

DESIGN INTERPRETATION



(1) Material and color of walls reflect interpretations of the desert landscape.



(2) Roadside services in the Mojave High Desert segment can utilize desert materials, color tones, and architecture of the desert.



(3) The statewide welcome center could include distinctive shade structures.



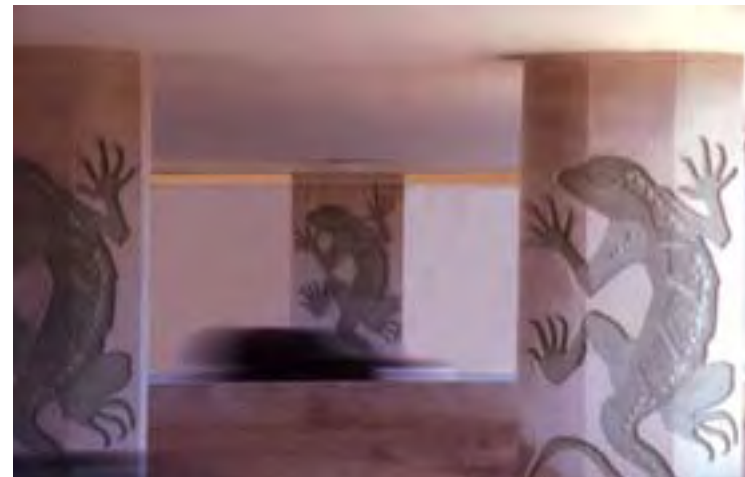
(7) This enhanced native landscape interpretation contributes significant unity to the highway corridor by providing a consistent plant palette.



(4) Mesquite trees provide verticality in the landscape of the corridor and enhance shadow patterns.



(5) The natural history of the region can be conveyed via highway design elements.

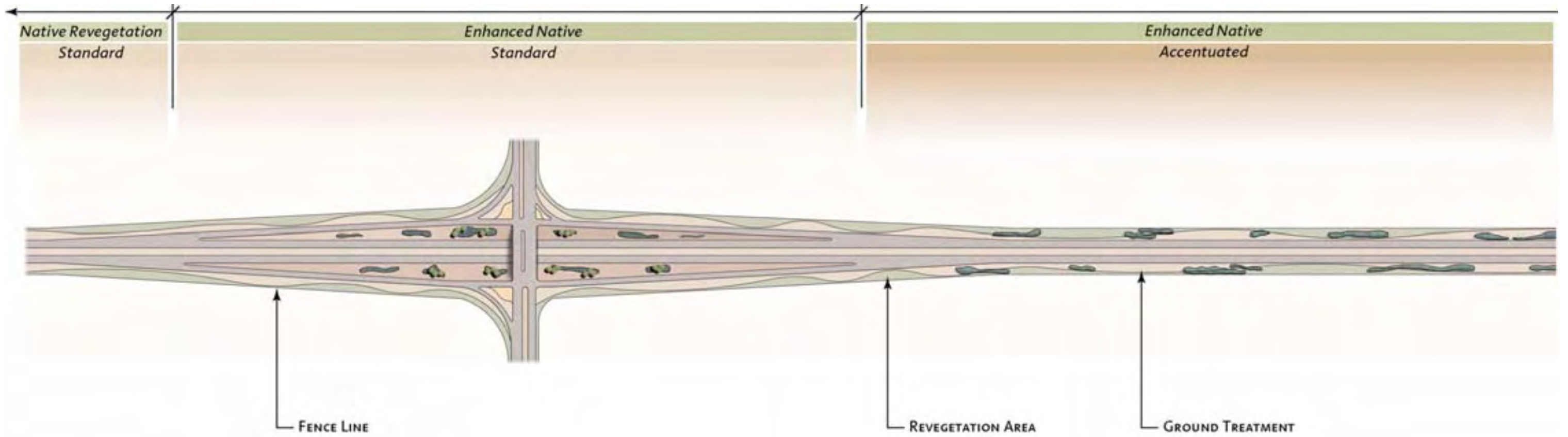


(6) Representations and interpretations of the flora and fauna of the Mojave High Desert landscape can enhance structures and hardscape.

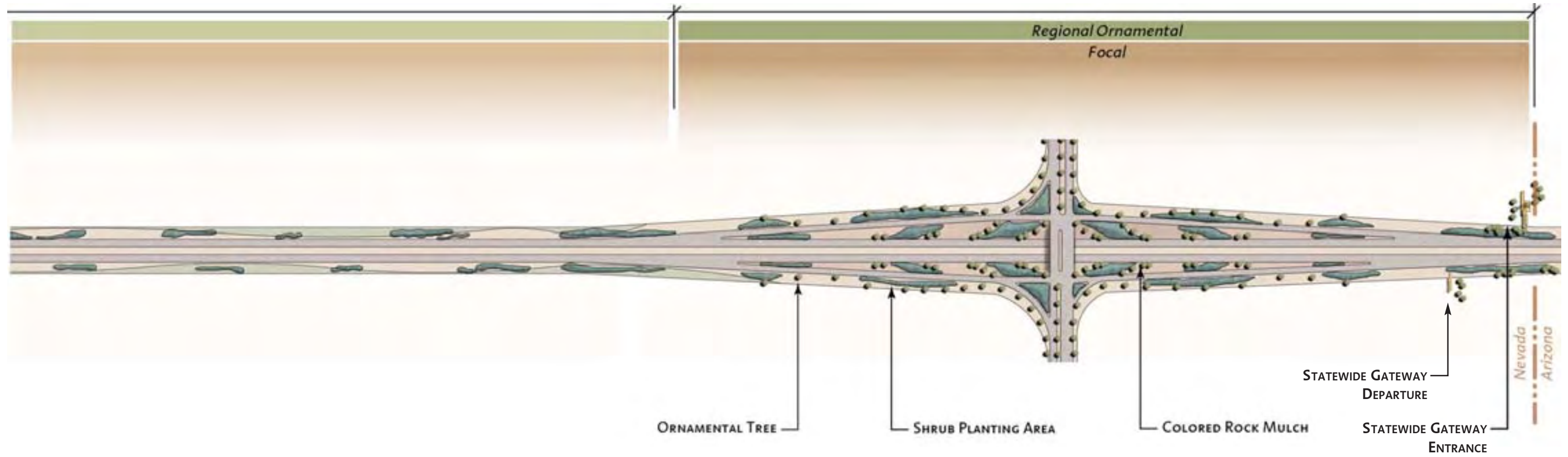


(8) Form, texture, and color are found in the plant palette of Regionally Adapted softscapes.

MOJAVE HIGH DESERT



(1) At Mesquite, two community gateways are included in the theme. These would receive Regionally Adapted planting and Focal hardscape.



(2) The concept for the statewide gateway from the east will be defined with a vertical monument and stone wall located at the entry point into Nevada from Arizona.

CORRIDOR DESIGN GUIDELINES FOR I-15

Purpose of Design Guidelines

These landscape and aesthetics guidelines are intended to guide physical changes for existing and new highway projects. The result will be a cohesive highway corridor that is compatible and sensitive to its context. These guidelines will accomplish better design for Nevada's highways.

Design guidelines provide a framework for improving landscape and aesthetics when designing new and retrofit highway projects. The guidelines are written statements of recommended performance that establish qualitative levels of design to meet the objectives of each Landscape Design Segment. Some of the guidelines are accompanied by concept diagrams, sketches, or photographs. These images are illustrative and are intended to demonstrate ways the design intent could be achieved. Ultimately, these design guidelines will assist in successful revitalization and overall landscape and aesthetic improvement of the I-15 highway corridor.

These design guidelines have been prepared to assist in developing design solutions that:

- Guide the interpretation of the design themes for each Landscape Design Segment.
- Create a visual design unity among all highway structures and facilities.

- Select finish, color, and surface patterns to coordinate structures with the surrounding landscape.
- Apply a consistent color palette for all structures.
- Incorporate transportation art motifs and media that depict the Gateway to Nevada's Excitement, the Dynamic Desert Metropolis, and the Mojave High Desert Landscape Design Segment themes.

These guidelines outline ways in which to achieve the enhancement of the highways' most valuable assets, including scenic views, important cultural and environmental features, and the surrounding Mojave Desert landscape.

Corridor Plan Guidelines

NDOT, designers, and communities are strongly encouraged to use these guidelines to ensure that individual projects comply with the design spirit and literal intent of the corridor plan. NDOT will review each project design for consistency with these guidelines and the overall *Landscape and Aesthetics Corridor Plan*. When designing a highway project the full design team should:

- 1) Become familiar with design guidelines for the design segment in which the project is located. The guidelines are intended to direct the design toward the objective of aesthetic cohesiveness for the design segment.

- 2) Understand the context of the project site. The landscape surrounding the proposed project provides directions for enhancement. These include predominant materials, colors, and enhancement to structures as well as natural resources, cultural, and social elements.
- 3) Seek early review of the project. Making changes at the beginning of the project is far easier than at the end. Involving others early in the planning/design process helps ensure that the project is feasible, both economically and aesthetically.



(1) The purpose of these guidelines is to create a cohesive highway corridor that is compatible with Nevada's existing landscape, communities, and urban areas.

These design guidelines are directed at avoiding project to project design in favor of comprehensive corridor design.

1.0 PROJECT DESIGN PROCESS

- 1.1 **Understand the design segment theme and select design concepts that interpret the theme.** Review the vision and objective for the Landscape Design Segment as described in the *Corridor Plan* and ensure the theme guides the project design. Understand the context of the site, including viewshed analysis and Landscape Design Segment objectives as described. Ensure project design successfully interprets the Landscape Design Segment theme.

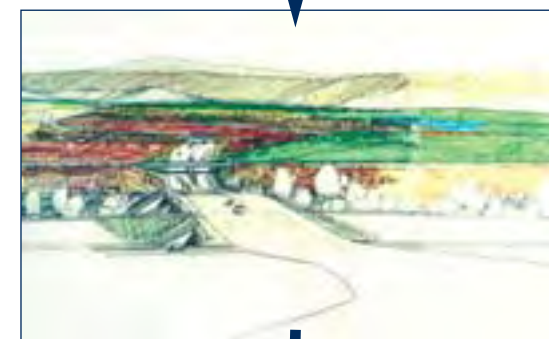
- 1.2 **Understand the site context, including the surrounding landscape, and conduct a comprehensive analysis.** Conduct a comprehensive environmental analysis for each project. Site inventory for each project should extend past the project boundaries, and analyze the site and surrounding landscape. Ensure the planning and design of the highway project responds to this comprehensive analysis. Consider characteristics such as precipitation, topography, ground cover, size and location of plant material, visual conditions, soils, site drainage, rock outcroppings, and other natural features, both on the site and surrounding the site.

- 1.3 **Visualize design concepts for highway improvements.** Utilize sketches, models and digital visualization tools to understand design concepts from a three-dimensional perspective. Plan view design alone does not accurately represent the experience of the traveler along the highway or illustrate issues of visual design. "Roadview Explorer" is an excellent tool for this purpose.

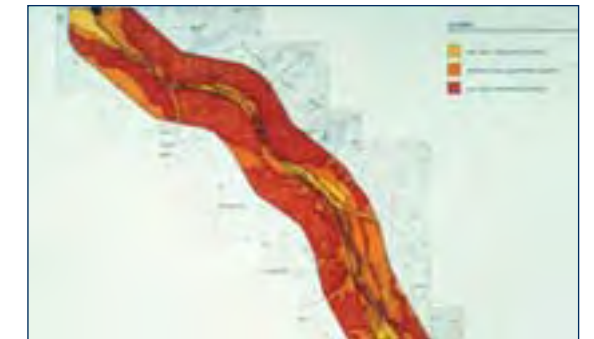
- 1.4 **Integrate landscape and aesthetics at the onset of planning, design and engineering of all highway projects.** Landscape and aesthetics should not be an afterthought to a highway project. Rather, landscape and aesthetics need to be considered at the onset of the planning design and engineering of all highway projects. NDOT's STET report regarding type, size and location of highway structures should include information on landscape and aesthetics. Engineering design should incorporate landscape and aesthetics to create highway structures and facilities that are effective, safe, and aesthetically appealing. The ability for a roadway and roadway facilities to blend successfully into the surrounding landscape or integrate appropriately with surrounding land uses should be fundamentally addressed at the outset.

- 1.5 **Consider Landscape and Aesthetics costs alongside baseline costs.** Landscape and aesthetics should be considered simultaneous to a project's capital budget and estimates. In addition to determining a project's baseline construction cost, allocation of budgets and resources for landscape and aesthetics should be clearly outlined at the start of a project.

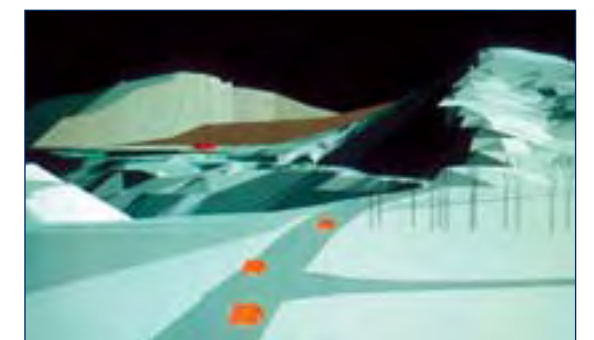
LANDSCAPE AND AESTHETICS IS NOT AN AFTERTHOUGHT TO ENGINEERING, BUT THE STARTING POINT FOR INTEGRATED CONTEXT SENSITIVE SOLUTIONS.



(1), (2), (3), (4) This series of highway design studies shows the process of visualization from computer modeling to the built project.



(5) Understanding the corridor conditions and context is a critical part of the design process.



(6) Computer simulation of a planned highway at the conceptualization of the project.



(7) Photo simulation of a highway project allows visualization of physical design.

2.0 WELCOME CENTERS AND STATEWIDE GATEWAYS

2.1 Provide vibrant, visually rich gateway welcome centers. Promote and provide information about statewide travel opportunities and services in a gateway welcome center at the California boundary in Primm and the Arizona/Utah border in Mesquite. Promote the gateway welcome centers as important civic facilities and ensure these centers have strong visual presence. The gateway welcome centers should convey the identity of Nevada and make the entry into the state a notable and memorable experience. Welcome centers should also signify the departure from Nevada and leave the traveler with a positive memory. Program elements offered at centers include interpretation of time, history, and the Mojave Desert landscape. The state gateway at Primm should fully span the northbound approach and capture the visual character shown in sketches 4 and 6 on this page. Emphasize the sequence of arrival and departure by extending the approach for several miles. The gateway should be visually appealing at night and connect travelers with the natural landscape and scenic views. The gateway at Primm should be Regional Ornamental softscape type and Focal hardscape type. The statewide gateway at Mesquite should capture the visual character of sketch 3 on this page. The gateway at Mesquite should be Regional Ornamental softscape type and Focal hardscape type. Each statewide gateway shall include the Nevada name and state seal, feature stone materials from the local region of the state and landscape planting type as identified in the Landscape Design Segments shown on pages 4.5 and 4.25.

2.2 Accommodate a stop for the California/Nevada High Speed Rail. Ensure the gateway/welcome center in Primm accommodates a station for the proposed high-speed California/Nevada train to stop. In addition, provide a direct pedestrian connection from this station to a stop for the existing monorail system in Primm.

2.3 Right-of-way corridor preservation from California/Nevada state line to Sloan. The I-15 corridor from the California state line to the entrance to the Las Vegas metropolitan area at Sloan is the

most traveled corridor in the state. The visual analysis identified the special characteristics of this segment and its role as the tourism entrance to the state. Multi-modal transportation use is also a consideration in the right-of-way width. Control over the landscape and aesthetics of this section of roadway may require collaboration with federal, state, and local governments concerning landscape and aesthetics matters. Occupancy permits should not be allowed in this segment. The application of a scenic easement may be necessary to manage the visual future of the segment.



(3) Required design elements illustrated for the Mesquite statewide gateway.



(5) Existing conditions at Nevada stateline.

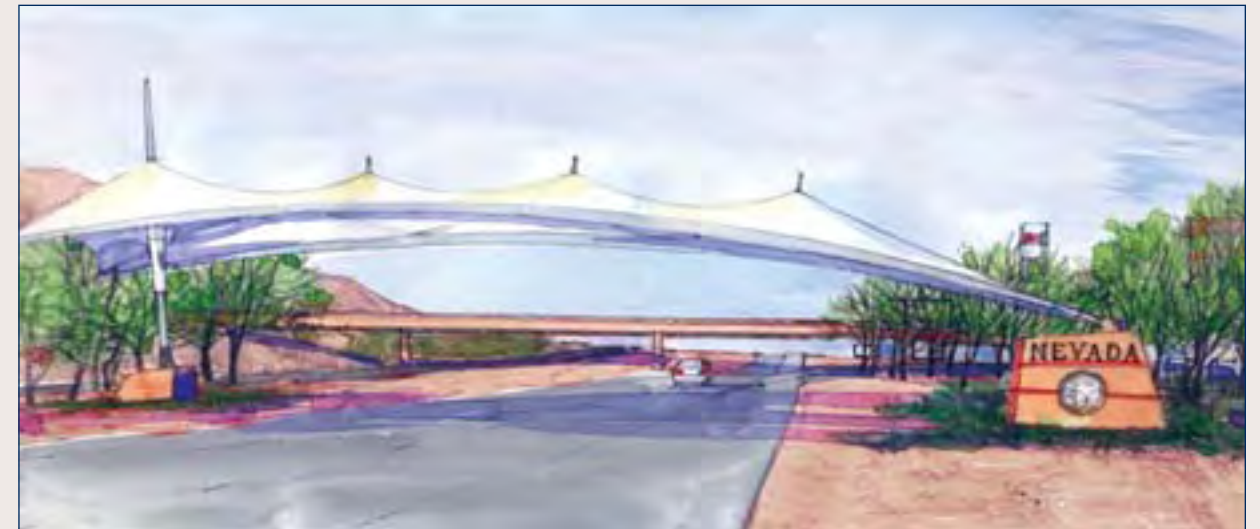


(1) Mojave Desert civic architecture with strong visual presence should be illustrated in the state welcome center at Primm.



(2) Notable outdoor space and welcome center entry feature example.

Image courtesy of Elizabeth Murrell, Fabric Structures Inc.



(4) Required design elements illustrated for the Primm statewide gateway.



(6) From dusk into the evening, the tent-like structure would be visible as a distant beacon with lighting below the span.

3.0 COMMUNITY GATEWAYS

3.1 Engage agencies and organizations in the planning and design process. Engage applicable state and local agencies as well as local stakeholder groups and organizations in the planning, design and implementation of community gateways. Mark the entrances and exits of communities using Enhanced Native, Regionally Adapted, or Regional Ornamental softscape types, and Accentuated, Focal, or Landmark structures and hardscape. Community gateways are intended to be visually impressive. Maintain and enhance important community features through careful gateway planning and design. Use appropriate landscape and/or structural techniques to screen unsightly land uses.

3.2 Locate gateways accordingly. Community gateways for the *Gateway to Nevada's Excitement Landscape Design Segment* should be located at Primm, Jean and Sloan (Map 1B, pg. 4.6). Primm should be highlighted by a gateway welcome center as discussed on page 5.3. The gateway to Jean should be marked by an Accentuated / Enhanced Native treatment; the gateway at Sloan should be marked by a Focal / Enhanced Native treatment.

Community gateways for the *Dynamic Desert Metropolis Landscape Design Segment* should be located at the four major entrances to the Las Vegas Valley (I-15 north and south, US 95, and I-515), North Las Vegas, Henderson, Town Center, Summerlin, Red Rock Canyon, Lone Mountain, and Kyle Canyon as shown on Sections 2A through 2F of the *Plan* (pages 4.12-4.17). Sections 2A through 2F also indicate the types of gateway features and landscape plantings that should be used to mark these gateways.

Community gateways for the *Mojave High Desert Landscape Design Segment* should be located at Moapa and Mesquite. Mesquite should be highlighted by a gateway welcome center as discussed

on page 5.3. The gateway to Moapa should be highlighted with a Focal feature and a Regionally Adapted softscape type.

3.3 Integrate the Gateway into the Highway Facilities. Free standing signs are not allowed in the right-of-way. Community gateways need to be integrated with highway structures and landscape.

Refer to Softscape and Hardscape Types and Treatments (pages 3.2-3.7) and Softscape Type Guidelines (pages 5.24-5.29) for more details about the type of features and plants to consider for community gateways.

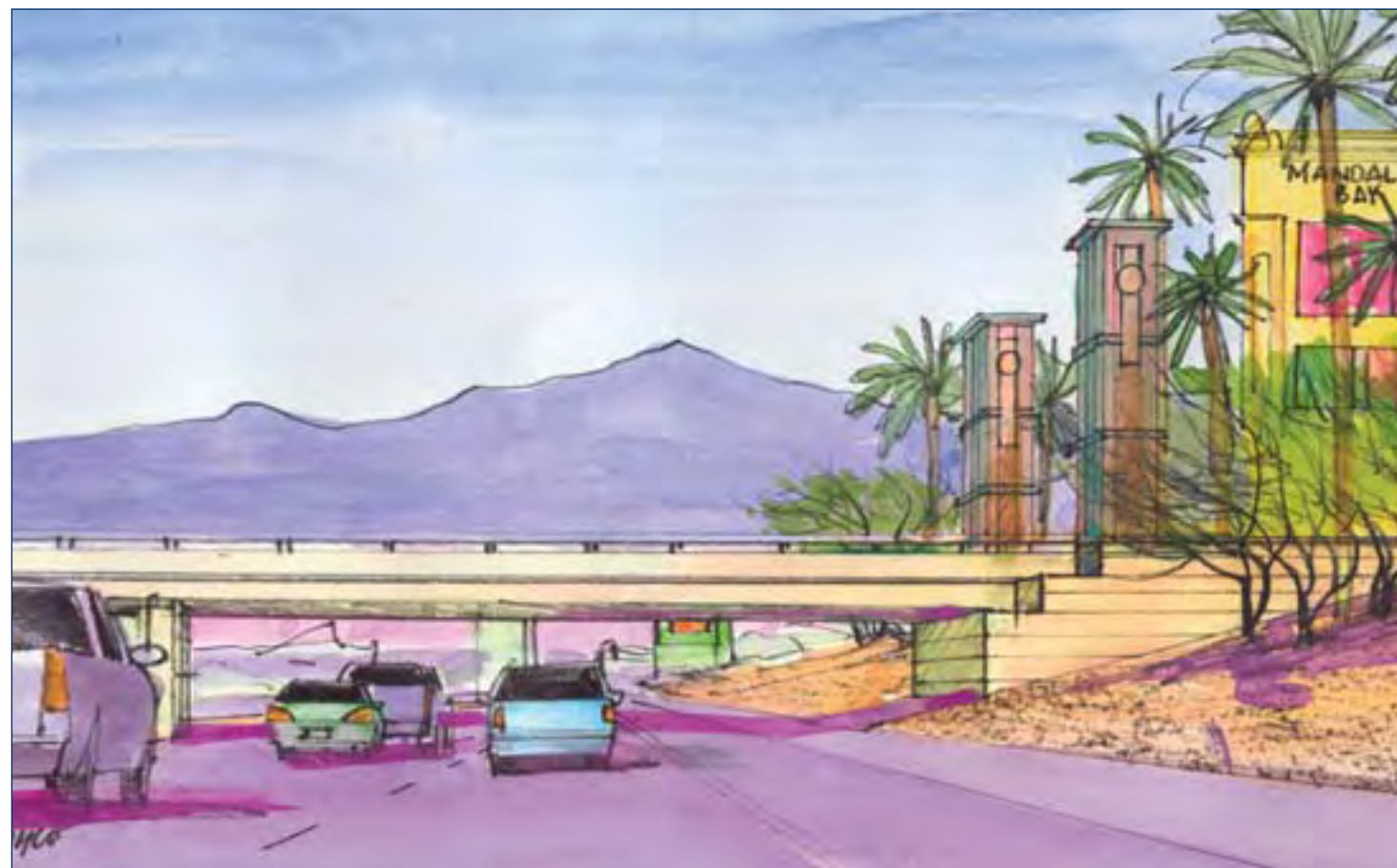


Image courtesy of Arriola & Fiol Architects

(1) This plaza provides an example of hardscape and/or structures that could be used to create a "focal" area at a community gateway.



(2) This unique pedestrian overpass provides an example of a bridge feature that is used to create a "landmark" for a community gateway.



(3) The landmark qualities displayed in this example of a Dynamic Desert Metropolis community gateway represent the highest level of treatment identified within the Landscape Design Segments.



(4) Example of a community gateway incorporated into retaining wall and bridge structure.

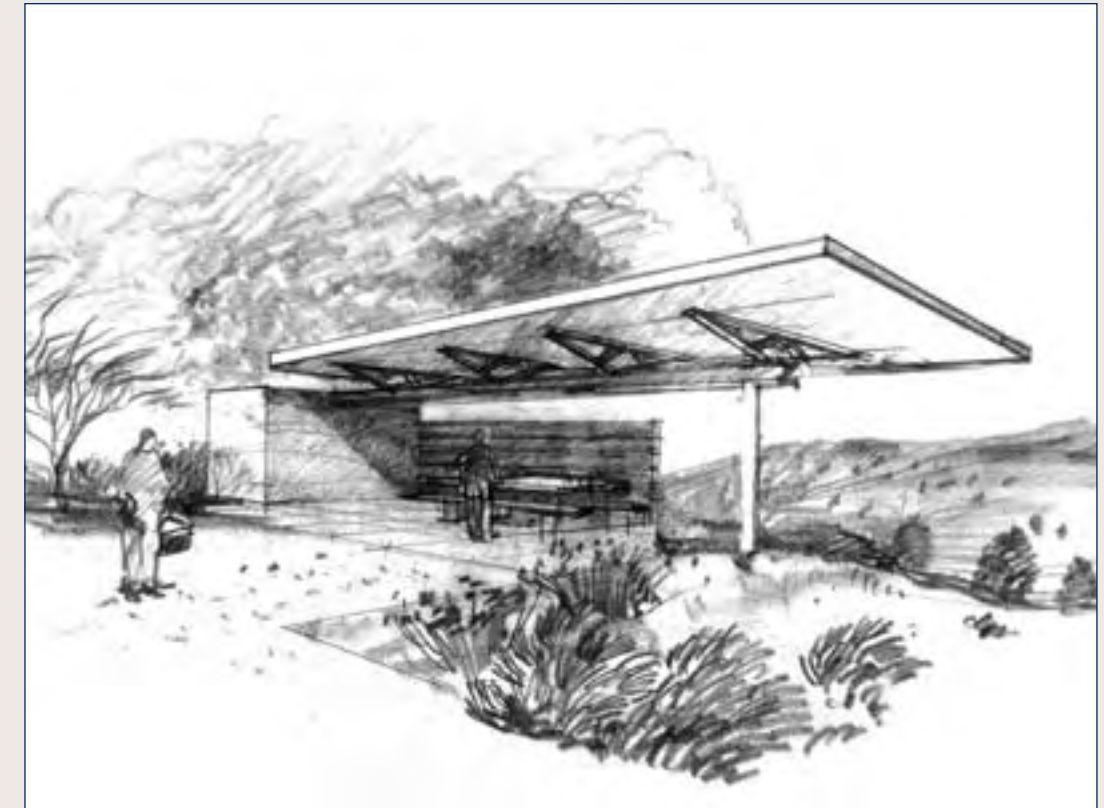
4.0 REST AREAS, VIEWPOINTS, AND PULL-OFFS

4.1 Implement a comprehensive roadside service program. Roadside services are key components of the highway corridor, particularly where long distances separate developed areas. Implement a comprehensive roadside service program throughout the corridor. Refer to the Road Service Program outline for a detailed description of road services (page 3.10). Locations for Road Service sites are located on the Landscape Design Segment maps (pages 4.4, 4.11, and 4.24).

