8-01 Erosion Control and Water Pollution Control

GEN 8-01.1 Introduction

Although many items of construction in this chapter are specialized; the procedures for sampling materials, documenting construction, and requiring that work be done in accordance with the specifications is not different from other types of highway construction work. Wherever feasible, plan the work so there is a smooth transition between temporary erosion and sediment control (TESC) best management practices (BMPs) and permanent stabilization that uses soil amendments and plant material.

Federal, state, and local water quality regulations prohibit sediment and other pollutants associated with construction activity from impacting air and water quality. All projects must comply with these laws and the required permits. WSDOT creates a Temporary Erosion and Sediment Control (TESC) plan and a Roadside Work Plan and Weed and Pest Control Plan to prevent erosion, and protect adjacent properties and the environment. *Standard Specifications* Section 8-01 and 9-14 covers the requirements for controlling erosion, water pollution, and stabilizing roadside areas. Applicable provisions are included in the contract and must be enforced by construction staff to ensure effective erosion prevention and water quality protection.

The National Pollutant Discharge Elimination System (NPDES) Construction Stormwater General Permit (CSWGP) is one of the most common permits on WSDOT projects. It requires specific actions prior to and during construction. Projects must obtain coverage under the CSWGP when over an acre of soil will be disturbed and a stormwater discharge from project boundaries may occur. Refer to WSDOTs TESC Manual M 3109.01 for detailed information about TESC planning procedures and CSWGP requirements during construction.

It is WSDOT policy to attach all permits to the contract as appendices; the CSWGP will be included there. Within a permit may be site specific requirements. If the CSWGP includes site specific requirements they will typically be specified on the permit coverage letter from Ecology, or in and Administrative Order issued in conjunction with the CSWGP. The contract-relevant permit conditions should be included in the contract, but review the CSWGP related documents and the contract to ensure that all environmental commitments made during the permitting process were incorporated into the contract. For example, additional environmental commitments may have been made as a result of existing site contamination or outfalls into impaired receiving waters.

Since the CSWGP is reissued by Ecology every five years the requirements change over-time. Because the CSWGP is usually obtained sometime after the main design work was done, it is important to verify that the final TESC plan meets the conditions in the TESC Manual for the permitted project before construction starts.

Project Delivery Memo #15-01 directs all projects to transfer the CSWGP to the Contractor unless the Assistant State Construction Engineer (ASCE) authorizes the project to forgo transferring coverage. If ownership of the CSWGP has been

transferred to the Contractor, the Contract includes General Special Provisions (GSPs) associated with transferring the CSWGP. Additional guidance about the transfer of coverage process can be found on WSDOT's internal Erosion Control webpage, always use the Transfer of Coverage (TOC) guidance document to ensure Ecology's TOC form is filled out, routed, and submitted properly.

It is important to partner with environmental agencies during construction. Early, open communication sets up a good working relationship that may prove invaluable later if problems occur. Permit requirements normally require notification to environmental agencies prior to conducting construction activities. On some projects it may be advisable to invite representatives from regulatory agencies to participate in the preconstruction meeting when environmental issues are discussed.

GEN 8-01.2 Record Keeping and Reporting

All projects covered by a CSWGP must collect weekly discharge samples, or confirm that no discharge occurred, and report the data in a monthly Discharge Monitoring Report (DMR) to the Department of Ecology (Ecology). Ecology requires that all discharge samples be collected by a Certified Erosion and Sediment Control Lead (CESCL). Monthly DMR reporting must begin as soon as the CSWGP is issued, even if construction has not started yet or no discharge has occurred. Monthly reporting continues until the CSWGP has been terminated. Failure to report DMRs as required is a permit violation.

If WSDOT is the permittee, the Region or project office must enter their discharge data into the Construction Water Quality Monitoring (CWQM) database. The HQ Erosion Control program uses CWQM to review data and electronically submit DMRs reports to Ecology. If the project is required to do additional sampling due to outfalls in impaired waters or site contamination they will need to report their DMR data directly into Ecology's WebDMR system instead of CWQM. Refer to Chapter 4 of the TESC Manual for more information about CSWGP monthly reporting requirements and procedures.

When WSDOT submits a Transfer of Coverage (TOC) form, the Contractor becomes the permittee on the effective transfer date listed on the TOC form. Most transfer effective dates are mid-month, complicating the monthly DMR submittal; work with the Erosion Control program to ensure DMRs are submitted correctly for the transfer month. Once the Contractor is the permittee for an entire month the DMR submittal responsibility is fully theirs. Discharge sample data collected by the Contractor should not be entered into the CWQM database. Contractors must use Ecology's WebDMR system to submit their monthly DMRs directly. Project staff can verify the Contractor is submitting their monthly DMRs by using Ecology's Permit and Reporting Information System (PARIS). Additional guidance about reporting procedures when the Contractor owns the CSWGP can be found in Project Delivery Memo #15-01 and on WSDOT's intranet page for Erosion Control.

The CSWGP requires a site log book be maintained on-site. The site log book must contain the following:

- Proof of permit coverage (permit coverage letter or a Transfer of Coverage form),

- A record of the implementation of the TESC plan which includes; an updated version of the TESC and SPCC plan,
- Copies of all site inspection reports, discharge sampling data, CESCL contact information, and information pertaining to installation and maintenance of BMPs (documentation of BMP adaptive management).

The site log book should also contain any project specific permit related documentation such as information about:

- An active chemical treatment system,
- Additional planning or sampling requirements related to outfalls in impaired waters or site contamination, or
- Administrative Orders issued with the CSWGP.

Refer to Chapter 4 of the TESC Manual for more information about maintaining the site log book.

Project offices must retain documentation of compliance with permit requirements during the life of the contract and for a minimum of three years following the termination of the contract. This includes the site log book, discharge sampling data, site inspection reports, TESC plans and other permit related documentation.

SS 8-01.3 Construction Requirements

SS 8-01.3(1) General

SS 8-01.3(1)A Submittals

All projects covered by a CSWGP are required do stormwater pollution prevention planning prior to and throughout construction. WSDOT uses the TESC plan and the Spill Prevention, Control, and Countermeasures (SPCC) plan to meet this planning requirement. The SPCC plan is created by the Contractor to ensure compliance with the "Control Pollutants" stormwater pollution prevention planning element in the CSWGP. The Contractor may bring material on-site that can be hazardous. The Contractor must develop and submit the SPCC plan to the PE in accordance with *Standard Specifications*. Additional information about SPCC plans can be found in Chapter 3 of the TESC Manual or on the Hazardous Materials and Solid Waste webpage.

A TESC plan consists of both a narrative section and plan sheets. The narrative document must include a project specific analysis of erosion risk, a strategy for managing risk, and a list of best management practices (BMPs) that may be used to manage the risk. The plan sheets must show the locations of BMPs and other features such as topography and location of sensitive areas. TESC plans must show locations of the high visibility fence (HVF). High visibility fencing protects sensitive areas and their buffers where impacts are not permitted. Procedures on marking clearing limits and protecting sensitive areas can be found on the Environmental Compliance Guidance for Construction webpage. All TESC plans must meet the conditions in the TESC Manual.

Projects with under an acre of soil disturbance that do not trigger CSWGP coverage must also take measures to prevent discharges where feasible. If discharges cannot be prevented, BMPs shall be used to ensure compliance with all Federal, State, tribal, or local laws, ordinances, and regulations that affect Work under the Contract to prevent impacts to surface waters of the state. These projects should have an abbreviated TESC plan to discuss how surface waters will be protected. An abbreviated TESC plan will be required by the local jurisdiction if there is potential to discharge into a municipal separate storm sewer system (MS4) covered by a Municipal Stormwater Permit (Phase I or II). Refer to Chapter 4 of the TESC Manual for more information or contact Region Environmental for more information.

Although TESC plan designers try, it is difficult to account for all erosion risks that may occur during construction. This known difficulty is why the CSWGP requires the stormwater pollution prevention plans (TESC and SPCC plans) be implemented using adaptive management, meaning the plans must be updated throughout construction to manage changing site conditions as needed to minimize erosion related risks and the discharge of pollutants.

There may be times when it is necessary to exceed the maximum acreage exposure limits allowed by *Standard Specifications* Section 8-01.3(1). If the Engineer grants the Contractor's request to exceed these limits, the Contractor must provide to the Engineer a revised plan, commensurate with the scope and risk of the variance proposed, stating what measures will be used to protect the project from erosion damage, how water quality and sensitive areas will be protected, and include the schedule of methods employed to regain adherence to *Standard Specifications* Section 8-01.3(1). The CSWGP prohibits the Engineer from increasing the time periods required in *Standard Specifications* Section 8-01.3(1) for covering erodible soil that is not being worked.

The Contractor can either adopt or modify WSDOT's TESC plan per *Standard Specifications* Section 8-01.3(1)A. When the CSWGP is transferred to the Contractor the GSP pertaining to the TESC plan submittal requires the Contractor to either: adopt and modify the agency provided TESC plan, or develop a new TESC plan in accordance with the TESC Manual. Prior to construction, determine whether any TESC plan changes are necessary. It is important to clearly understand the TESC plans prior to work beginning. The actual site conditions may not match those described in the original plan due to development in the area, changed construction dates, and inaccuracies in the original plan. Newly paved areas or housing developments located up gradient from the project site may increase surface water flows to the site. Also consider that the original TESC plan may have missed a potential risk. For example, sources of offsite water should be identified so they can be managed in accordance with *Standard Specification* 8-01.3(1)C. Permanent sources of off-site water may require permanent design solutions. Any offsite water run-on that comes into contact with the construction area becomes the responsibility of the permitted project. An accurate evaluation of current site conditions is essential for preventing erosion.

When conducting an initial evaluation, the inspector should walk through the site with the TESC plan. Any needed changes are marked on the plan sheets so that necessary changes can later be shown to the contractor. It is important when the CSWGP is transferred to the Contractor that the instructions to the Contractor are to comply

with the contract and permit requirements and that the inspector does not direct the Contractor's work methods. Some of the most important factors leading to erosion control problems include: offsite run-on, groundwater seeps, unstable slopes, soils that are vulnerable to erosion or long suspension time, and exposing too much soil during the wet season. Construction staff responsiveness to problem areas and changing site conditions are the most important determining factors in whether or not the TESC plan is effective.

Knowledge of soil types, climate patterns, and hydrology in the project area are of particular importance for TESC planning. If erodible soils are present, special consideration must be given to reducing erosion when these materials are encountered in cuts or used in embankment construction on the project. If problems are encountered during construction, contact Region Environmental or Materials Lab staff for assistance.

Infiltration can often be used when other BMPs fail to treat stormwater runoff and to reduce stormwater volumes. Vegetation should be preserved to the maximum degree practicable and infiltration should be considered whenever conditions allow. On sites with highly permeable soils and large undisturbed areas, infiltration should be used as one of the main stormwater management BMPs.

Should an environmental non-compliance event occur, i.e. an action not in compliance with environmental standards, permits, or laws during construction refer to Section SS 1-07.5 for the appropriate internal notification and corrective action procedures. If a noncompliance event may cause a threat to human health or the environment, or if a discharge exceeds the numeric effluent limit for an impaired receiving water, Ecology must be notified immediately and immediate actions must be taken to correct or stop the noncompliance. In addition a detailed written report may be required by the permit to be submitted to Ecology that includes the date, time, and location of the event, a description of what happened and how it was (or will be) corrected to prevent reoccurrence. Failure to notify Ecology when required is a permit violation.

The Contractor may be required to submit additional plans to the PE for review. For example *Standard Specification* Section 8-01.3(1)C requires a submittal if the Contractor plans to infiltrate certain types of shaft drilling slurry.

Additional erosion control guidance is available on WSDOT Environmental Office web pages.

SS 8-01.3(1)B Erosion and Sediment Control (ESC) Lead

The CSWGP requires that site inspections be performed on active construction projects a minimum of once a week and within 24 hours of a discharge rain event. Site inspection frequency may be reduced to once a month on temporarily stabilized inactive sites (e.g., projects in winter shut down). Site inspections must include all areas disturbed by construction activity, BMPs, and discharge points. The individual performing the site inspection must be a Certified Erosion and Sediment Control Lead (CESCL).

Contractors shall perform site inspections in accordance with *Standard Specifications* Section 8-01.3(1)B. The contractor must identify their Erosion and Sediment Control (ESC) Lead for the project and include the ESC Lead on the Emergency Contact List.

The ESC Lead must have, for the life of the contract, a current CESCL from a course approved by the Washington State Department of Ecology. Information on approved training can be obtained at www.ecy.wa.gov/programs/wq/stormwater/construction/index.html.

WSDOT staff should verify the Contractor is performing the site inspections, and maintaining the TESC plan in accordance with *Standard Specifications* Section 8-01.3(1)B . A copy of all ESC Lead site inspection reports must be kept on-site in the site log book. Chapter 4 of the TESC Manual has additional guidance about site inspections, documenting BMP adaptive management, and maintaining the site log book.

