shoulder as shown on the plans. During placement, perform the following:

- (1) Seed,
- (2) cultipack the seedbed,
- (3) Place Type 1 mulch,
- (4) Immediately disk anchor the mulch as required by the contract, and
- (5) Uniformly overspray with Type natural Tackifier as a continuous operation.

Use a distributor spray bar to spray the 3884.2.A, "Tackifiers", at an application rate of 200 lbs per acre [225 kg/ha] that provides 90 percent ground coverage.

#### **I Compost Blanket**

Uniformly apply a 2 in [51 mm] deep layer of 3890.2.B, "Grade 2 Compost". as a, compost blanket over the soil after preparing the soil in accordance with 2574. Distribute the compost by hand with a shovel, spreader unit, or pneumatic blower. Incorporate seed into the compost or broadcast the seed over the top after uniformly spreading the compost. When placing compost blanket adjacent other erosion control products or existing vegetation provide an overlap of at least 2 ft [60 cm]. When placing compost blanket on a 1:2 (V:H) slope, place and anchor open weave textile netting over the top.

#### **J Weed Control**

Control and prevent the spreading of state listed Prohibited Noxious Weed (PNW) and/ or invasive weeds as per contract or as directed by the Engineer. The current state listed PNW species is determined by the Minnesota Department of Agriculture. Identify, mark, map, and monitor weed infestation areas and apply treatments at the appropriate time in order to prevent seed production and spreading.

Minimize the spread of weed seed and other propagules from designated infested areas by minimizing disturbance and by cleaning vehicles and equipment. Cleaning shall remove soil and vegetation debris from vehicles and equipment before moving out of infested areas or moving into project limits. Stockpile of PNW infested soils shall be separate from non-infested stockpiles.

## **K Maintenance**

### **K.1 Sod**

Sod maintenance period is 45 calendar days. Water within ½ hour after sod is laid on soil. Provide 1 inch (2.5 cm) of water so that soil beneath sod is wet and soil 3 inches (10 cm) below surface is moist. Apply water at a rate that prevents runoff should occur. Supply water to sod daily for the first 10 calendar days at a rate to keep soil surface below sod moist. For the remainder of the 45 calendar days, water sod as needed to provide 1 inch (2.5 cm) per week. The 45 calendar day maintenance period stops at freeze up and resumes April 15<sup>th</sup>.

During the maintenance period, replace sod dried, dead, damaged, displaced, or weakened or sod infected with over 50 percent weeds. Maintain areas replaced with new sod for at least 20 calendar days after replacement.

After maintenance period has ended and as directed by the Engineer apply additional water to supplement rainfall not to exceed 1 inch (2.5 cm) per week until November 1.

### **K.2 Rolled Erosion Control Products**

Maintain the erosion control blanket installation for 45 calendar days if required by the contract or if substituting erosion control blankets and seed for sod, as approved by the Engineer. Maintain turf reinforcement mats for 45 calendar days. Water the blankets and mat systems immediately after placement at a rate of at least 3,000 gal per acre [28 cu. m per ha]. Control erosion and establish a permanent vegetative cover as approved by the Engineer until contract acceptance. Restore areas with seeding failure or erosion during the maintenance period at no additional cost to the Department.

### **K.3 Seed**

Repair damage within the area caused by Contractor operations and within the Contractor's control at no expense to the Department. Reseed areas where the original seed has failed to grow, as directed by the Engineer.

### **K.4 Mulch**

Remulch areas where the original mulch has eroded, washed away, or blown off, and reseed areas where the original seed has failed to grow, as directed by the Engineer. Use the seed mixture shown on the plans or other seed mixture approved by the Engineer to perform reseeding.

### **K.5 Mowing and Weed Spraying**

Perform the work required to control the Department of Agriculture State listed Prohibited Noxious Weeds, either on the areas seeded or sodded under the Contract or as directed by the Engineer. The weed spray mixture to be furnished and used shall be as required for that weed control. All work and weed control material must be approved by the Engineer prior to the start. The equipment used shall not be so heavy that it causes soil slips or ruts on the slopes or in the ditches. Perform the work at such time and in such a manner that will avoid spray drift outside the areas designated for spraying

### **L Turf Establishment**

Turf Establishment by a lump sum is for establishing permanent vegetation on small areas of 2 ½ acres [1 ha] or less per Contract. Such work shall include; soil bed preparation; fertilizer; sod or mulch, blanket, and seed.

