CHAPTER 900 – LANDSCAPE ARCHITECTURE – ROADSIDES

Topic 901 – Landscape Architecture General

Index 901.1 – Landscape Architecture Program

The Landscape Architecture Program is responsible for the development of policies, programs, procedures, standards, and guidance for all aspects of the California Highway System Roadside Program including planting, irrigation, permanent erosion control, mainstreet livability, structure aesthetics, roadside safety features, and landform grading.

The Landscape Architecture Program also serves as the coordinator for Safety Roadside Rest Areas, Vista Points, Park & Ride facilities, Scenic Highways, Classified Landscaped Freeways, Blue Star Memorial Highways and Landscape Administration Facilities such as Transportation Art, Gateway Monuments, and Community Identification.

Guidance in the Chapter 900 series is the responsibility of the Landscape Architecture Program and represents minimum standards.

901.2 Landscape Architecture Design Standards

Design roadsides to maximize sustainability and livability benefits through context-sensitive design solutions. Sustainable design solutions are those that consider balanced and long-term benefits to social, economic, and ecological well-being.

Sustainable landscape architecture designs:

- improve safety for workers and travelers
- improve the quality of the public realm
- conserve water and natural resources
- sequester carbon and improve ecosystem resiliency
- address fire safety
- preserve or improve visual quality and aesthetics
- reduce unnecessary maintenance activities
- employ cost-effective solutions
- consider life-cycle costs and benefits.

Attention should be given to the following considerations:

(1) Worker Safety. Design roadsides for the safety of highway workers and the public by considering the following:

- Site new roadside features outside of the clear recovery zone and away from gore areas and driver decision points.

- Provide access for workers including maintenance vehicle pullouts, maintenance access roads and gates.
- Design solutions that facilitate the use of mechanical equipment to reduce worker activities on foot including the use of new technology.
- Select design solutions that eliminate maintenance activities.
- Relocate existing roadside elements to accessible areas outside the clear recovery zone or to protected locations.

Incorporate the above design considerations when designing roadsides. For example, provide access gates from local streets and frontage roads for maintenance personnel; coordinate with District Maintenance managers for preferred access points. Provide paved maintenance vehicle pullout areas away from traffic on high-volume highways where access cannot be made from local streets and roads. Consider providing maintenance access roads to the center of loop areas or other open, flat areas. Pave narrow areas and areas beyond freeway gore entrances and exits to reduce the need for maintenance. See Index 504.2(2) for contrasting surface treatment guidance.

(2) *Maintainability.* Field observations with maintenance personnel should be performed during project development, Pre-PID through PS&E. Ongoing communication between designers, landscape specialists, landscape maintenance personnel, and construction inspectors will ensure that maintenance concerns are addressed.

Design roadsides to minimize routine and ongoing roadside maintenance and to accommodate:

- graffiti control and removal.
- homeless encampment removal.
- mowing and weeding.
- litter, debris, and/or dead vegetation removal.
- exotic or "volunteer" vegetation control.
- pesticide and/or fertilizer application.
- pruning or removal of vegetation.
- irrigation and waterline break repair.
- irrigation scheduling for water budgeting.
- replacement of plants and repairs to inert materials.
- maintenance requirements of permanent stormwater pollution prevention treatment BMPs.

(3) *Livability.* Livability describes the degree to which the built environment improves human quality of life. Designs that improve livability are those that consider how the public realm and roadside can support travel and local community goals. Livable transportation systems connect people to opportunity and promote public health and safety, ecological quality, economic development, community vitality, social equity and interaction, multimodal travel, sense of place, and human health.

Create a state highway public realm through designs that improve community visual quality, provide inviting public spaces, and encourage active transportation. Encourage and support Landscape Architecture Administered Facilities such as Transportation Art, Gateway

Monuments, and Community Identification to enhance livability. Livable roadside facilities often include:

- connectivity of active transportation and complete streets facilities.
- site furnishings such as benches, bicycle racks, and trash and recycling receptacles.
- Street trees and other vegetation that provide shade and a separation for vehicles and pedestrians

(4) *Visual Quality and Aesthetics.* Design roadsides to integrate the facility with the adjacent community or natural surroundings. Buffer objectionable views of the highway facility from adjacent homes, schools, and parks. Soften visual impacts of large structures and graded slopes. Screen objectionable or distracting views. Frame or enhance good views. Provide visually attractive roadsides, entrances to communities, and mainstreets.

(5) *Ecological Function.* Design roadsides to incorporate native and climate appropriate vegetation, with attention to supporting pollinators, and facilitating stormwater infiltration on-site. Improve soil with compost to build healthy soils, sequester carbon and mitigate greenhouse gas emissions.