If WSDOT can identify potential erosion-prone areas early, we can prevent problems such as stop work orders and fines, construction delays, and unfavorable publicity. Site inspections help verify that the Contractor is implementing the TESC and SPCC plans and that BMPs are working as required. Projects should not accept site inspection reports that are incomplete, inaccurate, or misleading. WSDOT inspectors should walk through the site to verify site inspection report findings or to ensure BMPs are installed, maintained, and repaired as required. WSDOT inspectors should work with the Contractor's ESC Lead when TESC issues are identified.

Whenever feasible, WSDOT inspectors should be present during BMP installation to ensure proper methods and materials are used. Improperly installed BMPs will not be effective and can contribute to an erosion or noncompliance event. Some temporary products have materials requirements in the *Standard Specifications* Section 9-14. The permit requires that BMP effectiveness be evaluated in the field (through site inspections and discharge sampling). If installed BMPs are ineffective they must be improved or replaced (BMP adaptive management) to control erosion and prevent turbid discharges. BMP adaptive management and maintenance must be documented in the site log book or drawn onto the TESC plan sheets. The on-site TESC plan (narrative or plan sheets) should be updated as needed to reflect current site conditions and BMPs. Chapter 4 of the TESC Manual has additional guidance on BMP adaptive management and site documentation requirements. When the CSWGP has been transferred, compliance becomes a contract enforcement issue. Project Delivery Memo #15-01 provides guidelines for how projects can enforce contract requirements related to CSWGP compliance.

SS 8-01.3(1)C Water Management

Water quality monitoring is a permit requirement on many WSDOT construction projects, whether work is being done in the water or on land. Sampling frequency and location, compliance triggers, planning and reporting requirements vary depending on the type of permit or certification issued.

Turbidity and pH are the two most common measurements for pollutants used during construction activity. Turbidity is measured in nephelometric turbidity units (NTUs) and is a measurement for the clarity of water and is the most common pollutant sampled during construction. The second most common pollutant is acidic and alkaline water. The acidity or alkalinity of a water sample is measured in terms of its pH with lower numbers indicating acidity and higher numbers indicating alkalinity. Water that is too acidic or alkaline (outside the range of pH 6.5 – 8.5) can kill fish and cannot be

discharged to surface waters under the CSWGP. Discharge samples must be evaluated for pH when a project will use a significant amount (1,000 cubic yards or more) of fresh or recycled concrete, or other substances such as engineered or amended soils that could modify the pH of the water.

WSDOT has developed detailed protocols in the TESC Manual to comply with the CSWGP discharge sampling and monthly reporting requirements. Discharge samples must be collected weekly to verify that on-site BMPs are working as required. Discharge sample values must be compared to the benchmark and phone reporting trigger values for turbidity (and pH if a significant amount of concrete or pH modifying substance is used), to determine if BMPs need to be adapted or maintained. If discharge samples exceed benchmark or phone reporting trigger values, several follow-up actions become required. It is a violation of the CSWGP if any of the follow-up actions are not performed.

If a discharge of 250 NTU or higher occurs the Department of Ecology must be notified with 24 hours via their regional Environmental Report Tracking System (ERTS). Failure to notify Ecology as required is a permit violation. Follow the procedures in Chapter 4 of the TESC Manual to ensure the sampling, BMP adaptive management, and notification requirements in the CSWGP are met.

The CSWGP authorizes uncontaminated stormwater discharges (and some non-stormwater discharges such as uncontaminated dewatering) from construction areas to surface waters of the state. If the project determines that active chemical treatment, such as chitosan enhanced sand filtration (CESF) will be needed to prevent the discharge of pollutants, contact Region Environmental or the HQ Erosion Control program to ensure all requirements are met prior to construction. The Department of Ecology has design, operational and chemical usage requirements for active chemical treatment systems that must be followed. Ecology also requires a Request for Chemical Treatment form to be filled out and submitted by the permittee prior to any discharge from an active chemical treatment system. Additional information on active chemical treatment can be found on the Erosion Control internal webpage.

The CSWGP allows high pH stormwater (stormwater that has come into contact with a pH modifying substance) to be neutralized using approved methods prior to discharge (refer to BMP 5-1.1.17 - High pH Stormwater Neutralization in Chapter 5 of the TESC Manual).

The CSWGP prohibits specific discharges including: concrete slurry from grinding operations, wastewaters, fuels, chemicals, soaps, solvents, and other contaminated discharges. Process wastewater generated on-site as part of a construction process, including shaft drilling wastewater, tire wash water, and concrete washout, cannot be discharged to surface waters under the CSWGP. If groundwater or stormwater is used as part of a construction process, it becomes process wastewater, and cannot be discharged to surface waters. Under certain conditions some types of process wastewaters may be infiltrated. Infiltration of process wastewater shall be in accordance with the CSWGP, the *Standard Specifications*, and the TESC Manual. As standard practices for dealing with different sources of process wastewater continue to evolve, contact Region Environmental or Headquarters Environmental Services to determine if infiltration is an acceptable treatment option.

Sometimes neighboring sites or projects cause increases in turbidity that can be falsely blamed on WSDOT. It is important to document such events or report them so that we are not unfairly blamed for other people's impacts to water quality.

Projects that involve in-water work may be issued a Hydraulic Project Approval (HPA), a Letter of Verification (LOV), or a 401 Individual Water Quality Certification. Compliance for in-water work is evaluated differently than it is on land based construction covered by a CSWGP. In-stream sampling (e.g., upstream and downstream) is different than discharge sampling for a CSWGP. Refer to Chapter 1 of this manual for additional information about in-water work monitoring.

The permittee is required by law to report any water quality exceedance or permit violation to the Department of Ecology. WSDOT has developed Environmental Compliance Assurance Procedures (ECAP) that must be implemented immediately to report any permit non-compliance when we own the permit. These procedures are contained in SS1-07.5.

It is important that environmental agencies hear about a problem from us as soon as it happens rather than from the public or by discovering it themselves. Self-reporting sends a message that we are making a good faith effort and have nothing to hide. Not reporting suggests that we are covering up a problem or simply do not care.

As part of ECAP, all Contractor ESC Leads must notify the Project Engineer upon discovery of a water quality standard exceedance or situation that may lead to a permit violation such as an exceedance of the CSWGP phone reporting trigger value (250 NTU). Nevertheless, it is our responsibility to be watching ourselves. If a problem is identified, WSDOT inspectors should notify the Project Engineer and immediately take all measures possible to reduce impacts of the problem.

SS 8-01.3(2) Seeding, Fertilizing, and Mulching

The CSWGP makes an important distinction between temporary stabilization (e.g., inactive over winter sites stabilized with temporary BMPs) and final stabilization. The CSWGP cannot be terminated until a project has reached final stabilization and the Contract Work is physically complete, all temporary BMPs have been removed unless approved by the Project Engineer to remain, and all exposed soil areas have been fully stabilized with permanent BMPs such as vegetation, rock, or equivalent permanent stabilization measures. Failure to remove non-biodegradable BMPs and permanently stabilize soil prior to submitting the Notice of Termination form is a permit violation. All permit requirements must be performed until the CSWGP has been terminated. Refer to Chapter 4 of the TESC Manual for more information about terminating a CSWGP.

Upon final stabilization, all temporary BMPs must be removed in accordance with *Standard Specification* Section 8-01.3(16). Per Section 8-01.3(16) the contractor must remove temporary BMPs in a way that minimizes soil disturbance, but it is the responsibility of the inspector to ensure this is done and soil stabilization is maintained. Some projects may choose to leave sediment control BMPs such as silt fence in place until permanent vegetation has established, even if the duration extends beyond contract completion. If the silt fence is left in place, the permit cannot be terminated and all of the CSWGP requirements still apply, including the monthly reporting requirements (refer to chapter 4 of the TESC Manual). The Project Engineer may need

to coordinate with State Maintenance forces to arrange for silt fence or other BMP removal occurring after the contract is completed.

The permanent protection of earth cut and fill slopes should be accomplished as soon as possible. When provided in the contract, compost blanket should be evenly placed on the slopes to a depth specified, prior to seeding or other planting. The timing and scheduling of the compost application may occur as early as possible for erosion control purposes and not necessarily immediately prior to seeding and planting operations. If compost is applied days or weeks before seeding and mulching, or in arid and/or windy climates, the soil or compost needs to have a tackifier applied to prevent the compost from blowing away.

When provided in the contract, topsoil should be evenly placed on the slopes at the specified depth for areas to be seeded. After placement of top soil, large clods, hard lumps, rocks 2 inches in diameter or larger, and litter shall be raked up, removed, and disposed of by the Contractor. Refer to *Standard Specifications* Section 8-02.3(4) for more information.

Areas to be seeded are to be prepared after final grading so that the soil surface is rough and loose, with ridges and furrows (narrow depressions) perpendicular to the slope or to the natural flow of water. This will slow the water velocity, increase water detention and infiltration, decrease runoff, and promote grass growth. This can be done through catwalking, the use of a cleated roller, crawler tractor, or similar equipment. Refer to *Standard Specifications* Section 8-01.3(2)A for more information.

Seed and fertilizer are to be uniformly applied on the slopes at the rate and mixture specified in the contract. Application shall be by hydro-seeder, blowing equipment, properly equipped helicopters, or power drawn drills or seeders. Where areas are inaccessible for this equipment, or when specified, approved hand seeding will be permitted.

In order for the Contractor to order the proper amount of materials for the project and to provide the Inspector a method of checking the rate of application of the seed and fertilizer, the Project Engineer should measure the areas to be seeded and fertilized as soon as they can be determined and inform the Contractor of the anticipated acreage. If, in the opinion of the Engineer, the seeding and fertilizing areas can be accurately determined using digital terrain modeling or other design data, the Engineer has the option of using this data in lieu of field measuring. During the seeding and fertilizing operation, the Inspector shall see that the material is placed at a uniform rate and compare the amount of seed and fertilizer applied, by counting the number of bags of material, with the area covered to verify that the proper rate of application is being placed.

The seed and fertilizer may be applied in one application provided the seed and fertilizer are not mixed more than 1 hour prior to application. Mixing more than 1 hour prior to application will damage the seed. Otherwise, the seed shall be applied in a separate application prior to fertilizing and mulching. Lime, if specified should be applied separately from the seed and mulch.

Seed on soil is not considered adequate erosion control until a stabilizing cover vegetation is established. For this reason, mulch is often applied with seeding to provide immediate coverage. Straw, wood strand mulch, and compost often get used with seeding application, as do a variety of hydraulically-applied erosion control products (HECPs).

West of the summit of the Cascade Mountain Range, HECPs may be applied with seed and fertilizer. Each pass must be applied from a different direction to get complete coverage of the soil.

East of the summit of the Cascade Mountain Range, the seed and fertilizer must be applied in a first pass. Short-term mulch may be added as a tracer. Consult with the Region Landscape Architect or the HQ Design Landscape Architect if assistance is needed.

Mulch is uniformly applied to the seeded areas within 48 hours after seeding. Straw mulch is to be applied with a forced air spreader. Straw mulch may not be practical in windy areas or in areas of concentrated flow. HECP is normally applied with a hydroseeder. Checks are necessary to determine that the mulch is applied uniformly and at the required rate. HECP should completely cover the ground surface with no gaps. In areas that cannot be reached by a mulch spreader, hand methods resulting in uniform application may be used.

If using an active chemical treatment system, such as chitosan enhanced sand filtration (CESF), minimize the potential for chemical products such as tackifiers or polyacrylamide (PAM) as it may impact treatment system performance. Organics from mulch products, especially compost and straw, may also impact treatment performance.

In order to control the possible erosion resulting from fast runoff on steep slopes, biodegradable erosion control blankets are often used (see Chapter 5 of the TESC Manual). Blankets also get used on flatter slopes where erodible soils are encountered. Using biodegradable erosion control blankets can provide a quick temporary protection until the grass has grown enough to be permanent protection for the soil, but the blanket cannot be expected to hold up to concentrated flows, so top of slope protections should be made to prevent such flows from developing and hitting the slope. Ditching, drains or dispersion BMPs such as compost socks should control drainage from above or beyond the raw slope. Every effort should be made to ensure that this kind of runoff is diverted away from the slope. In some cases, as determined by geotechnical analysis, permanent erosion control blankets or turf reinforcement mats (not biodegradable) may be needed to stabilize a slope.

8-02 Roadside Restoration

GEN 8-02.1 General

Inspection of all roadside plants and planting areas should be performed by trained and experienced personnel. This section is written to provide a unified source of information for project personnel, including the landscape architect. It is not intended as a substitute for professional assistance. In most cases, the assistance of the region landscape architect should be engaged to provide this expertise. The *Roadside Manual* M 25-30, and in particular Sections 700, 710, 720, 800, and 820, provide additional

information on restoration related topics. When questions of adequacy of roadside restoration materials and procedures are encountered, or when differences of opinion concerning the acceptance or rejection of materials occur and the answers are not readily found in this section, the Region Landscape Architect or HQ Landscape Architect can provide assistance. In cases where insect damage and diseases are suspected, the services of an entomologist or plant pathologist may be required.