Unless otherwise shown on the plans, establish vegetative cover by sodding or by seeding and mulching. Fertilize the areas with a Type 3, slow release fertilizer in accordance with 3881.2.B3 at a rate derived from a topsoil fertility test. If seeding, provide and place seed Mixture 25 141 as specified in 3876, "Seed", and provide 3882, Type 3 mulch with disc anchoring or Category 3 Erosion Control Blanket on slopes 1;3 and steeper. The Engineer will accept the areas after the seed germinates and establishes a70 percent vegetative cover. If the seeding fails to germinate, correct and reseed failed areas to establish turf. If using sod, place and maintain sod in accordance with 2575.3 F and K. The Engineer will accept sod in accordance with 2575.3N

### **M Rapid Stabilization**

Work consists of operations necessary to rapidly stabilize small contiguous exposed areas, each less than 2 acres, temporarily to prevent off site sedimentation in AES and near resource waters and keep in conformance to MPCA construction stormwater permits. Perform rapid stabilization at any time when work is stopped temporarily and there is a risk that sediment will enter the resource waters due to stormwater runoff. Provide the materials for the methods of rapid stabilization in accordance with Table 2575-3:

<p style="text-align: center;"><b>Table 2575-3</b> <b>Rapid Stabilization</b></p>
---

Method	Materials
1	Type 3 mulch placed at a rate of 2 ton per acre [4.5 tonne per ha] with disc anchoring
2	Type 3 mulch placed at a rate of 1.5 ton per acre [3.4 tonne per ha]. 3884, Type Hydraulic Mulch, placed at a rate of 750 lb/acre [840 kg/ha].
3	3884, Type Hydraulic Mulch, placed at a rate of 750 lb/acre [840 kg/ha]. Seed mixture 22-111 placed at a rate of 10 lb per 1,000 gal [4.5 kg per 3.8 cu. m] of slurry mix Type 3 Slow Release Fertilizer 10-10-10 placed at a rate of 50 lb per 100 gal [ 22.7 kg per 3.8 cu. m] of slurry mix. Water placed at a rate of 875 gal per 1,000 gal [3.3 cu. m per 3.8 cu. m] of slurry mix. Apply mixture at a rate of 6 000 gal per acre [56 cu. m per ha]
4	Category 3 erosion control blanket. Seed mixture 22-111 placed at a rate of 2 lb per 100 sq. yd [1.1 kg per 100 cu. m]. Type 3 Slow Release Fertilizer 10-10-10 placed at a rate of 8 lb per 100 sq. yd [4.3 kg per 100 cu. m].
5	Rip Rap Class II Geotextile Type III

## M.1 Placement

### M.1.a Method 1

Use Method 1 to place mulch on a coverage area from ½ acre to 2 acre [0.2 ha to 0.8 ha]. Loosen the soil surface before placement to allow anchoring the mulch. Place the mulch to obtain 90 percent ground coverage. Use blower equipment to place mulch. In areas inaccessible to a blower, place mulch by hand. Immediately after placement, use a disc anchoring tool to anchor the mulch.

### M.1.b Method 2

Use Method 2 to place mulch on a coverage area from ½ acre to 2 acre [0.2 ha to 0.8 ha]. Loosen the soil surface before placing the mulch. Place mulch to obtain 75 percent ground coverage. Use blower equipment to place mulch. In areas inaccessible to a blower, place mulch by hand. Immediately after placement, overspray the mulch with Type Hydraulic Mulch, at a rate of 750 lb per acre [840 kg per ha].

### **M.1.c Method 3**

Use Method 3 to place slurry on a coverage area from ½ acre [0.2 ha] to 1.5 acres [0.6 ha]. Apply material in quantities to obtain 100 percent soil surface coverage. In inaccessible areas, the Contractor may pump the mix through a hose.

### **M.1.d Method 4**

Use Method 4 to place fertilizer, seed, and erosion control blanket on a coverage area from 100 sq. yd [83.5 sq. m] to 800 sq. yd [668 sq. m]. Bury the upgrade end of each blanket strip at least 6 in [150 mm] in a vertical check slot. Place staples at seams and throughout the blanket spaced no greater than 2 ft [0.6 m] apart.

### **M.1.e Method 5**

Use Method 5 to place riprap class II and geotextile to coverage areas and configurations as directed by the Engineer.

## **N Acceptance of Work**

Notify the Engineer at least 24 h before beginning or changing turf establishment operations.

### **N.1 Seeding**

The Engineer will accept permanent seeding in area increments after the placement of seeding in accordance with the specifications 2575.3B. For hydroseeding acceptance will be based on uniform soil coverage.

### **N.2 Mulching**

Mulching will be accepted 2 calendar days after initial placement. Remulch areas where the mulch has blown off or washed away during the 2 calendar day period at no additional cost to the Department.

### **N.3 Sod**

After expiration of the sod maintenance period, the Engineer will inspect the work and will accept living sod that is placed in accordance with 2575.3F. and when pulled does not lift from soil.