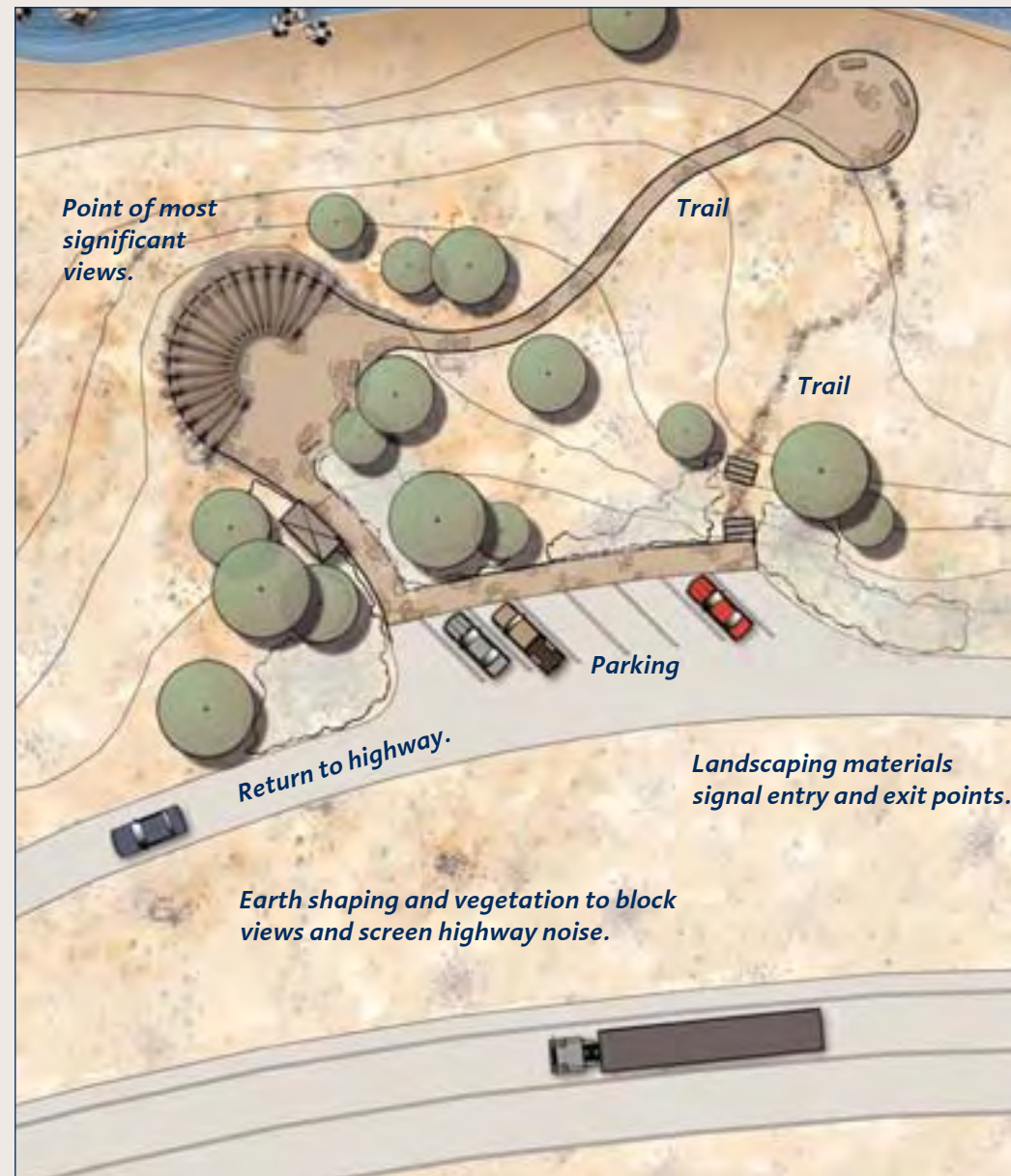
4.2 Ensure rest stop design reflects the local setting. Ensure highway rest stops and other such facilities reflect the landscape and natural setting of the local area. All rest stops, view points and pull-offs should readily accommodate travel needs and reflect a desert design theme. Desert materials and design elements, such as rammed earth and metal roofs, are to be used to impart a sense of permanence and connection to the desert. Avoid using makeshift, adapted site facilities with no distinctive architectural style. Concrete barriers should not be used for parking delineation or site boundaries at rest stops and pull-outs. Ensure all built facilities, such as restrooms, information signs/services, and shade are rooted in the desert landscape. Sustainable architecture or green building design is highly suitable to many highway rest stops and other such facilities where water, energy, and landscape resources are difficult to secure and maintain (refer to the Sustainable guidelines, page 5.32).



(1) Prototypical shade structure for all types of road service areas.



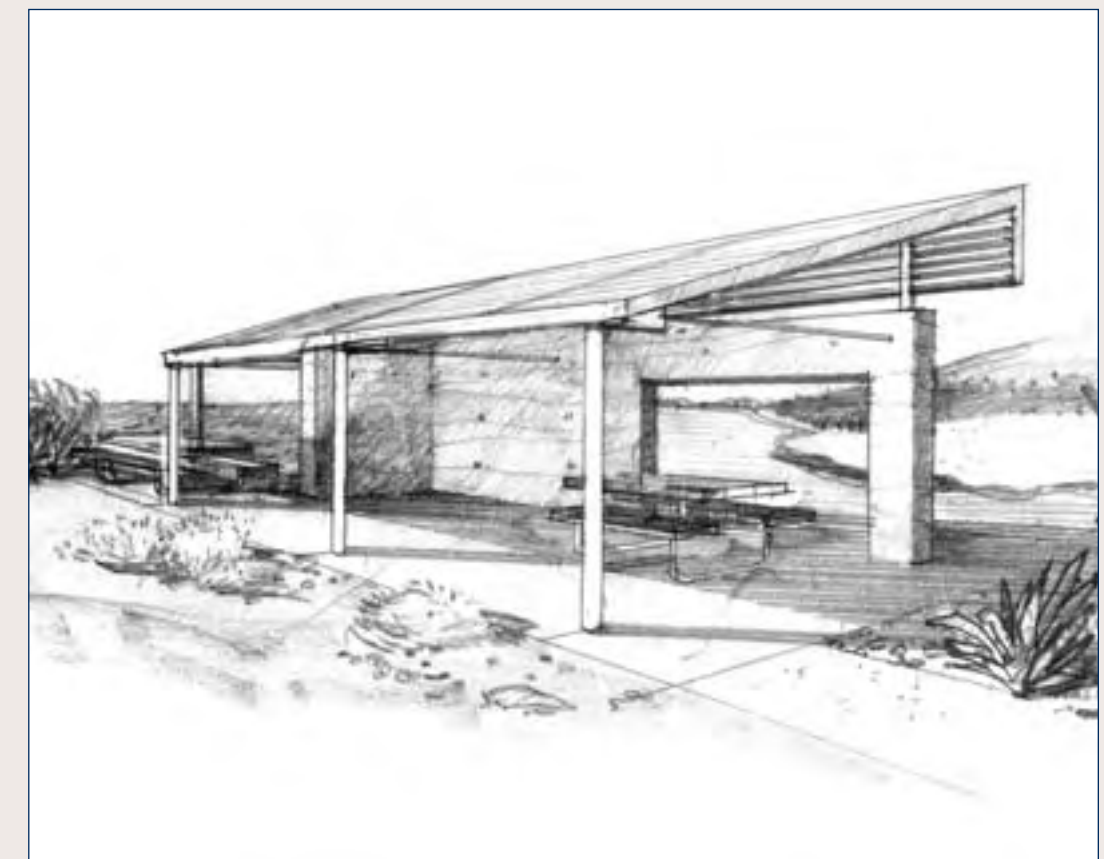
(4) Required prototypical shade structure protects users from wind and sun.



(3) Representative Viewpoint / Point of Interest.



(2) Geologic point of interest included as interpretation program at rest area.



(5) Required prototypical interpretive rest stop with table, benches, and shade structure that frames significant views.

5.0 SIGNAGE

5.1 Provide a standard, cohesive system of service signage.

NDOT will manage the location of Tourist Oriented Directional Signage (TODS) along the highway in a cohesive, understated manner. A cohesive set of standard TODS is encouraged over numerous private individual business signs and billboards. Work with local community agencies and businesses to develop and locate TODS. Refer to Outdoor Advertising Program (page 3.13) for more information about billboards along the corridor.

5.2 Implement a Statewide Place Recognition Sign Program.

A comprehensive place recognition signage program should be implemented through partnership initiatives with local communities and agencies.

Areas of interest within the *Gateway to Nevada's Excitement* Design Segment that could be highlighted include:

- **Historic Features:** Goodsprings, Old Spanish Trail
- **Geographic Features:** Bonanza Wash, Jean Lake, Little Devil Peak, Table Mountain, Sheep Mountain, Mount Potosi
- **Geological Places of Interest:** Quarry/Mining Sites
- **Cultural/Recreational Resources:** Spring Mountain Ranch State Park, Sloan Canyon National Conservation Area, Red Rock Canyon National Conservation Area

Areas of interest within the *Dynamic Desert Metropolis* Design Segment that could be highlighted include:

- **Historic Features:** Mormon Fort State Park, Old Las Vegas
- **Flora:** Desert Demonstration Gardens, UNLV Xeric Garden, Ethel M Botanical Cactus Garden, North Las Vegas Desert Demonstration Garden
- **Wildlife Viewing Areas:** Ash Meadows National Wildlife Refuge
- **Geographic Features:** Tule Springs Lake, Corn Creek Wash, Las Vegas Wash, Black Mountain, Lone Mountain, La Madre Mountain, Turtlehead Mountain, Blue Diamond Hill, Mount Wilson, Rainbow Mountain, Sunrise Mountain, Frenchman Mountain
- **Landmarks:** Hoover Dam, Silver Bowl Stadium, Las Vegas Strip, Thomas and Mack Center, University of Nevada Las Vegas, Nellis Air Force Base
- **Cultural/Recreational Resources:** River Mountain Trail, Neonopolis, Fremont Street Experience, Mount Charleston, Wet & Wild Water Park, Las Vegas Motor Speedway
- **Museums:** Las Vegas Natural History Museum, Lied Discovery Museum, Liberace Museum, Secret Gardens, Shark Aquarium

Areas of interest within the *Mojave High Desert* Design Segment that could be highlighted include:

- **Wildlife Viewing Areas:** Desert National Wildlife Refuge, Moapa Valley Wildlife Refuge, Overton Wildlife Management Area

- **Geographic Features:** California Wash, Dry Lake Valley, Muddy River, Meadow Valley Wash, Virgin River, Halfway Wash, Touquop Wash, Moapa Peak, Davidson Peak, Little Virgin Peak, Flat Top Mesa, Virgin Peak
- **Cultural/Recreational Resources:** Virgin River Recreational Lands, Valley of Fire State Park, Old Spanish Trail, Las Vegas Dunes Recreation Area, Moapa River Indian Reservation
- **Museums:** Lost City Museum of Archeology, Desert Valley Museum

5.3 Icon Representation. The features and points of interest to be recognized in this program will be approved by the NDOT signage committee. The image icons depicting each feature to be recognized on the sign should be derived from the actual physical shape of the point of interest as shown in illustration 1, 2, 3 and 4 on this page. Name and labels included shall be consistent with state archives, and map naming conventions. Final icon and name approval will rest with NDOT.

5.4 Incorporate the anti-littering campaign. Anti-littering messages located at highway stops that include food and beverage services will provide an immediate reminder to travelers. Work with local vendors to place the anti-littering messages on disposable cups, plates, and other items likely to be tossed out of the vehicle window.

5.5 Implement an Audio Interpretation Program. Develop an audio/multimedia interpretative program that would tie into the Statewide Sign Program. This program could be implemented via broadcast radio, CD or DVD programs, wireless Internet hot spots, satellite transmission, or other media that allows travelers to access additional information about cultural and natural resources, tourist opportunities, and services along the corridor from their car. Link the Audio Interpretation Program to the Statewide Place Recognition Sign Program and State welcome centers so that travelers will be able to access specific information on selected sites. Utilize synchronous technologies that allow the users to control how and when they access this additional information. Incorporate the program into the Intelligent Transportation System Regional informative architecture to allow messages to be updated in real time and be coordinated with AMBER alert and 511 traveler information messages. Partner with other groups, organizations, agencies and municipalities along the corridor and explore ways to expand the Audio Interpretation Program.



(1) View of the Hoover Dam.



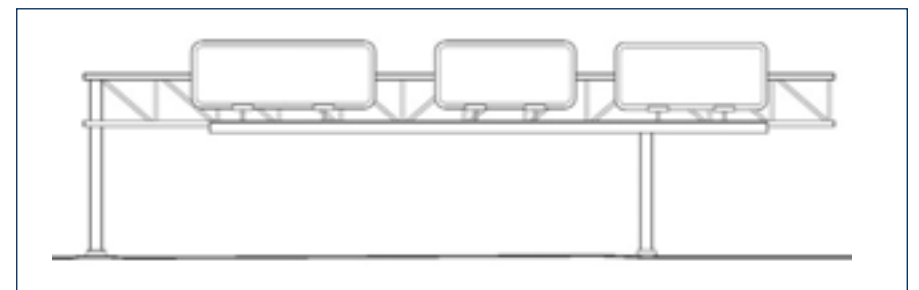
(2) Hoover Dam depicted on the Nevada sign program.



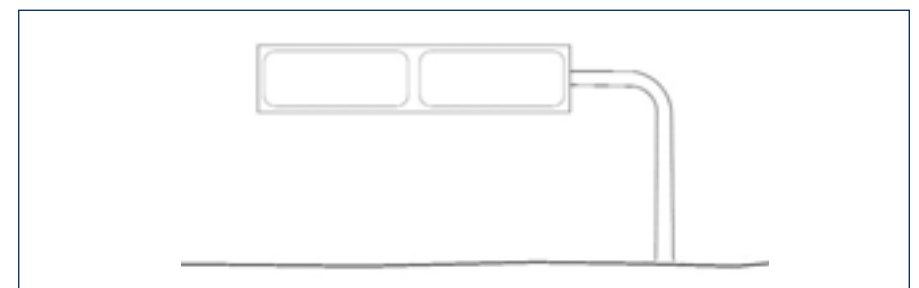
(3) Ghost Town of Goodsprings.



(4) Goodsprings depicted on the Nevada sign program.



(5) Sign bridge with numerous trusses are visually cluttered.



(6) Single arm monotube with one signage board clarifies appearance of information.

6.0 TRANSPORTATION ART

6.1 Create regionally appropriate, meaningful art.

For the roadway user, an artscape enhances the travel experience and the impression of place. Transportation art should be authentic and should evoke clear meaning and purpose that relates to the surrounding place, the unique culture and environment of the area, and the travel experience. Patterns imprinted on a highway structure should be designed with an artistic composition of objects, imprints, or patterns. While complementing other highway structures in form and color, patterns should offer a level of complexity and interest that responds to the unique experience of the place and roadway travel. Art work should be of a scale appropriate to highway travel speed. Consider artwork that expresses the element of light, both natural sunlight and artificial. Select sculpture that captures the desert sun as an element of its design. To engage the viewer, patterns and objects should be used thoughtfully. Even abstract elements can and should evoke a response to the physical reality of travel, time, the uniqueness of the site and/or the surrounding landscape to depict appropriate character and essential meaning. Avoid monotony in the duplication of repetitive literal pictorial applications. An example of this is profiled mountains rendered in concrete texture.

6.2 Ensure artwork expresses an excellence of craftsmanship, quality, truthfulness and originality. Elements of highway art should not be obvious nor inauthentic. Avoid the use of ready-made, randomly placed, stand-alone objects or imprints that depict little meaning. Rather, transportation art should depict an excellence of craftsmanship, quality, truthfulness and originality. Use evocative artistic

expressions that complement highway structures and the surrounding landscape, and engage observers. Rather than imprints of obvious subject matter, select more complex artistic expressions that encourage viewers to "fill in the blanks" and in so doing, evoke a high level of meaning.

6.3 Consider each art piece as part of a larger whole. Highway art can be carefully crafted and the simplest of all elements have a very powerful effect. When planning transportation art, the entire length of each design segment and the corridor should be considered. Each design segment theme is planned around views and vistas to the surrounding landscape of which the art is complementary.



(1) Artistic application of ground treatment.



(2) Culturally important mural along roadside created as a tile mosaic.



(3) Cultural symbols sandblasted into stone mark aspects of the historic emigrant travel.



(4) Towering metal sculpture as part of a bridge is intended to be seen from a distance.

Image courtesy of Catherine Widger

6.0 TRANSPORTATION ART cont.

6.4 Ensure transportation art supports the Landscape Design Segment themes.

Transportation art is not a typical project, and the choice of appropriate subject matter and media is essential to obtaining the desired expression for each Landscape Design Segment theme. Choose art subjects that support the Landscape Design Segments' themes such as:

Gateway to Nevada's Excitement:

- Celebration of arrival to Nevada
- Gateway / Threshold (visually prominent day and night)
- Travel
- Entertainment Culture
- Mojave Desert landscape and wildlife features

Dynamic Desert Metropolis:

- Travel / Tourism
- Unique Urban Metropolis
- Entertainment Culture
- The Las Vegas Strip / Resort Corridor (visually vibrant day and night)
- Red Rock Canyon
- Hoover Dam
- City of Lights

Mojave High Desert:

- Threshold/gateway; arrival to Nevada
- Travel / Tourism
- Outdoor Recreation
- Agriculture
- Mojave Desert landscape and wildlife features
- Virgin River Valley
- Old Spanish Trail
- Valley of Fire
- Lost City

Enhance bridges, pedestrian structures, sound walls and retaining walls with appropriate motifs and consider sculptural ornamentation, decoration, and landmark features.

6.5 Engage local agencies and organizations in the planning process.

Significant transportation art opportunities exist in each design segment of the I-15 corridor. Artwork can be included as a component of landscape and aesthetic projects, or as free-standing art installations. Relationships with local agencies as well as the Nevada Arts Council and/or Las Vegas Art Council should be developed to assist in the review and implementation of proposed transportation art projects. Consider transportation art at the onset of project development. Engage community members, artists, landscape architects and architects early in the design and development stages of highway projects to ensure an integrated and comprehensive art program. For Community Matching Fund and Transportation Art programs, refer to NDOT's guidelines outlined in the *Landscape and Aesthetics Procedures Manual: Guidelines, Applications, Instructions and Forms for the Community Matching Funds and Transportation Art Program*.



(1) Illuminated chain curtain enhances urban character.



(2) Glowing wall panels reflect light to create a bright, colorful art piece.



(3) Sound wall with decorative imprint motif created with custom form liner. This is both imprint as well as "additive relief" to project beyond the wall surface.



(4) Example of sculptural art in urban setting.

Image courtesy of Catherine Widgery



(5) An example of art integrated into pedestrian railing.










7.0 COLOR PALETTE APPLICATION

7.1 Use a uniform, consistent color palette for all highway structures. Standard NDOT practice should use a uniform and consistent color palette for all new and existing highway structures that complements the surrounding landscape. Base and accent stain or paint colors for all highway structures along the I-15 Corridor have been selected. For color reference purposes, the colors have been matched to the Dunn-Edwards system and are shown below.

From the palette below, each highway structure should use a selection of one base color and up to two accent colors. Ensure roadway structures within a single Landscape Design Segment use the same base color and accent color(s). As existing structures require refinishing, they should be stained or repainted to be consistent with the selected color palette. Specific logos and transportation art are exempt (refer to Transportation Art guideline, page 5.7).

7.2 Ensure accent colors highlight structural aspects. Accent colors should be used to highlight structural aspects and/or details of highway structures, such as the beam of a bridge or a bridge railing. Ensure accent color application logically responds to and reinforces structural features or change in materials.

7.3 Blend new rock cuts and/or soil with the surrounding landscape. Match new rock and soil treatments with existing rock and soil color. Where possible application shall occur in a central location and away from sensitive receiving waters. Treatments should blend newly excavated soil and rock with existing weathered rock. Any corridor project in which rock cuts are included should use this process.

| BASE COLORS | | ACCENT COLORS | |
|---|--|---|--|
|  | Gateway to Nevada's Excitement #6074 |  | Any two accent colors may be selected from the following palette. All Landscape Design Segments use these accent colors. |
|  | Dynamic Desert Metropolis #6130 |  | |
|  | Mojave High Desert #6221 |  | |
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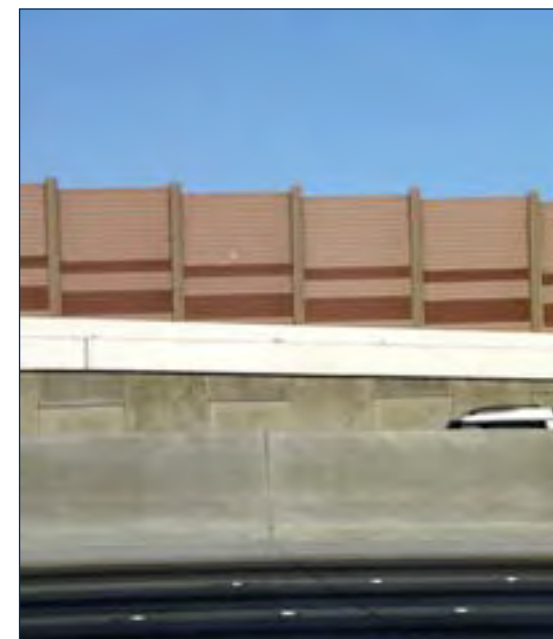
(1) The proposed color palette refers to the Dunn-Edwards paint system, for reference purposes only.



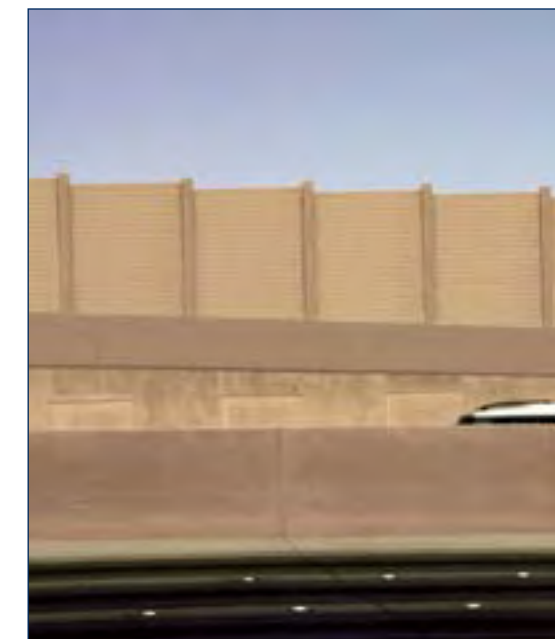
(2) The landscape inspires the color palette for each Landscape Design Segment. A different base color is used for each segment of the corridor.



(3), (4) Field testing of color palette in different light, orientation, and settings.



Existing condition.



After color application.

(5), (6) The following images demonstrate existing roadway structures before and after color palette application. Color application can be retrofitted to existing-in-place structures.

7.0 COLOR PALETTE APPLICATION cont.

7.4 Use color composition on bridges to visually reinforce structural elements. Use the base and accent colors to reinforce the structural elements and integrity of a bridge. Concrete bridge spans, superstructure support, and slope paving should be selected from the landscape segment base color. Railing and other features incorporating a material change should be accent colors. Steel bridge spans should use an accent color.



(1), (2) Appropriate coloring of bridge enhances visually quality

8.0 NON-MOTORIZED TRANSPORTATION SYSTEMS (NMT)

8.1 Engage agencies and organizations in the planning and design process. Engage federal, state and local agencies as well as local user groups and organizations in the planning, design and implementation of non-motorized transportation facilities. Ensure proper planning conveniently accommodates NMT while minimizing adverse safety and environmental impacts. Consult the statewide bicycle and pedestrian plans prepared by NDOT.

8.2 Integrate NMT into the right-of-way. NMT systems can be accommodated and should be encouraged within some areas of the highway right-of-way. Where right-of-way topography, site conditions, and land use warrant, separate bicycle paths may be built. Where possible ensure direct connections to existing and future trail systems and multi-use pathways.



(4) An accentuated pedestrian walkway along a roadway.



(5) Pedestrian/bicycle bridge over major roadway.



(6) Regional pedestrian trail integrated into highway right-of-way and providing connections for pedestrian under highway bridges into neighborhoods.



(7) Custom pedestrian bridge rail highlights crossing point.



(8) Native materials can be used to create unique pedestrian crossings.

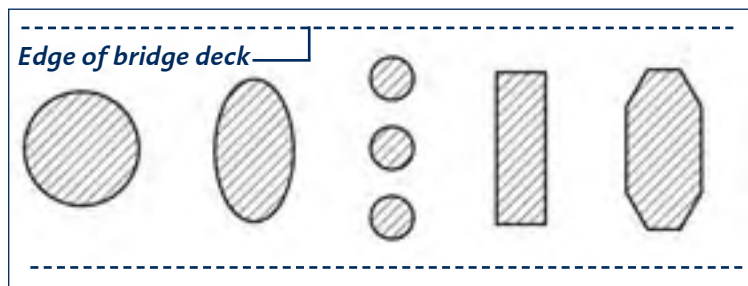


(9) Pedestrian underpass integrated into highway bridge design, rather than separate structure design. Height of opening allows light into underpass.

9.0 BRIDGES

9.1 Use a consistent bridge design. Use bridge structures of similar proportions, finish, and barrier rail design consistently throughout the corridor. In the Dynamic Desert Metropolis segment, street names should be embossed on the bridge span, providing place identification for the motorist. Where special conditions arise and larger or different bridge spans or types are required, ensure the new bridge is compatible with the type used elsewhere in the corridor.

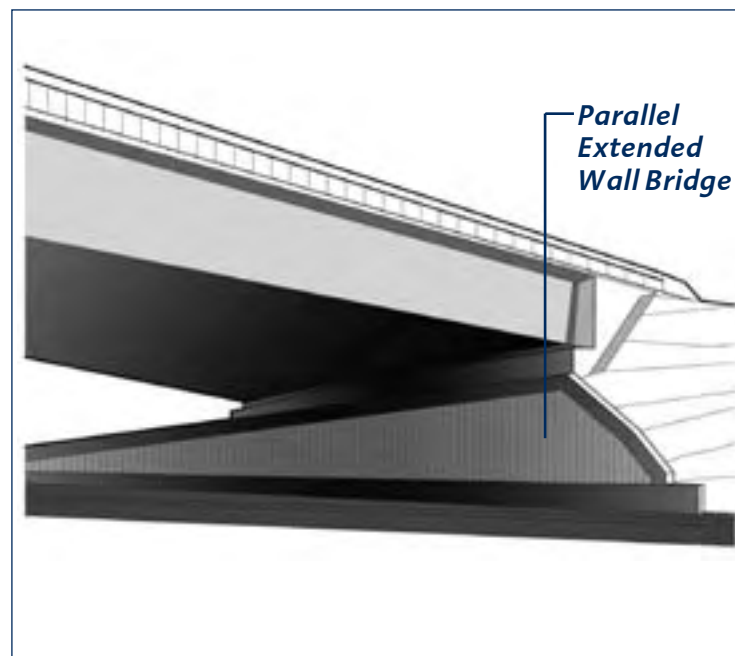
9.2 Use simple sub-structure and support features. Where possible, avoid "V," "Y" or flared support shapes in sub-structure and support features. Instead, use simple sub-structure and support features with strong proportional relationships in bridge design. Use simple geometric shapes to minimize the support profile as well as the number of supports required. When bridge supports involve stream crossings, a column shape must account for bridge scour.



(1) Sample bridge support cross sections.

9.3 Use visually light bridge rail structures. Consider open rail design of steel rail or concrete barrier and steel, both to create a more refined bridge with a lighter appearing span. Maintain scenic views and views to the surrounding landscape where possible. Where a solid concrete barrier is required for safety consideration, use shadow lines and patterns to avoid blank surfaces.