(6) *Water and Resource Conservation.* Roadsides must comply with State water conservation requirements including the Model Water Efficient Landscape Ordinance (MWELO). Comply with local water ordinances. In addition, design landscapes to conserve water by designing efficient irrigation systems and appropriate planting designs that:

- use non-potable or recycled water.
- use soil amendments to build healthy soils and increase water holding capacity.
- use drought tolerant, climate appropriate plants.
- use large groupings of spreading plants.
- use topical mulches to reduce evapotranspiration.
- use automated "smart" irrigation controllers.
- use moisture, wind, and rain sensors.
- use point source irrigation and tree well assemblies.
- minimize use of overhead irrigation.

(7) *Fire Safety.* Consider the risk of fire when designing landscape architecture projects. Consider the following in high fire risk areas:

- Create fire-resistant zones and defensible spaces to minimize the spread of wildfire
- Remove dead and dying vegetation
- Minimize or eliminate vegetative fire ladders
- Select plants with low sap or resin content and high moisture content
- Select plants with prostrate growth and minimal fuel volume
- Select nonflammable or low fuel inert materials for ground surface cover

(8) *Cost-effectiveness.* The design should maximize short and long-term benefits for the costs involved by:

- Optimizing scheduling, performance, constructability, maintainability, and material life cycle costs.

- Specify commercial/industrial quality materials and methods to improve cost-effectiveness.
- Utilize long-lived plant species.

901.3 Landscape Architecture Administered Facilities

Landscape Architecture administers local projects related to Transportation Art, Gateway Monuments, Community Identification, and Blue Star Memorial Highways. These projects are typically installed through an encroachment permit project.

When a project will impact an existing Landscape Architecture Administration Facility, coordinate with the local agency charged with maintaining the facility to move it if the facility cannot be preserved and protected. Refer to the LAP website and the PDPM for additional information.

Topic 902 – Sight Distance and Clear Recovery Zone Standards

902.1 Landscape Sight Distance and Clear Recovery Zone Standards

Three considerations affect the placement of new landscape features:

(1) Sight Distance. To keep the continuous length of highway ahead visible to the driver. Sight distances for safety surpass aesthetic considerations. Applicable minimum sight distance standards are set forth in Topic 201 – Sight Distance, and Topic 405 – Intersection Design Standards.

(2) Clear Recovery Zone (CRZ). To keep the CRZ free of discretionary fixed objects. Refer to Index 309.1(2).

(3) *Maintenance Access.* To provide worker access without the need for lane or shoulder closure to perform routine maintenance.

Topic 903 – Landscape Site Design

Landscape site design for roadsides involves landform grading and the placement of landscape elements, such as boulders, or other site furnishings for aesthetic or functional purposes.

903.1 Landscape Site Analysis

Landscape site analysis is the study of the site's ability to address Department, corridor, and project goals. Landscape site analysis identifies opportunities and constraints on the site that may have physical, social, fiscal or environmental impacts. Landscape site analysis helps evaluate competing needs and to determine which design decisions will bring the greatest return of investment. Emphasis should be given to design solutions which provide benefits in multiple areas, within a reasonable project schedule and life cycle cost.

Areas typically evaluated include:

- built features, such as existing infrastructure and adjacent land uses
- natural features, such as land form, slopes, soil type, erosion
- community characteristics that may influence design decisions, such as the presence of underserved communities, scenic highways, or other aspects
- travel conditions, such as multimodal access to connections and opportunities to include complete streets features
- existing visual quality and aesthetic conditions
- opportunities to improve livability on mainstreets

903.2 Landscape Site Layout

Landscape site design involves the layout of landscape architectural areas such as planting/irrigation areas, erosion control areas, inert landscape groundcovers and main street elements such as, pedestrian pathways, bicycle paths, tree grates, ornamental pedestrian paving, bus shelters, bollards, benches, tables, trash/recycling receptacles, and bicycle racks.

Landscape site design should start with site analysis that evaluates the optimum location for landscape areas. Consider natural drainage, natural landform, existing vegetation, slope, pedestrian and bicycle circulation patterns (existing and planned), microclimate and any other element that may affect the landscape site layout.

Layout landscape architectural elements to optimize existing site conditions and respond to site constraints.

903.3 Roadside Amenities

Inert landscape features or facilities, that are not necessary for the safety, maintenance, or operation of the highway may be considered discretionary fixed objects. See Index 309.1 for more information. Examples of these objects include but are not limited to boulders placed for decorative purposes, gateway monuments, and transportation art.

903.4 Additional Roadside Site Design Considerations

Consider site features and elements that minimize impacts to natural resources.

(1) Low Impact Development. Consider including low impact development features. Low Impact Development mimics natural processes to capture and infiltrate stormwater runoff.

(2) Landscape Grading. Integrate highway improvements into the existing environment using contour grading to preserve existing natural topographic features and plant material. Refer to Index 304.4 and 304.5.