### **N.4 Erosion Netting, Blankets, and Turf Reinforcement Mats**

For contracts not requiring maintenance, the Engineer will accept blankets and erosion control netting and mats when installed in accordance to 2575.3

### **N.5 Hydraulic Erosion Control Products**

The Engineer will accept hydraulic erosion control products providing 90 percent exposed soil coverage, except for Type BFM and Type FRM. The Engineer will accept areas covered by Type BFM and Type FRM at 100 percent exposed soil coverage.

**O Restoration**

After the Engineer accepts the turf establishment in an area, restore areas damaged by erosion and sedimentation beyond the Contractor's control as directed by the Engineer. Scarify, grade, shape, excavate, and till to restore eroded areas and clean up sedimentation as directed by the Engineer. Shape, fill, and compact depressions and washouts resulting from erosion with suitable topsoil borrow meeting 3877, "Topsoil Borrow," as approved by the Engineer. Remove deposited sedimentation as directed by the Engineer. Spread or dispose of sediment removed as approved by the Engineer.

Use seed, mulch, erosion blankets, and sod in the restoration as approved by the Engineer.

**P (Blank)**

**Q Workmanship Rework Schedule**

Correct work, workmanship, and work processes not in compliance with the contract requirements in accordance with Table 2575-4, "Required Corrective Action" at no additional cost to the Department.

<b>Table 2575-4 Required Corrective Action</b>		
<b>Item</b>	<b>Corrective Action Required if:</b>	<b>Corrective action</b>
<b>Seeding</b>	Not uniformly placed	Re seed
	Not seeded with drill when required	
	Depth of seed incorrect	reseed
	No cultipacking	Cultipack area
	Incorrect rate of seed application	Apply at additional rate
	(Hydroseeding) Insufficient soil coverage	Reseed areas not covered properly
	Not mulched within 24 h	Reseed area
	Incorrect seed mixture	Reapply with correct mixture
<b>Mulch material, hydraulic erosion control products</b>	Incorrect rate of application	Remulch to provide proper coverage
	Not uniformly placed	Adjust placement of mulch to provide uniform placement
	Rutting on slopes from equipment	Fix ruts , remulch and reseed
<b>Erosion control blankets and mats</b>		
	Upgrade ends not embedded on slopes	Properly imbed blanket
	Improper overlaps and joints	Provide proper joints and overlaps
	Insufficient number of staples	Provide for the additional required staples
	Improper stapling pattern	Staple at proper patterns
<b>Turf establishment lump sum</b>	No embedment of joints in drainage ways	Embed joints properly
	Erosion not controlled	Fix erosion and reapply practices
	Insufficient established vegetative cover	Over seed area

## **2575.4 METHOD OF MEASUREMENT**

### **A Seeding**

The Engineer will measure seeding with the adjusted bulk seeding, regardless of the seed mixture or quantity of seed used, and regardless of whether the Contractor or the Department provided the seed.

### **B Seed**

Measure seed by the weight of pure live seed (PLS) of each mixture or species based on the application rates as shown in Table 3877-1.

### **C Mulch**

The Engineer will measure mulch in accordance with the following:

- (1) Type 1, Type 3, Type 7, and Type 8 mulch by weight of each type provided and applied acceptably 2575.3.C, "Applying Mulch"
- (2) Type 5 and Type 6 mulch material by volume (vehicular measure) of the material provided and installed in accordance with 2575.3.C, "Applying Mulch"
- (3) Type 9 (aggregate) mulch by volume, based on the area of aggregate provided and a placed in accordance with 2575.3.C, "Applying Mulch" to the thickness shown on the plans, and
- (4) Additional mulch materials ordered and accepted by the Engineer in remulched areas.

### **D Water**

Measure water used by volume for turf establishment of seeded or sodded areas when directed by the Engineer.

### **E Disk Anchoring**

The Engineer will measure disk anchoring for Type 1, Type 3, Type 7, and Type 8 mulch by the area of mulch disked in accordance with 2575.3.D, "Disk Anchoring."

### **F Sod**

Measure installed and maintained sod by the surface area based on field measurement. Include the overlapped portion of shingled sod in the measurement

### **G Hydraulic Erosion Control Products**

Measure Type Tackifier by the area covered in accordance with 2575.3.E, "Hydraulic Erosion Control Products" . Measure all other hydraulic erosion control

products by weight of each type used or by square yard [square meter] converted from weight

## **H Turf Establishment**

Measure turf establishment by lump sum, no measurement will be made of any individual turf establishment item. Included are all materials and labor as necessary to accomplish the work regardless of quantities involved.

## **I Rolled Erosion Control Products**

Measure will separately erosion netting and blankets of each kind by the area covered. Overlapped portions in the area measured for erosion netting or blankets will not be included.