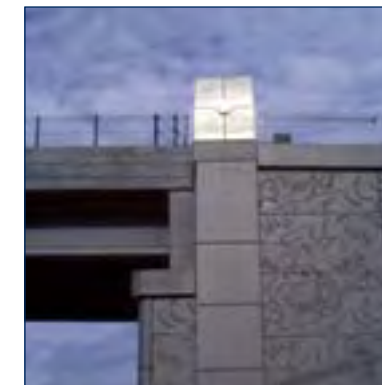
9.4 Consider fill embankments and approach rails as part of the bridge design. Consider fill embankments and approach rails in concert with the abutment, bridge barrier rail, and superstructure. Materials, height, and attachment details should be carefully considered when connecting guardrails to the bridge. Minimize slope pavement at bridge embankments and consider flattening slopes to 3H:1V. Use rock mulches, stone riprap, or decorative slope paving (minimally) to stabilize steep banks immediately below the bridge.



(2) Avoid bridge structure design that creates walls parallel to the travel lane. Utilize graded slope and abutments.



(3) Simple bridge design integrated into embankment with landscape planting.



(4) Bridge design with Focal hardscape features in urban setting.



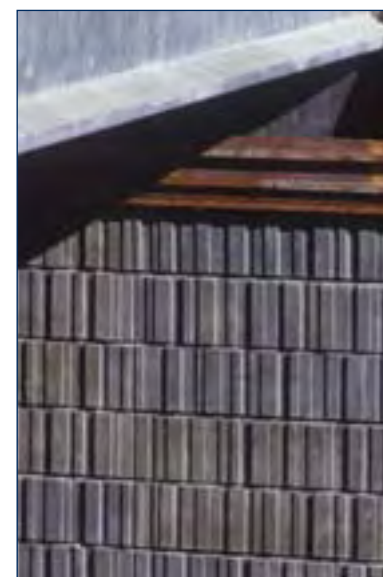
(5) Special bridge design elements to create a focal feature.



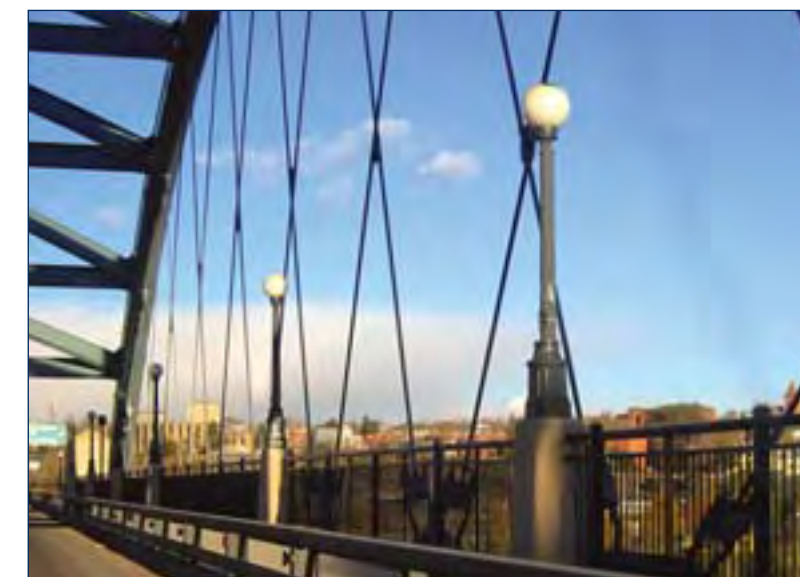
(6) This is an example of a landmark bridge detail.



(7) Bridge design with simple sub-structure and support feature.



(8) Horizontal pattering on bridge support using sunlight and shadow to enrich visual texture.

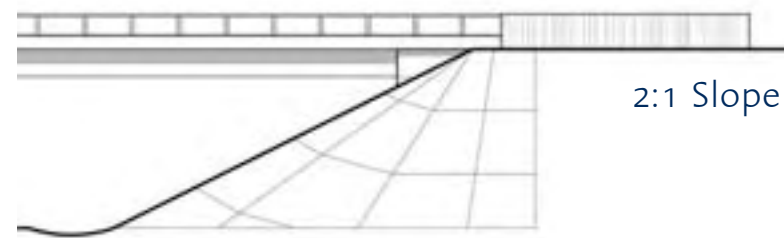


(9) This is an example landmark bridge design.

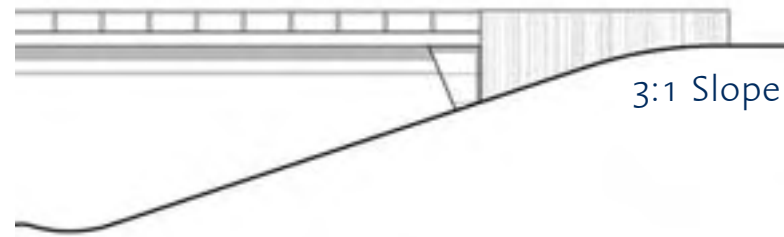
9.0 BRIDGES cont.

9.5 Use landscape or rock mulch to stabilize embankments. Contour grade embankments and use landscape planting to maintain embankment where possible. Use retaining walls to establish suitable flat landscape areas where right-of-way is narrow. Ensure mulch materials match bridge structure color and the surrounding landscape (see Color Palette guideline for appropriate color selection, page 5.9). Rock mulches, stone rip-rap, or decorative slope paving (minimally) are appropriate to stabilize abutments below the bridge. When slope pavement is used, include integral color to match base color palette.

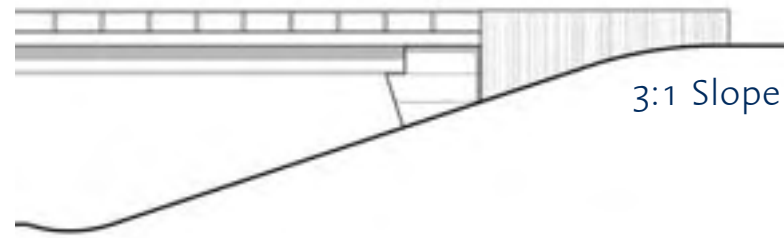
9.6 Select vandalism resistant finishes. Finish type, color, and surface patterns are important design elements in coordinating the structure with the surrounding landscape. Select bridge finishes of appropriate color (see Color Palette guideline, page 5.9) and vandalism-resistance. All exposed surfaces located in urban areas should be treated with non-sacrificial anti-graffiti finishes. Color and finish selections will assist in reinforcing the design intent of the bridge structure. Use “fine surface finish” as needed to apply color stains and anti-graffiti coatings.



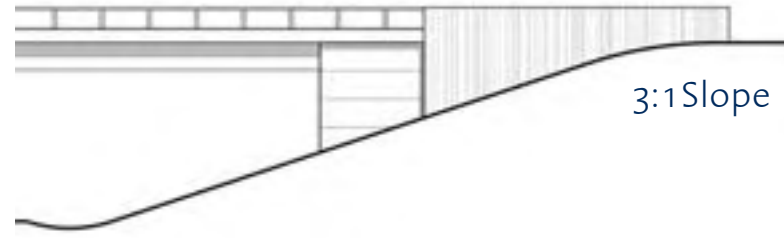
(1) Avoid 2:1 slope as primary bridge abutment and the need for slope pavement to stabilize steep slope.



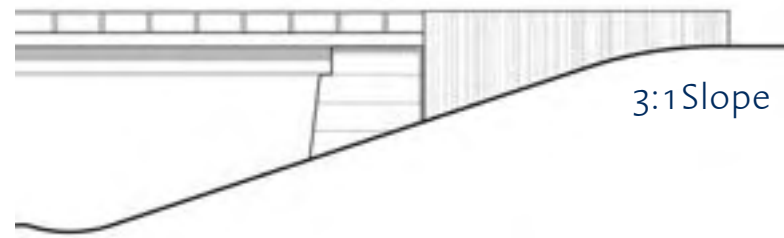
(2) Avoid weak proportions in bridges with shallow or undersized abutments.



(3) Avoid characteristic shapes that don't allow the structure to be visually supported.



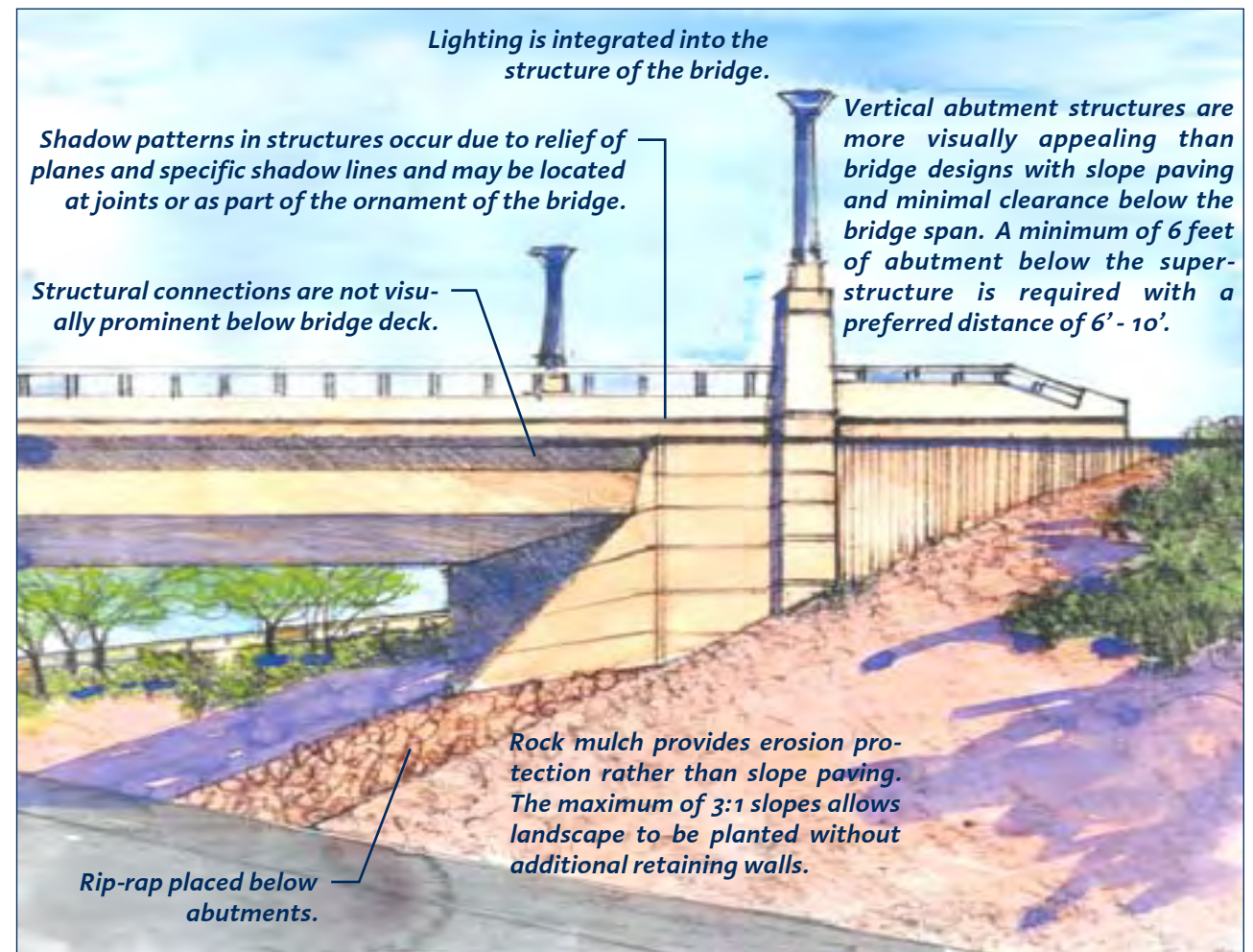
(4) Preferred use of bridges with retaining wall abutment and 3:1 slope is intended for the corridor.



(5) Preferred use of a batter to the abutment is a desirable feature.



(6) Proportions significantly affect visual appeal of structure.

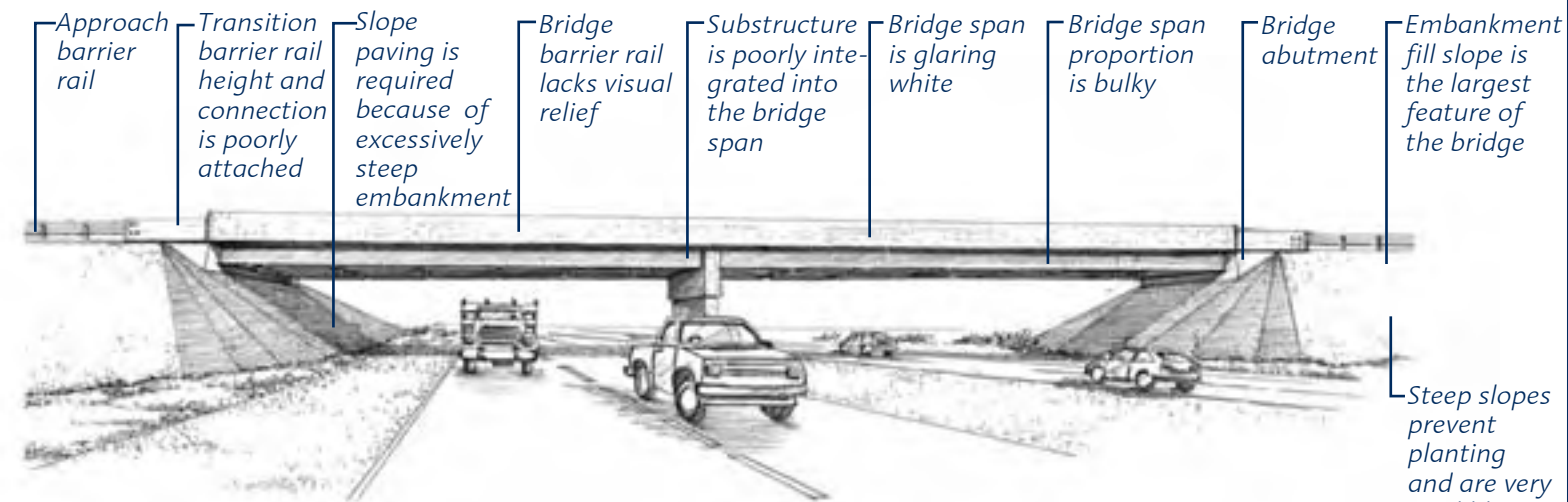


(7) Bridge abutment and barrier rail designed as a composition with jointing and materials consistently applied into a well proportioned bridge.

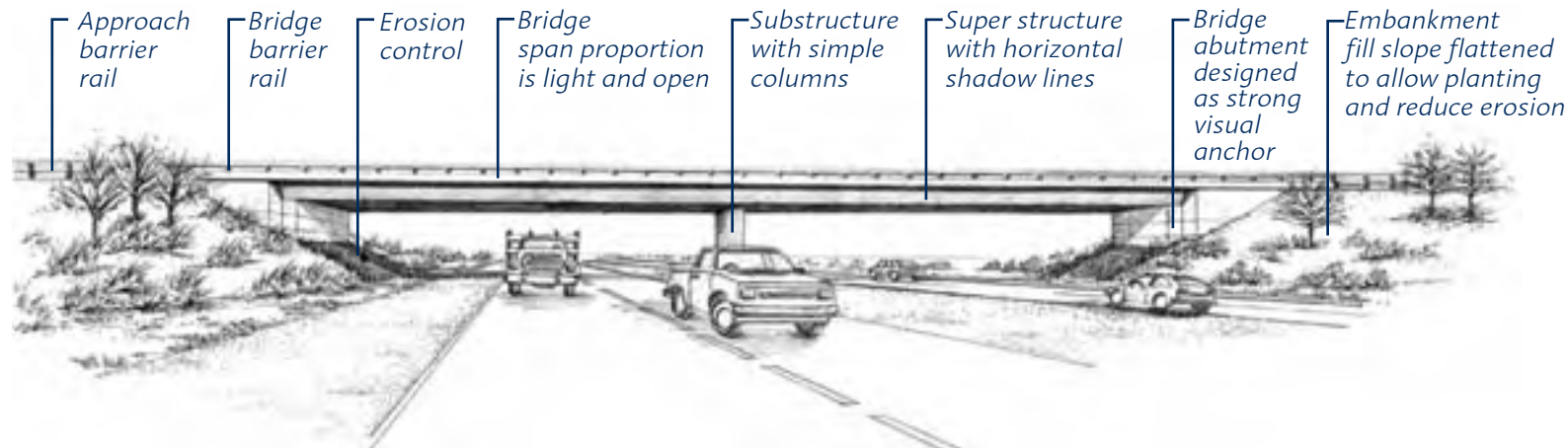
9.0 BRIDGES cont.

9.7 Create a visual design unity among all existing and new structures. Coordinate visual aspects of bridges with sound walls, retaining walls, and other highway structures. Create a visual design relationship that includes coordinating materials, patterns, color, and other design elements of structures. Establish visual design continuity of existing bridges and other structures by implementing a paint/stain retrofit program to unify color schemes where they vary within a corridor.

9.8 Integrate landscape and aesthetics at the onset of project planning. NDOT's initial report on type, size and location of highway structures should include information regarding landscape and aesthetics elements.



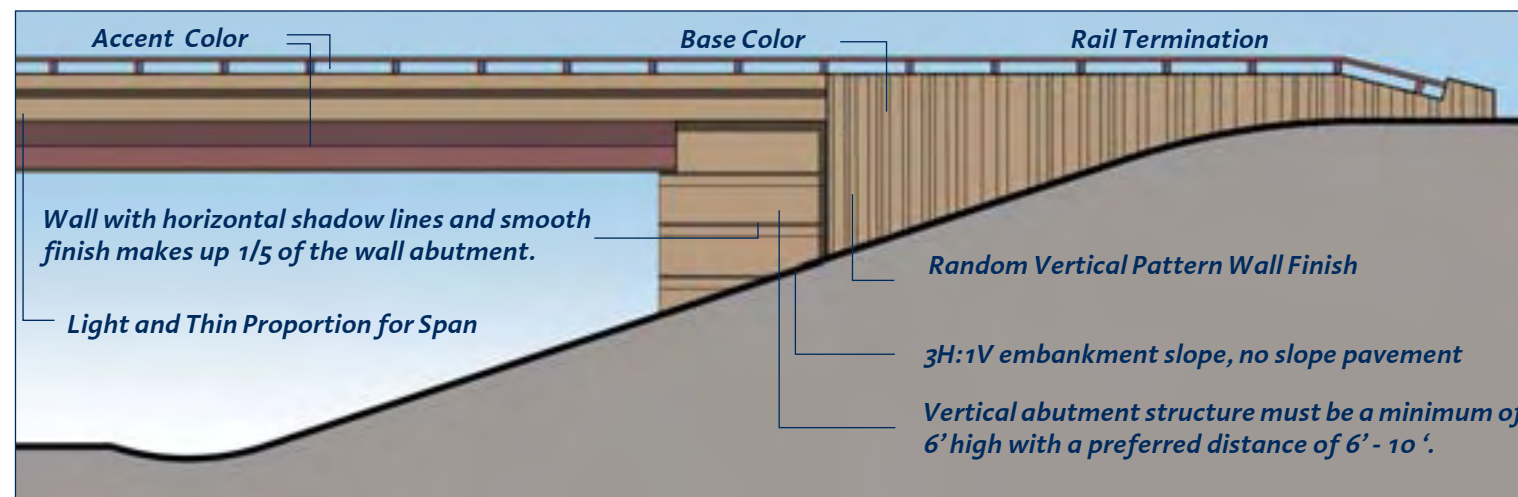
(2) Typical bridge components lack visual appeal.



(3) Landscape and aesthetic treatments improve the appearance of the bridge when guidelines from this section are applied.



(1) A Landmark bridge in the Flamboyant Resort Corridor segment.



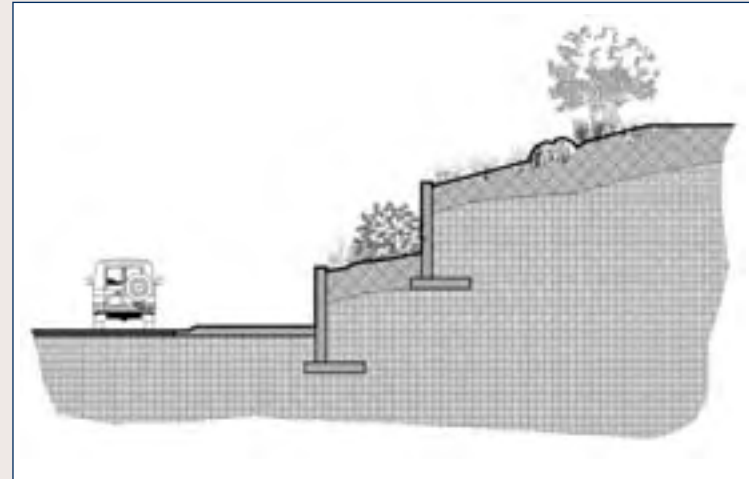
(4) Preferred bridge design elements for I-15 corridor.

10.0 RETAINING WALLS

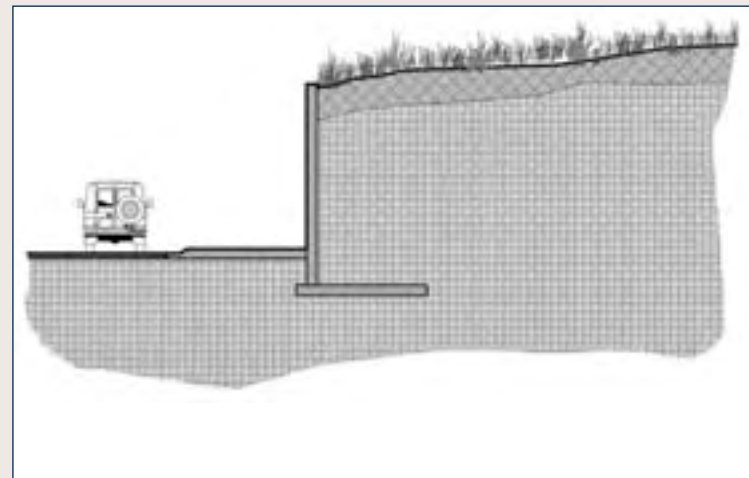
10.1 Consider grading to minimize wall height. Along steep embankments, terraced grades and low retaining walls to avoid the need for high walls and/or expansive facades are recommended. On gradual sloping grades, ensure the top of wall transitions appropriately with the slope. Match the top of wall with the adjacent contour. Use a step or change of plane where walls exceed 14 feet vertical height above the finished road surface (illustrations 1 and 4).

10.2 Provide landscape planting. Landscape plantings in front of walls will soften the appearance of large wall faces. When planning and designing retaining walls, landscape planting and maintenance space should be provided. Landscape planting space at the wall base should occur wherever retaining walls are included.

10.3 Anchor retaining walls to the earth. Turn the end portions of retaining walls into cut-slopes to provide greater stability to the wall's surface and to create the positive visual effect that the wall is "anchored" to the earth. Avoid over-steepened slope transition at retaining wall ends or introduction of rip-rap to correct this condition. Extend wall return to accommodate graded slope (illustrations 7 and 8).



(1) An example of a step or change of plane for a retaining wall greater than 14 vertical feet.



(4) An example of the tunnel effect created by a retaining wall greater than 14 vertical feet.



(2) An example of a cantilevered retaining wall with a simple, consistent use of materials. Vertical joints are most compatible with the finish.



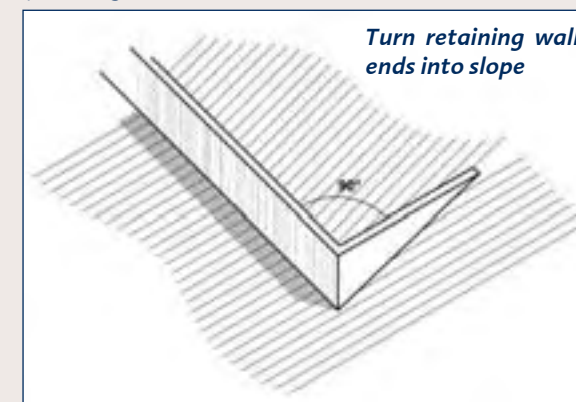
(5) Simple retaining wall patterning, railing design, and landscape palette. The wall is separated from the concrete barrier by a space and planting area.



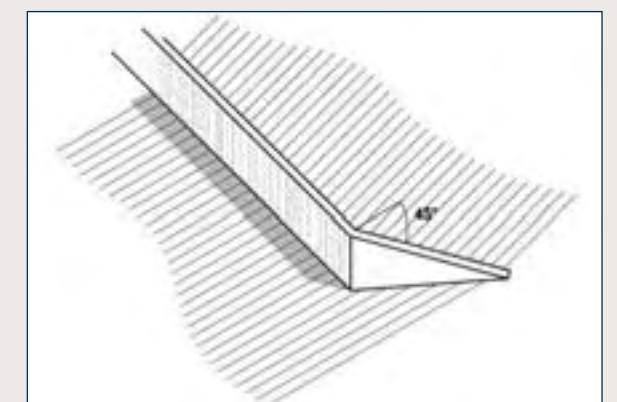
(3) Bridge design integrated into retaining wall with landscape planting to create moderately steep slopes and terraces for planting.



(6) Retaining wall and pedestrian walkway with desert visual design theme created with concrete form liners.



(7) Turning the ends of retaining walls "anchors" them into the earth and creates a finished end to the retaining wall.



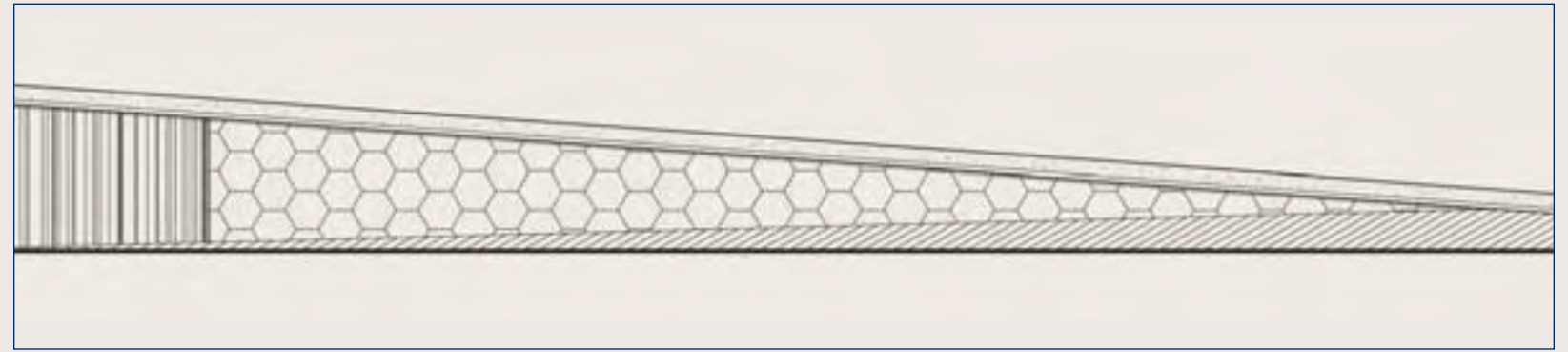
(8) Retained slopes with walls should return to meet uphill grade.