Topic 904 – Planting Design

904.1 Planting Design General

Planting provides vegetation for aesthetic, environmental, mitigation, stormwater pollution prevention, and erosion control purposes. Successful planting requires soil that will provide an

appropriate growing medium. Protection of existing vegetation, selection and location of the appropriate plant material, and an appropriate plant establishment period must be considered.

Planting contributes to climate resiliency with:

- carbon sequestration
- air quality benefits
- reduced fire risk
- heat island reduction
- habitat restoration
- revegetation
- stormwater treatment
- mitigation
- windbreak protection

Planting provides improvements to visual quality by:

- Integrating the highway into the local community
- graffiti reduction
- screening
- aesthetics

Ensure work within any existing Classified Landscape Freeway maintains the status of the Landscaped Freeway. Refer to the Business and Professions Code Sections 5216 and 5440.

In areas subject to illegal activities, provide open visibility to the roadside. In many areas, this may mean limiting landscape to planting trees and groundcover only.

Review the entire planting design with the District Coordinator, District Landscape Specialist, and Maintenance Landscape Supervisor.

904.2 Site Preparation

(1) *Preserve Existing Vegetation.* Preserving existing vegetation minimizes the disturbance of existing vegetation and soil. Preserving existing site vegetation is more effective at erosion control than removing and planting new vegetation. Where possible, minimize disturbed areas within areas impacted by construction. Consider temporary exclusionary fencing during construction to demarcate and retain significant existing vegetation.

(2) *Soil Health.* Healthy topsoil is needed to ensure successful vegetation establishment. The preservation of existing topsoil or amending poor topsoil is necessary to provide favorable growing conditions. Agronomic soil tests may be necessary to verify soil texture, pH, percent organic content, electrical conductivity, sodium content, the availability of Nitrogen, Phosphorus and Potassium, and other local soil deficiencies.

(a) Preserve Existing Topsoil and Duff. The best approach to soil health is to preserve the existing topsoil and duff.

Excavate existing soil and store, on-site during construction, and then replace it at select locations prior to seeding or planting. Care must be taken to ensure that topsoil stockpiles are protected and kept in an aerobic and de-compacted state. Stockpiles in

shallow windrows planted with temporary hydroseed will preserve the native seed bank and beneficial microorganisms. Consider the use of exclusionary fencing and signage to identify topsoil stockpiles.

Duff is partly decayed organic matter such as leaves, bark, pine needles, and twigs which have fallen to the ground. Duff is removed along with existing plants and shrubs from an identified area during clearing and grubbing or roadside clearing operations. Duff is then chipped or ground, stockpiled, and reapplied after completion of final grading. Duff may be reapplied within one year of stockpiling. Consider using duff in natural areas where existing organic material is plentiful and preferred for revegetation success.

Mix preserved existing topsoil and duff to maximize natural and organic matter in the soil.

Coordinate with the Design Project Engineer, Environmental, Right of Way, and Construction for acceptable stockpile locations.

(b) Amending Soil. Soil amendments are necessary to improve water holding capacity, soil nutrient availability, microbial activity, and texture.

- *Compost.* Compost is manufactured through the controlled aerobic biological decomposition of biodegradable materials. Compost is used to improve soil health by increasing organic content, water holding capacity, and adding nutrients. When feasible, use compost in lieu of fertilizer.
- *Organic Mulch.* Typically, mulch is comprised of tree bark, wood chips, pine needles, shredded bark, or a combination of these.

(c) Imported Topsoil. When there is insufficient topsoil, preserving topsoil is infeasible, or the existing topsoil is not able to support vegetation establishment, imported topsoil may be considered. Imported topsoil is obtained from outside the project limits.

(d) Soil Texture Rehabilitation. Improve soil texture when compaction restricts air or water movement and inhibits vegetation growth.

- Cultivation. Soil can be cultivated or ripped to de-compact the soil.
- Incorporate Materials. Incorporate materials is the process of tilling topsoil with amendments. It improves soil health by providing nutrients and biotic activity for vegetation growth and establishment. Use incorporate materials to increase infiltration or when existing soils are compacted or low in nutrients.

904.3 Plant Selection

Plants should be well suited to local environmental conditions such as sun exposure, aspect, climate, annual precipitation, temperature extremes, wind, soil type, and recycled water quality.

Plants should be selected for their anticipated ability to adapt to changing climatic conditions such as extreme temperature, wind or other weather events.

Select plants with a growth rate, longevity, size, and appearance appropriate for their intended use. Select plants that minimize ongoing maintenance requirements.

Select drought tolerant plants that will survive if supplemental water is discontinued. To minimize the risk of pest and disease infestation, select a diverse mix of plant species. Consider using no more than 33 percent of one species.

Whenever possible, select native plant species. Include species with a wide range of bloom times to enhance pollinator habitat.