Measure erosion stabilization mats by the area covered. Overlapped portions in the area measured will not be included. Measure separately the seed, fertilizer, topsoil, and blankets placed in conjunction

## **J Rapid Stabilization**

The Engineer will measure Method 1 and Method 2 rapid stabilization are measured by the acre [hectare] acceptably installed. Minimum measure is ½ acre [0.2 ha] and in 1/6 acre [0.07 ha] increments per area measured.

The Engineer will measure Method 3 rapid stabilization will be measured by the metric gallons [cubic meter] of slurry furnished and acceptably placed. Minimum measure is ½ acre [0.2 ha] and in 1/6 acre [0.07 ha] increments per area measured.

The Engineer will measure Method 4 rapid stabilization will be measured by the square yard [square meter] of blanket acceptably installed. Minimum measure is 100 sq yd [83.5 sq m] and in 25 sq yd [20.9 sq m] increments per area measured.

The Engineer will measure Method 5 rapid stabilization will be measured by the ton [tonne] of rock provided and acceptably installed

## **2575.5 BASIS OF PAYMENT**

The contract unit prices for establishing turf and controlling erosion will include the cost of maintenance, replacement, and repair as required by the contract. If work meets the contract requirements, the Department will pay for additional seed and mulch material used for reseeding and remulching and repairing damaged areas beyond the Contractor's control at the relevant contract unit prices for establishing turf and controlling erosion

### **A Erodible Acres Partial Payment**

The Engineer may divide the project into separate control areas for release of the withholding.

The Department may make partial payments for erodible surface area based on withholding reductions approved by the Engineer and in accordance with Table 2575-5:

<b>Table 2575-5 Partial Release</b>	
<b>Control Area Surface Condition</b>	<b>Withholding Reduced</b>
Possible erosion damage or water pollution exists	No release until fixed
Rough grading completed and permanent topsoil placed	50 percent
Permanent stabilization completed	Full release

### **B Erosion Control Items**

The contract square yard [square meter] price for *Erosion Control Blanket* will include the cost of maintenance, including watering, replacement, and repair as required by the contract.

If the contract requires maintenance, the Department may pay for installation of Erosion Control Blanket or Turf Reinforcement Mat in a partial payment no greater than 80 percent of the contract unit price as approved by the Engineer. If the Department provides a partial payment, the Department will pay the remaining percentage after the Engineer makes final acceptance of the item.

The Department may pay for Hydraulic Erosion Control Products, excluding Type BFM and FRM in a partial payment no greater than 80 percent of the contract square yard [square meter] price after acceptance of the application by the Engineer and satisfactory installation as approved by the Engineer. If the Department provides a partial payment, the Department will pay the remaining percentage after the Engineer makes final acceptance of the item. The Department will not pay for seed or seed and fertilizer mixture sitting in the tank for greater than 1 h.

### **C Blank**

### **D Seed**

The Department will pay for seed by the PLS weight of each mixture or species measured.

The Department will reject seed not meeting the germination and purity requirements of 3876, "Seed," in accordance with 1503, "Conformity with Contract Documents," and 1512, "Unacceptable and Unauthorized Work." Reseed areas

missing components from the specified mixture with the correct mixture at no additional cost to the Department.

### **E Hydroseeding**

The Department will not pay for seed mixture or seed/fertilizer mixture that is in the hydroseeder for greater than 1 hour.

### **F Mulch**

The contract unit price for *Mulch Material, Type 9* includes the cost of the plastic sheeting for the area covered.

### **G Sod**

The Department may pay for sod upon satisfactory placement in a partial payment no greater than 80 percent of the contract unit price as approved by the Engineer. If the Department provides a partial payment, the Department will pay the remaining percentage after expiration of the sod maintenance period or as otherwise required by the contract.

If the Engineer finds unacceptable sod during final inspection, the Department will deduct 100 percent of the contract unit price for unacceptable sod from any moneys due or that may become due the Contractor or require the sod to be replaced at no cost to the department..

### **G Rapid Stabilization**

The contract unit prices for rapid stabilization will include the cost of mobilization.

The contract acre [hectare] price of *Rapid Stabilization, Method 1 or Method 2* includes the cost of disc anchoring or hydraulic erosion control products.

The contract metric gallon [cubic meter] price for *Rapid Stabilization, Method 3* includes the cost of seed, fertilizer, and hydraulic erosion control products.

The contract square yard [square meter] price for *Rapid Stabilization, Method 4* includes the cost of seed and fertilizer.

The contract ton [metric ton] price for *Rapid Stabilization, Method 5* includes the cost of geotextile.

### **H Shoulder Mulch Overspray**

The Department will pay for *Hydraulic Erosion Control Products, Type Tackifier* separately from Type 1 mulch and disk anchoring for Shoulder Mulch Overspray

### **I Compost Blanket**

The contract unit price for compost blanket will include compost and all work to perform the task.