10.0 RETAINING WALLS cont.

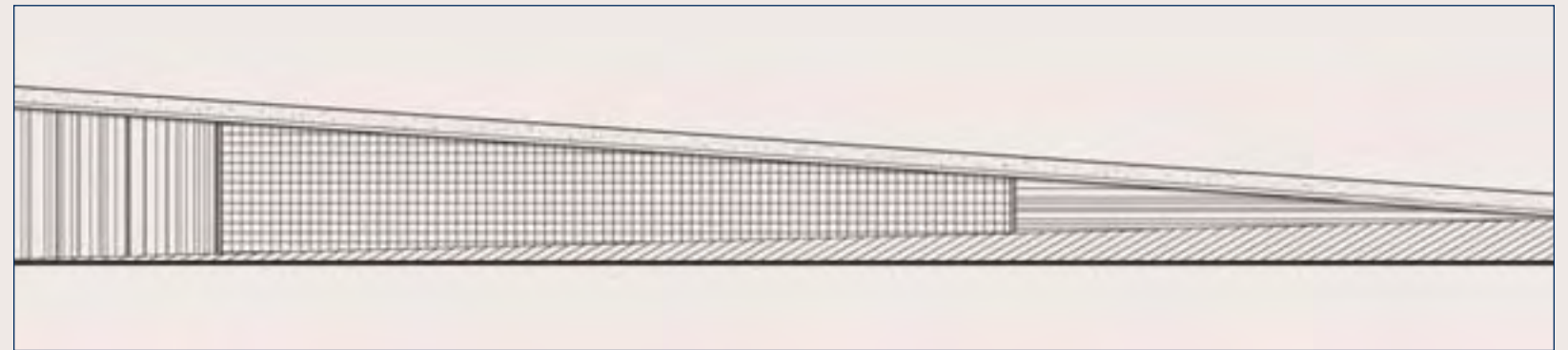
10.4 Select a simple design palette. Choose a simple design palette of material, pattern, color, and texture that coordinates with the corridor's Landscape Design Segment theme for retaining walls. Maintain consistent use of the selected material, pattern, color and texture. Avoid using multiple materials, such as steel, concrete, key-stone block or CMU on walls (refer to Color Palette guideline, page 5.9, and Transportation Art guideline, page 5.7, for more information about appropriate patterns). Exterior finish for retaining walls should have the same visual appearance independent of the type of wall. For MSE walls, 50 square foot size panels are preferred with vertical joints and a rectangular shape. All panels should have a rusticated variable vertical pattern that extends across the entire surface. The prototypical surface finish is shown in illustration 3 and is detailed in illustration 6 on page 5.16.

10.5 Choose an appropriate visual design subject.

Use visual design themes and/or pictorial motifs comprised of simple patterns and distinct surface texture, and carefully design the motifs composition (height and position) on the wall. Ensure that visual design themes and/or pictorial motifs are an appropriate subject and scale for the highway segment in which they are located (refer to Transportation Art guideline, page 5.7, for more information about appropriate subject matter).



(1) Avoid small scale joints, octagon, or cruciform shaped panels. These are only acceptable when textured with a rusticated variable vertical pattern.



(2) Avoid multiple materials, shapes, and joint patterns.



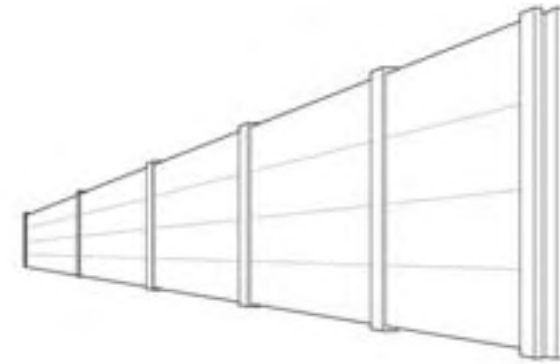
(3) Preferred finish is rusticated variable vertical texture and pattern. Surfaces should have a single finish whether MSE, cast-in-place, or other wall type is used. Consistency with other structures is required.

11.0 SOUND WALLS AND VISUAL SCREEN WALLS

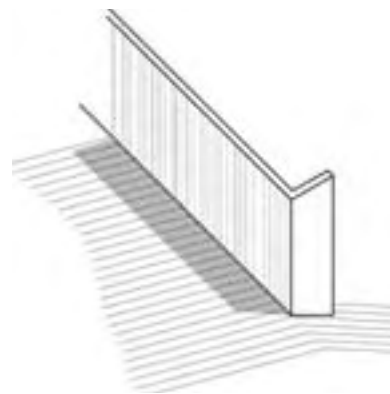
11.1 Consider grading to minimize wall height. This guideline is not intended to change or supersede federal sound wall requirements. Aesthetic improvements for sound walls should be considered in concert with specific site characteristics, available space, cost, and noise protection procedures. Where possible, free-standing sound walls should not exceed 14 feet in height without a step in the wall plane. Consider an embankment slope to buffer sound, or use a combination of earth berms and sound walls to achieve structural integrity and buffer sound while limiting actual wall height. Walls used only for visual screening should not exceed 10 feet.

11.2 Provide landscape planting and setback space between the vehicle recovery zone and the sound wall. Landscape plantings in front of walls will soften the appearance of large wall faces. Ensure planting and planting maintenance is accommodated both in front of and behind the wall.

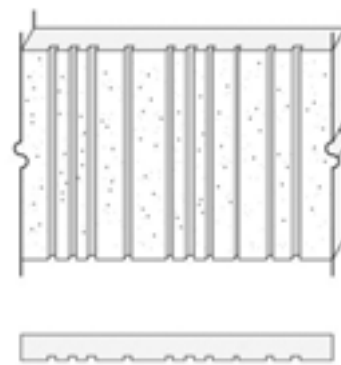
11.3 Select a simple design palette. Choose a simple design palette of material, pattern, color, and texture that coordinates with the corridor's Landscape Design Segment theme for retaining walls and sound walls. Maintain consistent use of the selected material, pattern, color, and texture. The required prototypical surface pattern is shown in illustration 6. Avoid using multiple materials, such as steel and concrete or CMU, on continuous spans of wall. Post and panel systems are not recommended for permanent sound wall construction and should be used only for temporary applications. If a post and panel system is used, then it should be constructed of a single material, preferably pre-cast concrete.



(1) Avoid post and panel system for permanent sound wall application.



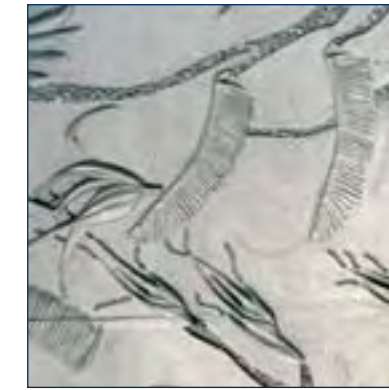
(5) A wall return of three feet is recommended for sound walls at the beginning of the wall facing the driver (outside clear zone).



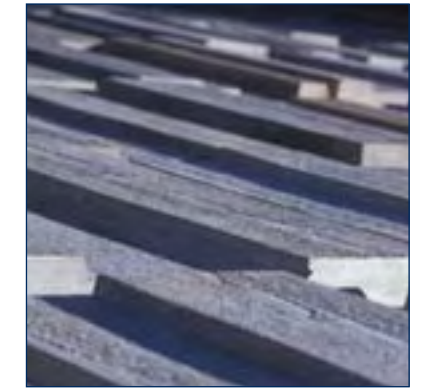
(6) Required prototypical surface pattern is rusticated variable vertical ribbing. Dimensions vary between 2"- 8" apart.



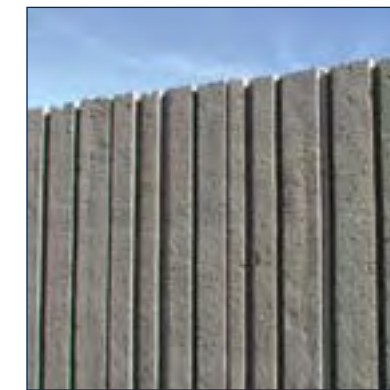
(2) Use culturally important design motifs on sound walls as a pattern to avoid "blank monotony" of wall surfaces.



(3) Form liners can produce details in wall patterns.



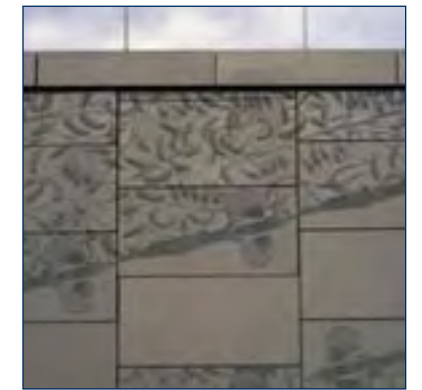
(4) Horizontal sound wall patterning add visual interest.



(7) Rusticated variable vertical patterning adds visual interest.



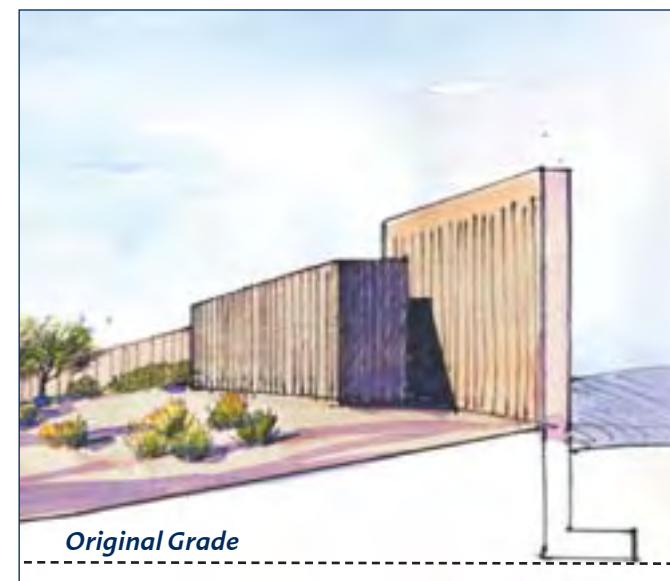
(8) Pattern treatment avoids singular, obvious repetitive design.



(9) Motif patterned retaining wall and sound wall considers the location of the pattern on the wall.



(10) Integrate sound walls into highway right-of-way with landscape planting between wall and roadway. The setback also allows earth contour grading to vary the wall heights and base grade.



(11) Grading in combination with walls will reduce the height of walls while still meeting federal noise standards.



(12) Earth berms or embankment slopes are effective as sound barriers and can be used in combination with partially depressed road profiles. This can avoid walls where sound attenuation is required.

11.0 SOUND WALLS AND VISUAL SCREEN WALLS cont.

11.4 Choose an appropriate visual design subject.

Use visual design themes and/or pictorial motifs comprised of simple patterns and distinct surface texture, and carefully design the motifs composition (height and position) on the wall. Ensure that visual design themes and/or pictorial motifs are an appropriate subject and scale for the highway segment in which they are located. Walls over 12 feet in height require special graphic or pattern treatment (refer to Transportation Art guideline, page 5.7, for more information about appropriate subject matter).

11.5 Create visual breaks and interruptions to avoid monotony along walls.

Use staggered and/or curved walls of varying lengths to provide visual interest along extended stretches of sound walls. Prototypical wall layout designs are illustrated on pages 5.17 and 5.18. Battered walls, which are inclined walls, can provide additional interest. Shadow patterns can be introduced to create visual interest that shift and change throughout the day. Configure walls as illustrated in the illustrations below.

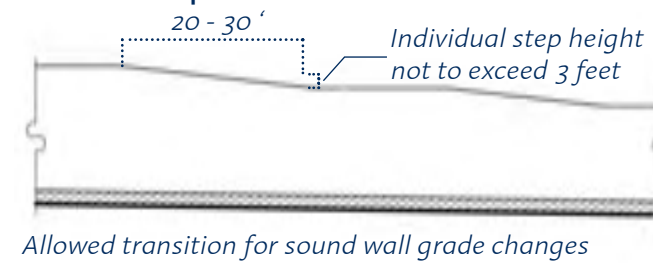
11.6 Separate walls from other highway structures and set back from travel lanes.

When practical, avoid attaching walls to concrete barriers and/or retaining structures. When walls are attached to such structures, avoid mixing materials and incompatible forms. Ensure walls are carefully planned for and integrated with the design of the highway and/or bridge. Set walls back a minimum of 30 feet from edge of travel lane where possible. Walls may be placed on top of concrete barriers only when no other practical solution exists.

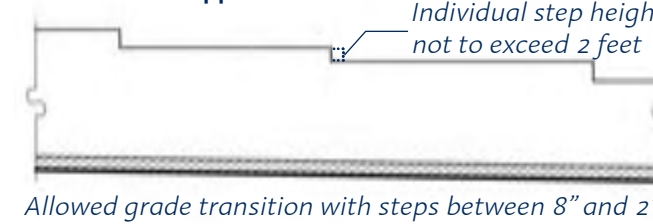
11.7 Encourage noise-compatible land uses adjacent to highway corridors.

At the planning level, encourage land uses adjacent to highways that are more compatible with highway noise such as commercial and light industrial areas. Noise sensitive receptors, such as residential areas, schools, hospitals, and recreation facilities require sound abatement strategies while other types of uses may not. Coordination at the planning stages is critical to avoid conflicts.

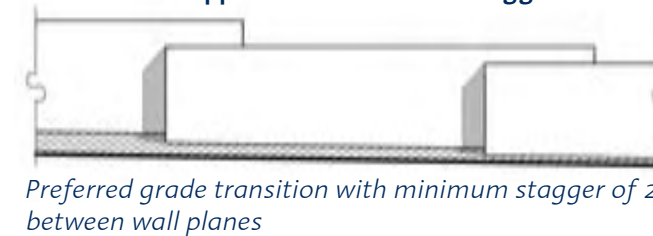
Preferred - Tapered Transition



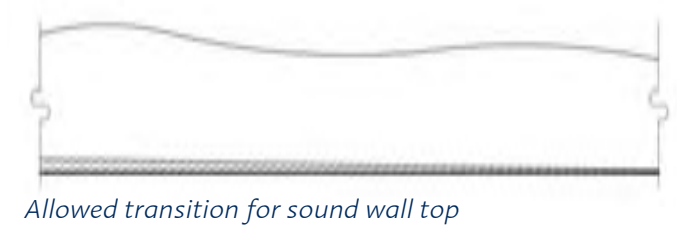
Preferred - Stepped Transition



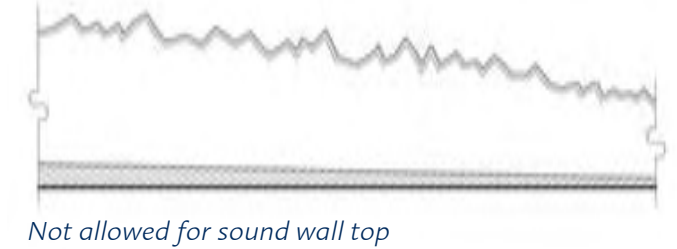
Preferred - Stepped Transition with Staggered Walls



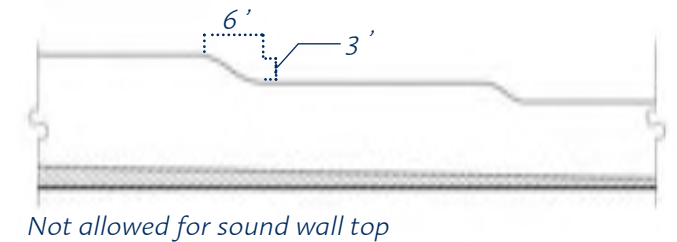
Preferred - Curved



Avoid - Angular Wall Top



Avoid - Eased Transition



(2)



(3), (4), (5) This sequence of travel over approximately 1,000 feet illustrates a prototypical sound wall design for the corridor. Characteristics include staggered wall planes, landscape planting in front of the wall face, and patterning on the wall face.

11.0 SOUND WALLS AND VISUAL SCREEN WALLS cont.



Plan view of curved wall configuration

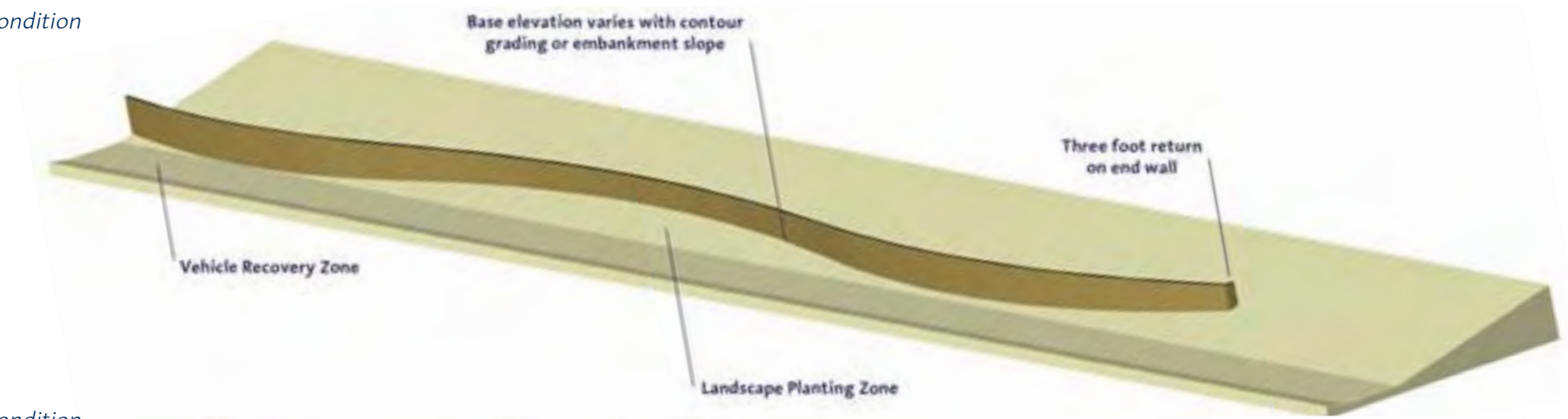


Plan view of offset staggered wall configuration

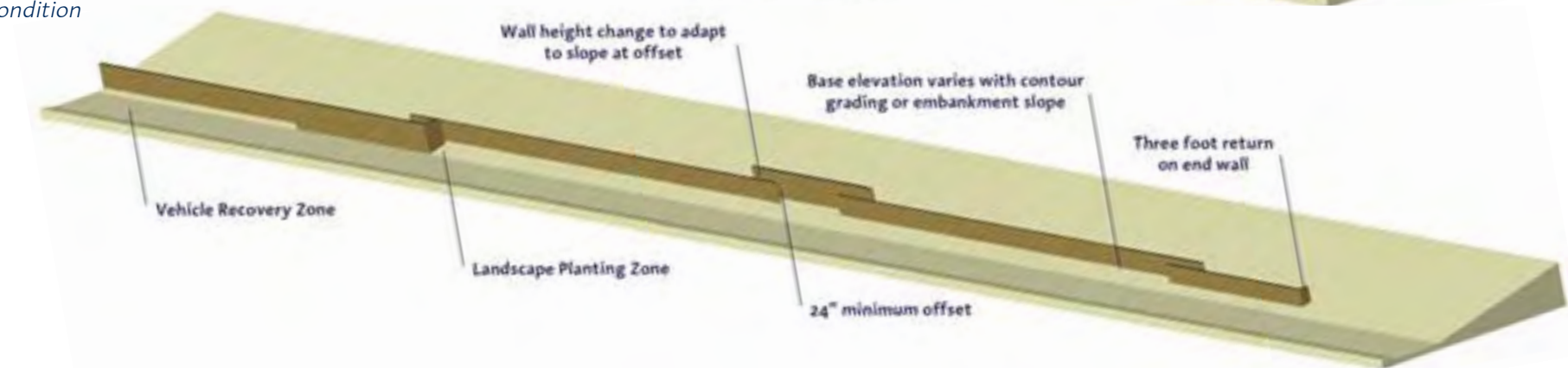
Note: Provide for maintenance access to both sides of walls

(3) Using curved and/or staggered sound walls creates visual interest and reduces the impact of a monolithic structure.

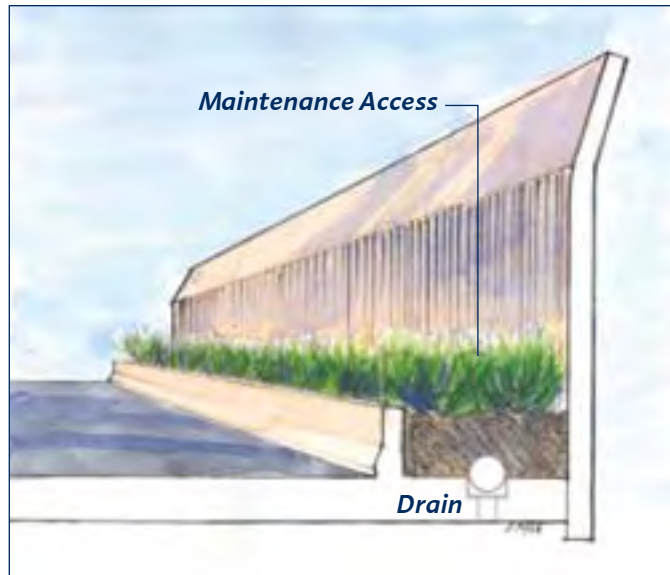
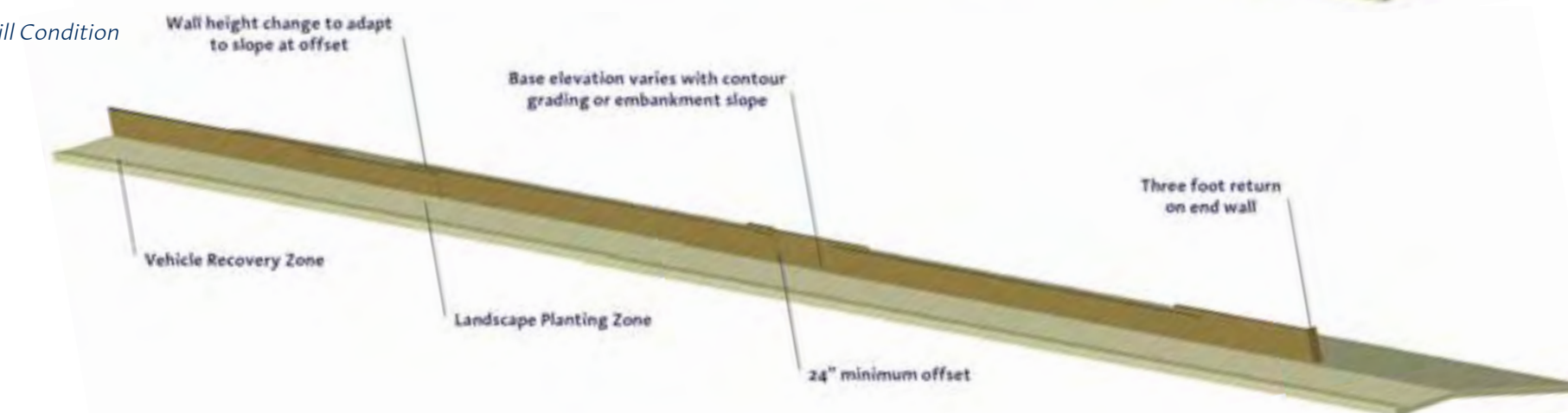
(4) Uphill Condition



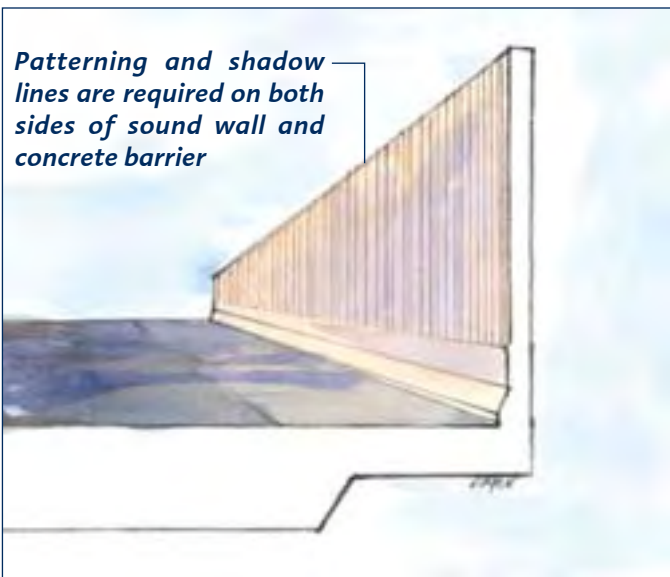
(5) Uphill Condition



(6) Downhill Condition



(1) Walls approaching bridges can be adapted with a setback and planting strip. A flare of the upper one-fourth of the wall further prevents an enclosed, narrow passage.



(2) When concrete barrier and walls co-exist without buffer space, wall is integrated into the concrete barrier rail.

12.0 CONCRETE BARRIERS AND GUARD RAILS

12.1 Stain concrete barriers. Concrete barriers should be stained to match the segment's base color (refer to Color Palette guideline, page 5.9, for more information on color selection).

12.2 Avoid bright, shiny steel appearance in visually sensitive areas. Use acid washed steel guardrails where appropriate to reduce glossy appearance.



(1) Acid washed steel guardrail should be used in remote locations.

13.0 LIGHTING

13.1 Analyze lighting requirements. Excessive high mast lighting can create light pollution along a corridor and excessive height masts can impact the view of surrounding vistas. Avoid overlighting facilities. Study lighting level standards currently in place and determine levels needed for safety only. Adjust current standards, if necessary, and use a minimum height, illumination, and number of light masts required. Focus attention on luminance vs. illumination (i.e. how bright is the pavement vs. how bright is the light).

accent color palette for poles (refer to Color Palette guideline, page 5.9, for more information). The desired pole configurations are shown at the right. Allow for context sensitive design in fixtures and poles where appropriate in areas such as historic sites.

13.2 Avoid high-mast lighting. Along all sections of the corridor, use lighting fixtures that minimize light pollution and provide even light dispersion. Eliminate lighting where not necessary. High mast lighting should be avoided in favor of cobra head or shoe box type pole and fixtures.

13.3 Use a consistent lighting fixture and pole.

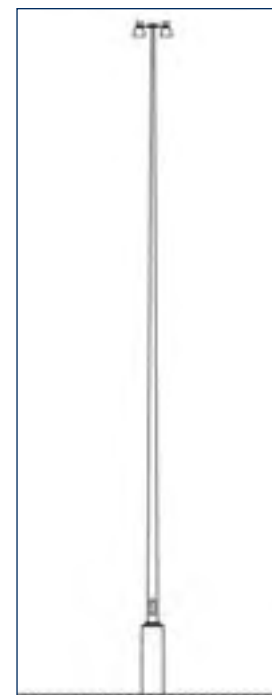
In urban areas, use a durable, powder-coated finish for light poles of a color that matches other structures and the surrounding landscape. Use



(2) Lights are incorporated in the bridge design as a feature of the approach.



(3) Powder coat coloring blends into surrounding environment.



(6) Avoid high mast lighting.



(4) This is an example of monumental light incorporated into road design.



(7) Avoid this type of pole design in favor of more streamlined attachments.



(8) Preferred fixture and pole configuration.



(5) This is an example of a colored shoebox style fixture on a steel pole.

14.0 FENCING

14.1 Ensure right-of-way fencing blends with the landscape. Fencing can be used in non-urban areas to delineate the highway right-of-way. Where appropriate use three-strand wire fencing. Ensure right-of-way fencing is well maintained. Where fencing is required in urban areas, use powder coated or stained colored galvanized fencing.



(1) Three-strand fencing should be used within the rural segments of the corridor.

15.0 GRADING

15.1 Avoid creating steep slopes. Smooth, moderately inclined slopes will blend more readily with the surrounding desert landscape, are safer to maintain, and are less vulnerable to erosion. Place top soil salvaged from construction site on cut/fill slopes. Flattened fill slopes can assist in slowing down the erosion process. Grade slopes to provide for water harvesting (reclaimed surface runoff) wherever feasible. In addition, flatter slopes reduce the need for guardrails and provide better accident recovery in the vehicle clear zone. Where site conditions and cost analysis permit, acquire adequate right-of-way to provide enough land to design and build the desired slope and grade. In some locations, steeper slopes may be unavoidable to protect important natural or cultural resources adjacent to the highway.

15.2 Create smooth landform transitions and revegetate slopes. Finish-grading techniques such as slope rounding at the top and bottom of cuts should be used to create smooth landform transitions that blend with the natural terrain. Carefully grade slopes around natural outcrops and abrupt topography to improve aesthetics and allow for easier and more cost-effective maintenance. Ensure all constructed

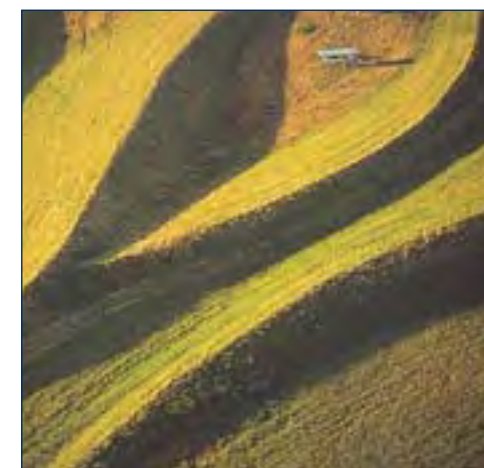
slopes are revegetated (refer to Native Plant Revegetation softscape guideline, page 5.25). Use fill material to reduce the visual rigidity of the constructed slope geometry. In addition, soil-coloring treatments that blend newly cut or filled soil with existing soils should be implemented.