Consider carbon sequestration rates of species selected.

In fire prone areas select plants that will minimize fire risks. Refer to local fuel modification plans for recommended plants for the specific area.

When selecting plants also consider species availability.

Landscaping projects with federal funding shall include California native wildflowers and grasses in the planting design. Refer to Chapter 29 of the Project Development Procedures Manual for wildflower requirements.

To ensure maintainability of plant selections, consult with your District Landscape Specialist, and Maintenance Landscape Supervisor.

(1) Tree Selection. When proposing large trees, the mature size, form, and growth characteristics of the species should be considered. Select tree species that will not require regular pruning at maturity to maintain clearances. Review species selections with the District Landscape Specialist and Tree Crew Supervisor.

(2) Other Considerations. Consider avoiding:

- short lived plant species.
- restricted plants listed as noxious or invasive on the Federal or California Noxious Weed List managed by the U.S. Department of Agriculture (USDA) or the California Invasive Plant Inventory Database managed by the California Department of Fish and Wildlife (CDFW).
- restricted plants by the State or local County Agriculture agencies for agricultural purposes.
- plants with edible or attractive fruits, berries or nuts.
- plants with thorns or stiff branches that may capture litter.
- plants that are known to be poisonous to humans and animals.
- trees that may be brittle, susceptible to disease, or that increase in size by suckering.

904.4 Locating Plants

Locate plants as appropriate for the adjacent existing or planned environment. Arrange plants to be visually and culturally compatible with local indigenous plant communities.

Place plants according to the perspective of the viewer and their traveling speed. For example, compositions viewed by freeway motorists should be simplified and large scale. Compositions primarily viewed by pedestrians may be designed with greater detail.

Plants with similar water requirements are to be grouped together to conserve water.

Wherever feasible, trees should be used to create the main structure of the planting composition.

Median planting should not be installed on freeways. See Index 305.1(2) for median guidance on conventional highways.

Planting must not interfere with the function of safety devices (e.g., barriers, guardrail), traffic control devices (e.g., signals and signs), shoulders, utilities and facilities.

In areas subject to frost and snow, plantings should not be located where they will cast shade and create patches of ice on vehicle and pedestrian thoroughfares.

Without exception, locate plants to maintain visibility to legal off-premise and on-premise outdoor advertising displays. Typical visibility viewsheds are as shown in the Encroachment Permits Manual 509.4.

(1) *Maintenance Considerations.* Consider the safety of maintenance workers and the traveling public when locating plants. Evaluate the mature size, form, and characteristics of the species, and long-term maintenance requirements.

Locate plants so that pruning will not be required.

Groundcover should be located so it will not extend onto shoulder backing, into drainage channels, or through fencing.

Minimize worker exposure to traffic and reduce the need for shoulder or lane closures. Locate vegetation away from shoulder, gore, and narrow island areas between ramps and the traveled way to reduce the need for shoulder or lane closures to perform pruning or other maintenance operations.

Refer to the Maintenance Manual and Roadside Vegetation Management Handbook for additional considerations.

904.5 Locating Trees

Trees must be located to not visually restrict existing roadside signs and signals.

Locate trees to maintain a minimum vertical clearance of 17 feet from the pavement to the lower foliage of overhanging branches over the traveled way and shoulder. Locate trees to maintain a minimum vertical clearance of 8 feet from sidewalks or walkways to the lower foliage of overhanging branches for pedestrian passage.

For sidewalks and pedestrian plazas, design tree wells with a minimum of 2 feet from the tree trunk to the edge of the tree well to protect pavement from tree root displacement. Include root barriers to protect the pavement surrounding the tree well. Allow for an appropriate soil volume when designing tree wells.

Without exception, do not plant large trees over gas lines or under overhead utilities and/or structures. Coordinate with local utility provider or District Utility Engineering for guidance.

(1) *Large Trees.* Large trees are defined as plants which at maturity have trunks 4 inches or greater in diameter, measured 4 feet above the ground. Examples of large tree species are Coast Redwood (*Sequoia sempervirens*), Coast Live Oak (*Quercus agrifolia*), and Deodar Cedar (*Cedrus deodara*).

(2) *Small trees*. Small trees are defined as smaller trees or plants usually considered shrubs but trained in tree form that will develop up to a 4-inch diameter trunk at maturity. Examples of small trees are Crape Myrtle (*Lagerstroemia indica*), and Bottlebrush (*Callistemon sp.*) trained in standard form.

(3) *Clear Recovery Zone (CRZ).* Locate trees to be outside the CRZ. The CRZ provides an area for errant vehicles the opportunity to regain control. Refer to Index 309.1(2) for additional information and requirements of the CRZ.

Setbacks are measured from the edge of traveled way to the face of tree trunk. Situate trees to accommodate the anticipated mature tree size.