## **J Turf Establishment**

The contract unit price the contract price includes all costs incurred to complete the work. The cost of restoring disturbed areas, including tilling, fertilizing, mulching and establishment of vegetative cover.

## **K Weed Control**

Payment for mowing and weed spraying at the Contract prices per unit of measure will be compensation in full for all labor and equipment employed in the work, and for all materials used, except that separate payment will be made for the weed spray mixture furnished and applied in conjunction with the item of weed spraying.

## **L Payment Schedule**

The Department will pay for establishing and maintaining turf and controlling erosion on the basis of the following schedule:

<b>Item No.:</b>	<b>Item:</b>	<b>Unit:</b>
2575.501	Seeding	acre [hectare]
2575.502	Seed, Mixture ____, or (Species)	pound [kilogram]
2575.505	Sod, as specified	square feet [square meter]
2575.511	Mulch Material, Type ____	ton [metric ton]
2575.513	Mulch Material, Type ____	acre [hectare]
2575.519	Disk Anchoring	acre [hectare]
2575.521	Erosion Control Netting, Type ____	square yard [square meter]
2575.523	Erosion Control Blanket, Type ____*	square yard [square meter]
2575.525	Turf Reinforcement Mat, Type ____	square yard [square meter]
2575.535	Water	M gallons [cubic meter]
2575.555	Turf Establishment	lump sum
2575.560	Hydraulic Erosion Control Products, Type ____	pound [kilogram]
2575.561	Hydraulic Erosion Control Products, Type 1 ____	square yard [square meter]
2575.570	Rapid Stabilization Method 1 or Method 2	acre [hectare]
2575.571	Rapid Stabilization Method 3	M gallons [cubic meter]
2575.572	Rapid Stabilization Method 4	square yard [square meter]
2575.573	Rapid Stabilization Method 5	ton [metric ton]

\* If maintenance applies, the Department will place the note, "Includes Maintenance" on the pay item shown in the summary of quantities on the plans.

## **2577 SOIL BIOENGINEERED SYSTEMS**

### **2577.1 DESCRIPTION**

This work consists of installing vegetation with geosynthetic or natural materials to stabilize areas susceptible to erosion. The Contractor may use soil bioengineering as a permanent soil stabilization system in ditches, along stream banks, on shorelines, or on slopes. This work also consists of providing and installing a composite system on the project.

### **2577.2 MATERIALS**

<b>A Seed, mix as specified .....</b>	<b>3876</b>
<b>B Mulch, Type as specified .....</b>	<b>3882</b>
<b>C Rolled Erosion Control products.....</b>	<b>3885</b>
<b>D (Blank)</b>	
<b>E. Nursery plant stock.....</b>	<b>3861</b>
<b>F. Sediment Control Logs.....</b>	<b>3895</b>
<b>G. Riprap .....</b>	<b>3601</b>
<b>H. Concrete Armor Units .....</b>	<b>3608</b>

### **2577.3 CONSTRUCTION REQUIREMENTS**

#### **A General**

The installation locations and layouts shown on the plans are approximate. The Engineer will determine the exact locations and layouts of bioengineered systems.

Provide a qualified nurseryman, landscape specialist, or experienced crews working under the direct supervision of a qualified nurseryman or landscape specialist to harvest and install plant material.

Do not begin planting operations or deliver planting stock to the project until the Engineer determines that weather and soil conditions are suitable for planting and preparations for planting are complete.

During placement, install components until complete. Prevent overnight drying out of plant stock by storing in water. On slopes, begin installing material at the bottom of slope and proceed in horizontal layers upward. On shorelines and banks, begin installing material below the water line and proceed up the bank.

During the work, prevent siltation and turbidity of flowing or impounded waters of the State. If working in water, protect the work site with curtains, barriers, or other containment devices to prevent sediment and debris from entering the receiving water body.

### **B Harvesting Plant Stock**

Obtain plant stock and cuttings from the regions, zones, or both shown on the plans.

At least three days before harvesting planting stock for the project, notify the Engineer of the harvest date to allow for inspection.

### **C Season of Placement**

Refer to Table 2577-1 for the dates for seasonal placement. The Engineer may adjust a date specified in Table 2577-1 by no more than 20 calendar days, based on the prevailing weather conditions.

Provide plant material in a dormant stage; before buds burst open in the spring or after leaves change color and drop in the fall.

<b>System</b>	<b>Spring</b>	<b>Fall</b>
Wattling	Before April 15	After Nov 1
Brush Layering	Before April 15	After Nov 1
Live Stake	Before April 15	After Nov 1
Root-Rap	April 15 – June 10	July 20 – Sept 20

### **D Wattling**

Dig trenches along the contours of the slope, place bundles of dormant plant cuttings into the trenches, and tamp loose soil over the bundles. Before trenching, drive wooden stakes 16 in [0.4 m] on center along each trench location. Provide stakes with a diameter of 2 in [50 mm] and a length of 2 ft [½ m]. Drive the stakes to a firm hold with the tops 6 in [150 mm] above grade.