15.3 Create artful earthwork. Grading is the foundation of all aspects of the corridor. In addition to grading for effective roadway alignment, carefully consider contour grading. Create landforms that respond to the uniqueness of the site, the surrounding landscape, and the roadway travel experience. Contour grade to create effective planting embankments, as well as shadow patterns, and artful earthwork.

15.4 Blend earthwork with existing slope conditions. Patterns of topography should be considered with proposed grading. Valleys, high points and ridges require graded transitions, rather than abrupt embankment cuts or fills.



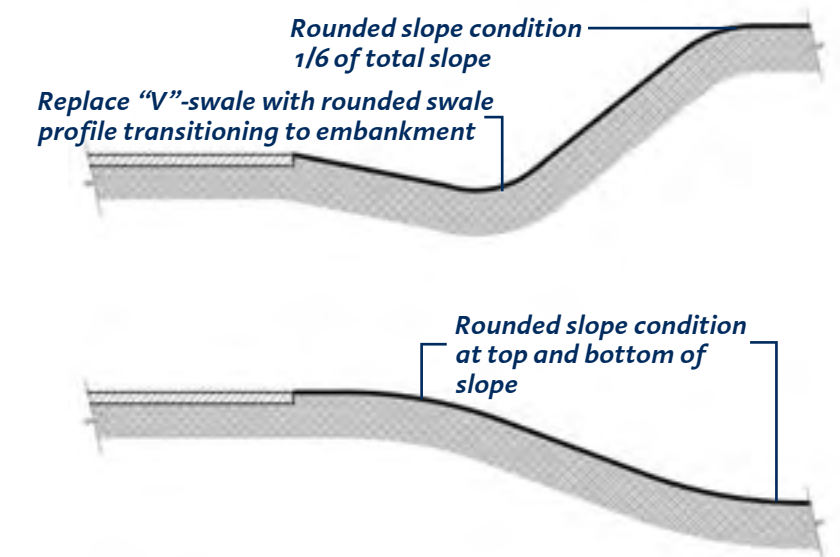
(2) Naturalized contour grading.



(4) Artful earthwork and contour grading will create landscapes that integrate with Nevada's existing topography.



(3) The travel route sequence is defined by earthwork which defines space.

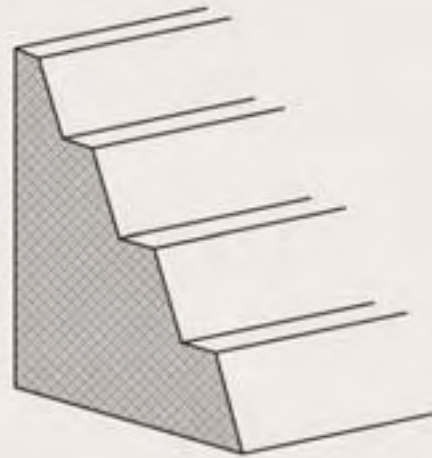


(5) Smooth transitions between cut and fill slopes and existing conditions can be accomplished by rounding the slopes.

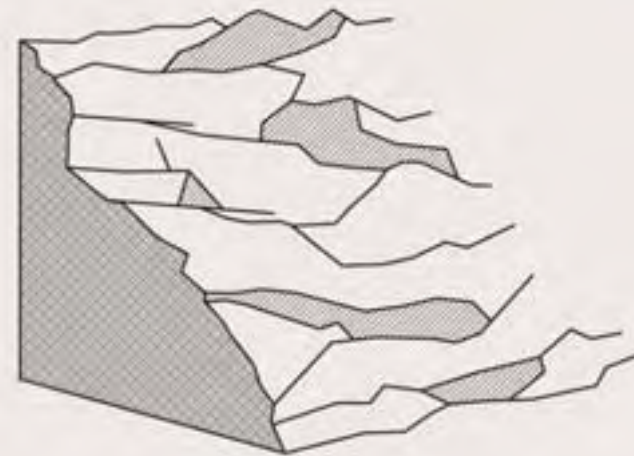
16.0 ROCK CUT AND EXCAVATION

16.1 Analyze rock geology. Work with a multi-disciplinary team of civil engineers, geotechnical engineers and landscape architects whose job it is to ensure that the inherent character of a rock's natural bedding planes, fractures, joints, and overall stability. Conduct careful rock geology, site and cost analysis, and design rock cuts to avoid the need for rock fall protection fencing.

16.2 Design rock cuts to be natural in form. Ensure rock cuts are designed to look natural in form, texture, and color in relationship to the surrounding landforms. Customize fracture rock cuts to match natural rock form and use naturalized bedding planes to avoid creating a sheer, unnatural rock face. Ensure all designed landforms are natural in appearance and blend with the topography and geology of the surrounding landscape. Match new rock and soil excavations with existing rock and soil using rock staining, soil-coloring treatments, and/or accelerated weathering techniques. Such treatments will successfully blend newly cut or filled soil and rock with existing weathered rock. Where site conditions and cost analysis permit, acquire adequate right-of-way to provide enough land to design and build the desired rock cut slope and grade.



(1) Artificially appearing straight cuts and benches would be replaced with custom naturalized cuts.



(2) An example of custom benching, following the natural formation of the rock and accomplishing the same elevation change as example 1.



(3) Artificial terracing in an existing road cut creates poor visual appearance.



(4) Rock cuts and excavation should be natural in form, shape, and texture. Rock formations, such as this rhyolite outcrop, have an inherent visual form that can be duplicated in custom rock excavations.



(5) Example of the rock cut in which natural bedding planes were used to excavate naturalized landform. Weathering techniques blend this rock cut.



(6) Re-sculpted rock cuts change artificial slope banks into naturally occurring landforms. Plan cuts that terrace, bench, and use bedding planes found in existing rock formations.

17.0 DRAINAGE

17.1 Use naturalized channel design and infiltration methods. Where possible avoid paving drainage ditches or check dams with asphalt or concrete. Secure check dams with rock and use naturalized channel design and infiltration methods to enhance, both functionally and visually, highway drainage systems. On a case by case situation, utilize geotextiles, impervious mats, or stone lining to maintain a naturally appearing channel. When excessive flow velocities or soil conditions must be accommodated, paved drainage surfaces may be used.

17.2 Revegetate drainage infrastructure. Drainage detention and infiltration areas should be shaped with natural undulating edges and bottoms rather than angular embankment slopes. Upper slopes of drainage detention basins should be revegetated or covered with appropriate ground treatment (refer to Ground Treatment softscape type guideline, page 5.24, and Native Plant Revegetation softscape type guideline, page 5.25).

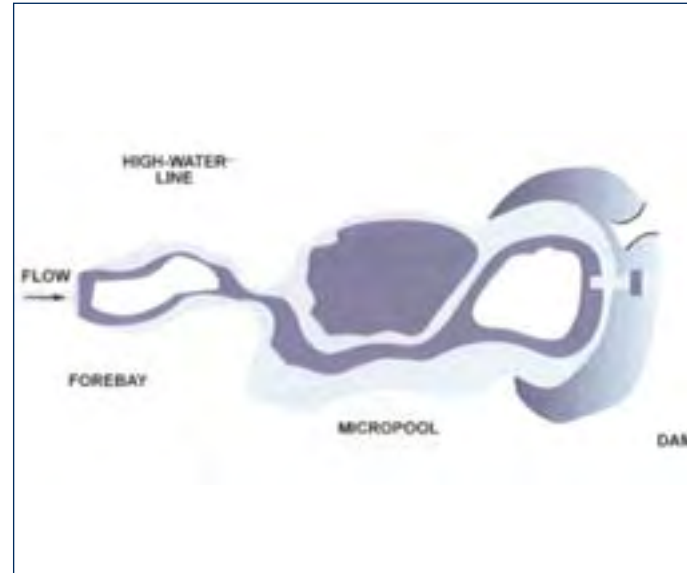


Image courtesy NDOT Stormwater Quality Manuals

(1) Design of detention basin **avoids** engineered flow patterns.



Image courtesy NDOT Stormwater Quality Manuals

(2) Fiber rolls reduce sediment migration.



(3) Rock bed drainage allows water to infiltrate and provide water for adjacent plant materials.

18.0 EROSION CONTROL

18.1 Stabilize soils and ensure successful revegetation to control erosion. Stabilize soils and control erosion using techniques such as heavy textured soil and/or gravel mulches to slow water run-off and provide dust control. Where water concentrates, rip-rap material and/or geo-textile reinforcement may be used to avoid erosion. The success of permanent revegetation efforts can be improved by providing in situ topsoil, native vegetation fragments, rocks, improving soil salvage techniques and seed mixes.

18.2 Refer to temporary and permanent erosion control best management practices as prepared and documented by NDOT.



(4) Water basins blend into their natural surroundings.



(5) Application of soil stabilizer aids in dust and erosion control.



(6) **Avoid** asphalt drainage channels.

19.0 WATER HARVESTING

19.1 Maintain soil moisture and improve water retention by preserving top soil, site surfacing, track walking, and applying mulches and tackifiers.

Soil moisture and water retention can be maintained and enhanced in several ways, including:

- Topsoil Preservation: Stripping and salvaging the existing topsoil, vegetation seeds and plant fragments for later reapplication should be done to increase both the quantity of organic matter and water holding capacity of the soil.

- Site Surfacing: Rock surface composition should simulate the original or adjacent surface cover. Placing rocks and shaping landforms to create depressions will increase water retention, providing needed moisture to the plants. Rocks create impervious cover, resulting in water harvesting for the remaining soil and seeds. Rocks also create a rough, uneven surface, thereby slowing water runoff, and allowing water to collect.

- Track Walking: Where possible, track walk all slope surfaces to stabilize material and minimize potential erosion.

- Mulches and Tackifiers: Use mulch and tackifiers to keep seeds and topsoil cover in place and to assist with moisture retention during germination.

19.2 Use natural and/or artificial products to collect, store, and release water for plant use.

Use products such as:

- Pumice wicks
- Polymer products
- Diatomaceous earth
- Wattles

20.0 IRRIGATION

20.1 Select efficient and effective irrigation systems.

Select efficient drip irrigation systems that have a central controller and that can be easily maintained. Consider the use of reclaimed water, including fully treated effluent and water harvesting techniques, as a supplement to irrigation.

20.2 Provide appropriate supplemental irrigation for each softscape type.

Temporary irrigation may be provided for establishment of Native Plant Revegetation softscape plantings. This may include using drip irrigation and/or water applied by truck. The early stage of revegetation growth demands the most water use and is the critical period when young plants are starting to establish them-

selves in the arid climate. As revegetation becomes more established and mature, the demand for water will lessen to the point of being removed. Temporary watering may be required for containerized native plants. Permanent irrigation to individual plants is usually required for all Regionally Adapted and Regional Ornamental softscape types.

20.3 Manage the high concentration of salts.

In Nevada's desert soils, in drip irrigation situations, salts often concentrate at the outer edge of the wetted soil volume, including near the soil surface. Salt management techniques include flushing the soil periodically with heavy watering and/or planting salt tolerant materials.

20.4 Use natural and/or artificial products to collect, store, and release water for plant use.

Use products such as:

- Pumice wicks
- Polymer products
- Diatomaceous earth
- Wattles

21.0 GROUND TREATMENT SOFTSCAPE TYPE

21.1 Implement appropriate "Ground Treatment" softscape type. Use Revegetation softscape type and an appropriate ground treatment to assist in erosion and dust control. (refer to Native Plant Revegetation softscape type, page 5.25, for more information about revegetation practices). Where used, rock mulch should complement and/or match the surrounding natural environment. For rural areas, ground treatment plant palettes should be derived from natural patterns found in playas, foothills or ephemeral drainages. For areas within urban settings, use rock mulches to create aesthetically rich patterned and textured ground treatments. Implement a ground treatment retrofit program to treat areas which are bare soil.

21.2 Consider aesthetics and maintenance. Select ground treatment in all non-paved areas that meets both aesthetics and maintenance requirements.

21.3 Coordinate ground treatment with the surrounding landscape. Ground treatment should coordinate in size, texture, color, and aggregate mix with the surrounding landscape. Mulches composed of multi-sized rock that create natural patterns of surrounding soils should be considered as a matching technique. Where ornamental plantings are used, the ground should be treated with combinations of rock mulches, colored soil, and/or boulders to break up expansive ground planes and provide visual interest.

Avoid asphalt paving in median conditions. Use stone mulch or native plant revegetation in lieu of hard paving.



(1) Match texture and variety of size of stone found in the surrounding landscape.



(2) Large-scale ground cover stone placement of various sizes.



(3), (4) A mix of aggregate size and color re-establishes the graded slope to a naturalized condition.

22.0 NATIVE PLANT REVEGETATION SOFTSCAPE TYPE

22.1 Re-establish the native desert condition using the Native Plant Revegetation softscape type.

The Native Plant Revegetation softscape type should be implemented as shown in the Landscape Design Segments. Ensure all roadway construction in these areas re-establishes native desert conditions. The Mojave Desert community is dominated by a mix of widely spaced shrubs and short-lived annuals prompted by winter rains. All revegetative projects should follow native plant spatial and frequency patterns. In addition, native plant revegetative projects should be evaluated in terms of elevation, site soil conditions, and ecosystem types such as riparian, playa, or salt barren, when selecting an appropriate native plant revegetation palette.

22.2 Select perennial grasses, herbs, and shrubs that can be established with little or no maintenance over the long term.

Select plants that have been evaluated for drought tolerance, salt and alkali tolerance, seedling vigor, fire retardant characteristics, growth habit, suitable soil groups, seeding rates, Pure Live Seed (PLS), availability, and general costs of native seed sources. Ecosystem categories and suitable plant species have been identified for revegetation specifications along Nevada's highways in *Mapping Ecosystems Along Nevada Highways and the Development of Specifications for Vegetation Remediation* (Tueller et al, 2002). Tueller's report offers a complete description of suitable plant species and plant communities, soil classification units, and best management practices for vegetation remediation

and should be used as a guide for revegetation. For excerpts regarding plant communities appropriate to the I-15 corridor, refer to Appendix A of this plan.

22.3 Salvage native plants and topsoil prior to construction.

Salvage existing native plant material prior to construction. The species to be salvaged depends on location, soils and analysis of plant value including the potential survival rate. Salvaged plants can readily improve the roadside aesthetic by providing mature plants that would normally take many years to establish. In addition, ensure native topsoil is collected and stored for reuse. Native topsoil provides a seed source and important bacteria for salvaged plant establishment and growth. Carefully remove, stockpile, and store the native top soil of new construction projects to be used as final bedding material. Ensure native soil stockpiles are protected from the wind to avoid erosion and the creation of a dust hazard.

22.4 Apply a prescribed soil treatment and conduct effective site preparation.

Every revegetation project requires a prescribed soil treatment. Soil treatments include plowing, disking, harrowing, furrowing, hydroseeding, applying mulches (such as straw), and using tackifiers (such as dark colored netting) to firmly anchor the mulches to the site. Soils should be roughened before and after planting to create favorable seed sites, particularly for grass and forb seeds. In silty conditions, a soil stabilizer, such as a hydromulch or a matting material, should be applied to reduce potential dust problems. Some sites require deep

ripping in order to loosen hardpan and improve seeding success. In conditions of steep cut and slopes greater than 40 percent, slope disking is required to create seed pockets.

In most cases, organic material will need to be added to the site to improve soil quality. Each site should be carefully analyzed to determine the type of fertilizer application. On sites with hardpan and salts near the surface, an amendment to control or ameliorate pH should be applied. Scattered rock mulch is to be used with this softscape type as groundcover. It will provide seed pockets and protection that will assist in the establishment of seed.

22.5 Collect native seed. Initiate a process for native seed collection at the start of a each project where revegetation is designated. Native seed should be collected from a site in close proximity to the revegetation area. Because unpredictable weather patterns can affect seed availability, plan ahead to ensure usable seed. Native seed can also be purchased through seed companies.

22.0 NATIVE PLANT REVEGETATION SOFTSCAPE TYPE cont.

22.9 Monitor revegetation construction. Carefully monitor revegetation to ensure the specified materials and installation methods have been used in applying treatments. In addition, continue to monitor revegetation plantings for up to five years after construction to ensure successful establishment. Include temporary irrigation if needed. Provide training to NDOT staff overseeing revegetation administration. Failures in revegetation can often be attributed to poor installation and maintenance.

22.10 General plant section. Carefully select native plant species. In addition to plant species identified in *Mapping Ecosystems Along Nevada Highways and the Development of Specifications for Vegetation Remediation*, refer to the list of native plant species provided for revegetation efforts. Ensure the plant palette selected for the site complements existing vegetation in the surrounding landscape. Use native plant species to create plant communities with variations in plant height and width. Additional plants not included in the adjacent list can be included upon review and approval. Consider sunlight, water and wind exposure when placing plant material.

22.11 Preserve healthy, mature trees and/or vegetation within the right-of-way. Mature vegetation is an integral part of community life and an important public resource that enhances the quality of life. All previously landscaped areas with ornamental plant materials measuring 4' above the ground and trees with greater than 3" caliper in good condition, form, and health shall be preserved. All softscape treatment projects

should be initiated by a tree inventory plan listing all protected trees and other landscape materials within the right-of-way which includes: a listing of species, size and condition of each tree, index of trees to be removed and trees to preserve, and an outline of specifications for tree maintenance during construction.



(1) Nursery grown plants harden in the sun in order to survive environmental conditions.



(2) Appropriate tree boxing techniques are necessary for proper transfer of tree materials during construction.

Recommended Native Plant Revegetation Plant Palette

| | Height x Width | Exposure to Sun | Water Requirement | Seasonal Interest |
|--|----------------|------------------|--------------------|-------------------|
| Trees: | | | | |
| <i>Acacia greggii</i> - Catclaw Acacia | 15-25' x 15' | Full Sun | Low water use | Sp/ Fall |
| <i>Chilopsis linearis</i> - Desert Willow | 20' x 15' | Full Sun | Med- low water use | Sp/ Fall |
| <i>Prosopis glandulosa</i> - Honey Mesquite | 25' x 35' | Full Sun | Medium water use | Summer |
| <i>Yucca brevifolia</i> - Joshua Tree | 30' x 15' | Full Sun | Low water use | Spring |
| Shrubs: | | | | |
| <i>Ambrosia dumosa</i> - White Bursage | 2' x 3' | Full Sun | Low water use | Fall/Sp |
| <i>Atriplex canescens</i> - Four Wing Saltbush | 5' x 8' | Full Sun | Low water use | Year round |
| <i>Baccharis spp.</i> - Baccharis | 9' x 9' | Full-Partial Sun | Low water use | Spring |
| ***note: plant male species only | | | | |
| <i>Coleogyne ramosissima</i> - Blackbrush | 5'x6' | Full Sun | Low water use | Spring |
| ***note seed with <i>Erioneuron pulchellum</i> | | | | |
| <i>Ephedra nevadensis</i> - Mormon Tea | 3' x 3' | Full Sun | Low water use | Year round |
| <i>Larrea tridentata</i> - Creosote Bush | 10' x 10' | Full Sun | Low water use | Spring |
| Cacti, Perennials and Accents: | | | | |
| <i>Baileya multiradiata</i> - Desert Marigold | 1' x 1' | Full-Partial Sun | Low water use | Sp/Sum/Fall |
| <i>Echinocereus engelmannii</i> - Hedge Hog Cactus | .4' x 1.25' | Full Sun | Low water use | Year round |
| <i>Encelia farinosa</i> - Brittlebush | 3' x 4' | Full Sun | Low Water Use | Spring |
| <i>Erioneuron pulchellum</i> - Fluffgrass | 2" x 6" | Full Sun | Low Water Use | Sp/Sum |
| <i>Ferocactus acanthodes</i> - Barrel Cactus | 3-5' x 1.5' | Full Sun | Low water use | Sp/Sum |
| <i>Opuntia bigelovia</i> - Teddy Bear Cholla | 4' x 2' | Full Sun | Low water use | Spring |
| <i>Sphaeralcea ambigua</i> - Desert Globemallow | 3' x 3' | Full Sun | Low water use | Spring |
| <i>Yucca schidigera</i> - Mojave Yucca | 12' x 6' | Full Sun | Low water use | Spring |

For additional plants appropriate to the different plant communities, refer to Appendix A.

Note: Several of the plants listed above and within the Appendix A will require establishment from seed since they are not available in containers.



(3) Native plant materials northwest of Las Vegas including: Hedge Hog Cactus, Blackbrush, Fluff grass, and Mojave Yuccas.

23.0 ENHANCED NATIVE SOFTSCAPE TYPE

23.1 Enrich the native softscape palette with the Enhanced Native softscape type. The Enhanced Native softscape type should be utilized as shown in the Landscape Design Segments. The Enhanced Native softscape type enriches the Mojave Desert's limited palette with a mix of vertical heights and densities. A variety of native species are planted in moderately dense patterns to create this landscape. The Enhanced Native softscape type uses the same plant materials as the native revegetative palette, however it adds regionally adapted trees for diversity in vertical form. Plants are placed in closer proximity to one another in order for planting to be seen as a mass.

23.2 General plant selection. Use regionally adapted and native plant species. In addition to the plants listed in the Native Plant Revegetation softscape type, the following list of plants should be consulted to comprise the Enhanced Native softscape type. Use these species to create plant communities with variations in plant height and width. Ensure the plant palette selected for the site complements existing vegetation in the surrounding landscape. Additional plants not listed in the adjacent list can be included upon review and approval. Consider sunlight, water, and wind exposure when placing plant material.

23.3 Preserve healthy, mature trees and/or vegetation within the right-of-way. Mature vegetation is an integral part of community life and an important public resource that enhances the quality of life. All previously landscaped areas with ornamental plant materials measuring 4' above the ground and trees with greater than 3" caliper in good condition, form, and health shall be preserved. All softscape treat-

ment projects should be initiated by a tree inventory plan listing all protected trees and other landscape materials within the right-of-way which includes: a listing of species, size and condition of each tree, index of trees to be removed and trees to preserve, and a outline of specifications for tree maintenance during construction.

Recommended Enhanced Native Plant Palette

| | Height x Width | Exposure to Sun | Water Requirement | Seasonal Interest |
|---|-----------------|------------------|--------------------|-------------------|
| Trees: | | | | |
| <i>Acacia shaffneri</i> - Twisted Acacia | 18' x 20' | Full Sun | Low Water Use | Spring |
| <i>Acacia smallii</i> - Sweet Acacia | 10-35' X 15-25' | Full Sun | Low Water Use | Spring |
| <i>Cercidium microphyllum</i> - Foothills Palo Verde | 20' x 20' | Full Sun | Low Water Use | Spring |
| <i>Chitalpa tashkentensis</i> - Chitalpa | 30' x 30' | Full Sun | Moderate Water Use | Fall |
| <i>Cordia parviflora</i> - Little Leaf Cordia | 4' x 8' | Full Sun | Low Water Use | Summer |
| <i>Parkinsonia aculeata</i> - Mexican Palo Verde | 30' x 30' | Full Sun | Low Water Use | Spring |
| <i>Prosopis alba</i> - Colorado Mesquite | 30' x 30' | Full-Partial Sun | Moderate Water Use | Summer |
| <i>Prosopis chinensis</i> - Chilean Mesquite | 25' x 40' | Full Sun | Moderate Water Use | Summer |
| <i>Prosopis velutina</i> - Velvet Mesquite | 25' x 30' | Full Sun | Moderate Water Use | Spring |
| <i>Rhus lancea</i> - African Sumac | 20' x 30' | Full-Partial Sun | Low-Mod Water Use | Spring |
| <i>Vitex agnus-castus</i> - Chaste Tree | 25' x 25' | Full Sun | Moderate Water Use | Summer |
| Shrubs: | | | | |
| <i>Acacia cultriformis</i> - Knifeleaf Acacia | 10-15' x 10-15' | Full Sun | Low Water Use | Spring |
| <i>Cassia artemisioides</i> - Feathery Cassia | 6' x 6' | Full Sun | Low Water Use | Spring |
| <i>Cassia nemophila</i> - Desert Cassia | 6' x 6' | Full Sun | Low Water Use | Spring |
| <i>Chrysothamnus nausseosus</i> - Rabbit Brush | 4' x 4' | Full-Partial Sun | Low Water Use | Fall |
| <i>Ephedra viridis</i> - Mormon Tea | 3' x 3' | Full Sun | Low Water Use | Year Round |
| <i>Eremophila spp.</i> - Valentine (TM) | 4' x 4' | Full Sun | Low-Mod Water Use | Winter |
| <i>Ericamerica larcifolia</i> - Turpentine Bush | 2' x 3' | Full Sun | Low Water Use | Fall |
| <i>Leucophyllum frutescens</i> - Texas Ranger | 5' x 5' | Full Sun | Low Water Use | Summer |
| <i>Santolina virens</i> - Green Santolina | 2' x 3' | Full Sun | Low Water Use | Summer |
| <i>Simmondsia chinensis</i> - Jojoba | 6' x 6' | Full Sun | Low Water Use | Spring |
| <i>Vaquelinia californica</i> - Arizona Rosewood | 14' x 10' | Full Sun | Moderate Water Use | Spring |
| Cacti, Accents, Grasses, Groundcovers, and Perennials: | | | | |
| <i>Berlandiera lyrata</i> - Chocolate Flower | 1.5' x 1.5' | Full-Partial Sun | Moderate Water Use | Sp/Sum |
| <i>Datura meteloides</i> - Sacred Datura | 3' x 6' | Full-Partial Sun | Moderate Water Use | Summer |
| <i>Erigeron divergens</i> - Native Fleabane | 1.5' x 1' | Full Sun | Low Water Use | Summer |
| <i>Euphorbia rigida</i> - Narrow Leaf Spurge | 3' x 4' | Full-Partial Sun | Moderate Water Use | Win/Sp |
| <i>Ferocactus wislizenii</i> - Fish Hook Barrel | 5' x 2' | Full Sun | Low Water Use | Summer |
| <i>Gaillardia grandiflora</i> - Blanket Flower | 1' x 1.5' | Full Sun | Moderate Water Use | Summer |
| <i>Oenothera berlandieri</i> - Mexican Evening Primrose | 1' X 3' | Full-Partial Sun | Moderate Water Use | Sp/Sum |
| <i>Opuntia microdasys</i> - Polka Dot Cactus | 3' x 3' | Full Sun | Low Water Use | Summer |
| <i>Psilotrophe cooperi</i> - Paper Flower | 1' x 1.5' | Full-Partial Sun | Low-Mod Water Use | Sp/Sum/Fall |
| <i>Santolina chamaecyparissus</i> - Lavender Cotton | 1.5' x 3' | Full Sun | Low Water Use | Spring |
| <i>Tetranneuris acaulis</i> - Angelita Daisy | 1' x 1.5' | Full-Partial Sun | Moderate Water Use | Sp/Sum/Fall |
| <i>Yucca spp.</i> - Yucca | 10' x 6' | Full Sun | Low Water Use | Summer |



(1) This is an example of Enhanced Native softscape type planting in front of a highway sound wall using the plant palette above.

24.0 REGIONALLY ADAPTED SOFTSCAPE TYPE

24.1 Enhance welcome centers, gateways, and urban areas using the Regionally Adapted softscape type. Use Regionally Adapted softscape type where identified in each Landscape Design Segment. For this softscape type, the Mojave plant palette and dry land plants from other regions, such as the Sonoran region, are planted in greater densities, forming a layer of over-story and under-story. Plant palettes create a richness of color, seasonal change, texture, and form to enhance the desert garden.

24.2 General plant selection. Use regionally adapted plant species. In addition to the plants listed in the Native Plant Revegetation softscape type and the Enhanced Native softscape type, refer to the following list of plants to comprise the Regionally Adapted softscape type. Use plant species to create plant communities with variations in plant height and spread. Additional plants not listed may be included upon review and approval. Consider sunlight, water, and wind exposure when placing plant material.