The Roadside Policy Manual requires vegetation to be saved and protected to the maximum extent possible. Construction activities, especially clearing, grubbing, and excavation, may result in damage to existing trees and shrubs that are designated to remain. If this happens, or if pruning of live vegetation is needed, the Inspector may contact the Region Landscape Architect or HQ Design Landscape Architect for assistance. Early identification and remediation of the damage will minimize shock to the vegetation.

Plants require a different understanding for construction. Drying out, excessive heat and cold, and other environmental stresses can be extremely detrimental to a restoration effort. The planting plan was developed to respond to the contract impacts, but the quality and treatment of the materials on the site will be of the utmost importance to ensure success.

Besides being used for environmental or aesthetic reasons, plants may also be used during construction in soil bioengineering. Soil bioengineering may be used as a BMP to stabilize and revegetate slopes and stream banks when changes in condition require adaptation to control sediment and erosion. For more information on the uses of soil bioengineering, see the *Roadside Manual* M 25-30 Chapter 740, and the Roadside and Site Development website.

Before planting begins, a meeting with the Project Engineer, the inspectors, and the Landscape Architect is recommended. The agenda for the meeting scheduled by the Project Engineer should include but not be limited to the following:

- The locations of planting areas with respect to the project as a whole.
- Construction issues such as mixing of soil amendments into the soil and compaction requirements. High levels of compaction are detrimental to roadside planting success. The ideal soil for plant growth is a loose soil with the right balance of organic matter, microorganisms, and minerals. Soils for plant establishment typically require a density less than 80 percent.
- Discuss the need for Maintenance involvement later in the project. At the initial layout stage, maintenance personnel may be better able to discuss plant layout and weed control coordination than may have been possible during the design phase.
- Discuss proposed modifications to the grading or planting plans with the Landscape Architect.

Ongoing coordination is needed between the Project Engineer, Inspectors, and Landscape Architects to assist in the successful completion of the Project and a successful hand-off to Maintenance at the end of plant establishment.

GEN 8-02.2 Landscape Terminology

Acid Soil/Alkaline Soil – The acidity or alkalinity of a soil is measured in terms of its pH. Various plants respond differently to pH variations. Generally, the soil west of the Cascades is acidic, while east of the Cascades is more basic. The pH scale ranges from 0 to 14. A pH measurement of 7 indicates a neutral soil; a pH measurement below 7 indicates an acidic soil; and a pH measurement above 7 indicates an alkaline soil or basic soil. Generally, plants are selected for a particular area based on their ability to survive without a need to change the pH of the soil.

Balled and Burlapped (B&B) – Plants are prepared for transplanting by digging them so that the soil immediately around the larger, central roots remains undisturbed. The ball of earth and root is then bound in burlap or similar mesh fabrics. An acceptable B&B root ball should contain 90 percent (visual estimate of volume) of the earth material held together with root system when removed from the burlap. The soil must remain moist, but not fully saturated, before planting.

Bare Root (BR) – Most deciduous plants are dug when dormant. The roots are cleaned, pruned, and usually stored in moist material. Roots must remain moist and not allowed to dry out.

Botanical Name – The botanical, or scientific name is the plant name, written in Latin, which is used universally. The common name is the name used in a local area, and is not necessarily the same name used in other areas. The correct botanical name is usually found in "Standardized Plant Names" and is available from the Landscape Architect. The botanical name usually consists of two names, Genus and Species, but may include additional names.

Genus:	1st word
Species:	2nd word
Variety:	3rd word (if appropriate)
Example:	Sambucus racemosa melanocarpa
Genus:	Sambucus
Species:	Racemosa
Variety:	Melanocarpa

Branch – An offshoot from a trunk or main stem. It could be also called a bough or a portion of a main stem.

Bud – A small protuberance on a stem, branch, or cutting containing an undeveloped shoot, leaves or flowers.

Caliper – The diameter of the trunk of a deciduous tree is measured 6 inch above ground level, up to 4 inch caliper size. If greater caliper than 4 inch, it is measured at 4.5 feet above ground level. The measurement at 4.5 feet is commonly referred to as diameter at breast height (dbh).

Cambium – A thin layer of generative tissue lying between the bark and the wood of a stem, most active in woody plants. The cambium produces new layers of phloem on the outside and of xylem (wood) on the inside, thus increasing the diameter of the stem. Healthy cambium is green in color.

Cane – A primary stem which starts from the ground of a shrub or at a point not higher than ¼ the height of the plant. A cane generally only refers to growth on particular plant material, such as roses, etc.

Clumps – Plants with at least double the number of canes required for standard material; trees with three or more main stems starting from the ground. Vine maples are sometimes sold by the clump.

Collected Material – Trees, shrubs, or other plant material collected from native stands, including Christmas tree stock and plants from native stands or forest plantings. After one growing season at the nursery, they are no longer considered collected material.

Compost – Stable, mature, decomposed organic solid waste that is the result of the accelerated aerobic biodegradation and stabilization under controlled conditions. The result has a uniform, dark, soil like appearance that smells like rich earth. Any ammonia smell indicates the compost is immature and a Solvita test should be run on the material.

Container Grown – Plants grown and delivered to the job site in plastic pots or other containers. Container grown plant should not be allowed to dry out while in the container. Usually, plants grown in containers are in a very free draining soil mixture made up of nutrient free components. Container grown plants have a tendency to dry out and decline in vigor when not under the care of the nursery.

Container grown material should have a firm root ball which will hold 90 percent (visual estimate of volume) of the ball material when removed from the container. Good container grown materials will hold virtually all of the soil in the root zone when a good growing medium is used. Some root growth should be visible in the outer edges of the ball. Excessive roots at the bottom of the ball indicate lack of proper root pruning. Excessive roots at the side or bottom of the container could indicate a root bound condition.

Cuttings – Cuttings are detached leaf buds or portions of branches which under favorable circumstances are capable of producing roots when placed in a growing medium. Common species used as cuttings are willow, cottonwood, and red osier dogwood.

DBH – Diameter at breast height. This is a standard measurement of a standing tree trunk and is measured at a height of 4.5 feet.

Fertilizer – Any natural or artificial material added to the soil or directly to the leaves to supply one or more plant nutrients. Generally, a complete fertilizer refers to a fertilizer that contains nitrogen, phosphorous, and potassium (NPK). Occasionally, sulfur (S) is used, especially in alkaline soils to lower the pH. Indications on a container are usually numerical 10-8-6 or 20-10-5, etc. These numbers indicate the percentage of actual nutrient element available, i.e., 10 percent nitrogen, 8 percent phosphorous, and 6 percent potassium (10-8-6). Other minor nutrients are sometimes added to NPK such as magnesium, manganese, boron, iron, zinc, calcium, etc.

Applying the wrong type of fertilizer can harm or kill plants. Consult with the Regional Landscape Architect or HQ Design Landscape Architect before applying fertilizers not specified in contract. In addition, approval by the State Construction Office may be required and approval by the Project Engineer and Regional Construction/Operations Engineer's Office is required (see the Change Order Check list).

Heeling In – A method of temporarily storing plants by covering roots with moist sawdust, mulch, soil, or a mixture of other materials capable of good moisture retention, to keep the roots from drying out.

Herbicide – An herbicide is a pesticide chemically formulated to control or destroy weeds. Herbicides are broken down into two main groups: Postemergence Herbicide and Preemergence Herbicide. Postemergence herbicide is a plant killing material that acts on the active growing surface of a plant after the plant has emerged from the soil. It is usually most effective during the rapid growth of the plant. Preemergence herbicide is a plant killing herbicide which acts to prevent the seeds, bulbs, tubers, stolons, etc., from sprouting (before-emergence).

Inoculated Seed – Seeds of the legume family that have been treated with nitrogen-fixing bacteria to enable them to make use of nitrogen from the soil atmosphere.

Mulch – Mulch is any loose material placed over soil, usually to retain moisture, reduce or prevent weed growth, insulate soil, or improve the general appearance of the plant bed. Additional fertilizer is sometimes necessary in order to offset the loss of plant nutrients used by the microorganisms that break down the mulch, especially when using non-native stock.

Mycorrhiza – A beneficial group of fibrous fungi that attach to the roots and absorb water and nutrients in solution and transfer this solution to the roots of plants. In effect, they multiply the plants' root systems many times. These can be seen as fine white netting on moist compost or bark mulch. This is a good thing and not something to be concerned about.

Node – A small protuberance on a stem, branch or cutting containing an undeveloped shoot, leaves or flowers.

Pesticide – A pesticide is any substance or mixture of substances intended to control insects, rodents, fungi, weeds, or other forms of plants or animal life that are considered to be pests.

Root Ball – Ball of earth encompassing the roots of a plant. Generally, the root ball will have a good portion made up of root networks. A "manufactured-root ball" is one where the root system is not adequate to hold the soil in place. Manufactured root balls should not be accepted, since the root system is not developed sufficiently.

Rootbound (Pot Bound) – The condition of a potted or container plant whose roots have become densely matted and most often encircle the outer edges of the container. Generally, this condition is a result of holding the plant in the container for too long a period. Root bound plants should be rejected. See *Standard Specifications* Section 9-14.6(2). Circling roots will eventually kill the plant.

Root Collar (Plant Crown) – Root Collar is the line of junction between the root of the plant and its stem, also known as the plant crown. The plant needs to be planted so the root collar is at or within an inch above the soil surface.

Runner – A long, slender, trailing stem that puts out roots along the ground. Where the nodes make contact with the ground, a new plant is produced. (For example: Kinnikinnick or wild strawberry.)

Soil Bioengineering – Soil bioengineering combines the use of live plants or cuttings, dead plant material, and inert structural members to produce living, functioning land stabilization systems.

Soil Amendment – A mixture of a growing medium, such as compost with the native top soil.

Vigorous – Plants that demonstrate vigorous growth have bright green cambium, strong stems and healthy leaves with no indication of stress (discoloration of leaves, insect damage, or wilt). Plants growing in a vigorous condition also have a well formed and healthy full crown with plump, firm and moist roots that have light growing tips during the growing season. A vigorous stand of grass has a lush, rich-green appearance with no dead patches or major gaps of growth within the established area. A stand of grass that displays rusting, wilting, stunted growth, diseased grass, or browning and yellowing of leaves is not considered vigorous.

Watering-in – Watering-in is a process used to settle the soil with water by eliminating air pockets during the planting process. This is also known as "puddling".

WSNLA – Washington State Nursery and Landscape Association.

GEN 8-02.3 Reference Reading

It is recommended that each office administering roadside planting, view point development, and rest area contracts, obtain and maintain a library of books and reference materials listed under Additional Sources of Information in Section 800 of the *Roadside Manual* M 25-30, before the Contractor commences work. Another resource is the *Inspection Guide for Landscape Planting* published by AASHTO.

SS 8-02.2 Materials

Materials for roadside restoration include many items besides plant material, such as compost, topsoil, bark or wood chip mulch, soil amendment, pesticides, fertilizer, seed, hydromulch, staking and tying material, irrigation/electrical material (pipe, pumps, sprinklers, backflow control devices, valves, etc.). Drainage and surfacing materials are covered in their respective sections of the manual.

SS 8-02.3 Construction Requirements

SS 8-02.3(2) Roadside Work Plan

Before starting any work in Sections 8-01, 8-02, and 8-03 that disturbs the earth, forward the Roadside Work Plan to the Region Landscape Architect or the HQ Design Landscape Architect for review and approval recommendation. The Plant Establishment Plan should be approved prior to initial planting acceptance.

Ensure the progress schedule is attached for approval. The Contractor's progress schedule should show the order in which the Contractor proposes to perform the work within the contract time. It should show the beginning and completion times for the work necessary to provide all Contract requirements covered in accordance with Sections 8-01, 8-02 and 8-03 as well as several prominent features of the work provided in the contract. Upon request of the Project Engineer, the Contractor will submit supplementary progress schedules in the form required by the Project Engineer. In the case of material to be grown, the progress schedule shall, in detail, specify planting and propagation times. Materials must be grown outside of greenhouses for a minimum of two weeks to ensure hardening off prior to placing them in the field.

The Roadside Work plan indicates the proposed timing to perform the work and should include (but is not limited to) the following activities :

- Site and Vegetation Protection
- Clearing, Grubbing, or Pruning
- Herbicide Application
- Wetland excavation
- Grading
- Soil preparation
- Planting and Seeding Preparation
- Compost placement and incorporation
- Bark Mulch Placement
- Planting and Seeding Operations
- Irrigation or watering methods

The Weed and Pest Control plan must be reviewed and approved before starting work on the project. Items that should be covered in the Plan include, but are not limited to:

- Unwanted Vegetation or Target Weeds
- Weed and Pest Control methods
- Chemicals proposed for use
- Dates of Weed and Pest Control operations
- The correct timing for herbicides, fertilizing, mulching, pruning and all other phases must be specified in relationship of one event to another.