(a) Freeways and Expressways. On freeways and expressways, including interchange areas, there should be 40 feet or more of clearance between the edge of traveled way and large trees; but, a minimum clearance of 30 feet must be provided where trees may become a fixed object to errant vehicles. However, large trees may be planted within the 30-foot limit if they cannot be reached by an errant vehicle. For example, on cut slopes above a retaining wall, in areas shielded behind concrete barriers, metal beam guardrail, thrie beam, etc. which has been placed for reasons other than tree planting. Additionally, exceptions to the 30-foot setback may also be considered on cut slopes which are 2:1 or steeper The minimum tree setback in these cases should be 25 feet from the edge of traveled way.

Special considerations should be given to providing additional clearance in potential recovery areas. Setback distances greater than 30 feet should be provided at locations such as on the outside of horizontal curves and near ramp gores.

Large trees should not be planted in unprotected areas of freeway medians or expressway medians except for separated roadways with medians of sufficient width to meet the plant setback requirements for tree planting.

(b) Conventional Highways. When locating large trees on conventional highways comply with the requirements in Table 904.5.

904.6 Locating Plants in Conformance with Sight Distances

Sight distance requirements restrict the height of plants or the horizontal distance of plants from the traveled way. Low growing plants may be planted if the requirements for sight distance are met as discussed in Topic 201 – Sight Distance. Locate plants to maintain sight distance.

When locating plants, preserve views of pedestrians and bicyclists at intersections and other conflict points.

Sight distance limits are measured from the edge of traveled way to the outside edge of the mature growth. Locate plants to meet sight distance requirements when the plant reaches mature size.

Refer to Index 405.1(2) for corner sight distance requirements at intersections and driveways.

Proposed mature planting should maintain sight distance required by the design speed of the facility. In cases where, due to geometric restrictions, the existing freeway facility does not provide optimum sight distance, no further reduction should be caused by planting.

When locating plantings at interchanges, provide ramp and collector-distributor road sight distance equal to or greater than that required by the design speed criteria. A minimum provision of sight distance of 40 miles per hour should always be maintained. At points within an interchange area where ramp connections or channelization are provided, keep plantings clear of the shoulders and sight line shown in Figure 504.3I, Location of Ramp Intersections on the Crossroads.

Ensure clear recovery and sight distances are retained for vehicles, bicycles and pedestrians on the inside of curves in interchange loops, in median areas, on the ends of ramps, and on cut slopes. Generally, in interchange areas, a 50-foot horizontal clearance from the edge of traveled way, within the loops, is considered the sight distance plant setback for plants that grow above a 2-foot height.

Table 904.5

Large Tree Setback Requirements on Conventional Highways

ROADSIDE[2]		
Condition	Posted Speed (mph)	
	≤ 35	≥ 40
With curb	18” min. from curb face, without exception	30’min. from ETW, and 18” min. from curb face, without exception
With barrier	Min. deflection distance from barrier face (barrier type specific), and 18” min. from face of barrier, without exception	
Without curb or barrier	30’ min. from ETW	
MEDIAN[1], [2]		
Condition	Posted Speed (mph)	
	≤ 35	≥ 40
With curb	5’min. from curb face, and 18” min. from curb face, without exception	30’ min. from ETW, and 18” min. from curb face, without exception
With barrier	Min. deflection distance from barrier face (barrier type specific), and 18” min. from face of barrier, without exception	
Without curb or barrier	30’ min. from ETW, without exception	

Notes:

[1]Trees in the median should be located at least 20 feet from manholes.

[2]Place trees in accordance with sight distance criteria.

904.7 Vine Planting

(1) *Vine Planting on Barriers.* Vine planting should be considered with all noise barriers to reduce the potential for graffiti and to soften the appearance of the barrier. If retaining walls or noise barriers are located within the clear recovery zone (see Index 309.1(2)), plants may be placed behind the walls and be allowed to grow over (or through) the barrier, plants placed in front of a noise barrier must be behind a safety shaped barrier. Plants are not permitted on concrete safety shaped barriers unless an exception is granted from the Division of Traffic Operations and all the following requirements are met:

- Only vines which have a natural tendency to cling to noise barriers or retaining walls may be planted on barriers. Support structures on barriers are prohibited. Vine species selected must readily adhere to the barriers. Do not select vines with a habit of peeling off hard surfaces at maturity.
- Each plant should be individually irrigated.
- Plants should not encroach onto the shoulder or create sight distance problems.

Consult with the District Landscape Specialist and Maintenance Landscape Supervisor when considering planting vines on barriers. See Index 1102.7 for maintenance considerations in noise barrier design.