24.3 Preserve healthy, mature trees and/or vegetation within the right-of-way. Mature vegetation is an integral part of community life and an important public resource that enhances the quality of life. All previously landscaped areas with ornamental plant materials measuring 4' above the ground and trees with greater than 3" caliper in good condition, form, and health shall be preserved. All softscape treatment projects should be initiated by a tree inventory plan listing all protected trees and other landscape materials within the right-of-way which includes: a listing of

species, size and condition of each tree, index of trees to be removed and trees to preserve, and a outline of specifications for tree maintenance during construction.



(1) The Agave spp. is a plant representative of the Regionally Adapted softscape type

Recommended Regionally Adapted Plant Palette

| | Height x Width | Exposure to Sun | Water Requirement | Seasonal Interest |
|---|-----------------|------------------|--------------------|-------------------|
| Trees: | | | | |
| <i>Cercidium Hybrid</i> - Desert Museum Palo Verde | 25' x 25' | Full Sun | Low Water Use | Spring |
| <i>Cordia boissieri</i> - Texas Olive | 10' x 10' | Full-Partial Sun | Low Water Use | Summer |
| <i>Fraxinus oxycarpa</i> - Raywood Ash | 35' x 25' | Full Sun | Moderate Water Use | Spring |
| <i>Fraxinus velutina 'Rio Grande'</i> - Modesto Ash | 50' x 30' | Full Sun | Moderate Water Use | Spring |
| <i>Gleditsia triacanthos inermis</i> - Thornless Honey Locust | 35' x 25' | Full Sun | Moderate Water Use | n/a |
| <i>Parkinsonia floridum</i> - Blue Palo Verde | 20' x 25' | Full Sun | Low Water Use | Spring |
| <i>Pistacia chinensis</i> - Chinese Pistache | 40' x 20' | Full Sun | Moderate Water Use | Fall |
| <i>Populus spp.</i> - Cottonwood | 75' x 50' | Full Sun | Low-Mod Water Use | Sp/Fall |
| ***note: plant where ground water access is available | | | | |
| <i>Quercus spp.</i> - Oak Tree | 40-70' x 20-50' | Full-Partial Sun | Moderate Water Use | Sp/Fall |
| <i>Robinia spp.</i> - Locust | 40-50' x 20-40' | Full Sun | Moderate Water Use | Sp/Sum |
| <i>Ulmus parvifolia</i> - Drake Elm | 60' x 70' | Full Sun | Moderate Water Use | Fall |
| <i>Vauquelinia californica</i> - Arizona Rosewood | 14' x 10' | Full Sun | Moderate Water Use | Spring |
| Shrubs: | | | | |
| <i>Anisacanthus quadrifidus</i> - Mountain Flame | 3' x 3' | Full-Partial Sun | Low Water Use | Fall/Sum |
| <i>Buddleia davidii</i> - Navajo Purple Butterfly Bush | 8' x 6' | Full-Partial Sun | Low Water Use | Spring |
| <i>Buddleia marrubifolia</i> - Woolly Butterfly Bush | 6' x 6' | Full-Partial Sun | Moderate Water Use | Summer |
| <i>Cassia phyllodenia</i> - Silver Leaf Senna | 6' x 6' | Full Sun | Low Water Use | Spring |
| <i>Chrysactinia mexicana</i> - Damianita | 2' x 2' | Full Sun | Low Water Use | Summer |
| <i>Convolvulus cneurom</i> - Bush Morning Glory | 2' x 3' | Full Sun | Low Water Use | Sp/Fall |
| <i>Dalea spp.</i> - Dalea | 4' x 5' | Full Sun | Low Water Use | Fall |
| <i>Dodonea viscosa</i> - Hopbush | 10' x 6' | Full Sun | Low Water Use | Year Round |
| <i>Justicia candidans</i> - Red Justicia | 3' x 3' | Full-Partial Sun | Moderate Water Use | Summer |
| <i>Leucophyllum spp.</i> - Texas Ranger | 4' x 4' | Full Sun | Low Water Use | Summer |
| <i>Rhus ovata</i> - Sugar Bush | 10' x 10' | Full-Partial Sun | Low Water Use | Spring |
| <i>Salvia clevelandii</i> - Chaparral Sage | 4' x 6' | Full Sun | Low Water Use | Spring |
| <i>Tecoma x Goldstar</i> - Texas Yellow Star | 20' x 8' | Full Sun | Moderate Water Use | Summer |
| Cacti, Accents, Grasses, Groundcovers, and Perennials: | | | | |
| <i>Agave weberi</i> - Weber's Century Plant | 3' x 2' | Full-Partial Sun | Low Water Use | Summer |
| <i>Artemisia frigida</i> - Wormwood | 1' x 1' | Full Sun | Low Water Use | Spring |
| <i>Convolvulus mauritanicus</i> - Ground Morning Glory | 1' x 3' | Full-Partial Sun | Low Water Use | Sp/Sum |
| <i>Coreopsis lanceolata</i> - Sunray | 1.5' x 1' | Full Sun | Moderate Water Use | Sp/Sum |
| <i>Hemerocallis spp.</i> - Daylily | 2' x 2' | Full-Partial Sun | Low Water Use | Spring |
| <i>Lantana spp.</i> - Lantana | 4' x 4' | Full Sun | Moderate Water Use | Summer |
| <i>Muhlenbergia rigens</i> - Deer Grass | 3' x 4' | Full Sun | Low Water Use | Summer |
| <i>Nolina erumpens</i> - Beargrass | 4' x 6' | Full Sun | Low Water Use | Spring |
| <i>Penstemon spp.</i> - Penstemon | 3' x 2' | Full Sun | Low Water Use | Spring |
| <i>Salvia leucantha</i> - Mexican Bush Sage | 3' x 3' | Full-Partial Sun | Moderate Water Use | Sp/Fall/Win |
| <i>Tulbaghia violacea</i> - Society Garlic | 3' x 3' | Full Sun | Low Water Use | Sp/Sum |



(1) This is an example of Regionally Adapted softscape type planting at the embankment of a highway bridge using the plant list above.

25.0 REGIONAL ORNAMENTAL SOFTSCAPE TYPE

25.1 Use the Regional Ornamental softscape to create cultural meaning and/or a landmark feature. The Regional Ornamental softscape type should be used where identified on the Landscape Design Segments. This softscape type is meant to emphasize the unique cultural elements of these particular urban environments. The use of non-native, ornamental plant species in this softscape type accentuates the composition possibilities inherent in form and color. Dynamic ornamental forms, colors, and textures enhance the native Mojave landscape in complimentary patterns.

25.2 General plant selection. Use regional ornamental plant species. In addition to the plants listed in the Native Plant Revegetation softscape type, the Enhanced Native softscape type, and the Regionally Adapted softscape type, refer to the following list of plants to comprise the Regional Ornamental softscape type. For installation of containerized plant stock, use one-gallon container size for groundcovers and perennials, a minimum five-gallon container for all shrubs and cacti, a minimum 24 inch box for trees, and a minimum 20 foot brown trunk height for palms. Additional plants not listed in the plant palette may be included upon review and approval by NDOT. Consider sunlight, water, and wind exposure when placing plant material.

25.3 Preserve healthy, mature trees and/or vegetation within the right-of-way. Mature vegetation is an integral part of community life and an important public resource that enhances the quality of life. All previously landscaped

areas with ornamental plant materials measuring 4' above the ground and trees with greater than 3" caliper in good condition, form, and health shall be preserved. All softscape treatment projects shall be initiated by a tree inventory plan listing all protected trees and other landscape materials within the right-of-way which includes: a listing of species, size and condition of each tree, index of trees to be removed and trees to preserve, and an outline of specifications for tree maintenance during construction.

Recommended Regional Ornamental Plant Palette

| Height x Width | Exposure to Sun | Water Requirement | Seasonal Interest |
|--|-----------------|-------------------|----------------------------------|
| Trees: | | | |
| <i>Gleditsia triacanthos inermis</i> - Thornless Honey Locust | 28' x 16' | Full Sun | Moderate Water Use Summer |
| <i>Koelreuteria paniculata</i> - Goldenrain Tree | 35 x 40' | Full-Partial Sun | Mod-High Water Use Summer |
| <i>Olea europaea 'Swan Hill'</i> - Olive Tree | 30' x 30' | Full Sun | Moderate Water Use Summer |
| <i>Pinus eldarica</i> - Mondel Pine | 50' x 30' | Full Sun | Moderate Water Use Fall |
| <i>Pinus halepensis</i> - Aleppo Pine | 60' x 40' | Full Sun | Moderate Water Use Fall |
| <i>Pinus pinea</i> - Italian Stone Pine | 80' x 40' | Full Sun | Moderate Water Use Year Round |
| <i>Pinus roxburghii</i> - Chir Pine | 80' x 40' | Full Sun | Moderate Water Use Fall |
| <i>Pistacia chinensis</i> - Chinese Pistache | 40' x 20' | Full Sun | Moderate Water Use Fall |
| <i>Sophora secudiflora</i> - Mescal Bean | 15' x 10' | Full Sun | Moderate Water Use Spring |
| Palms: | | | |
| <i>Brahea armata</i> - Mexican Blue Palm | 30' x 15' | Full Sun | Low Water Use Year Round |
| <i>Butia capitata</i> - Pindo Palm | 20' x 15' | Full Sun | Low Water Use Year Round |
| <i>Chamaerops humilis</i> - Mediterranean Fan Palm | 20' x 20' | Full Sun | Low-Mod Water Use Summer |
| <i>Cycas revoluta (not a true palm)</i> - Sago Palm | 5' x 8' | Full-Partial Sun | Mod-High Use Year Round |
| <i>Phoenix canariensis</i> - Canary Date Palm | 40' x 40' | Full Sun | Moderate Water Use Summer |
| <i>Phoenix dactylifera</i> - Date Palm | 50' x 25' | Full Sun | Moderate Water Use Year Round |
| <i>Trachycarpus fortunei</i> - Windmill Palm | 20' x 20' | Full-Partial Sun | Moderate Water Use Year Round |
| <i>Washingtonia filifera</i> - California Fan Palm | 50' x 15' | Full Sun | Low-Mod Water Use Summer |
| <i>Washingtonia robusta</i> - Mexican Fan Palm | 80' x 10' | Full Sun | Low-Mod Water Use Summer |
| Shrubs: | | | |
| <i>Acacia redonlens 'Desert Carpet'</i> - Prostrate Acacia | 5' x 10' | Full Sun | Low Water Use Late Winter |
| <i>Caesalpinia mexicana</i> - Mexican Bird of Paradise | 10' x 6' | Full Sun | Moderate Water Use Summer |
| <i>Calliandra eriophylla</i> - Fairy Duster | 4' x 4' | Full-Partial Sun | Low Water Use Sp/Sum/Fall |
| <i>Cotoneaster congestus</i> - Rockspray | 2' x 6' | Full-Partial Sun | Low-Mod Water Use Spring |
| <i>Cotoneaster x Lowfast</i> | 2' x 10' | Full-Partial Sun | Moderate Water Use Spring |
| <i>Eleagnus x Ebbingei</i> - Ebbing's Silverberry | 9' x 9' | Full Sun | Moderate Water Use Summer |
| <i>Lagerstromia indica</i> - Crape Myrtle | 20' x 12' | Full-Partial Sun | Moderate Water Use Summer |
| <i>Rosmarinus officialnus 'Huntington Carpet'</i> - Spreading Rosemary | 2' x 8' | Full Sun | Low Water Use Sp/Sum |
| <i>Rosmarinus officialnus 'Tuscan Blue'</i> - Upright Rosemary | 6' x 4' | Full Sun | Low Water Use Sp/Sum |
| Accents Cacti and Grasses: | | | |
| <i>Agave weberi</i> - Weber's Century Plant | 3' x 2' | Full-Partial Sun | Low Water Use Summer |
| <i>Dasyliion acrotriche</i> - Green Desert Spoon | 4' x 6' | Full Sun | Low Water Use Sum/Fall |
| <i>Dasyliion wheeleri</i> - Grey Desert Spoon | 4' x 6' | Full Sun | Low Water Use Sum/Fall |
| <i>Drosanthemum hispidum</i> - Ice Plant | 2' x 3' | Full Sun | Low-Mod Water Use Spring |
| <i>Echinocactus grusonii</i> - Golden Barrel | 2' x 3' | Full-Partial Sun | Low Water Use Spring |
| <i>Euphorbia charachias</i> - Shrubby Spruge | 3' x 2' | Full-Partial Sun | Moderate Water Use Win/Sp |
| <i>Fouquieria splendens</i> - Ocotillo | 18' x 10' | Full Sun | Low Water Use Spring |
| <i>Hesperaloe spp.</i> - Yucca | 4' x 4' | Full Sun | Low Water Use Sp/Sum/Fall |
| <i>Muhlenbergia capillaris</i> - Regal Mist | 3' x 6' | Full-Partial Sun | Moderate Water Use Spring |
| <i>Opuntia santa-rita</i> - Purple Prickly-Pear | 2' x 3' | Full Sun | Low Water Use Spring |
| <i>Phormium tenax</i> - New Zealand Flax | 15' x 4' | Partial Sun | Low-Mod Water Use Sp/Sum |



(1) This is an example of Regional Ornamental softscape type planting at the embankment of a highway bridge using the same plants listed in the plant palette above. This type of softscape is limited to the Las Vegas "Flamboyant Resort Corridor."

26.0 WILDLIFE CROSSINGS AND PROTECTION

26.1 Engage appropriate agencies in planning and designing wildlife crossings. Engage federal, state, and local agencies, and wildlife professionals in the initial stages of planning and design through implementation of wildlife crossings. Incorporate wildlife professionals as members of the design team in all non-urban areas.

26.2 Observation points and opportunities to observe animal movement may be possible in the design of crossings. Provide appropriate viewing areas where possible.



Image courtesy of Tony Clevenger

(1) This is an example of a wildlife undercrossing.

27.0 CONSTRUCTION PRACTICES

27.1 Clear the site only within the limits of construction. Ensure the project site is cleared only within the limits of construction to avoid excessive site disturbance.

27.2 Protect important environmental, landscape and cultural features. Ensure trees, shrubs, landscape and cultural features, and environmentally sensitive areas to be preserved are identified and protected during construction. In areas where vegetation is to remain, avoid disturbance and compaction of the ground. Maintain and enhance existing groundcover to ensure the area is left in a condition consistent with the surroundings.

27.3 Coordinate with construction personnel when planning and designing projects. Implementation of project design requires close cooperation with the personnel directly

responsible for its construction. Involve construction personnel early on in the design stage through to the development of final specifications. Maintain effective communication with construction personnel through the construction process.

27.4 Ensure erosion and sedimentation is controlled during construction. Ensure sediments are controlled through the timely control of soil erosion. Consider site specificity, timing of execution, and application of man-made devices and/or vegetative cover to stabilize banks during construction. Consider alternatives to hard surface paving. Give preference to other sediment control devices including sediment basins, diversion berms, vegetative buffer areas, channel linings, energy dissipators, seeding, and mulching. Build permanent erosion controls

into structural earthwork design through terracing, flattening slopes, stone and durable synthetic blankets, retaining walls, rip-rap, and/or native revegetation. Maintain compliance with necessary permits throughout construction.

27.5 Carefully manage and dispose of waste material. Avoid disposing of milled asphalt by placing it as a cover on highway shoulders. This can inhibit revegetation on slopes and create a cluttered, unfinished appearance to the corridor.

27.6 Salvage and store topsoil and native plant materials. After soil erosion and sediment control measures have been implemented and before grading work begins, remove and store topsoil for project reuse. Salvage areas should be designated on plans and laid out

on the site. Salvaged plant materials shall be stored and maintained during the period prior to planting. Stripped topsoil in excess of the quantity required for the project should be stored at specified locations. Topsoil of lesser quality can be blended with soil amendments to improve condition for final bedding.

27.7 Carefully consider location/reclamation of construction areas. Construction staging areas, borrow pits, and other construction areas must be carefully located and returned to a condition as good or better than original, and consistent with the *Corridor Plan* design guidelines.

28.0 MAINTENANCE PRACTICES

28.1 Consult Best Management Practices and provide for efficient and effective maintenance.

Design new projects that are low maintenance. Provide areas where maintenance equipment can be conveniently located. Consider maintenance routines required for the design program, and identify areas that may need additional care or attention initially and/or as the project matures. NDOT maintenance practices include:

- Trash and debris removal
- Surface finish maintenance (painting, patching, graffiti removal)
- Grading, and earthwork
- Ground treatment (raking, replacing mulch or decorative rock, reconfiguring drainage structures)
- Weed control
- Plantings (interim, temporary, and permanent irrigation, trimming, pruning of shrubs and trees, manual weed control, fertilizing)
- Disease and pest management (including invasive species control)
- Repair and replacement of structural and electrical components, irrigation, signage, and lighting

28.2 Create a visual design unity among all existing and new structures.

Ensure a visual design relationship exists among all highway structures. This includes coordinating materials, patterns, and color. Ensure structures can be readily patched or painted with matching colors. When paint or stain repair is made, complete repairs, joints, or logical edge point. Use anti-graffitti treatment on all accessible structures. District level maintenance teams

should use the same color palette for all maintenance and repairs (refer to Color Palette guideline, page 5.9, for more information).

28.3 Locate and screen maintenance staging areas appropriately.

Maintenance staging areas need to be adequately set back from the highway, situated at or near an interchange, located to be visually unobtrusive from the highway, and safe for ingress and egress by maintenance workers. Drainage is an important aspect in the design and location of a maintenance area in order to prevent any environmental damage that results from leachates in salt and gravel stockpiles. Salt and sand piles should be covered to avoid watercourse and groundwater degradation according to the NDOT Best Management Practices Manual. Provide space for equipment storage, vehicles, and supplies as well as employee or visitor parking. Consider, future expansion needs. Architectural or landscape architectural screening of maintenance areas, particularly stockpiles and equipment, should be provided if a maintenance area is visible from the highway or from adjacent developed property. Security fencing may be appropriate in some locations.

28.4 Coordinate with personnel when planning and designing maintenance areas.

Planning and design of maintenance area requires close cooperation between designers and the personnel directly responsible for its use.

29.0 RECOMMENDATIONS FOR SUSTAINABLE HIGHWAY ENVIRONMENTS

29.1 Sustainable development is defined as achieving stability of both physical and social systems by meeting the needs of current generations without compromising the ability of future generations to meet their needs. Sustainable design is a holistic philosophy that includes all aspects of function and construction operations, including but not limited to: energy use, air quality, material selection, energy generation, water conservation, heat and solid waste, habitat enhancement, and protection. In this document, the focus is on sustainability for design and construction of the elements that comprise the physical highway system. Restoration of disturbed man-made and natural habitat is an important component in achieving a sustainable highway related landscape.

29.2 Three key principles in highway construction and natural resource management include Avoid, Minimize, and Mitigate. Concepts central to these principles include:

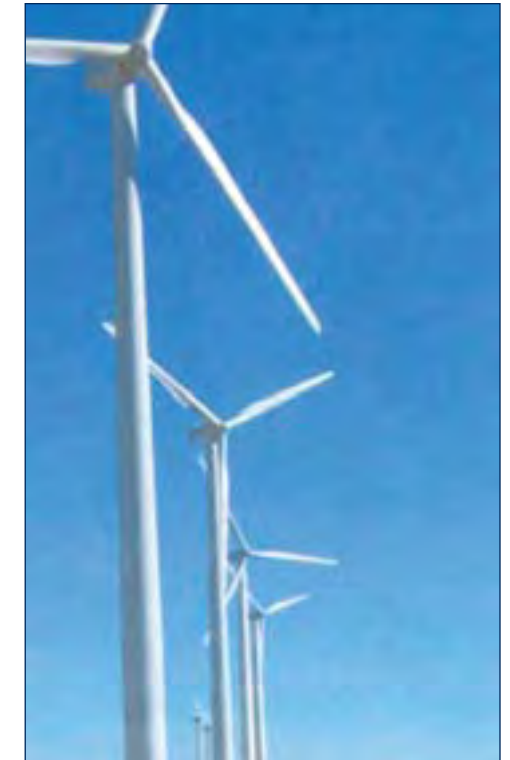
- Water conservation: efficiency, protection and reuse.
- Construction materials selection: reduce, reuse and recycle.
- Air quality protection.
- Energy efficiency: use renewable energy.
- Design innovation.

29.3 Techniques for creating sustainable highway environments.

- Develop systems that encourage sustainable highways. Develop performance standards, monitoring procedures, and promote coordination between environmental and transportation agencies.
- Preserve air quality. Use construction mitigation techniques to minimize dust from construction sites.
- Minimize energy consumption and incorporate alternative energy sources. Where possible use solar powered electronic signs, low energy use lights (such as LED), and passive solar design.
- Use recycled materials for construction. When applicable use reclaimed concrete and asphalt, scrap tires, plastics, steel slag, roofing shingles, coal fly ash, and composted municipal organic wastes.
- Reduce waste. Waste reduction concepts include right-of-way management, reuse of organic materials, water conservation, and selection of long-lived materials.



(1) Solar power provides a sustainable, renewable energy in remote locations.



(2) Wind power generates a clean renewable energy source.



(3) Materials like this recycled plastic modular unit can be used in roadway construction.



(4) Existing condition of asphalt millings being placed along the shoulder should be reused in repaving projects.

OVERVIEW

To understand the cost implications of the improvements proposed by this *Corridor Plan*, estimates on a cost per square foot (SF) and per acre basis have been prepared. At the planning budget level, these values can be applied over the Landscape Design Segments to produce planning level cost for the right-of-way sections and individual interchange improvements. These estimates will inform NDOT in the decision-making process and help influence budget allocations for the landscape and aesthetics highway improvements.

PROCESS

Costs for individual hardscape and softscape treatments, such as concrete form liner imprints, retaining walls, and landscape irrigation, were gathered from several sources, including NDOT, local engineering and landscape architecture firms, contractors, and product manufacturers. This information was analyzed and compiled into a database that could be applied to several prototypical examples of landscape and aesthetic treatment levels. The softscape and hardscape costs presented here represent the capital costs of construction and do not include extended maintenance costs. The treatments correlate to those presented in the NDOT *Landscape and Aesthetics Master Plan*. A separate report prepared by UNLV, entitled *Maintenance Cost Study for Corridor Planning*, examines long-term maintenance costs such as graffiti removal, plant care, and irrigation.

Prototypical designs for each of the five softscape types and four hardscape treatments were devel-

oped for the interchanges at Blue Diamond Road and Sahara Avenue. Overall cost estimates for each level of treatment were created from these and compared to the costs from actual projects for verification. The project area was then incorporated into the estimate to create a per square foot and per acre cost.

Prototypes were also created for the sections of highway right-of-way that exhibit the various types of treatment. A similar process was applied to these areas to create a per square foot and per acre cost for each hardscape and softscape type.

APPLICATION OF DESIGN GUIDELINES

The Design Guidelines included in this report describe the elements that compose a typical highway interchange and right-of-way section. They also describe a base level of landscape and aesthetic quality that is used to predict costs. The intent of this section is to develop a definition of what is considered as a “standard” treatment. The next step following adoption of the *Corridor Plan* is for NDOT to initiate internal review to determine implementation strategies. This review will include cost evaluation, priorities and scheduling, and visual preference evaluations to test each standard proposed by this section.

Funding for the landscape and aesthetics portion of a project will generally not be used to cover the ordinary construction costs. The landscape and aesthetics budget is available for softscape and hardscape treatments that exceed the ordinary construction costs.

The following is a summary description of the components contained within an NDOT standard project that are not generally considered landscape and aesthetic elements:

ROADWAY SERVICE AREAS

- Service area program as defined inclusive of designated services

NON-MOTORIZED TRANSPORTATION SYSTEMS

- Maintain existing sidewalk dimension of intersecting road across bridge overpass
- Maintain existing bike lane dimension of intersecting road across bridge overpass
- New bicycle paths and walkways that are part of an approved transportation plan

BRIDGE STRUCTURE

- Steel and concrete I-girders or steel and concrete box girder
- Cast in place concrete with variable vertical ribbed design
- Two color palette - base color with one accent color
- Concrete barrier rail with acrylic stain base color application or steel rail with finish
- Bridge/road name identification signs
- Apply a long-term, non-sacrificial anti-graffiti treatment coating to all appropriate structures as needed
- Pedestrian access across bridges

RETAINING WALLS

- Cast-in-place or pre-cast concrete with variable vertical ribbed design
- Acrylic stain base color application
- Apply a long-term, non-sacrificial anti-graffiti treatment coating to all appropriate structures as needed

SOUND WALLS

- Cast-in-place or pre-cast concrete with variable vertical ribbed design
- Acrylic stain base color application
- Apply a long-term, non-sacrificial anti-graffiti treatment coating to all appropriate structures as needed
- Variation in sound wall geometry, material, color, texture, and pattern to eliminate monotonous linear stretches of wall

CONCRETE BARRIER

- Cast-in-place concrete barrier
- Acrylic stain base color application
- Apply a long-term, non-sacrificial anti-graffiti treatment coating to all appropriate structures as needed

GUARD RAIL

- Galvanized steel triple corrugated guard rail

FENCING

- Chain link fencing with color application - vinyl clad or painted finish with steel post supports where required (selected urban areas)
- Multi-strand wire fencing with painted steel post supports at right-of-way limits (rural areas)

- Fencing required to control access, grading, and drainage

GRADING

- Steepest desired slope of 3H:1V
- Rounded slopes that blend into existing grade
- See Project Design Development Manual (PDDM) 2.2.4.2 side slopes

ROCK CUTS

- Rock cuts appear natural in form and blend with existing landforms
- Staining of rock cut to provide weathered finish
- Rock fall protection structures if necessary

DRAINAGE

- Basic channel conveyance, culverts, and drainage structures
- Erosion resistant channels
- Water quality basins
- Man-made or constructed wetlands fulfilling mitigation requirements

EROSION CONTROL

- Temporary erosion control provided during construction
- Permanent erosion control
- Temporary and permanent erosion control best management practices

NATIVE REVEGETATION FOR ALL DISTURBED PORTIONS OF HIGHWAY CONSTRUCTION

- Salvage and storage of topsoil (6" horizon minimum) with native plant fragments

- Respreading of stockpiled topsoil and native plant fragments to minimum 6" depth (amend topsoil when necessary)
- Application of native plant revegetation seed mix in combination with scattered rock mulch
- Supplemental irrigation to establish plantings when necessary (two year minimum maintenance contract)
- Provide invasive and noxious weed control (two year minimum maintenance contract)

CONSTRUCTION AND MAINTENANCE MANAGEMENT PRACTICES

- Dust control practices
- Construction fencing to preserve sensitive areas
- Traffic control and project site security
- Maintenance period to ensure establishment of native revegetation
- Development of a native revegetation general maintenance program

PROJECT COMPONENTS REQUIRED FOR COMPLIANCE

- All practices must be in compliance with applicable Federal and State regulations

COST ANALYSIS

Softscape Treatments

Using the process described on page 6.1, planning level construction cost estimates for the different softscape treatments were determined in 2004 dollars. They are as follows:

| <u>Softscape Type</u> | <u>Cost Estimate (sf & acre)</u> |
|--|--|
| Ground Treatment / Native Revegetation: | \$1.15 - \$1.35 sf \$50,000 - \$59,000 acre |
| <i>L & A Cost</i> | \$0.00 sf \$0.00 acre |
| Enhanced Native: | \$1.40 - \$1.60 sf \$61,000 - \$70,000 acre |
| <i>L & A Cost</i> | \$0.25 - \$0.45 sf \$11,000 - \$20,000 acre |
| Regionally Adapted: | \$2.25 - \$2.75 sf \$98,000 - \$120,000 acre |
| <i>L & A Cost</i> | \$1.10 - \$1.60 sf \$48,000 - \$70,000 acre |
| Regional Ornamental: | \$3.50 - \$6.00 sf \$152,000 - \$262,000 acre |
| <i>L & A Cost</i> | \$2.35 - \$4.85 sf \$102,000 - \$212,000 acre |

The cost for Ground Treatment/Native Revegetation is covered under the general construction costs as part of the project. The data shown for the different treatment levels represents a total cost. The *L & A Cost* is the portion of the total cost that is above the ordinary construction costs and would be paid for through the Landscape and Aesthetics budget.