- Supervisor/Responsible Contractor Contact Information
- Pesticide Applicator Contact Information and Pesticide Applicator's License Number. All pesticide applicators must be licensed.

Plant establishment begins when plants are planted and the planting has been accepted. The Plant Establishment Plan must show the scheduling, frequency, dates, materials and equipment utilized, whichever may apply, for all plant establishment activities including, but not limited to, the following:

- Weed Control for Target Weeds within Planting Areas
  - Chemical Applications (post and pre-emergent)
  - Hand weeding and removal
- Fertilizing
- Watering
- Litter and Debris Removal
- Pruning
- Insect and Disease Control
- Erosion Control Methods and Procedures
- Plant Replacement
- Irrigation system (if applicable)
  - Winterization and Procedure
  - Spring Start-up and Procedure
  - Cross-Connection Control Device – Annual Testing and Inspection for Complete Operation

SS 8-02.3(5) Planting Area Preparation

Complete preparation steps prior to installation of plant materials according to the requirements of the contract plans and specifications:

- Weeds are controlled throughout the entire planting and seeding areas, as called for by the contract specifications. Inspect weed root systems to ensure complete weed eradication. The interior color of dead or dying roots is usually tan or brown, whereas healthy roots are usually white. If the weed's root systems are still alive, delay planting until they can be killed. Perennial weeds with extensive root systems such as Canada thistle, Japanese and Bohemian knotweed, horsetail, wild pea, field bindweed, and quack grass (see *Common Weeds of the United States* – United States Department of Agriculture) should only be controlled with herbicides by a licensed applicator, to avoid the spread of live plant parts that might produce further weed patches with manual removal.
- Planting holes, pockets, or beds are excavated to the required size and depth, and spaced as shown on plans.
- The backfill mixture is prepared and stockpiled according to contract specifications.
- The planting holes are excavated to the sizes indicated in the Contract Plans. The *Standard Plans* contain minimum planting hole diameters.

SS 8-02.3(7) Layout of Planting

The layout of planting areas in wetlands or stormwater facilities is critically important to the wetland's success. Many plants have exact water requirements and will not thrive or even survive if planted in water too deep or too shallow. Changed conditions happen frequently during the grading phase. Work with the Landscape Architect to ensure the hydrology of the grades are finished to the necessary elevations before planting. Close coordination with the designer during the grading and plant layout phases can identify potential problems and fix them before they become costly mistakes.

Tree locations might need to be adjusted to anticipate the size of the tree when fully grown for:

- Minimum clearance to roadways
- Mowing edge setbacks
- Sight lines
- Existing utilities
- Signs
- Structures
- Drains

Planting areas might also need to be adjusted to align with the plans and the disturbed areas, and the edge should create a "flowing" outline that is aesthetically pleasing and mowable. It is important that sufficient stakes are used to clearly outline the planting areas. Again, the Landscape Architect should be consulted to ensure proper planting area placement.

- Review the plan sheets, quantities, details, specifications, and other provisions in the contract with the Contractor Questions or interpretations can be answered or problems resolved through discussion with the Region Landscape Architect.
- All materials that have specification requirements shall have an approval of source prior to incorporation or use on the project. The Contractor is required to submit samples of materials to verify that the materials adhere to the specifications. See Chapter 9 for further instructions and Section 8-2.6 for examples.
- The Inspector should check and accept the stakeout of all planting areas and planting hole locations prior to excavation. Minor relocation of planting areas and holes can be done at this time to avoid utility lines, rock outcrops, drainage ditches, signs, obstructions, or impervious or wet soil conditions. If minor relocation of plantings is not possible, the Inspector should contact the Landscape Architect to adjust the design requirements or quantities.

SS 8-02.3(8) Planting

Plant Material

Inspection at the Nursery – Upon Contractor request, inspections may be done at the nursery. However, acceptance is only given once on-site inspection determines the adequacy of the material to meet the specifications. The Region Landscape Architect or HQ Landscape Architect should perform this inspection and make recommendations to the PEO to be communicated to the Contractor.

Inspection at the nursery or other source of supply should include the following:

1. Review the general condition of the plant in the block from which the stock is to be taken:
   a. **Uniformity of Leaf Coloration** – Yellowing or other leaf discoloration could indicate poor drainage, fertilizer deficiency, herbicide damage, insect damage, or disease, and may not meet specifications.
   b. **Bud Development** – During dormant periods of the growth cycle, plants should have buds that are firm, moist, and uniformly spaced. A slight cut into the bark may be made to determine that the cambium, or growing layer just beneath the bark, is moist and green.
   c. **Uniformity of Growth** – Acceptable plants in any given block should exhibit uniform vigor and health.
   d. **Spacing of Plants in the Nursery Row** – Sufficient spacing is needed to permit vigorous development of the individual plant.
   e. **Soil** – Plants to be balled and burlapped must be grown from soil that will hold a firm ball. Reject broken or loose balls due to the potential for damage to the hair roots.
   f. **Presence of Weeds** – Reject containers with an abundance of weeds in the containers. An overgrown, weed-infested nursery block indicates lack of care and the plants growing in it may be in a poor state of vigor.
2. Check individual plants for freedom from defects such as:
   a. **Decay** – Reject trees with spots of decayed tissue on the trunk and branches.
   b. **Sunscald or Sunburn** – Plants with damage to cambium tissue and bark due to sun scald on the south or southwest side are unacceptable due to the potential for secondary insect and/or disease infestation.
   c. **Abrasions of the Bark** – Abrasions severe enough to damage the cambium tissue may be sufficient for rejection.
   d. **Girdling Roots** – Roots that grow around another root or a stem are cause for rejection.
   e. **Improper Pruning** – Pruning cuts should be made just outside the branch collar and close to the trunk or supporting branch. When a cut is made to encourage branching, it should be made back to a bud. Improperly pruned stubs that have died back are a significant point of entry for disease organisms.
   f. **Frost Cracks** – Long vertical splits in the bark and/or wood may occur on the south and southwest sides of young and thin-barked trees. Such cracks may be invaded by canker or decay-producing fungi and bacteria.
   g. **Signs of Injury** – Dead leaves, dry buds; dieback of twigs and branches; blackened sapwood and sudden, discolored patches of bark (sunscald) on the trunk or limbs.

h. **Diseases** – Look for abnormal growth of leaves, twigs, fruits, discoloration of leaves and bark, unusual discharges of sap through the bark, etc. Reject plants showing evidence of disease.

i. **Insects** – Look for insect eggs, spider webs, or evidence of damage from insect feeding on leaves, twigs, buds, or other plant parts. Examine the trunks of trees for borer holes which appear as tunnels drilled into the bark and inward into the wood of the trunk. Reject trees with evidence of borers or other insect damage. Often sawdust-like material can be found below bore holes.

3. Check individual plants for proper habit of growth as follows:

   a. If a particular habit, i.e., single stem, multiple stem, has been specified, plants must conform to this requirement.

   b. If no particular growth habit has been specified, then the current *American Standard for Nursery Stock, Z60.1* as published by the American Association of Nurserymen should be used as a guide.

   c. Top growth on shade and flowering trees should be symmetrically balanced, have a single leader, and well-developed branching characteristic of the species.

   d. Evergreen trees should be uniformly dense. Sheared plants, such as Douglas fir sheared for Christmas trees, are not allowed, unless specified.

   e. Shrubs should be well branched in a manner characteristic of the species. If not specified in the contract, the standards for size and number of branches by species listed in the current *American Standard for Nursery Stock, Z60.1* applies.

4. Remove a random sampling of plants from their containers to verify that the root system is healthy. Reject root-bound plants and plants that have insufficiently developed root systems to hold the soil together. Healthy roots will hold the soil mass together yet not be crowded around the outside perimeter of the container.

5. Tag planting stock meeting the above criteria with seals placed on all plants or representative samples at the nursery to assist in future inspection of these plants when delivered on the job site. Seals placed on planting stock for later identification do not imply acceptance on the construction site.

Inspection at the Construction Site – Acceptance of stock may only be given at the construction site according to the *Standard Specifications*. It ensures that the plants delivered are from an accepted source, are in a healthy and undamaged condition, and conform to sizes, quantities, and standards called for in the specifications. Plant inspection lots should be established and a representative number of plants should be inspected in accordance with Section 9-4.44.

Inspect the condition of the plant and verify that proper handling procedures have been followed from the time of initial inspection to delivery at the construction site. If there are questions about the following checklist, consult with the Landscape Architect for clarification.

Inspect plants delivered to the construction site for the following:

1. All planting stock are of the genus, species, variety, and sizes specified and conform to the contract specifications for the particular species, or variety, regarding straightness of trunk, branching structure, proportion, and size of material.
2. Individual plant measurements meet the contract specifications. If a particular detail of measurement has not been specified, the current edition of *American Standard for Nursery Stock, Z60.1* shall be used.
3. Use judgment and selectivity to sample plant materials. Inspect the entire lot for the same criteria as in the nursery inspection. Ensure each shipment of plants is free of disease and insect pests, and meets all applicable State and Federal certification requirements. All necessary quarantine or State nursery inspection certificates accompany each shipment.
4. All trees and a representative sample of shrubs are legibly tagged with the correct botanical name, common name, and size to agree with the specifications and plant list. Bare-root plants have been shipped in bundles with each bundle properly tagged.
5. Inspect planting stock as the material is being unloaded, or immediately thereafter, so that plants that are obviously unacceptable can be set aside for removal from the project site.
    a. It is sometimes helpful to mark the pots of unacceptable plants with a dot of spray paint to ensure they are set aside to return to the supplier.
    b. Set plants in blocks of 10, 25, 50, or 100 containers for ease of counting plants – block size is dependent on the scale of the project.
6. Large root stubs on nursery grown balled or bare-root stock are indicative of lack of proper care and root pruning, and sufficient grounds for rejection of such plants. Root stubs frequently characterize "collected" stock and precautions should be taken to ensure that root systems are adequate

7. Damage to plant material caused by improper operation of mechanical diggers may be sufficient cause for rejection at the construction site. Plants dug with equipment leave a cone-shaped ball; these should be carefully checked to make sure that an excessive portion of the root system has not been cut away. Feeder roots are the newly formed roots, usually white in color.

8. Bare Root Plants:

   a. Where root formation is irregular on bare-root plants, measure the average spread of the roots, considering all sides of the plant, rather than the maximum root spread. The Inspector may allow moderate deviations (±10 percent) from exact measurements in the case of plants which normally have irregular root systems. Example: Vine Maple.

   b. Bare root plants must be dormant when gathered and prepared for shipping. The normal test for dormancy is observation; if the plant has been subjected to cooling environment and the majority of the leaves have fallen naturally it is a good indication of dormancy. Expert advice from the Landscape Architect should be obtained in all other cases. Bare-rooted plants meeting the quality expectation have adequate live, damp, fibrous roots, free of rot and mold. Earth balls should be unbroken and of specified size.

   c. Precautions should be taken to prevent the drying of root systems in all shipments of plants to ensure arrival in good condition. During transport, plants must have been protected by a covering such as canvas or plastic sheeting. Bare-root plants should have been protected by moist burlap, sawdust and surrounded by plastic, etc. Under no conditions should the roots system have been allowed to dry out. All plants must exhibit normal health and vigor.

   d. Reject plants with roots that have dark brown tips, are shriveled, dried up, soft, slimy, smelly, or moldy.

   e. Reject plants with dull green, streaked, or brown cambium. The inspector is authorized to examine cambium on randomly selected woody plants by removing a thin scraping of bark with a fingernail, small knife, or other tool.

   f. Following completion of inspection, all plants accepted should be carefully stored as required below until planted.

9. Quality – The size and quality of planting stock are standardized as much as is practicable considering that the materials are live and may vary due to growing conditions. Judgment should be exercised and allowances made for reasonable variation in growth and appearance.

Planting Media – Various additives are sometimes used to improve the root growing environment of the soil that exists on a site. Generally, soil amendment consists of compost. Additives may be either used as a blanket or incorporated into the existing soil. Check the planting (growing) media material against the specification.

Pesticides – The person applying the pesticides must be a licensed applicator. The licensed applicator is responsible to only apply according to the label to ensure the proper material is used on the specific target, and with an appropriate timing of application. The pesticide label will give instructions such as intended use of the product, directions for use, and warnings. The Pesticide Application Record (WSDOT Form 540-509) is required to be completed daily by the Licensed Applicator with a copy given to the Project Engineer. The Project Engineer is to distribute a copy of this record daily to the Region Operations or Maintenance Engineer and to the Roadside Maintenance Section at the HQ Maintenance and Operations Office in Olympia. Only herbicides listed at the Roadside Vegetation Management website shall be used.