(2) *Planting of Vines on Bridge Structures.* Vines should not be planted where they might grow over any portion of the bridge structure. When the regular inspection of bridge structures is required and where rapid visual inspection of these structures is required in areas of high seismic activity, the planting of vines on bridge structures or columns is prohibited, without exception. There are certain conditions such as low average daily traffic, high redundancy in the substructure, etc. where exceptions from Structure Maintenance may be granted to plant vines.

904.8 Planting in the Vicinity of Airports and Heliports

All plants selected must comply with the height restriction standards contained in Topic 207 – Airway-Highway Clearances. Mature plant height must be used to determine if there is an obstruction to navigable airspace.

904.9 Plant Establishment

Plant Establishment is the period of time necessary that allows newly installed plant material to reach a state of maturity and ensures the operability of the irrigation system, to minimize future maintenance. The plant establishment period typically includes the following:

- replacement of dead or damaged plant material
- weed, rodent, and pest control
- litter removal
- irrigation operation and repair
- activities required to ensure the long-term survival of plant material

Depending on the type of project, there may be different requirements for plant establishment.

For Highway Planting within the right-of-way of all federally funded highways, plant establishment periods must be of a sufficient duration for establishment within the highway

environment. This period is used for identification and resolution of problems, and to minimize long-term maintenance requirements.

Provide a three-year plant establishment period, if planting is installed with a highway construction project, otherwise provide a one-year plant establishment period.

Projects with less than 5,000 square feet of planting or irrigation should have a plant establishment period of at least six months.

Mitigation planting may require longer plant establishment periods. Refer to specific permit requirements.

Topic 905 – Irrigation Design

905.1 Irrigation Design General

Irrigation systems should be designed to conserve water, minimize maintenance, minimize worker exposure to traffic, and sustain the planting. The design should be simple and efficient.

Irrigation systems that use recycled, non-potable, or untreated water must comply with State and local regulations.

Permanent irrigation systems are to be designed for automatic operation.

Review the entire irrigation design with the District Water Manager, District Landscape Specialist, and Maintenance Landscape Supervisor.

905.2 Water Supply

Use recycled or non-potable water for permanent irrigation systems. Designers should be familiar with the provisions of the California Streets and Highways Code, Section 92.3.

When the irrigation system is being installed as part of a separate contract install the water supply connection with the parent highway construction project.

Temporary irrigation systems may use potable water.

Coordinate water connections with the local water purveyor, follow water purveyor requirements for MWELO requirements, water meters, and cross contamination requirements.

905.3 Irrigation Conduit

Irrigation Conduits should be provided on Highway Construction Projects under new roadways and ramps, and on new Bridge Structures when future irrigated planting is anticipated. Extend existing conduits, as needed, on highway construction projects when widening or modifying roadways and ramps or modifying Bridge Structures.

Irrigation conduit consists of a conduit with a water supply line and sprinkler control conduit with a pull tape.

Coordinate with the District Landscape Architect to determine irrigation conduit needs, sizes, and locations.

(1) *Conventional Highways, Freeways, and Expressways.* Consider the following when sizing and locating irrigation conduits under roadways or ramps:

- Irrigation conduit consists of a minimum size of 8-inch DN conduit, with a 3-inch water supply line and a 2-inch DN sprinkler control conduit with pull tape. Consider sizing conduits and water supply lines larger when using nonpotable water.
- Irrigation conduits are typically spaced 1,000 feet apart on freeways. Consider using undercrossings for alternative crossing opportunities.
- Keep drainage facilities and irrigation conduit separate.

(2) *Bridge Structures.* Coordinate with Structures for location and placement of irrigation conduit in new bridge structures.

Consider the following when designing irrigation conduits for Bridge Structures:

- Generally, locate the irrigation conduit on the side of the bridge closest to the water source.
- Consider the maximum water demand and number or irrigation controller stations. The water supply line should be a minimum 3-inch DN and conduit for the sprinkler control conduit should be a minimum 2-inch DN and contain a pull wire.
- Ductile iron pipe is required for potable water supply line for pipes 4-inch DN or larger because of its superior strength and flexible joints.

905.4 Irrigation System Equipment

Use standard, commercially available irrigation components. Nonstandard features may be used to address unique site conditions.

Select “smart” irrigation equipment and controllers to minimize worker exposure and conserve water.

Consider security measures, such as locking cabinets, enclosures and valve boxes.

When selecting irrigation components, consider water quality, such as sediment, salinity, and increased particulate content often found in recycled, and non-potable water sources. Include an appropriate filtration system when the recycled water quality contains undesirable suspended particles.

Place irrigation components that require regular maintenance as far from traffic as possible, outside the clear recovery zone, or behind safety devices. Place irrigation components in areas easily accessible by maintenance forces.

Consider potential damage from pedestrians or vehicles when locating irrigation equipment. Minimize exposure to traffic and reduce the need for shoulder or lane closures, irrigation equipment must be located far away from shoulder areas, gore areas, driver decision points, and narrow island areas between ramps and the traveled way.