For example, a Regionally Adapted softscape costs about \$1.10 sf more than the standard Ground Treatment / Native Revegetation level of treatment, for a total cost of \$2.25 sf (\$1.15 + \$1.10 = \$2.25). The additional \$1.10 sf would be funded through the *L & A* budget because it is above and beyond the ordi-

nary construction costs. The Regional Ornamental treatment exhibits the widest range of costs due to the highly customized nature of this type.

To place the estimates in the context of a highway corridor, an estimate was calculated for a one-mile section of road. A typical section of highway right-of-way that is 240' wide with two 40' wide paved areas for travel lanes was used to determine this value (Figures 1-4, page 6.4). The approximate softscape costs to develop one mile of corridor right-of-way at each treatment level were calculated to be:

| <u>Softscape Type</u> | <u>Cost Estimate (1 mile)</u> |
|--|-------------------------------|
| Ground Treatment / Native Revegetation: | ~ \$800,000 |
| <i>L & A Cost</i> | \$0.00 |
| Enhanced Native: | ~ \$950,000 |
| <i>L & A Cost</i> | ~ \$150,000 |
| Regionally Adapted: | ~ \$1,600,000 |
| <i>L & A Cost</i> | ~ \$800,000 |
| Regional Ornamental: | ~ \$2,250,000 - \$3,800,000 |
| <i>L & A Cost</i> | ~ \$1,450,000 - \$3,000,000 |

Structures and Hardscape Treatments

The construction of the bridge at an interchange composes the majority of hardscape costs. For the purposes of cost estimation, a 12,000 square foot (60' x 200') bridge was assumed. The estimate for the various hardscape levels is:

| <u>Hardscape Type</u> | <u>Cost Estimate (sf & total)</u> |
|-----------------------|---|
| Standard: | \$110 - \$115 sf \$1,320,000 - \$1,380,000 |
| <i>L & A Cost</i> | \$0.00 sf \$0.00 total |
| Accentuated: | \$125 - \$135 sf \$1,500,000 - \$1,620,000 |
| <i>L & A Cost</i> | \$15 - \$25 sf \$180,000 - \$300,000 |

| | |
|-----------------------|---|
| Focal: | \$170 - \$185 sf \$2,040,000 - \$2,220,000 |
| <i>L & A Cost</i> | \$60 - \$75 sf \$720,000 - \$900,000 |
| Landmark: | \$210 - \$250 sf \$2,520,000 - \$3,000,000 |
| <i>L & A Cost</i> | \$100 - \$140 sf \$1,200,000 - \$1,680,000 |

Again, the overall construction cost is listed as well as the cost specific to landscape and aesthetics enhancements. Similar to the Regional Ornamental softscape, the Landmark level contains many custom elements and the widest range of potential cost.

A typical interchange encompasses an area of about 6.5 acres including on/off ramps and infield landscape areas (Figures 5-8, page 6.5). To develop an estimate for an interchange, the softscape data was applied to the infield areas and added to the cost of the bridge deck. Likely softscape and hardscape treatment combinations were used to create the following interchange estimates:

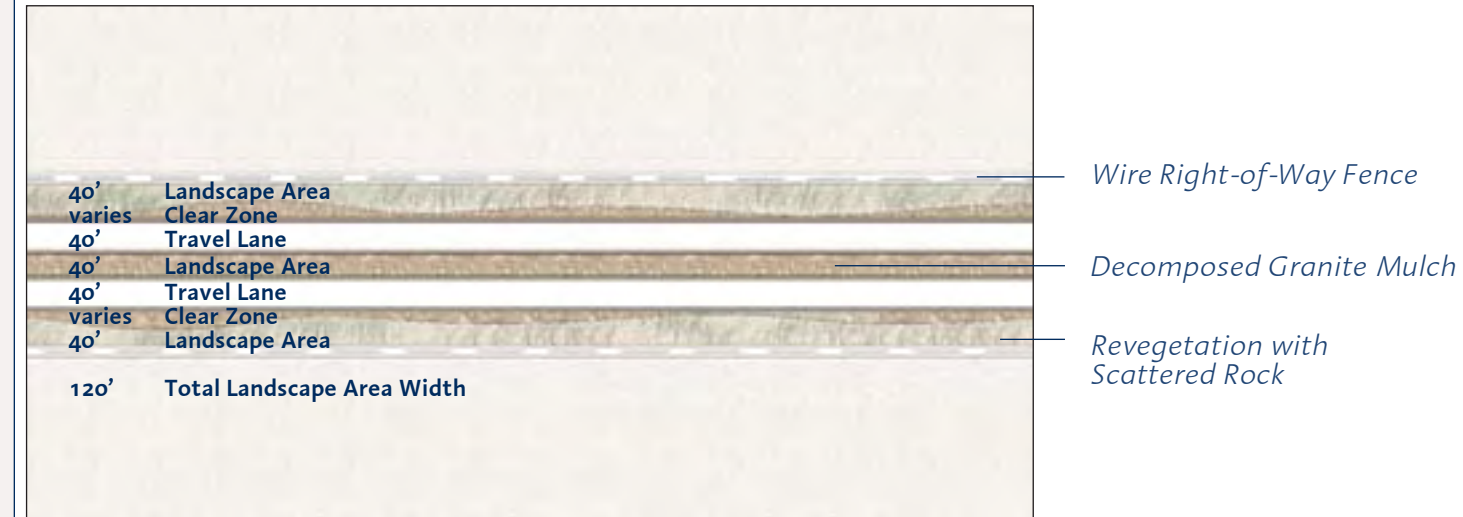
| <u>Type</u> | <u>Cost Estimate (total)</u> |
|---|------------------------------|
| Ground Treatment / Native Revegetation & Standard: | ~ \$1,700,000 |
| <i>L & A Cost</i> | ~ \$0.00 |
| Enhanced Native & Accentuated: | ~ \$2,000,000 |
| <i>L & A Cost</i> | ~ \$300,000 |
| Regionally Adapted & Focal: | ~ \$2,750,000 |
| <i>L & A Cost</i> | ~ \$1,050,000 |
| Regional Ornamental & Landmark: | ~ \$4,000,000 |
| <i>L & A Cost</i> | ~ \$2,300,000 |

Cost information presented here is provided for the purpose of long range planning and budgeting. It is not intended to substitute for a project-level detailed cost projection.



Figure 1

STRUCTURES AND HARDSCAPE TYPE - **STANDARD**
 SOFTSCAPE TYPE - **GROUND TREATMENT / NATIVE REVEGETATION**

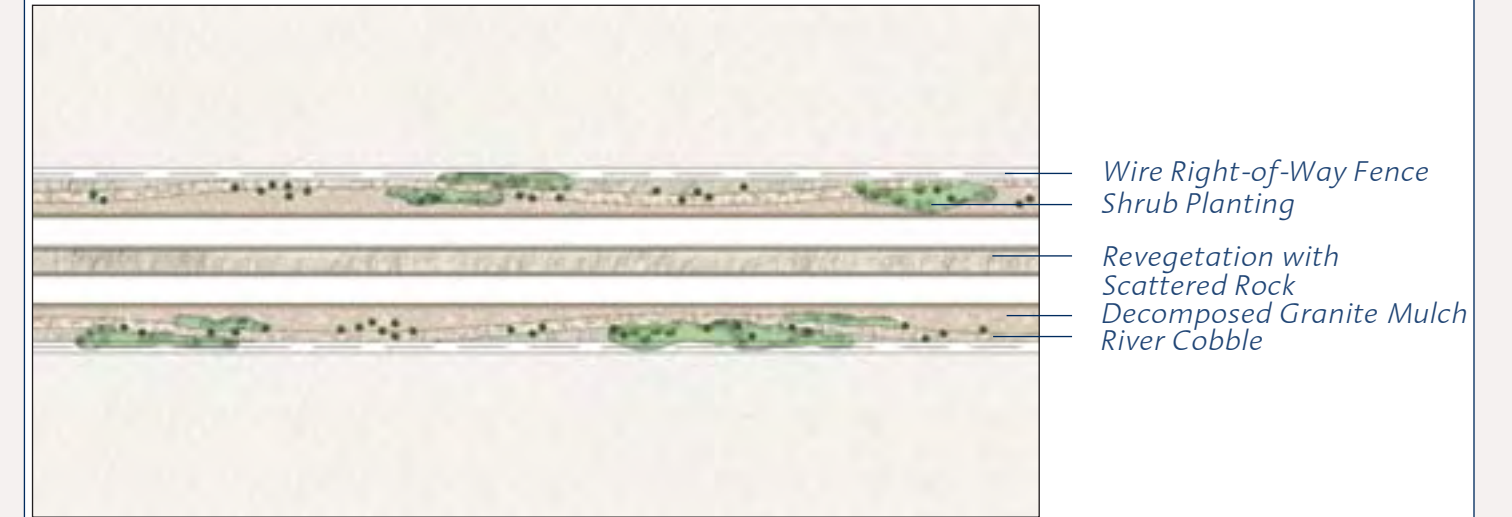


Total Cost: \$50,000 - \$59,000 acre of ROW area

L & A Cost: \$0.00 acre

Figure 2

STRUCTURES AND HARDSCAPE TYPE - **ACCENTUATED**
 SOFTSCAPE TYPE - **ENHANCED NATIVE**

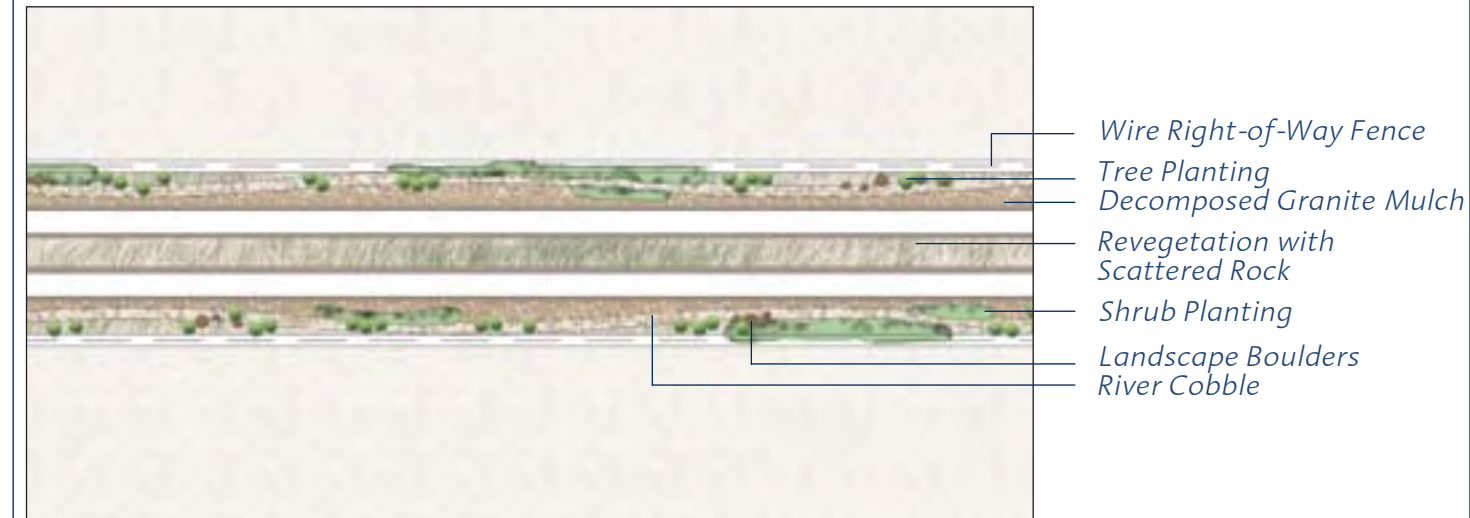


Total Cost: \$61,000 - \$70,000 acre of ROW area

L & A Cost: \$11,000 - \$20,000 acre

Figure 3

STRUCTURES AND HARDSCAPE TYPE - **FOCAL**
 SOFTSCAPE TYPE - **REGIONALLY ADAPTED**



Total Cost: \$98,000 - \$120,000 acre of ROW area

L & A Cost: \$48,000 - \$70,000 acre

Figure 4

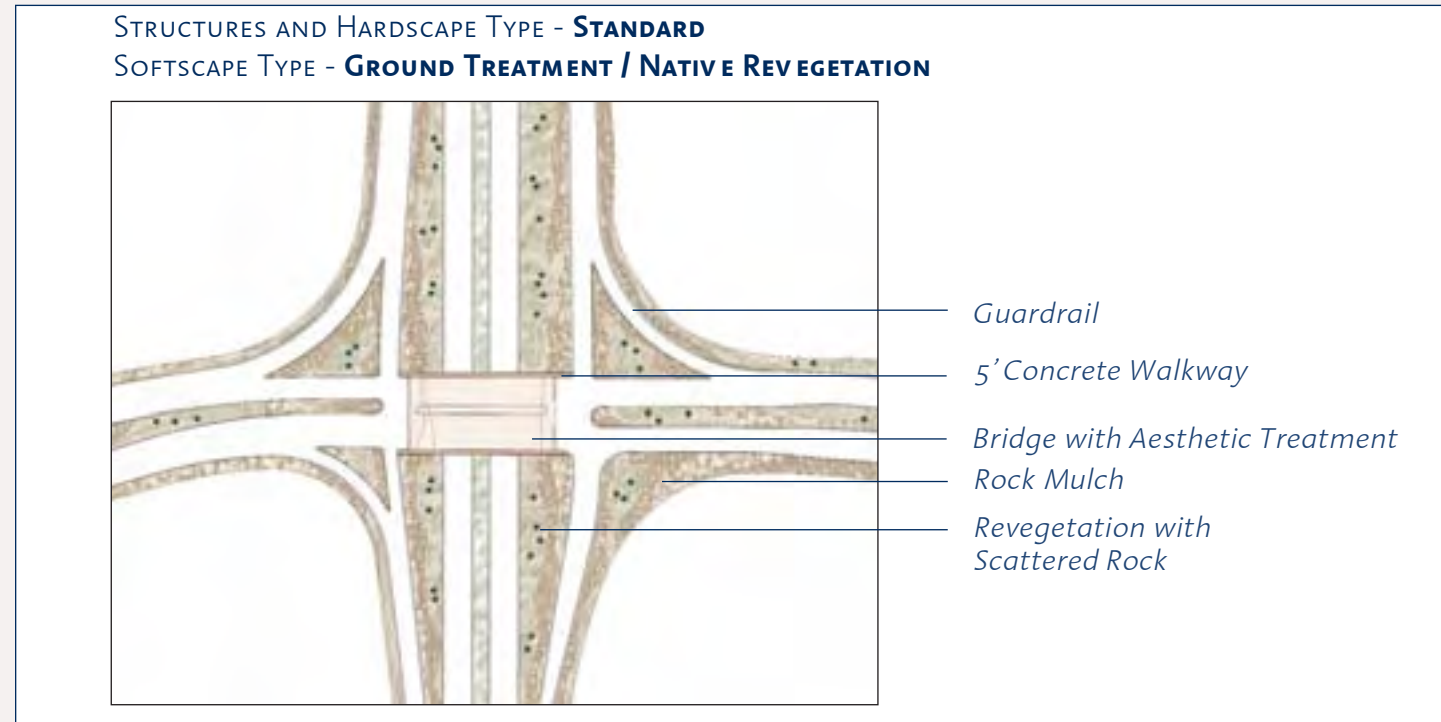
STRUCTURES AND HARDSCAPE TYPE - **LANDMARK**
 SOFTSCAPE TYPE - **REGIONAL ORNAMENTAL**



Total Cost: \$152,000 - \$262,000 acre of ROW area

L & A Cost: \$102,000 - \$212,000 acre

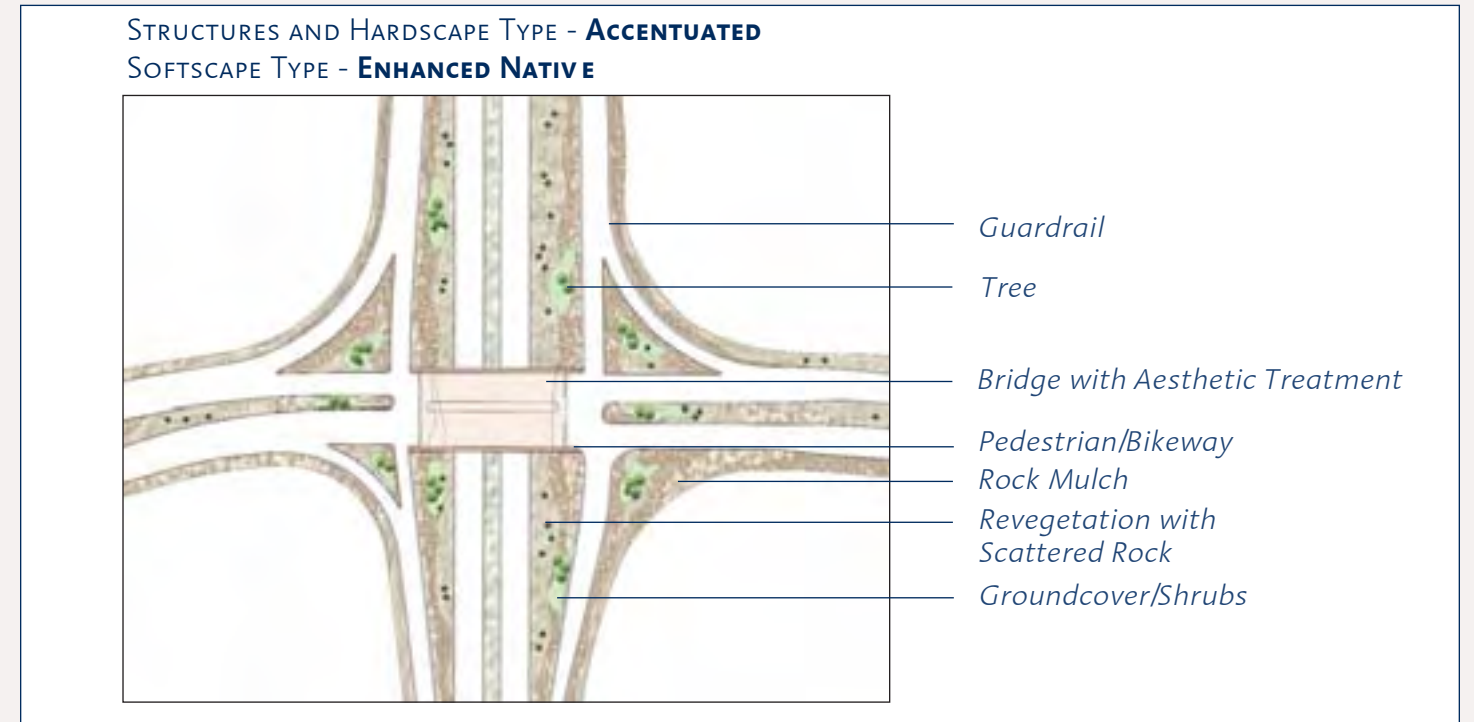
Figure 5



Total Cost: \$1,700,000 (infield landscape and bridge deck)

L & A Cost: \$0.00

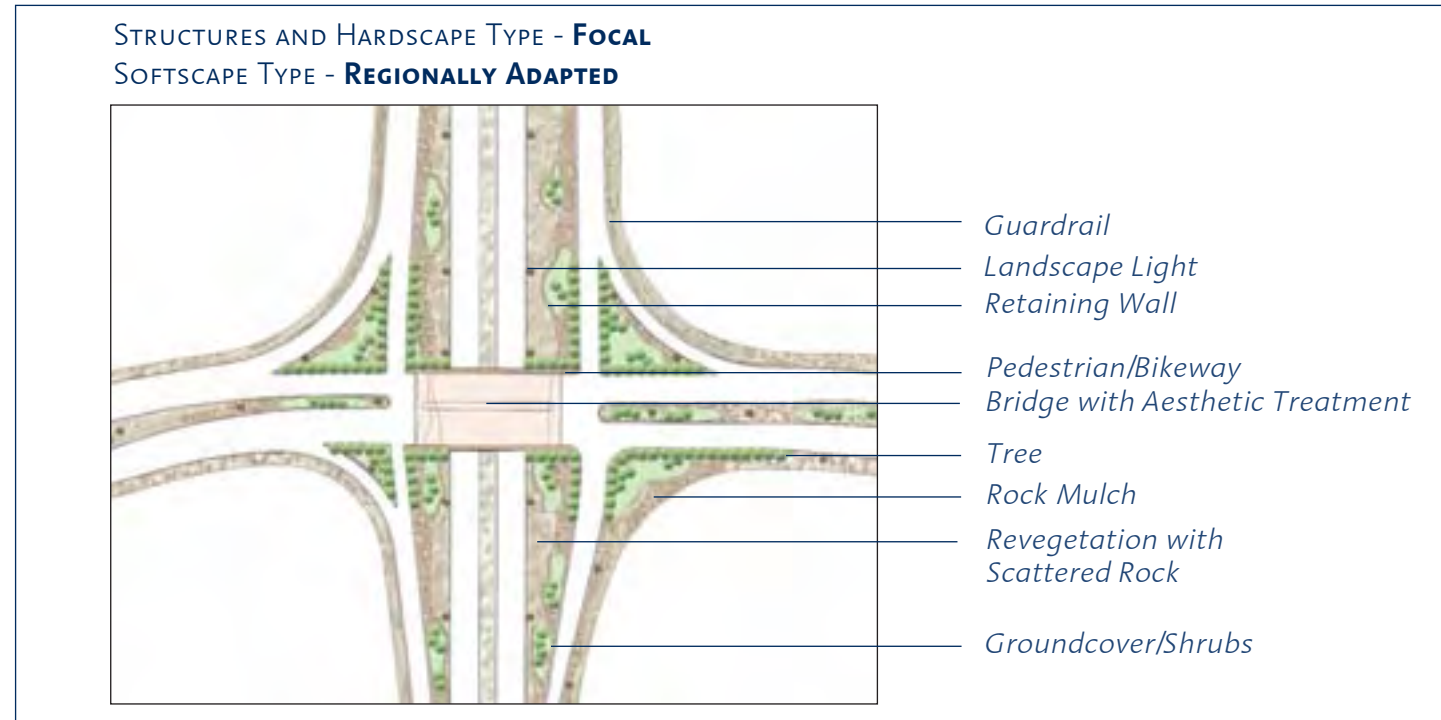
Figure 6



Total Cost: \$2,000,000 (infield landscape and bridge deck)

L & A Cost: \$300,000

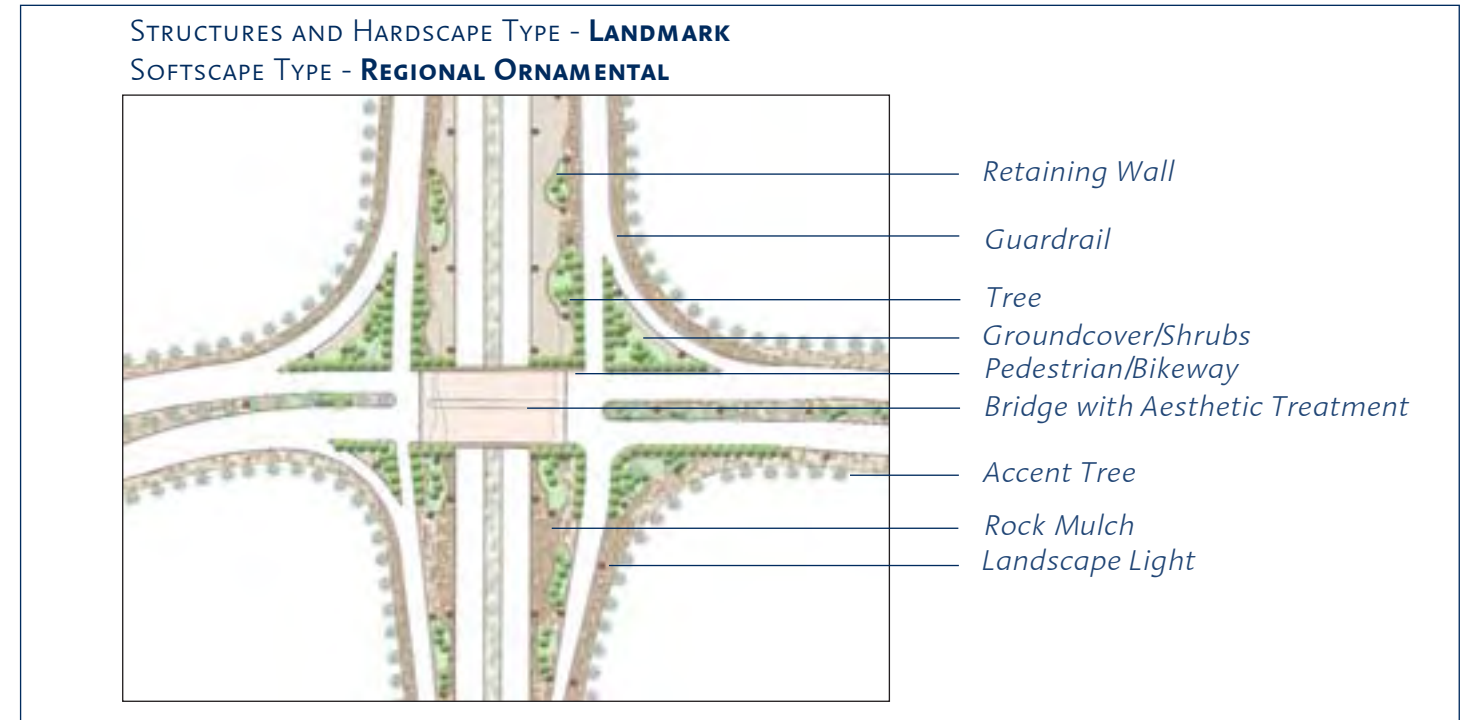
Figure 7



Total Cost: \$2,750,000 (infield landscape and bridge deck)

L & A Cost: \$1,050,000

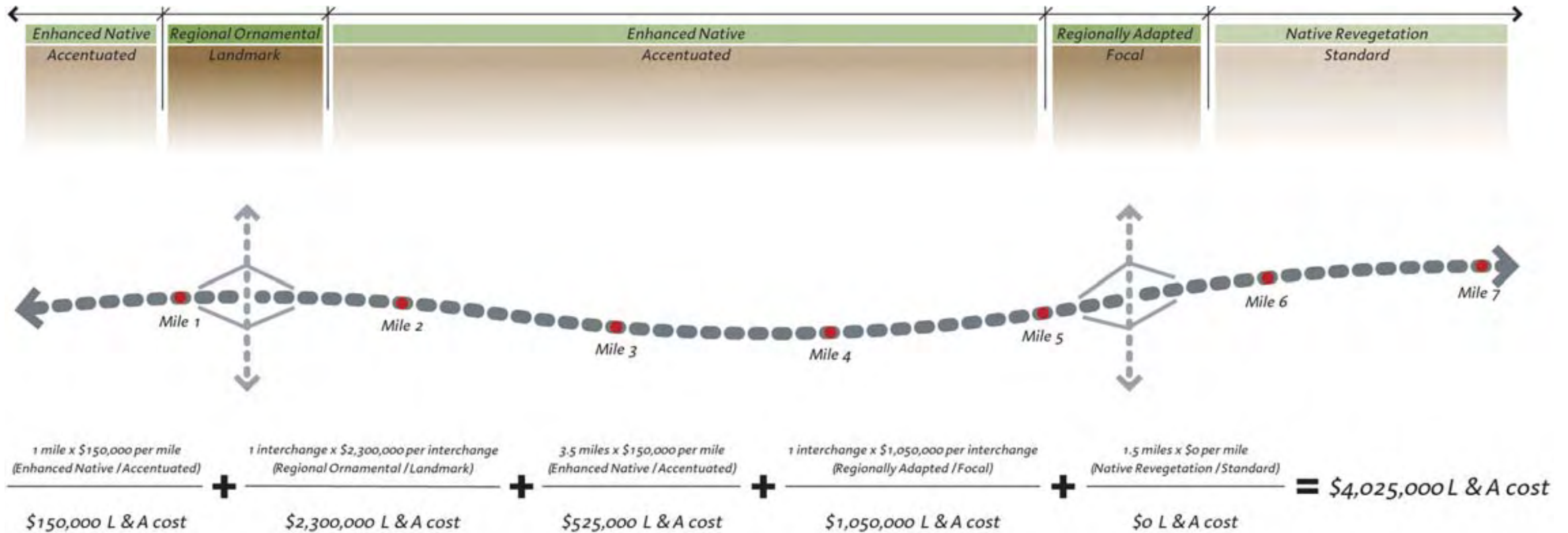
Figure 8



Total Cost: \$4,000,000 (infield landscape and bridge deck)

L & A Cost: \$2,300,000

The diagram below shows how the cost estimate information can be used to determine a planning level estimate of the landscape and aesthetics costs for this hypothetical seven mile section of highway corridor. The costs shown are for landscape and aesthetic enhancements that are above the ordinary project construction costs.