Dig trenches no more than 1 h before installing plant materials to minimize drying of soils. Leave the overall soil surface in a rough condition with clods, and ridges for maximum resistance to erosion. Immediately following trenching, place bundles of dormant plant cuttings into the trench. Lay cuttings in bundles together with the butt ends located at alternate ends of the bundle and tightly tied with binder twine at least three points along the bundle. Provide bundles consisting of dormant woody cuttings from ¾ in to 2 in [9.5 mm to 50 mm] in diameter and from 3 ft to 8 ft

[1 m to 2.4 m] long. Provide bundles from 6 in to 8 in [150 mm to 200 mm] in diameter. Overlap wattle ends in the trench. Drive additional stakes through bundles at a spacing no greater than 2 ft [0.5 m] on center. During placement of the bundles, cover the bundles with loose soil, working it into the wattles leaving a uniform fringe of plant material, exposed to a height from 2 in to 3 in [50 mm to 80 mm].

### **E Brush Layering**

Make trenches along the contour of the slope and embed dormant green plant cuttings into the slots and tamp loose soil over the cuttings. Make trenches 2 ft [0.61 m] deep, angled downward into the slope. Provide plant cuttings consisting of stems 3 ft [1 m] long, and from ½ in to 2 in [10 mm to 50 mm] in diameter. Transport cuttings in containers of water and keep cuttings in the containers until installation. As soon as possible after making the trenches, place the plant cuttings into the trenches with the butt end placed into the trench and at least 6 in [150 mm] of the cuttings protruding out of the trench. Place the stems randomly with some crisscrossing. While placing plant cuttings, immediately backfill the trench cuttings with soil and firm the backfill to meet the Engineer's approval.

### **F Live Stakes**

Insert dormant live cuttings into the soil and tamp soil lightly around the cutting. Provide cuttings consisting of stems at least 3 ft [1 m] long and from 1 in to 2 in [25 mm to 50 mm] in diameter. Transport cut material in containers of water and keep material in water until installation. Insert the bottom end of the cuttings so the bottom-end is at right angles to the slope face for at least two-thirds to three-quarters of the cutting length and tamp. Do not split the ends or damage the bark of the cuttings. Place cuttings 2 ft [0.67 m] on center, using a triangular spacing. Place cuttings at a density of two to four stakes per square yard [square meter].

If rip rap is less than 2 ft [0.67 m] thick, stake the riprap (joint planting). Make a pilot hole by driving a tool, such as a pry bar or rebar, through the rip rap and filter layer, to reach the ground soil. Use a dead blow hammer to tamp the cuttings and avoid damaging the bark. Place the cuttings in a random configuration 2 ft [0.67 m] on center.

### **G Placing Coir log**

Place biodegradable coir log for stabilizing shorelines. Before installing the coir log, drive wooden stakes with a diameter of 2 in [50 mm] and a length of 3 ft [1 m], 1 ft [0.3 m] on center along the planned alignment of the coir log. Ensure the stakes extend from 8 in to 10 in [200 mm to 250 mm] above the elevation of the water surface shown on the plans. After placing the stakes, install the coir log so the upper surface of the coir log is parallel to the water surface and 2 in [50 mm] protrude above

the normal water level. Lace coir logs together end to end with woven nylon twine,  $\frac{1}{8}$  in [3 mm] in diameter to create a continuous length. Bury both ends of the coir rolls 5 ft [1½ m] laterally into the bank.

## **H Root-Rap**

Place a gravel channel lining or riprap, and overseed or plant the completed channel in accordance with the details, typical sections, and elevation controls as shown on the plans. The Engineer will stake the actual alignment. During the work, continuously place the granular channel lining or riprap and shape the channel. Begin seeding or planting within 48 h of shaping the channel.

## **I Concrete Armor Units**

Prepare grade to place Type IV geotextile in accordance with 3733, "Geotextiles." Place the geotextile so that it is completely in contact with the ground surface and is free of folds and wrinkles. Overlap adjacent strips of geotextiles by 3 ft [1 m] with the upstream strip overlapping the downstream strip. Place concrete armor units so not to tear the geotextile tightly interlocked matrix. Begin placement of the system at the toe termination trench and proceed up the slope.

## **J (Blank)**

## **K Acceptance of Work**

Upon satisfactory installation of the bioengineered systems, the Engineer will authorize partial payment not to exceed 80 percent of the contract unit prices. The remaining percentage shall not become due and payable until after the 30-day maintenance period.

## **2577.4 METHOD OF MEASUREMENT**

### **A Wattling**

The Engineer will measure wattling by the linear foot [meter] of each trench made and planted. If several trenches are made and planted, the Engineer will add each length of trench planted and accepted to the total.