Review the proposed location of backflow preventers and irrigation controllers in the field with the District Maintenance Supervisor and the District Water Manager.

(1) *Backflow Preventer Assembly.* The use of a reduced pressure principle backflow device is required for permanent irrigation systems using potable water. Include an enclosure with backflow preventer assemblies.

Use master remote control valves directly downstream of the backflow preventer assembly.

(2) *Booster Pump System*. When water pressure is insufficient, a Variable Frequency Drive (VFD) booster pump may be required in the irrigation design. Determine booster pump specifications by conducting calculations to determine the horsepower and electrical power input requirements. Coordinate with Division of Engineering Services Office of Electrical, Mechanical, Water and Wastewater Engineering. If necessary, consult with an irrigation pump manufacturer for assistance.

Coordinate with the District Electrical Design and Maintenance field personnel to coordinate power supply specifications and location.

(3) *Irrigation Controller.* Use the district specific "smart" irrigation controller that automatically adjusts water application rates based upon weather conditions. Include a vandal resistant cabinet. Coordinate with the District Maintenance Water Manager for irrigation controller information.

Locate irrigation controllers where they are easily accessible, protected from vehicular traffic, and in an area away from shoulders. Locate the irrigation controller cabinet so maintenance personnel will be able to see oncoming traffic in the nearest traffic lane when accessing the controller. Locate controllers away from dense shrubbery, in an area with good lighting, and out of the spray from sprinklers.

(4) *Sprinklers.* Select sprinklers appropriate for local wind and soil conditions. Include swing joints with sprinklers. Consider check valves, flow shutoff devices and other water conservation measures when selecting sprinklers. Install sprinklers on fixed risers only in areas away from the roadway.

Overhead irrigation systems should be limited to irrigating low shrub masses, ground cover or establishing native grasses.

Individually water trees and shrubs spaced farther apart than 10 feet on center. Trees in overhead irrigated ground cover areas should receive basin water with a separate irrigation valve using tree well assemblies.

When possible, locate sprinkler heads outside the clear recovery zone. Design irrigation to spray towards the roadway, but not on the pavement. Protect sprinklers by locating them away from areas where damage from vehicles, bicyclists, or pedestrians may take place.

(5) *Flow Sensor.* Select a flow sensor that can be used in conjunction with the irrigation controller and has capability to monitor low flow, excess flow, and communicate learned flow to the irrigation controller.

(6) *Valves.* Select industrial grade plastic valves to deter theft.

Remote control valves, including master valves should be normally closed to minimize water loss if a break occurs.

Cluster remote control valves and consolidate manifolds whenever possible. Install a ball valve or gate valve up stream of the manifold.

Locate valves adjacent to access paths or in locations accessible from outside the right of way via access gates.

Install gate valves on each side of irrigation conduits. To minimize the risk of water hammer do not use ball valves at irrigation conduits.

(7) *Sprinkler Protectors.* Use sprinkler protectors around pop-up sprinklers and quick coupling valves adjacent to the roadway, bicycle paths, or walkways and sidewalks.

905.5 Temporary Irrigation

Native and drought tolerant plants may require temporary irrigation for successful establishment. Consider using a temporary irrigation system if establishment of non-irrigated vegetation will be difficult.

Manual, battery, or solar operated valves and controllers may be used when systems are temporary.

The use of drip irrigation systems or on grade irrigation system may be considered with a temporary irrigation system.

Temporary irrigation systems should be removed once they are no longer needed.

Topic 906 – Erosion Control

906.1 Erosion Control General

Permanent erosion and sediment control are required when surface soils are disturbed by construction activities. Erosion control prevents erosion by water, wind, or gravity from moving soil particles away from their original location.

Establishing non-irrigated vegetation is the preferred permanent erosion control measure. Permanent erosion control is accomplished with a combination of soil surface protection (mulches and blankets) and planting techniques.

Steep slope applications and stormwater treatment biofiltration areas may require the application of specialized techniques to ensure the establishment of permanent erosion control.

Sediment control is the interception of eroded soil particles from moving offsite when they become dislodged. Sediment control is accomplished by installing interruption devices on slopes and at concentrated flow locations. Examples include fiber rolls and check dams.

Refer to the LAP website Erosion Control Toolbox and the California Stormwater Quality Handbook: Project Planning and Design Guide (PPDG).

906.2 Soil Surface Protection

Soil surface protection is a necessary component of the erosion control strategy to ensure that soil is protected.

Soil surface protection includes application of the following measures:

(1) Organic Material. Locally obtained or imported organic material applied to the soil surface. Duff, wood chips, and mulch applied topically.

(2) Inorganic Material. Inert mulches such as rock gravel can be applied to protect soil surface erosion.