Fertilizers – Apply fertilizers in accordance with the specifications. Cross check the label on the bag or container with the specifications. When water soluble nitrogen fertilizers are used, particularly in lawn areas, adequate moisture is needed to prevent fertilizer burn of the grass.

Seed – Seed mixes are chosen specifically to meet different functions that include erosion and weed control, aesthetics, and permit obligations. Applying the incorrect seed mix to an area can lead to costly erosion and weed control problems.

- Collect seed labels from *each* bag and check them against the Specification.
- Verify all the applicable licenses, endorsements, and seed test certification from a certified seed testing laboratory as stated in the Specifications.

Compost – Compost is used for multiple functions on projects. It serves as a soil amendment, may be a component of topsoil, and is used as an erosion control BMP when applied as a blanket over soil.

- Prior to placement review the compost for physical contaminants (plastics, concrete, ceramics, metal, etc.) and ammonia odor.

Inspection During Planting – Planting stock on hand and ready for planting at the construction site should have been inspected upon delivery, in accordance with the checklist under "Inspection at the Construction Site".

Interim Care of Planting Stock – Plants not planted on the day of arrival at the site should be stored and handled as follows:

- Outside storage should be shaded and protected from the wind.
- Plants stored on the project should be heeled-in to protect them from drying out at all times by covering the bare root or balls with moist sawdust, wood chips, shredded bark, peat moss, or other accepted mulching material. Plants, including those in containers, should be kept in a moist condition until planted by using a fine mist spray or soaker hose, instead of a heavy stream which may cause damage.
- Avoid damaging plants being moved from the storage area to the planting site. Balled and Burlapped (B&B) plants should be protected against drying and handled carefully to avoid cracking or breaking the earth ball. Plants should not be handled by the trunk or stems.
- Bare-root plants should be watered when removed from the heeling-in bed to protect the roots from drying and they must be planted quickly.
- Should damage occur, or be found at this time, the plants should be rejected and removed from the site.
- At the time of planting, the Inspector should be alert for any damaged soil balls, leaders, major branches, or roots. Pruning is permitted to remove minor damaged branches, if it will not affect the characteristic shape of the plant (see Western Garden Book – Pruning Techniques). All rejected plants should be replaced during the current planting season. All broken, torn, or damaged roots should be pruned, leaving a clean cut surface to help prevent rot and disease.
- In order to ensure against reuse of discarded plants, seals should be removed and the trunk or stems above the root crowns should be marked with a small spot of paint or dye. Since discarded plants are the property of the Contractor, they should not be marked or mistreated in such a way as to make them unfit for other uses.

Planting Operation – The contract specifications identify the work necessary to accomplish the planting. The following is a checklist of horticultural practices that may be used by the Inspector.

- Plantings should be performed only during the specified planting season according to the specifications.
- Check for proper positioning of the plants and the spread of the root system in the planting hole. For example, on live stakes, the buds must point up, see *Standard Plan H-10-15-00*.
- When laying out shrub and ground cover beds, define the perimeter by placing plants in a flowing line that clearly outlines the bed border. The interior should then be staked in accordance with the plant pattern and spacing.
- Before B&B plants are set into the planting hole, burlap, twine, and all other foreign materials shall be completely removed.
- Check for correct depth of the root collar. Tree root collars should be above the soil but roots must be completely covered by soil. Occasionally, contractors leave a portion of the rootball above the soil on the assumption that the mulch will cover it up. This is not an acceptable practice. Plants should not be planted deeper than the root collar – this is the point where the roots begin to spread from the trunk. In some cases, trees may have been planted too deeply at the nursery so make sure root collars are visible above the soil surface before planting.
- Before backfilling, especially in drilled holes, the sides and bottoms must be scratched and loosened to break all "glazing." This promotes moisture transfer between different soils (existing and backfill).
- Place accepted backfill material around plant roots or plant balls, being careful not to damage the ball or the fine root system of bare-rooted plants. Do not allow backfill which is frozen or saturated.
- Eliminate air pockets in the backfill by filling, tamping, and watering. It is required in the *Standard Specifications* to water the plants thoroughly before the backfilling of the pit is completed. Container plants should be moist at the time of planting.
- When the above operations have been completed, unless otherwise specified, the *Standard Plans* planting detail H-10-10-00 requires a berm of soil to be formed from soil around the perimeter of the pit to form a basin or saucer to facilitate watering and retention of rain or irrigation water. When planting on slopes, the berm should be on the downhill side only. This allows the plant to catch runoff from up slope.
- Plants should be mulched to the specified depth with accepted mulch material. The *Standard Plans* require mulch to be feathered away from tree root collars. When mulching ground covers, ensure the plants are not buried in mulch.
- Excessive moisture in a planting area is defined as visible water in an area not designated as a wetland, and may require elimination or adjustment of planting in that area. Consult with the Region Landscape Architect when excessive moisture is encountered. Mounding may be considered when it is necessary to raise the bed above the water table. Planting in saturated soil often kills the plant because the water keeps oxygen from reaching the plant roots.

SS 8-02.3(9) Pruning, Staking, Guying, and Wrapping

Plants should be wrapped and staked only if specified. Details for staking are shown in *Standard Plan H-10-10-00*.

- Trees normally should not be pruned except for broken branches, unless otherwise specified or directed.
- All staking and tying shall be removed at the end of the first year of plant establishment to prevent damage to the plant.

SS 8-02.3(12) Completion of Initial Planting

The planting is complete when:

- 100 percent of plants are installed and watered-in. Watering is required by *Standard Specification* 8-02.3(8) as a part of plant installation
- The planting areas are completely cleaned up.
- All repairs to irrigation systems have been completed, mulch is applied, and weeds are completely controlled.

SS 8-02.3(13) Plant Establishment

Plant establishment begins at Initial Planting Acceptance. The major items included in plant establishment are watering, weed control, litter pickup, start up and shut down of irrigation systems, and replanting. Weather and soil conditions dictate the need for watering. Over-watering is as harmful as under-watering. Plant establishment work is needed to ensure the survival and ongoing vigor of the plants.

Inspection During the Plant Establishment Period

Plants may be planted in any given area a considerable period of time prior to the granting of initial planting acceptance. During the interim between when plants are installed and initial planting acceptance the Contractor is responsible for the upkeep of planting areas and continued growth of plants.

Although planting stock has been properly selected, delivered to the planting site in a vigorous, healthy condition, and planted in accordance with good horticultural practices, survival and normal growth depend to a large degree upon appropriate care during the establishment period. A well rounded program of horticultural practices used during the establishment period may include watering, fertilizing, pruning, insect, disease, and weed control, and replacement of unsatisfactory plants in accordance with the specifications.

When plant establishment starts the area should be inspected to make sure that all plants are in place and healthy. Monthly inspections of the planting areas should take place with the Contractor on or near the first of each month during the Plant Establishment Period to spot any potential problems to which the Contractor needs to attend.

If differences of opinion concerning the need for a particular procedure occur, and the answers are not readily found in this guide, the Inspector should consult with the Region or HQ Landscape Architect.

The project specifications should clearly indicate the length of the establishment period, which may vary from one area of the state to another, depending on the local conditions, project commitments, climate, and the type of plant materials utilized. The default period for plant establishment in the *Standard Specifications* is a minimum of one year.

A. **Inspection Checklist** – The following inspection checklist includes the primary items which should be observed periodically during establishment.

- The project areas are weeded.
- Plants that have sagged, fallen over, or are otherwise not situated in a natural growing position, as appropriate for the species, may require repositioning.
- Firmly embed stakes or reinstall as necessary.
- Protect the root mass to avoid disturbance to the root mass. Replace topsoil as required if soil has subsided.
- Staked trees are straight. Adjustment of stakes may be needed. Where used, protective wrapping on trunks or stems is secure.
- Damage due to vandalism, vehicles, or fire is noted and corrective action taken.
- Record damage caused by animals (i.e., deer, rodents) and seek advice on protective measures.
- Report infestations of insects and disease to the Landscape Architect for corrective action.
- Broken branches have been pruned just above the break.
- Where discoloration of foliage occurs, especially in evergreen material, seek advice on corrective measures. Once evergreen foliage is brown recovery is not possible.
- Dead and severely damaged plants are removed immediately and replaced during the next appropriate planting period.
- Mulch is to the correct overall depth. Add or replace as required.
- Berms and water basins (constructed for the purpose of retaining water) are functioning properly. Repair and rebuild as necessary.
- If natural rainfall during the establishment period is insufficient for normal plant growth, supplemental water has been supplied.
- Supplemental fertilizers have been applied if required by the Contract Specification.

B. **Inspection at the End of the Plant Establishment Period** – Conduct a plans-in-hand review of each planting area or bed to determine that the arrangement, number, and species of healthy plants called for on the Planting Plans are present.

This inspection is of major importance to the ultimate success of the project; include a Landscape Architect, the Inspector, and Contractor on the inspection team.

Remove all plants rejected during the inspection and replace with new plants that meet all of the requirements of the contract and the *Standard Specifications*.

The final acceptance of the project is not complete until all plant establishment requirements have been satisfactorily made.

SS 8-02.5 Payment

The Project Engineer shall make an inspection of the planting areas before payment is made, to determine if the required work has been accomplished and the number and species of plants shown on the Planting Plans are in a healthy condition. No payments shall be made for plants that are not in a healthy condition, although partial payment may have been made following a previous inspection.

8-03 Irrigation System

GEN 8-03.1 General

The objective of irrigation on WSDOT contracts is to help ensure plant survival by supplementing natural precipitation during dry periods. This can often be accomplished with far less water than that required to obtain maximum growth and yields. Application rates of irrigation systems are, therefore, designed from the standpoint of minimum moisture requirements of the plants.

A properly designed and installed irrigation system will distribute water uniformly over the intended planting area at a predetermined precipitation rate, or by irrigating within the root zone of plants by bubblers or a drip system. Many factors influence the efficiency of a system's operation and must be taken into consideration during the design stage. In addition, care must be taken when inspecting installation of the irrigation system to ensure that the system not only follows the designer's intent, but also fully conforms to the *Standard Specifications*, project plans and provisions, and the manufacturer's requirements and recommendations.

The most efficient and economical irrigation design is only as good as its installation, and this depends upon careful and thorough inspections.

GEN 8-03.2 Inspection

Thorough inspections, carefully conducted during construction, are of utmost importance to help ensure proper installation. To be adequately prepared for inspecting the installation of irrigation systems, it is of great benefit for the Inspector to have previous knowledge, preferably some experience, in at least one of the various aspects of irrigation design, installation, and maintenance. This not always being possible, it becomes necessary for the Inspector to first familiarize themselves with those portions *Standard Specifications* Sections 8-03 and 9-15 and contract documents that pertain to inspection and irrigation systems before attempting the necessary inspections. In addition, since irrigation inspection requires such varied and versatile knowledge and experience, it is advisable for the Inspector to obtain additional advice and/or assistance from WSDOT personnel having the expertise in these specialty areas.

An inspection shall be conducted on all irrigation system components delivered to the project site to determine acceptance or rejection. If at any time, until the system is completed and turned over to WSDOT, components are found that are damaged, defective, or not formally accepted for use on the project, they shall be rejected. Information indicating acceptance or rejection of components shall be properly documented and maintained by the Inspector at all times.

SS 8-03.2 Materials

All components intended for use in an irrigation system must receive acceptance prior to their incorporation into the project as required in chapter 9-49.9.

Acceptance of items is determined from information supplied on the Request for Approval of Material (RAM) (WSDOT Form 350-071) and accompanying catalog cuts. Items selected off the *Qualified Products List* are already accepted for use and do not require the submittal of a RAM. All components of the irrigation system shall be listed and identified by their corresponding bid item number where applicable. Sufficient information must be included to positively identify each item listed. Each item shall be identified by size, catalog number, and the name of the manufacturer.

If samples are requested for preliminary evaluation, it will be the Contractor's responsibility to obtain and submit the designated items to the Project Engineer for testing. Unless destructive testing is required, all items will be returned to the Contractor upon completion of testing, at which time accepted items may be incorporated into the project.

8-03.3 Construction Requirements

8-03.3(1) Layout of Irrigation System

Irrigation is installed before planting. The outlines for turf areas and planting beds shall be designated prior to staking the irrigation system. If adjustments to a head-to-head irrigation system are required, they must produce a system which will provide a uniform spray pattern without leaving dry areas.

Spray heads to be located adjacent to the perimeter of planting beds should be laid out first to approximate as closely as possible the designed or accepted revised configuration of the planting area. The remainder of the planting area should then be filled with the spacing between heads not to exceed that which is shown on the plans or recommended by the manufacturer.

Review all layouts and measure the distance between adjacent heads to ensure that full coverage of water will be attained. If the pattern is not uniform in coverage, or if the distance between heads exceeds that recommended by the manufacturer, the layout will need to be adjusted.

Unless otherwise specified in the project provisions, all irrigation systems shall be completed, tested, accepted, and properly backfilled before planting can begin.