### **B Brush layering**

The Engineer will measure brush layering by the linear foot [meter] of each horizontal trench made and planted. If several trenches are made and planted, the Engineer will add each length of trench planted and accepted to the total.

**C Coir log**

The Engineer will measure coir log by the linear foot [meter] provided and installed including buried portions.

**D Granular channel liner**

The Engineer will measure granular channel liner by volume in cubic yard [cubic meter] placed in the final configuration.

**E Concrete Armor Units**

The Engineer will measure concrete armor units by surface area covered by each size provided, installed, and accepted by the Engineer, including the buried portions, using the outermost extremity of the units as required by the contract. On small projects, the Engineer will accept concrete armor units by the number of complete units assembled and installed as required by the contract.

**2577.5 BASIS OF PAYMENT**

If the contract does not include pay items for bioengineered systems, the Department will pay for bioengineered system items as extra work in accordance with 1402, "Contract Revisions."

**A Wattles**

The costs of plant cuttings, bundles, and stakes and rope to fasten logs are included in the contract unit price for wattling.

**B Brush Layering**

The costs of plant cuttings and stakes and rope to fasten logs are included in the contract unit price for brush layering.

**C Coir Logs**

The costs of stakes and rope to fasten logs are included in the contract unit price for coir logs.

**D Pay Items**

The Department will pay for bioengineered system items on the basis of the following schedule:

<b>Item No:</b>	<b>Item:</b>	<b>Unit:</b>
2577.501	Wattling	linear feet [meter]
2577.502	Brush Layering	linear feet [meter]
2577.504	Granular Channel Liner	cubic yard [cubic meter]

<b>Item No:</b>	<b>Item:</b>	<b>Unit:</b>
2577.505	Live Stakes	each
2577.506	Concrete Armor Units ____ (size)	each
2577.507	Concrete Armor Units ____ (size)	square yard [square meter]

## **2581 REMOVABLE PREFORMED PAVEMENT MARKING TAPE**

### **2581.1 DESCRIPTION**

This work consists of providing, placing, and removing temporary pavement marking material on pavement open to traffic and without permanent traffic markings.

### **2581.2 MATERIALS**

Provide removable preformed pavement marking tape for traffic lane delineation and legends in accordance with 3355, "Removable Preformed Pavement Marking Tape for Traffic Lane Delineation and Legends."

### **2581.3 CONSTRUCTION REQUIREMENTS**

Provide and place removable preformed pavement marking tape as shown on the plans or as directed by the Engineer immediately before modifying traffic flow. Place the marking tape on a clean and dry surface in accordance with the manufacturer's recommendations.

Removed marking material shall become property of the Contractor. Dispose of the removed marking material off the right-of-way in accordance with 1701, "Laws to be Observed."

The Department will base acceptance of pavement marking materials on the certification and quality control testing verified by the Materials Laboratory testing of verification samples and spot checks on samples obtained from contractor stock or from the project site in accordance with the Pavement Marking Qualification and Acceptance Program.

### **2581.4 METHOD OF MEASUREMENT**

The Engineer will measure removable preformed pavement marking tape by the actual length of pavement marking provided, placed, and removed as required by the contract.

The Engineer will base the measurement of removable preformed pavement marking tape on equivalent lengths of 4 in [100 mm] wide marking, regardless of the

color or type. The Engineer will adjust the measured length of removable preformed pavement marking tape with a width differing from the 4 in [100 mm] width by the ratio of the actual tape width to the 4 in [100 mm] width. The Engineer will measure broken or dotted line markings by the actual length of material placed. The Engineer will not measure gaps between the broken or dotted lines.

### **2581.5 BASIS OF PAYMENT**

The contract linear foot [meter] price for *Removable Preformed Pavement Marking Tape* includes the cost of providing, placing, maintaining, replacing, removing, and disposing of the marking tape.

The Department will pay for removable preformed pavement marking tape on the basis of the following schedule:

<b>Item No.:</b>	<b>Item:</b>	<b>Unit:</b>
2581.501	Removable Preformed Pavement Marking Tape	linear foot [meter]

## **2582 PERMANENT PAVEMENT MARKINGS**

### **2582.1 DESCRIPTION**

This work consists of providing permanent pavement markings for roadways, including pavement messages, linear pavement markings, and crosswalk block markings.

The Department defines pavement messages as word and symbol pavement markings installed in the roadway, including word and symbol messages that are not line segments or crosswalks.

The Department defines linear pavement markings as line segments of various widths installed in the roadway, including lane lines, center lines, no passing zone lines, edge lines, airplane markings, and stop lines. The Department does not consider crosswalk blocks or pavement messages as linear pavement markings.