(3) Straw. Natural fiber stalks from wheat, rice, or native grasses applied to the soil surface. Straw may be stabilized mechanically (punched straw) or with hydromulch and tackifiers.

(4) Hydraulic Erosion Control Products (HECPs). Temporary, degradable, pre-packaged fibrous mulch materials which are mixed with water into a slurry and hydraulically applied to

the soil surface. HECPs include hydromulch, and bonded fiber matrix (BFM), and other hydraulically applied materials.

(5) *Rolled Erosion Control Products (RECPs).* RECPs are a blanket that is typically an open weave, degradable material composed of processed natural (jute mesh) or polymer yarns woven into a matrix. RECPs may be applied to the soil surface where vegetation alone will not sustain expected flow conditions and/or provide sufficient erosion protection. RECPs include netting, blanket, and turf reinforcement mat (TRM).

Short term cover measures are intended as transitional soil protection until establishment of vegetation is achieved. Short term cover includes organic material, straw, hydromulch, RECP (Blanket), and RECP (Jute Mesh). Short term cover generally lasts between 1 and 18 months.

Long term cover measures provide immediate and long-term erosion protection where establishing vegetation may be difficult. Long term cover includes RECP (Netting), RECP (Blanket), and RECP (Turf Reinforcing Mat). Long term cover generally lasts 24 months.

906.3 Planting

Planting for erosion control purposes is typically accomplished with seeding, liner plants, seedling plants, and/or native grass sod. Coordinate with the District Biologist to determine specific permit requirements. Contract growing of site specific and genetically appropriate plant materials may be required.

(1) *Seeding*. Do not specify seeds that have a short shelf life. Seeds may be applied as hydraulically applied seed, drill seed, or dry seed.

(a) *Hydraulically applied seed*. This method uses hydroseed equipment to mix seed, fiber, tackifiers, and/or other materials with water into a slurry which is hydraulically applied to the soil surface. Hydromulch and bonded fiber matrix are HECPs used to hydraulically apply seed. Consider hydraulically applied seed for slopes 2:1 or flatter and larger than half an acre.

(b) *Drill Seed*. This method involves sowing seed into the soil using a drill seeder. Consider this method in areas 3:1 or flatter due to drill seeding equipment limitations. This method should not be used to provide temporary cover.

(c) *Dry Seed*. This method applies seed and amendments by hand to small areas. Consider this method in areas less than half an acre.

(2) *Liner and Seedling Plants*. Consider using small nursery grown perennial and woody plants for erosion control and mitigation purposes. These are usually native species. Liners are containerized. Seedlings are bare root without a container.

(3) *Native Grass Sod*. Consider using native grass sod whenever immediate and complete plant coverage is required. Consider the use of native grass sod in biofiltration strips and swales or for low impact development water quality control projects. Consider including temporary irrigation with native grass sod.

(4) *Brush Layering.* Consider brush layering when there is adequate soil moisture for the cuttings to grow; use temporary irrigation when brush layering is not installed near a seep, spring or waterway. Locally harvested cuttings from existing cottonwood or willow stands either on site or from an adjacent site are embedded in horizontal layers parallel to the contours of a slope. Consider using in areas 2:1 or flatter. Consult with Geotechnical for slopes steeper than 2:1.

906.4 Sediment Control

Linear sediment controls are utilized to slow and spread runoff, reduce concentrated flow, and limit the movement of sediment. Linear sediment control products are manufactured 3-dimensional tubes of a specified filler material encapsulated within a flexible containment material.

(1) *Fiber Roll*. Consider placing fiber rolls on the contour of the slope. Place along slope faces at regular intervals to minimize sediment loss while permanent vegetation is becoming established.

(2) *Compost Sock*. Consider placing compost socks on the contour of the slope. Place along slope faces at regular intervals to minimize sediment loss while permanent vegetation is becoming established. Compost socks will also provide biofiltration and organic content to the existing soil.

906.5 Permanent Erosion Control Establishment

Permanent Erosion Control Establishment (PECE) extends the contract period beyond the completion of the highway construction phase requiring the Contractor to be available to perform permanent erosion control repairs prior to "Contract Acceptance." This ensures that adequate vegetation cover and slope stabilization is attained prior to construction contract acceptance.

Having the Contractor available during the PECE period will hasten any repair work that may be needed, such as after severe weather events, and will reduce the workload on the Maintenance Division. PECE provides an additional 250 working days after completion of all other construction activity to assess the success of the erosion control work and meet the project's slope stabilization goals.

Include Permanent Erosion Control Establishment when slopes are steeper than 2:1, where poor soil conditions may inhibit vegetation establishment, erosion control elements are expected to need maintenance while vegetation is being established during construction, or there is the potential of direct discharge of sediment into 303D listed receiving waters.