Advise the Regional Landscape Architect when the irrigation system has been staked in the field.

SS 8-03.3(5) Installation

Once the irrigation system layout has been staked and accepted by the Project Engineer, the Contractor may commence excavation.

Trench bottoms shall be relatively smooth to provide support along the entire length of pipes to be installed. In addition, and as specified in *Standard Specifications* Section 8-03.3(2), trench bottoms shall be of sand or other suitable material free from rocks, stones, or any material which might damage the pipe.

All system components shall be installed in accordance with the project plans and documents, using methods or techniques recommended by the respective component manufacturers.

Solvent welding is a technique used to bond PVC pipe and fittings together. The solvent cement used in this type of installation is, as its name implies, a solvent which dissolves those portions of the pipe and fittings surfaces to which it is applied, to form a continuous bond between the mating surfaces. During the construction of PVC solvent weld joints, excess cement is forced out by the insertion of the pipe into the fitting socket. This excess cement, if not immediately removed, will dissolve the surface of the pipe at its point of accumulation and will result in a permanently weakened spot. It is necessary, therefore, that this excess cement be wiped at the time the joint is made and that the Inspector check to ensure that it has been done.

Plastic pipe is subject to considerable expansion and contraction with temperature changes. To provide for this, pipe should be snaked from side-to-side in the trench.

Care shall be taken during the installation of the pipe to ensure that rock, dirt or other debris is not allowed to enter the open ends of the pipe.

Protection from freezing must be provided as specified in the project documents. Either a three-way valve with compressed air fitting for blowing water out of the lines, or drain valves placed at the low point of each lateral must be used. If the three-way valve and air fitting is to be used, it must comply with one of the designed installations accepted for use by the Washington State Department of Health. If drain valves are used, care must be taken to ensure that the lateral lines are properly sloped to provide complete drainage. When handles are included as an integral part of the valves, the Contractor shall remove the handles and give them to the Engineer for ultimate distribution to the Maintenance Division.

SS 8-03.3(6) Electrical Wire Installation

Electrical control wire between the automatic controller and the automatic control valves, shall be bundled together at 10-ft intervals and snaked from side-to-side in the trench, either adjacent to or beneath the irrigation pipe. Snaking of the wire helps eliminate wire stressing or breakage caused by expansion or contraction of the earth due to variations in moisture content or extreme seasonal temperature fluctuations. Placement of the wires adjacent to or beneath the irrigation pipe is for protection against damage from possible future excavation. After partial backfilling of the irrigation trench, detectable marking tape shall be placed above the irrigation and wiring lines to facilitate future location of the lines. This is shown in the Plans.

Electrical splices shall be permitted only in valve boxes, junction boxes, pole bases, or at control equipment. No direct burial splices shall be allowed. Types of electrical splices allowed in WSDOT irrigation projects shall be only those accepted for use by the State Materials Laboratory. Accepted electrical splices are listed in the *Qualified Products List* or may be accepted through the use of a RAM.

SS 8-03.3(10) As-Built Plans

The Project Engineer is required to submit As-Built Plans in accordance with Section 10-3.11.

Accurate As-Built Plans are a valuable and necessary aid in designing and constructing future projects for the area, and for maintenance and repair of the irrigation system. Therefore, it is imperative that these As-Built Plans show the true location, size, and quantity of components installed.

Standard Specifications Sections 1-05.3 and 8-03.3(10) state that the Contractor is responsible for supplying working drawings, corrected shop drawings, schematic circuit diagrams or other drawings necessary for the Engineer to prepare corrected plans to show the work as constructed. To help ensure accuracy of this information requires that the Contractor or field representative record each change as it is completed. In addition, the Inspector shall inspect and verify this information prior to the commencement of backfilling. Upon completion of this, all working drawings and pertinent information shall be submitted for the Project Engineer's acceptance and use in preparing the As-Built Plans.

The Contractor may also be required to conduct a training and orientation session for WSDOT personnel covering the operation, adjustment, and maintenance of the irrigation system. The Project Engineer shall arrange to have the maintenance personnel who will be involved with the irrigation system attend this orientation session. The As-Built Plans shall be available so they can be reviewed and all features explained. One copy of the As-Built Plans shall be presented to the maintenance personnel at that time, along with parts lists, keys to vaults, and service manuals for all equipment.

SS 8-03.3(12) Cross-connection Control Device Installation

A cross-connection is any actual or potential connection between a potable water supply and a source of contamination or pollution.

Backflow is the unwanted reverse flow of liquids in piping system and is the major means by which contamination of potable water can occur. Backflow is the result of either back pressure or back-siphonage. Backflow from back pressure can occur any time pressure produced in the non-potable piping system is greater than that existing in the potable side. Backflow from back-siphonage is the result of a negative or subatmospheric pressure within a potable water system, causing contaminants from the non-potable side to be suctioned in.

Irrigation systems supplied by domestic potable water systems are potential pollution hazards to the potable water. Such cross-connections require protection to prevent the possibility of backflow.

A backflow prevention or cross-connection control device is any device, method, or type of construction used to prevent backflow into a potable water system.

An accepted backflow prevention or cross-connection control device is one that has been investigated and accepted by an appropriate regulatory agency. The approving or regulatory agency for backflow prevention, cross-connection control devices for the state of Washington is the Department of Environmental Health. This agency

periodically publishes a list of accepted cross-connection control devices. The HQ Design Landscape Architect will maintain a copy of this list to assist the regions.

The local water purveyor determines the type of backflow prevention device to be used to protect domestic water supply systems under their jurisdiction. This determination is based upon the water purveyor's estimation of the probability of backflow occurring and the degree of hazard created if it should. Once the type of device to be used has been determined, the device shall be selected from the Department of Environmental Health current list of accepted cross-connection control devices.

Installation of cross-connection control devices shall conform to the *Standard Specifications*, the project plans and documents, the manufacturer's recommendations, and the "Accepted Procedure and Practice in Cross-Connection Control Manual." In all cases, the backflow prevention device shall be tested by a certified inspector prior to activating the system. Additionally DOT Form 540-020 shall be filled out and the appropriate distribution made.

SS 8-03.3(13) Irrigation Water Service

The Project Engineer shall contact the serving water utility as soon as the Contractor's schedule is known, to arrange for the actual service connections, and to ensure that all agreements are completed and billing procedures are established.

SS 8-03.3(14) Irrigation Electrical Service

The Project Engineer shall contact the serving electrical utility as soon as the Contractor's schedule is known, to arrange for the actual service connections, and to ensure that all agreements are completed and billing procedures are established.

8-04 Curbs, Gutters, Spillways, and Inlets

SS 8-04.3 Construction Requirements

SS 8-04.3(1) Cement Concrete Curbs, Gutters, and Spillways

The *Standard Specifications* specify the class of concrete to use when constructing the various items. Quite often the Contractor places the concrete for these miscellaneous items at the same time of placing concrete for other work. When this is the case, it is usually more convenient for the Contractor to use the same class of concrete for all the work during the day. At the Contractor's request, the Project Engineer may accept a higher class of concrete in lieu of the class specified at no increased cost to WSDOT. This substitution should be documented in the diary, Inspector's daily report, or other records.

8-11 Guardrail

GEN 8-11.1 General Instructions

Since guardrail is expensive to construct and requires continual maintenance, it should be constructed only where hazardous conditions justify its use. During construction, the Project Engineer should investigate eliminating the need for guardrail by flattening the slopes, or otherwise removing, relocating, or modifying the hazard whenever possible. The final evaluation of the need for guardrail should be made in the field after the embankment has been constructed. Even though the fill has been widened for guardrail, it should not be constructed if it is determined at this time that guardrail is not needed.

See *Design Manual* Chapter 1610 and other pertinent instructions for design criteria for guardrail.

For safety reasons, the guardrail shall have the ends flared away from the roadway and anchored in accordance with the appropriate *Standard Plans*. The construction inspector should pay particular attention to make sure that the rail washers are consistent with the current *Standard Plans*.

SS 8-11.3 Construction Requirements

SS 8-11.3(1) Beam Guardrail

SS 8-11.3(1)A Erection of Posts

The posts shall be set to the true line and grade of the highway and spaced as shown on the *Standard Plans*. Post may be placed in dug or drilled holes. Ramming or driving will be permitted only if allowed by the Engineer and if no damage to the pavement, shoulders and adjacent slopes results therefrom. The post holes shall be of sufficient dimensions to allow placement and thorough compaction of selected backfill material completely around the post.

SS 8-11.3(1)C Terminal and Anchor Installation

Installation of guardrail terminals listed in the *Qualified Products List* shall be by an installer, that has been trained and certified by the manufacturer or is supervised by a representative of the manufacturer. The inspector should request to see the certification. The date on the certification must not be prior to the latest accepted effective date for the device. A listing of the latest accepted effective dates will be sent to each Project Engineer's Office when changes are made or can be requested from the Design Office.

8-12 Chain Link Fence and Wire Fence

SS 8-12.3 Construction Requirements

Since preservation of natural growth is being stressed, clearing will have to be performed specifically for the fence construction on many projects. In these cases, only the width necessary to accommodate the fence construction should be cleared. Some grading is usually necessary to prevent short and abrupt breaks in the ground contour that will affect the aesthetic appearance of the top of the fence. Care needs to be exercised to prevent clogging natural drainage channels while grading the fence line.

8-14 Cement Concrete Sidewalks

SS 8-14.3 Construction Requirements

SS 8-14.3(2) Forms

Forms may be of wood or metal and full depth of the sidewalk. The forms should be straight or uniformly curved and in good condition.

In rest areas and park areas where the sidewalks are normally laid out in a winding pattern rather than in straight lines, care must be taken in setting the forms so that the sidewalk will present a pleasing appearance with no kinks or angle breaks. The forms must be braced and staked sufficiently to maintain them to grade and alignment. Usually, spreaders are necessary to properly space the forms and hold them in position until the concrete is placed. If the Contractor uses thin strips of form material for winding sidewalks, more than one thickness with staggered joints should be used to obtain the smooth flowing lines. In forested areas, all roots should be removed or cut back.

After the forms have been set, the foundation shall be brought to the required grade, compacted and well dampened. Prior to placement of concrete, the inspector shall verify that the forms are set to line and grade, and shall check the forms for cross-slope and grade of the sidewalks and ramps, for conformance with the Plans, and to ensure that the requirements of the Americans with Disabilities Act (ADA) are met. If there are junction boxes, cable vaults, manholes or other utilities present in the sidewalk or ramp surface, they must be flush with the sidewalk or ramp surface.

SS 8-14.3(3) Placing and Finishing Concrete

Air entrained concrete Class 3000 (or Commercial Concrete) shall be used for construction of sidewalks. After the concrete is placed, it should be struck off with a straightedge. The concrete should be troweled smooth with a steel trowel and then lightly brushed in a transverse direction with a soft brush. On grades of over 4 percent, the surface shall be finished with a stipple brush or as the Engineer may direct. Following brushing of the surface, the concrete shall be edged and jointed as shown in the plans or the *Standard Plans*. In areas adjacent to existing sidewalks, the jointing pattern should be similar to the existing pattern. Consideration should be given to placing crack control joints adjacent to cracks in the existing sidewalk if they are not going to be repaired. If the cracks in the existing sidewalk are full depth, they may cause reflective cracking in the new adjacent sidewalk.

Expansion joints shall be constructed at the locations and of the sizes as detailed in the plans or in the *Standard Plans*.

All concrete sidewalks shall be properly cured. During this curing period, all traffic, both pedestrian and vehicular, shall be excluded. Vehicular traffic should be discouraged and by no means allowed until the concrete has reached its design strength. There is a risk that the sidewalk can be damaged as it was not designed to take these loads. Before any decision to allow vehicles on a sidewalk there should be a clear agreement that any damage will be repaired and who will pay for it.

8-20 Illumination, Traffic Signal Systems, and Electrical

GEN 8-20.1 General

Illumination and traffic signal systems, due to the very nature of the work, are a highly specialized type of installation. In designing these systems, every effort is made to avoid problems for construction, maintenance, and the utility company. If problems arise, the Engineer should contact those responsible for the design and operations for help in solving them.

GEN 8-20.2 Inspection

Inspection on electrical projects involves two aspects of work. The first of these is the physical aspect wherein conformance to the plan requirements relative to the materials used and general construction techniques must be the criterion for judgment. An Inspector who is thoroughly familiar with the requirements of *Standard Specifications* Section 8-20 and with normal construction techniques should be assigned the inspection responsibility for this portion of any signal or illumination project. The Fabrication Inspector shall be consulted if lighting or traffic signal standards arrive on the jobsite without prior inspection.

The second aspect of electrical work involves the conformance by the Contractor with the contract requirements in addition to the requirements of the State electrical construction codes and the National Electric Code. This aspect of inspection must be performed by an electrical Inspector. A further consideration within this aspect of work involves any changes authorized in the contract plans as it may affect circuit stability, circuit adequacy, and the ability of related electrical control devices to properly function through any such change of plans. The performance testing of the system is part of the second aspect of the electrical work.