The Department defines crosswalk block markings as blocks installed in the roadway parallel to the direction of travel in a pattern that is transverse to the direction of travel.

## **2582.2 MATERIALS**

<b>A</b>	<b>Preformed Pavement Marking Tape for Permanent Traffic Lane Delineation and Legends.....</b>	<b>3354</b>
<b>B</b>	<b>Epoxy Resin Pavement Markings.....</b>	<b>3590</b>
<b>C</b>	<b>High Solids Water-Based Traffic Paint .....</b>	<b>3591</b>
<b>D</b>	<b>Drop-On Glass Beads .....</b>	<b>3592</b>

Provide and use pavement marking materials listed on the Approved/Qualified Products List.

Do not change the following unless approved by the Department:

- (1) Product identification,
- (2) Chemical composition as indicated by infrared spectrophotometry or chemical analysis, or
- (3) Application requirements.

Submit proposed changes to the Materials Laboratory for further evaluation.

## **2582.3 CONSTRUCTION REQUIREMENTS**

### **A Certification of Materials**

The Department will base acceptance of pavement marking materials under the Pavement Marking Qualification and Acceptance Program on the product certification and quality control testing verified by Materials Laboratory testing of verification samples and spot checks on samples obtained from contractor stock or from project sites.

### **B Application**

Apply the pavement marking on a clean, dry pavement surface, free of dirt and foreign matter as recommended by the material manufacturer and as required by the contract.

Before applying the epoxy markings, sandblast new portland cement concrete surfaces to remove surface treatments or laitance.

### **C Acceptance**

Pavement markings in Minnesota shall meet or exceed the standards defined in the MN MUTCD.

#### **C.1 Alignment**

Provide linear pavement marking in the width specified in the contract, varying by no greater than  $\pm\frac{1}{4}$  in per 10 ft [ $\pm 6$  mm per 3 m]. Provide broken line segments with lengths varying by no greater than 3 in [75 mm]. Provide alignment deviating from the control guide or existing lines specified by the Engineer by no greater than 2 in [50 mm]. Ensure the transverse position of linear markings varies by no greater than 1 in per 10 ft [25 mm per 3 m]. Do not apply pavement marking material over a longitudinal joint.

### **C.2 Color**

Provide pavement markings in the color specified in 2582.2, "Materials," for the respective material.

### **C.3 Retroreflectivity**

Provide pavement markings meeting the following minimum initial pavement marking retroreflectivity when tested using 30 m geometry in accordance with ASTM E 1710:

	<b>White</b>	<b>Yellow</b>
Tape	600 mcd/sq. m/lux	500 mcd/sq. m/lux
Epoxy	300 mcd/sq. m/lux	200 mcd/sq. m/lux
Latex	275 mcd/sq. m/lux	180 mcd/sq. m/lux

Remove and replace, or repair, pavement markings not meeting the minimum initial pavement marking retroreflectivity values in accordance with Table 2582-1, as approved by the Engineer at no additional cost the Department.

If the retroreflectivity deficiency is no greater than 20 percent, the Engineer may accept the work at a unit price reduced by the percent of retroreflectivity deficiency.

### **D Pavement Marking Warranty**

Transfer pavement marking warranties to the Department or other appropriate road authority after construction.

### **E Correction of Defects**

Remove and replace, or repair, pavement markings not meeting the contract requirements as approved by the Engineer at no additional cost to the Department.

### **F Striper Operations Daily Log**

After applying pavement markings, complete the "Construction Striper Operations Daily Log" in the special provisions as approved by the Engineer. The

Department will not pay for pavement markings until the Contractor submits the completed "Construction Striper Operations Daily Log" to the Engineer.

**2582.4 METHOD OF MEASUREMENT**

**A Pavement Messages**

The Engineer will measure pavement messages of each type by the number of each type installed as required by the contract.

**B Lines**

The Engineer will measure pavement marking lines by the length of each type constructed in place as required by the contract. The Engineer will measure broken and dotted lines by the actual length of line marked. The Engineer will not include the gaps between the broken and dotted lines in the measurement.

**C Crosswalk Markings**

The Engineer will measure crosswalk blocks by type and by the area in square feet [square meter] of material installed as required by the contract.

**2582.5 BASIS OF PAYMENT**

The contract unit price for permanent pavement markings includes the costs of materials, installation, traffic control, surface preparation, and primers as required by the contract.

The Department will pay for permanent pavement markings on the basis of the following schedule:

<b>Item No.:</b>	<b>Item:</b>	<b>Unit:</b>
2582.501	Pavement Message *	each
2582.502	Linear Markings ___ in [ ___mm] width    † ‡	linear foot [meter]
2582.503	Crosswalk Marking	square foot [square meter]

- \* Specified message.
- || Specified material.
- † Specified type of line (solid, broken, or dotted).
- ‡ Specified color.