Electrical work is a specialized field of endeavor within WSDOT; therefore the Project Engineer must arrange for the assistance of an electrical Inspector from the Regional office. The electrical Inspector shall make periodic inspections throughout the course of construction of all electrical projects and shall advise the Project Engineer of appropriate times to enable the Project Engineer to occasion the required field tests of electrical circuits, as discussed in *Standard Specifications* Section 8-20, at such times that cause a minimum interference of the work scheduled by the Contractor. Should any question arise on a project pertaining to the technical nature of the work, the Project Engineer shall consult with the electrical Inspector or with the Regional Traffic Engineer, if necessary.

Our plans and specifications are designed generally to conform with existing national electrical codes. There are instances when the Department permits methods of construction that are considered equivalent to state and national codes.

Generally, local inspection authorities do not inspect highway work that is within the state highway right of way. From time to time, however, the Department of Labor and Industries or local electrical inspectors may visit a project to inspect or review the Contractor's work. They should be treated courteously and their judgment respected. The Department does have authority to permit alternate methods when equivalent objectives can be met if the work is within the State right of way. Should any question arise over a conflict between our plans and their opinions, the matter should be referred to the State Construction Office for advice.

SS 8-20.2 Materials

SS 8-20.2(1) Equipment List and Drawings

All materials for installation on illumination and traffic signal projects shall be selected off the *Qualified Products List* (QPL) or be listed on a Request for Approval of Material (RAM). Items not selected off the QPL shall be submitted to the State Materials Laboratory for appropriate action on a RAM. This list shall be complete and cover all materials which are identified on the plans or in the specifications. The list shall include the source of supply, name of manufacturer, size and catalog number of the units, and shall be supplemented by such other data as may be required including catalog cuts, detailed scale drawings, wiring diagrams of any nonstandard or special equipment. All supplemental data shall be submitted in six copies.

The Record of Materials (ROM) from the State Materials laboratory will list items for which preliminary samples or data are required. Preliminary and acceptance samples shall be submitted as required by the ROM, received from the State Materials Laboratory at the beginning of the project or as noted on the RAM. See Section 9-4 for material specific acceptance requirements.

Working Drawings for Illumination and Signal Standards

The Contractor is required to submit working drawings for all types of signal standards and for light standards without pre-approved plans. Pre-approved plans are listed in the Contract Provisions and on the Bridge and Structures website. If light standards with pre-approved plans are proposed, a working drawing submittal is not required. There are two different approval procedures for shop drawings. They are the State Bridge and Structures office approval, and Project Engineer approval only. In either case, the Contractor is required to submit one set of drawings as a Type 2E Working Drawing per instructions in *Standard Specification* 1-05.3. The two approval procedures include the following:

A. **Bridge and Structures Office Approval**

- Light standards without pre-approved plans.
- Types II, III, IV, V signal standards without pre-approved plans.
- Type SD (Special Design) signal standards.

B. **Project Engineer Approval Only**

- Types PPB, PS, I, RM and FB signal standards.
- Types II, III, IV, V signal standards with pre-approved plans.

After the Contractor has submitted working drawings, the Engineer shall make a field check of both contract plans and working drawings. The Project Engineer is responsible for checking the geometric features of these items. Specific items that should be checked include the following:

- Foundation locations.
- Light source to base dimension (H1), if required in the special provisions and clearance to overhead utility wires.
- Mast arm lengths. If foundation offsets are changed, mast arm lengths must be adjusted.
- Horizontal dimensions from single standard pole centerline to signal head attachment points.
- Vertical dimensions from signal standard base plate to signal mast arm connection points. Assistance is available from the Traffic Design office in estimating mast arm deflection to ensure vertical clearance requirements are met.
- Orientations of mast arms and all pole-mounted appurtenances.
- Signal head mounting details.
- Hand hole location and orientation.
- Base treatment for lighting standards (fixed, or slip, or breakaway).

If there are no changes to dimensions or orientations, the Project Engineer shall mark the drawings with a statement that all standards shall be fabricated according to dimensions and orientations shown in the Contract.

If there are corrections, the Project Engineer shall note all corrections on one set of shop drawings, with green markings only, and attach copies of signal standard chart and/or luminaire schedule from contract, noting any dimension changes in green. Or the Project Engineer may note the changes in a list form and submit it with the PDF within the email.

The State Bridge and Structures office will conduct a structural review, and make comments in red, incorporating the Project Engineer's geometric review comments.

The working drawings for supports without pre-approval shall be submitted to the State Bridge and Structures office, which will coordinate approval with the State Materials Laboratory as necessary. After approval, the State Bridge and Structures office will retain one set and forward the approved PDF file to the Project Office. The Project Engineer will forward the approved PDF file to the Fabrication Inspector, the Region Signal Superintendent (or designate), and the Contractor, who will forward to the Fabricator. See the Shop Plans and Working Drawings Table in Section SS 1-05.3.

If pre-approved shop plans have been submitted, a structural review by the State

Bridge and Structures office is not required. The Project Engineer shall mark all changes in red on the PDF file. The Project Engineer will then forward to the Regional Operations/Construction Engineer, the Fabrication Inspector, the Region Signal

Superintendent, and the Contractor, who will forward to the Fabricator. See the Shop Plans and Working Drawings Table in Section SS1-05.3.

All drawings shall be clearly marked (See SS 1-05.3) before returned to the Contractor, whether reviewed and checked by the Project Engineer or the Bridge and Structures Office.

SS 8-20.3 Construction Requirements

SS 8-20.3(4) Foundations

The foundations shall be located and constructed as detailed on the plans wherever possible. When foundations cannot be constructed as detailed, due to rock, bridge footings, drainage structures, or other obstructions, an effective foundation will have to be developed for the conditions encountered and acceptance obtained. The location of lighting standards or signal standards shall not be moved without discussing the problem with the Regional Operations/Construction Engineer and the Regional Traffic Engineer.

Foundations located on fills, especially those adjacent to bridge abutments, shall be deepened to provide stability as provided for in *Standard Specifications* Section 8-20.3(4).

SS 8-20.3(5) Conduit

Generally, conduit runs should be located on the outer shoulder areas, well away from the position where signs, delineators, guardrails and other facilities will be placed.

On new construction, all conduit located under paved surfaces shall be placed prior to construction of base course and pavement. It shall be the responsibility of the Project Engineer to see that all contractors on any project coordinate their work to this end.

Sufficient cover must be provided to protect the conduit from damage as provided in *Standard Specifications* Section 8-20.3(5).

At locations where plastic conduit is allowed and hard rock is encountered within the minimum depth required, steel conduit should be substituted for the affected runs, and the depth adjusted as necessary.

SS 8-20.3(5)B Conduit Type

SS 8-20.3(5)B1 Rigid Metal Conduit

Installation of conduit should be supervised to ensure against physical abrasion of the conduit or for rust on threads which would destroy the integrity of the galvanizing.

Electrically caused corrosion of metallic conduit is easy to avoid by proper construction supervision. If the causes of this type of corrosion are not properly inspected and controlled, the extent of electrically caused corrosion is commonly far more severe than the chemically caused corrosion.

In any metallic conduit system, the metallic conduit itself serves an electrical function. This function is to provide a low resistance return path for electricity which may leak out of an electrical conductor due to scraped insulation, cracks, or other causes. A point at which electricity can leak or escape from an electrical wire is called a “fault”. When

electricity flows through any non-insulated path (conduit), it can establish an electrical phenomenon called electrolysis. Electrolysis results in the transfer of metal from one location to metal at another location. Through this means, the metal that was used to make the metallic conduit may be transferred to other locations on the same conduit run or to other metallic appurtenances. With the ultimate degeneration of conduit at any point, the return path for the electricity through the conduit system itself is destroyed. In the event that a portion of a conduit was destroyed in this means and with the subsequent damage or failure of electrical conductors beyond that point, electricity would not have the ability to complete the circuit from the wire through the conduit system and return to service enclosure which would, in turn, cause a fuse to blow or a circuit breaker to trip. Hence, the protection offered by our electrical overload equipment is totally nullified.

To prevent this type of ultimate failure of the electrical system, all conduit joints should be carefully inspected to ensure that they are physically tight and that a good electrical bond does exist from one piece of conduit through the nipple to each adjoining piece of conduit. Additionally, conduit threads should be painted with an accepted corrosion inhibiting conduit paint. Any loose or improper union between conduit sections or conduit and junction boxes is a point of high resistance to the flow of electricity. When such a condition exists and with the faulting of an electrical conductor within the system, electricity does not have an easy return to its point of service. Electricity then takes alternate routes through the earth, structures, etc. This, in particular, establishes the condition of electrolysis and results in even greater failure of the physical system. The physical system failure attributed to this may present itself from two to five years after construction.

The seriousness of this matter cannot be overstressed in electrical construction. It is so important that if one factor, and only one factor, was to be examined on each electrical project, it would be the search for conditions that would result in electrolysis and the sloppy workmanship that causes them.

Additionally, to prevent electrical damage to the conduit system and, in particular, during the time of project construction, the conduit shall not be used as a temporary neutral return nor shall the conduit be used for the ground of construction equipment, i.e., welders, hand tools.

SS 8-20.3(5)B2 Conduit Plowing

Prior to installation, conduit shall be inspected for damage and deformities. For High Density Polyethylene (HDPE) conduit, this shall be done while the conduit is still on the reel. The inspector also needs to verify that HDPE conduit meets the thickness requirements in the Contract (examples: Schedule 80; SDR 9).

The inspector should verify that the plow shoe is marked as required by *Standard Specification* Section 8-20.3(5)E2. The inspector should monitor the plow operation to ensure that the mark remains below ground for the entire run. Should the mark come above ground, required actions are defined in *Standard Specifications* Section 8-20.3(5)E2. Spot checks of conduit depth are recommended. The most effective method for verifying conduit depth is continuous monitoring of the plow shoe during the plowing operation. The plow trench tends to cave in behind the plow, making measurement after placement difficult.

SS 8-20.3(6) Junction Boxes, Cable Vaults, and Pull Boxes

In most designs, precast concrete junction boxes are being used. These boxes are simple to install. A sump is excavated and partially filled with gravel. The open-bottom box is then seated by working it into the gravel until the required grade is reached. Care must be taken in junction box location to provide for drainage. Junction boxes and conduit should be placed away from areas that water is funneled to prevent it from entering into the conduits. For example, the bottom of ditches, sag vertical curves should be avoided or other low spots where water is likely to collect.

SS 8-20.3(8) Wiring

An electrical system is only as good as its conductors, terminals and splices, and it is important that the requirements of *Standard Specifications* Section 8-20.3(8) be strictly adhered to. If there is any doubt concerning the adequacy of a connector, the advice of the Regional Electrical Inspector should be obtained.

Practically all wiring for traffic signal and illumination systems is exposed to the elements, and it is very important that all splices be insulated with waterproof material, as prescribed in *Standard Specifications* Section 8-20.3(8) and 9-29.12.

SS 8-20.3(9) Bonding, Grounding

Because of the hazards of electrical shock, all grounds and ground bonds referred to in the plans and in the special provisions should be given special attention to ensure their effectiveness and completeness. See *Standard Specifications* Section 8-20.3(9) and *Standard Plan for* Typical Grounding Detail.

SS 8-20.3(10) Service, Transformer, and Intelligent Transportation System (ITS) Cabinets

Generally, Type “B,” “C,” “D,” and “E” service cabinets etc., will be factory assembled from drawings submitted with the material lists. Type “A” service equipment will be assembled in the field. Care shall be taken to ensure compliance with all provisions of the plans and specifications, and to determine that all bonds and grounds are complete.

Relations With the Serving Utility

Generally, during the design of an illumination or traffic signal system, the serving utility is consulted concerning the availability of power, the voltage needed, the location of the most convenient point of service, and agreements are prepared prior to the awarding of the contract. The Project Engineer should review all utility agreements and contact the serving utility as soon as the Contractor commences work to arrange for the actual service connections and other work which may have been agreed upon. The matter is important since, in many cases, the utility will have to extend lines, install transformers, and do other related work. Upon completion of the contract, the Project Engineer will instruct the serving utility to direct all future billings to the appropriate maintenance division.

Electrical Safety Tags

Commencing at the time that the serving utility makes the power drop to WSDOT electrical service cabinets, electrical safety tags shall be used. Any electrician working on any main or branch circuit shall cause that circuit to be de-energized and shall place an electrical safety tag at the point that the circuit is open. The electrician shall sign the electrical safety tag and only that electrician may make subsequent circuit alterations or remove the tag.

If the circuit that the electrician de-energized to work on is serving traffic, the electrician shall arrange the work so the circuit may be energized for nighttime operation. The electrician shall remove the safety tag and energize the circuit before leaving the jobsite and upon returning to work on the circuit, shall de-energize it again and place an electrical safety tag back on the circuit.

SS 8-20.3(11) Testing

All illumination and traffic signal systems shall be tested as outlined in *Standard Specifications* Sections 8-20.3(11) and 8-20.3(14)D. Particular care shall be taken in the performance of test No. 3. The Project Engineer shall insure that readings of the megohmmeter taken on every electrical circuit are furnished to the Regional Electrical Inspector. Caution must be exercised in the performance of this test to protect control mechanisms from damage due to the nature of the test voltages used. Also, the records made of this series of tests must identify the readings observed with each branch of the electrical circuit involved. Representative sampling of the Contractor's test readings may be made by the Electrical Inspector using State test equipment.

Field Test No. 4 of *Standard Specifications* Section 8-20.3(11) is to be performed on all illumination and signal projects. It is especially important that the Project Engineer obtain the consultation of the Regional Traffic Engineer in this portion of the field test when the tests are being performed in a traffic signal controller. Since the mechanism in these controllers is so interrelated and complex, only persons thoroughly schooled in such control mechanisms are qualified to determine when particular timing circuits and sequences are functioning properly. The simple turning on of an electrical switch and watching a light come on is not an acceptable electrical test.

SS 8-20.3(13) Illumination Systems

SS 8-20.3(13)A Light Standards

In erecting lighting standards or signal standards, rope or fabric slings should be used to reduce the danger of damage to galvanized or finished aluminum surfaces.

Existing Illumination Systems

Where existing illumination or traffic signal systems are to be removed, and the material stockpiled at the site of the work for delivery to WSDOT, it will be advantageous if prior arrangements are made to have Department personnel meet the contractor at the delivery storage site. These arrangements should be made with either the Regional Maintenance Engineer or the Regional Traffic Engineer.

Existing Communication Conduit Repair

When existing communication conduits are likely to be encountered during construction, the contractor should be prepared to immediately restore any communication conduit and cables damaged by the contractor's activities. This includes all types of conduit, including those with innerduct, and electrical and/or fiber optic cables.

When existing communication conduits are present within the project work area, the Engineer should coordinate a meeting between the contractor and WSDOT Maintenance personnel to develop a pre-approve repair procedure for damaged communication conduits and cables. This plan should include the method of repair, how long the repair would take, and the availability and type of repair kit to be used.

Communication conduit damaged during the work shall be repaired with an approved manufactured repair kit appropriate for the size and type of conduit. The repair kit shall be provided by the contractor.

Replacement communication conduit and cable shall be subject to the acceptance requirements of the appropriate *Standard Specifications*.

Damaged communication conduit and communication cables shall be repaired and the communication system shall be fully operational within 24 hours of being damaged. Temporary splices or repairs may be accepted in order to restore operation; however any temporary repairs that do not meet the requirements of the *Standard Specifications* shall be removed and replaced with permanent repairs in accordance with the *Standard Specifications*.

SS 8-20.3(14) Signal Systems

Traffic signal systems are a very specialized type of work. All work shall be done in strict accordance with the plans, the special provisions, and the *Standard Specifications*. The Regional Traffic Engineer will be responsible for the proper timing of each signal installation and will assist the Engineer in any way needed to ensure the proper completion of the work. The checklist (Figure 8-1) is provided to assist the Project Engineer in identifying the specific tasks that must be completed prior to signal turn-on. This checklist is a guide, and line items may be added or deleted as necessary to fit each specific signal installation.

SS 8-20.3(17) "As-Built" Plans

The Project Engineer is required to submit As-Built Plans in accordance with Section 10-3.7. For proper maintenance and repair of the electrical system, it is imperative that the location of all conduits and the diagram of all circuits be properly shown on the AsBuilt Plans.

Normally, the conduits should be constructed in the locations shown on the contract plans. Many times these conduits are positioned in a particular place to eliminate conflict with future construction.

Standard Specifications Section 8-20.3(17) requires the Contractor to submit any corrected shop drawings, schematic circuit diagrams or other drawings necessary to prepare the corrected as-built plans.

GEN 8-20.6B1 Conduit Plowing

Prior to installation, conduit shall be inspected for damage and deformities. For High Density Polyethylene (HDPE) conduit, deformities are usually visible while conduit is still on the reel. The inspector also needs to verify that HDPE conduit meets the thickness requirements in the Contract (examples: Schedule 80; SDR 9).

The inspector shall verify that the plow shoe is marked for the required depth as required by *Standard Specifications* Section 8-20.3(5)E2. The mark must remain below ground for the entire run. Should the mark come above ground, required actions are defined in *Standard Specifications* Section 8-20.3(5)E2. Spot checks of conduit depth are recommended. The recommended method for verifying conduit depth is continuous monitoring of the plow shoe during the plowing operation. The plow trench tends to cave in behind the plow, making measurement after placement difficult.

8-20.6D Wire and Cable

An electrical system is only as good as its conductors, terminals and splices, and it is important that the requirements of *Standard Specifications* Section 8-20.3(8) be strictly adhered to. If there is any doubt concerning the adequacy of a connector, the advice of the Regional Electrical Inspector should be obtained.

Practically all wiring for traffic signal and illumination systems is exposed to the elements, and it is very important that all splices be insulated with waterproof material, as prescribed in *Standard Specifications* Section 8-20.3(8) and 9-29.12.

Wire and cable pulling, including fiber-optic cable, requires the use of a dynamometer in accordance with *Standard Specifications* Section 8-20.3(8) to verify cable tension. Wire and cable pulling by means other than by hand shall not be allowed without a dynamometer present.

Contract #	Location	
Project Engineer		Date
Proposed* turn-on date	Proposed* test date	
Point of contact		Phone #

This checklist highlights the critical items of work that are to be complete before the signal system can be placed into operation.

*The Project Engineer has the authority to reschedule the test date or signal turn-on at their discretion.

	Applicable to project	Complete
Signing		
1. Advance warning “Signal Ahead/W3-3” signs (permanent)		
2. “New Signal” or “Signal Revision” signs (temporary)		
3. “Left Turn Must Yield on Green Ball” sign		
4. Lane control signs		
5. Street name signs		
Striping (Installed or Scheduled)		
6. Stop Bar(s)		
7. Crosswalk stripes		
8. Channelization		
9. Channelization aligns with signal heads		
Signal Display System		
10. All vehicle displays are connected and tested		
11. All pedestrian displays are connected and tested		
12. Restrictive left turn display is over left turn lane		
13. Combination of restrictive/permissive left turn display is over the gore stripe.		
14. Optically programmed displays are properly programmed for the intended movement.		
15. Vertical clearances are met.		
Signal Detection System		
16. All vehicle detection (temporary and permanent) is tested.		
17. If staging is required, all side street stop bar detection is tested as a minimum for semi actuated operation.		
18. All pedestrian detection (push buttons) are tested.		
19. All emergency vehicle preemption detection are tested.		
20. Railroad preemption is tested.		
Signal Control System		
21. Controller is tested and available		
22. Cabinet is installed, wired and ready for controller hookup.		
23. Interconnect is tested.		
24. Permanent power source is supplied to the system.		

Traffic Signal Turn-on Checklist Revised 1/10/00 (Page 1 of 2)
Figure 8-1

	Applicable to project	Complete
Contractor Contact Responsibilities		
25. Controller manufacturer representative (not required if state supplied controller)		
26. Uniformed Police/State Patrol for Traffic Control		
Electrical Inspector Contact Responsibilities (Five (5) days prior to proposed* signal test date):		
27. Signal Maintenance		
28. Signal Operations		
Project Engineer Contact Responsibilities (Five (5) days prior to proposed* signal test date)		
29. Local Agencies (City, County, State Patrol, Fire District, etc.)		

Comments:

Traffic Signal Turn-on Checklist Revised 1/10/00 (Page 2 of 2)
Figure 8-1

8-21 Permanent Signing

GEN 8-21.1 General

The complex design of today's freeway facilities has created an increased demand on signing. Signing is one of the features a layperson readily can evaluate on a new facility. Improper or inadequate signing detracts from the quality of the basic construction features of the project. Misplaced or irregular usage of signs on interchanges creates a critical hazard to traffic and hinders the proper operation of the facility.

Today's destination sign has increased in size to the extent that it is no longer a minor installation and the amount of time required to install an average freeway sign project has been extended to the point that close cooperation between all forces on highway construction projects is vital so that the facility is signed properly when opened to traffic.

Any sign that is erected on a section of roadway carrying traffic ahead of the time the message on the sign will be applicable to the traffic shall be covered in accordance with *Standard Specifications* Section 8-21.3(3) until the appropriate time for uncovering it. It is essential that signs with conflicting messages not be displayed.

SS 8-21.2 Materials

All materials for installation on permanent signing projects should be selected off the *Qualified Products List* (QPL) or listed on the Request for Approval of Materials (RAM). Materials listed on RAM which are not listed on the QPL shall be submitted to the State Materials Laboratory for appropriate action as soon as possible. This list shall be complete and cover all materials which are identified on the plans or in the specifications. The list shall include the source of supply, name of manufacturer, size and catalog number of the units, and shall be supplemented by such other data as may be required including catalog cuts, detailed scale drawings, wiring diagrams of any nonstandard or special equipment. All supplemental data shall be submitted in accordance with Section 1-05.3.

SS 8-21.3 Construction Requirements

SS 8-21.3(1) Location of Signs

Since it is impossible to visualize the actual physical features of final grade elevations, vertical curves, trees, and other factors that affect proper sign placement in the initial sign plan stage, it becomes necessary to make adjustments in sign location just prior to installation. The Project Engineer and Regional Traffic Engineer should coordinate a study of each location to determine that each sign will be in the most efficient location for visibility and nighttime reflectivity. Advance Destination signs may be moved up to 500 ft in either direction if severe ground or slope conditions are encountered. If the sign must be moved more than 500 ft, consideration should be given to revising the distance on the sign. All sign locations shall be staked by the Engineer prior to installation by the Contractor.

Following staking of the signs, the Project Engineer should furnish the Contractor with the list of post lengths for steel posts. For wooden posts, the Contractor should be able to order posts in commercial lengths from the approximate lengths shown in the plans. Final lengths of timber posts will be determined or verified by the Engineer at the request of the Contractor prior to fabrication.

SS 8-21.3(2) Placement of Signs

A "fabrication approval" decal dated and signed by the Sign Fabrication Inspector shall appear on the back of all permanent signs that are received on the project. Signs without such indicated acceptance shall not be permitted on the project. Damaged signs shall be rejected at the project site.

At the completion of a sign installation, the Project Engineer shall request the Regional Traffic Engineer to assist in making a final inspection.

SS 8-21.3(9) Sign Structures

SS 8-21.3(9)A Shop Drawings for Sign Structures

Working drawings of sign structures shall be reviewed by the Project Engineer for conformance with the *Standard Plans* Section G. The Project Engineer approves plans in conformance with the standard plans. Any request to deviate from standard plans should be reviewed by the State Bridge and Structures Office.

The working drawings of special design sign structures and/or special sign fittings shall be submitted to the State Bridge and Structures office, which will coordinate approval with the State Materials Laboratory. After approval, the State Bridge and Structures office will retain one set and forward the approved PDF file to the Project Office., The Project Engineer will forward the approved PDF file to the Fabrication Inspector, the Region Signal Superintendent (or designate), and the Contractor, who will forward to the Fabricator.

If a structural review is not required by the State Bridge and Structures office, the Project Engineer shall mark all changes in red on a PDF and distribute In accordance with the Working Drawings, Shop Plans, or Submittal Type in Section SS 1-05.3.

All drawings shall be clearly marked (See SS 1-05.3) before returned to the Contractor, whether reviewed and checked by the Project Engineer or the State Bridge and Structures Office. The Project Engineer is responsible for checking the geometric features of these items. Specific items that should be checked include the following:

- Foundation Location
- Handrail fitup with VMS Door Opening

The special provisions of the contract deal to a great extent with the proper fabrication of the signs to be installed and the manufacturing process requiring the use of approved application equipment. It is necessary, therefore, that the firm who actually makes the signs be approved as a source of supply. Such approval is made by the State Materials Laboratory.

SS 8-21.3(9)G Sign Structure Identification Information

Anytime an existing bridge mounted sign bracket, cantilever sign structure, or sign bridge structure is removed from service, the Contractor shall remove any existing sign structure identification plate and give it to the Project Engineer. The Project Engineer will return the identification plate to the State Bridge Preservation Office so the sign structure can be removed from the inventory.

SS 8-21.3(12) Steel Sign Posts and Structures

It is important to ensure the proper torque is applied to bolts connecting the bases when installing *Standard Plan* G-24.10.00 through G-24.60.00 Sign Structures. Procedures for assembling and inspecting high strength bolts are covered in Section 6-3.6B.
All base assemblies shall be checked with a torque wrench. This can be accomplished either by observing the Contractor's torquing or by the Inspector utilizing the Region's torque wrench. Documentation of the torquing method used should be accomplished by proper entries in the Inspector's Daily Reports.