MAINTENANCE COSTS

The *Corridor Plan* identifies the level of landscape and aesthetic treatment, and consequently, the maintenance investment. Therefore, it is important that maintenance cost data be incorporated in the *Corridor Plan*. Furthermore, local public agencies and others will be interested in maintenance expenses to help them fully understand the long-term maintenance implications of retrofit projects.

In collaboration with the *Corridor Plan*, long-term maintenance costs have been researched by UNLV and compiled as the *Maintenance Cost Study for Corridor Planning*. Figure 9 diagrams how total life cycle maintenance costs were developed for the different landscape and aesthetic treatments. Figure 10 shows the maintenance costs that were determined for the various combinations of softscape and hardscape types.

Current estimates exhibit relatively wide variations in cost due to the limited amount of data available, however further research and tracking of projects will result in more clearly defined maintenance cost estimates.

Figure 9

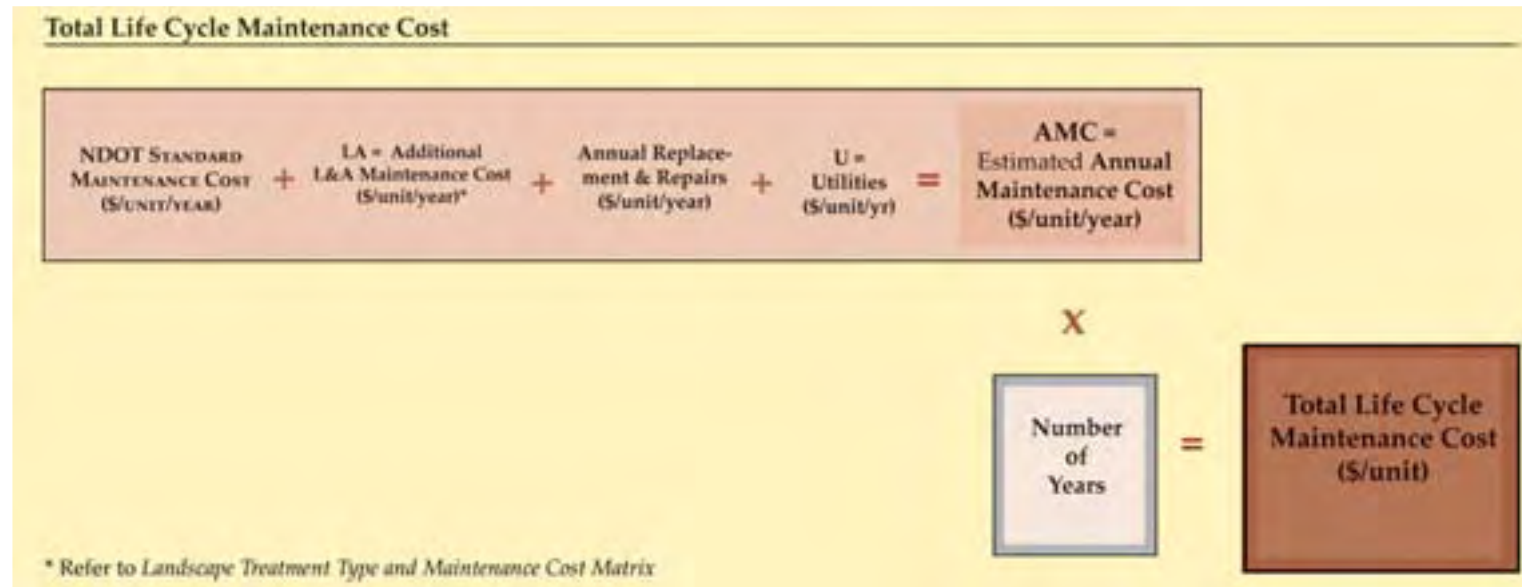


Figure 10

| Treatment Type | Hardscape | | | | |
|----------------|----------------------------------|--|--|---|---|
| | Standard | Accentuated | Focal | Landmark | |
| Softscape | Ground Treatment | High: \$4,655.11 Median: \$655.70 Low: \$520.00 | High: \$2,383.19 Low: \$1,524.00 | \$588.00 (based on one project, Cedar City) | Not Available |
| | Native Plant Revegetation | \$720.00* | \$1,676.40* | \$650.00* | Not Available* |
| | Enhanced Native | \$1,201.12 (based on one project only) | \$1,089.87 (based on one project only) | Entire Rest Area: High: \$549,200.00 Low: \$29,374.00 | Welcome Center Memorial Pt. Cost not available |
| | Regionally Adapted | High: \$15,840.00 Median: \$3,116.88 Low: \$673.02 | High: \$15,242.45 Median: \$5,445.00 Low: \$1,448.67 | \$3,054.55 (based on one project only) | Not Available |
| | Regional Ornamental | High: \$11,775.11 Median: \$7,200.00 Low: \$433.33 | High: \$8,500.00 Median: \$3,425.74 Low: \$2,279.59 | \$3,005.00 (based on one project only) | \$197,846.36 (based on one project only) |
| | Turf | High: \$12,325.46 Median: \$6,057.00 Low: \$1,529.79 | \$13,178.57 (based on one project only) | High: \$10,363.13 Low: \$3,135.00 (based on two projects, only) | High: \$9,214.70 Median: \$8,391.49 Low: \$3,325.82 |

High: Single project with highest cost
Median: Distribution of projects between high and low cost.
Low: Single project with lowest cost.

All entries are per acre annual costs unless otherwise noted.
* Natural Revegetation costs are assumed to be 10% more than Ground Treatment categories costs.

All entries are planning level estimates based on limited available data. NOTE: Utilities and Repair & Replacement are not included in numbers.



PROJECT FUNDING

Funding for the implementation of the projects that are included in the corridor may occur through several programs. Funding for new landscape and aesthetics projects associated with the state's highway program could come from both state and federal sources. Up to 3% of the total project construction cost may be allocated for landscape and aesthetics improvements.

When a landscape and aesthetics project can significantly influence an adjacent community or area, the community may choose to get involved in the process and participate in a matching funds program. This program assists in the funding of projects initiated independent of the statewide capital plan and annually funds specific projects based on applications received from local public agencies. Additionally, communities and developers can implement enhanced levels of landscape and aesthetics through long-term capital and maintenance cost sharing agreements with NDOT.

The landscape and aesthetics project funds may be banked to allow for better project distribution of capital funds. This would provide the mechanism for NDOT to shift landscape and aesthetics money to areas that have been identified to receive enhanced levels of treatment. The capacity to allocate funds will allow NDOT to broadly manage the landscape and aesthetics budget on a corridor-wide basis.

OVERVIEW

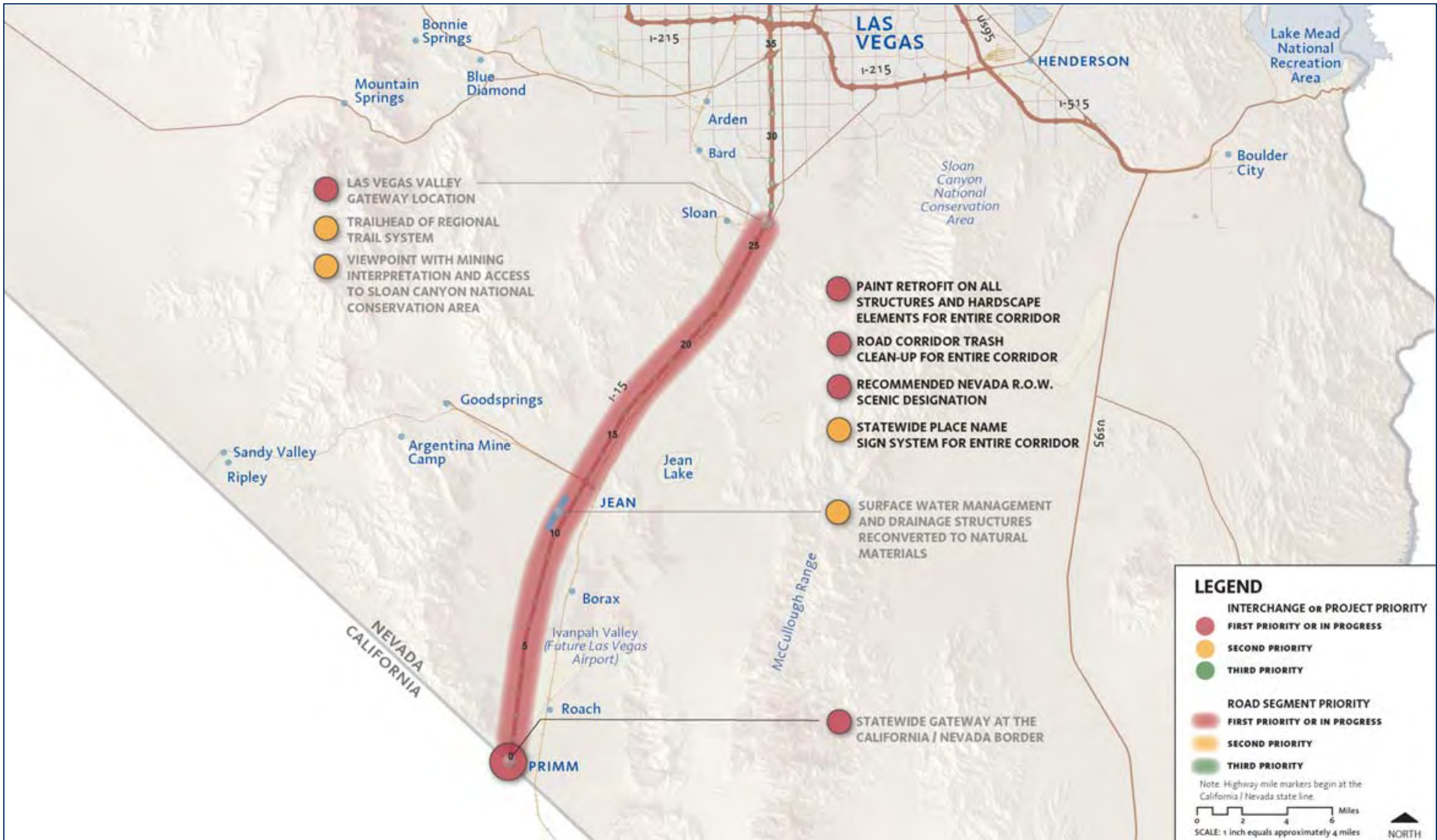
This section describes levels of priority for projects within the Landscape Design Segments. First priority was given to sections of road with a high degree of visibility or identity, areas that can contribute significant quality immediately, and projects that are currently in progress. Second priority applies to projects that will provide additional benefits and aesthetics as part of the longer range plan. Third priority was given to areas that currently display a reasonable level of aesthetic quality, and upon enhancement, will complete the Landscape and Aesthetics Program for that particular Landscape Design Segment.

It is important to note that corridor-wide roadside trash clean-up has been identified as the top priority for all three Landscape Design Segments. A color retrofit for all existing structures and hardscape elements is recommended as the first priority after the trash clean-up. These two activities have been selected because of the immediate and significant impact they will have on the overall aesthetics of the entire I-15 corridor.

A dominant feature of the Dynamic Desert Metropolis landscape design segment is the I-215 section. Improvements to enhance the appearance of the right-of-way are designed as a medium priority due to various ownership constraints.

The priority levels are based on current capital improvements and landscape and aesthetics planning. They are intended to act as a guide and represent those projects that the *Corridor Plan* recommends as having the greatest potential impact on the aesthetics of the entire corridor.

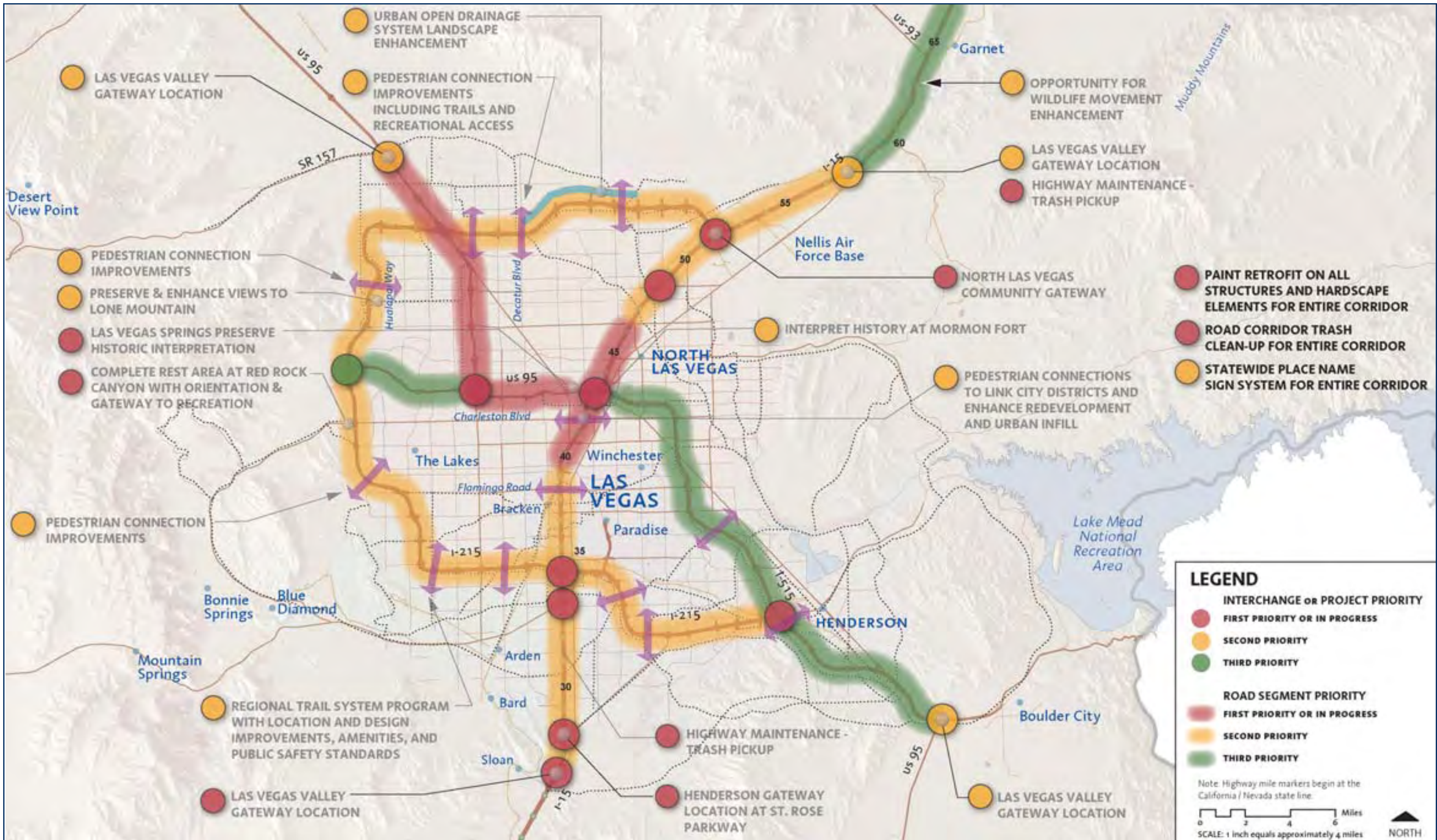
The priorities identified in this chapter are subject to change according to the availability of funds for the individual project improvements. Capital projects are significantly influenced by the availability of funding.



1-15 corridor plan

I-15: PRIMM TO SLOAN - PRIORITY PROJECTS

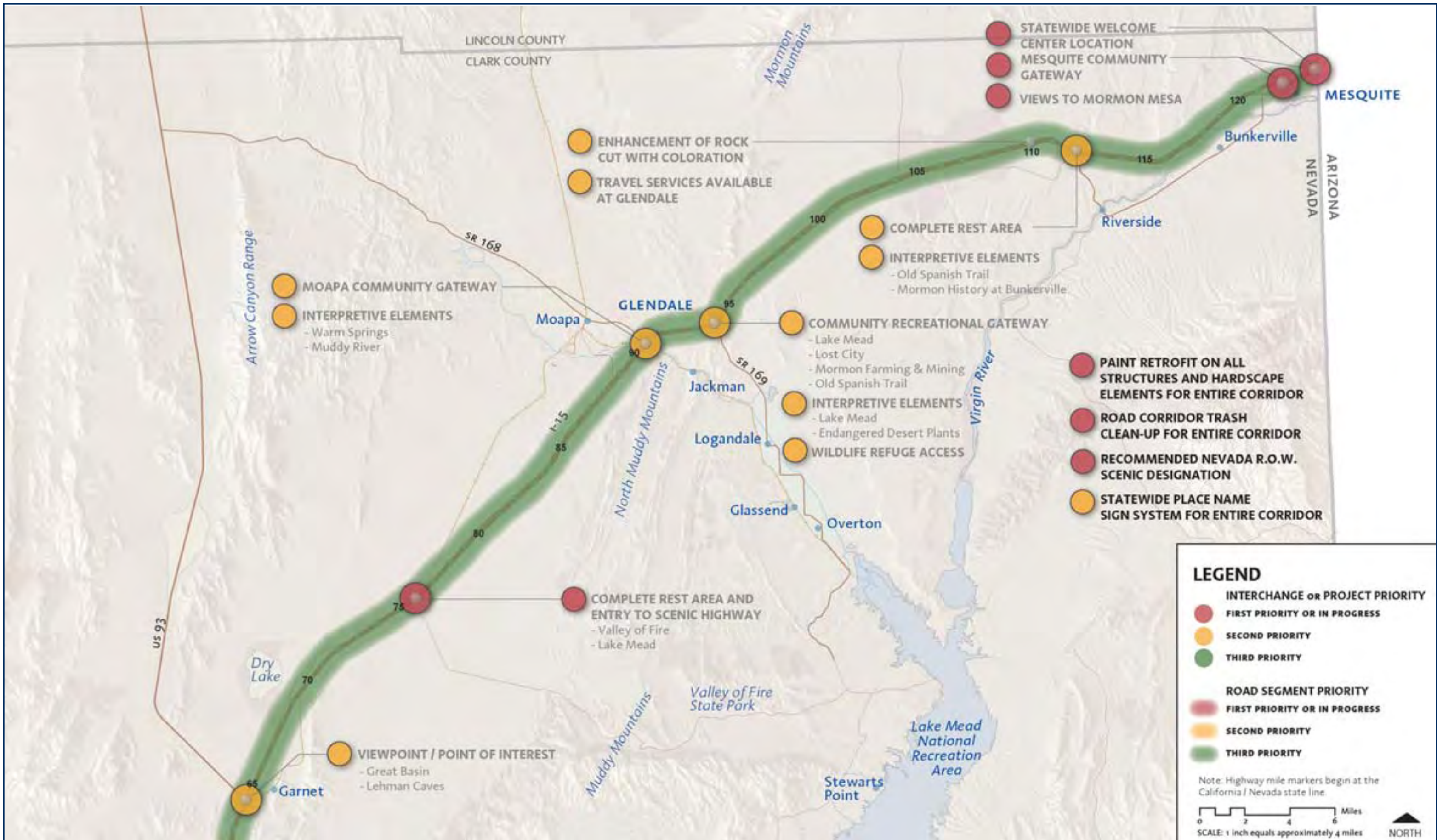
GATEWAY TO NEVADA'S EXCITEMENT LANDSCAPE DESIGN SEGMENT



1-15 corridor plan

LAS VEGAS METROPOLITAN AREA - PRIORITY PROJECTS

DYNAMIC DESERT METROPOLIS LANDSCAPE DESIGN SEGMENT



1-15 corridor plan

I-15: SPEEDWAY TO MESQUITE - PRIORITY PROJECTS

MOJAVE HIGH DESERT LANDSCAPE DESIGN SEGMENT

CONCLUSION

The *I-15 Landscape and Aesthetics Corridor Plan* represents a significant step in Nevada's renewed commitment to landscape and aesthetics as integral elements of the state's highways. This document is designed to guide decisions and policies that will affect the aesthetic quality of Nevada's highways on a corridor-wide basis down to the individual project level. It presents extensive research and analysis on the existing conditions of Nevada, its highway corridors, and its scenic natural landscapes. The *Corridor Plan* describes the composition of elements and programs that will be used to enhance the level of landscape and aesthetics across the state. Perhaps most importantly, the *Corridor Plan* sets the stage for discussion of:

- Implementation strategies
- Cost evaluation / strategies
- Priorities and scheduling
- Visual preference evaluation

To accomplish an increased level of landscape and aesthetics for Nevada's highways, the *Corridor Plan* has detailed a new NDOT standard level of treatment for capital projects. The new standard will raise the basic level of aesthetics on all future projects significantly.

The *I-15 Landscape and Aesthetics Corridor Plan* is a public/private partnership initiative. The *Plan* provides a foundation for this unique initiative to build a comprehensive vision for the landscape and aesthetics of the I-15 corridor. The partnership policy outlined in the *NDOT Landscape and Aesthetics Master Plan*, clearly states the unique and exciting result of this process.

Highways can be perceived as edges or boundaries that separate city or landscape. Interchanges are seen as intersections, nodes, and gateways. These perceptions argue strongly for a design approach that recognizes cultural boundaries and deals with the landscape and aesthetic design of the highway as a corridor segment, rather than on an individual project basis.



September 20, 2002



MAPPING ECOSYSTEMS ALONG NEVADA HIGHWAYS AND THE DEVELOPMENT OF SPECIFICATIONS FOR VEGETATION REMEDIATION

This report has been prepared by Dr. Paul T. Tueller, Professor in the Department of Environmental and Resource Sciences at UNR, Dick Post, Horticulture Specialist with University of Nevada Cooperative Extension (Emeritus) and Erin Noonan a graduate student at UNR (now employed with the National Park Service at Point Reyes, California).

Ecosystem Specifications

MOJAVE DESERT –
CREOSOTE
BUSH/BURSAGE SITES



Site Analysis

These are desert sites with plants adapted to very hot dry conditions. The soils are variable but are often quite rocky and gravelly. Many of the soils are underlain by a silica or calcium carbonate hardpan that restricts rooting depth. The plants are sparse. Perennial grasses are few and annuals and woody plants are common. Precipitation averages 3 inches or less over much of the range. The elevations are generally low, below 2500 feet.

| Shrubs | lbs.seed/acre |
|--|---------------|
| 1. Creosote bush – <i>Larrea tridentata</i> | 2.0 |
| 2. Bursage – <i>Ambrosia dumosa</i> | 2.0 |
| 3. Cattle spinach – <i>Atriplex polycarpa</i> | 2.0 |
| 4. Purple sage – <i>Salvia dorii</i> | 1.0 |
| 5. Blader cenna – <i>Cassia armata</i> | 0.5 |
| 6. Brittle bush – <i>Encelia farinosa</i> | 1.0 |
| 7. Fremont dalea – <i>Psoralethamnus fremontii</i> | 0.5 |
| 8. Wolfberry – <i>Lycium andersonii</i> | 0.5 |
| 9. Whitethorn acacia – <i>Acacia constricta</i> | 0.5 |
| 10. Utah century plant – <i>Agave utahensis</i> | 0.25 |
| | |
| Grasses | |
| 1. Big galleta – <i>Hilaria rigida</i> | 1.0 |
| 2. Desert needlegrass – <i>Achnatherum speciosum</i> | 1.0 |
| 3. Red brome – <i>Bromus rubens</i> | 0.25 |
| 4. Six-weeks gramma – <i>Bouteloa barbata</i> | 0.5 |
| 5. Ring muhly – <i>Muhlenbergia torreyi</i> | 0.5 |
| | |
| Forbs | |
| 1. Desert marigold – <i>Baileya multiradiata</i> | 1.0 |
| 2. California poppy – <i>Eschscholtzia californica</i> | 1.0 |
| 3. Desert globe mallow – <i>Sphaeralcea ambigua</i> | 1.0 |
| 4. Desert sunflower – <i>Viguiera deltoidea</i> | 0.5 |
| 5. Desert lupine – <i>Lupinus sparciflorus</i> | 0.5 |
| Total 17.5 lbs/acre | |

Site and Soil Preparation

Anything that adds organic matter to these harsh revegetation sites would be beneficial. In most cases fertilizer treatments would not be useful. Supplemental irrigation for establishment would be the most useful and would likely require the hauling of water. The presence of a hardpan and salts near the surface might require an amendment to control or ameliorate pH. This could be in the form of horticultural grade sulfur or calcium carbonate, which is usually less, water-soluble. The amount would have to be carefully regulated to avoid incurring any undue toxicity. On some sites deep ripping might help to loosen up a hardpan and improve seeding success.

Revegetation Procedures

In some cases we would recommend the placement of topsoil on disturbed sites in the Latr/Amdu vegetation. The soil should be roughened to provide safe seed sites. The seed can be broadcast or applied as a water-based slurry using a hydro-seeding method. Mature plant transplants may be appropriate in some cases. On most Mojave sites, some type of a mulch should be used. A number of mulch materials can be used and because of the high frequency of winds it would be necessary to tackify the mulch to the soil surface using one of several procedures.

MOJAVE DESERT - BLACKBRUSH SITES (*Coleogyne ramosissima*)



Site Analysis

Blackbrush is found at some of the higher elevations in the Mojave Desert, usually above 3000 feet. The dominant plant is black-brush, but an understory of Desert Needle grass (*Achnatherum speciosa*) may also be present. Other plants associated with this species are the Joshua tree (*Yucca brevifolia*) and Spanish bayonet (*Yucca baccata*). Soils are often gravelly, and slopes vary from nearly 0 degrees to 30 degrees. As part of the Mojave Desert these sites are mostly dry, and rainfall is usually no more than 4 or 5 inches. Little effort has gone into revegetation efforts on blackbrush sites.

Species Selection

| Shrubs | lbs. seed/acre |
|--|----------------|
| 1. Blackbrush – <i>Coleogyne ramosissima</i> | 1.5 |
| 2. Brittlebush – <i>Encelia farinosa</i> | 1.5 |
| 3. Purple sage – <i>Salvia dorrii</i> | 1.5 |
| 4. Three leaf sumac – <i>Rhus trilobata</i> | 1.0 |

| | |
|--|------|
| 5. Cliffrose – <i>Cowania mexicana</i> | 1.5 |
| 6. Apache’s plume – <i>Fallugia paradoxa</i> | 1.0 |
| 7. Wolfberry – <i>Lycium andersonii</i> | 1.0 |
| 8. Squaw apple – <i>Peraphyllum ramosissimum</i> | 1.01 |

Grasses

| | |
|---|-----|
| 1. Desert needle grass – <i>Achnatherum speciosum</i> | 1.5 |
| 2. Desert ricegrass – <i>Achnatherum hymenoides</i> | 1.5 |
| 3. Galleta grass – <i>Hilaria jamesii</i> | 1.0 |
| 4. Sand dropseed – <i>Sporobolus cryptandus</i> | 1.0 |

Forbs

| | |
|---|-----|
| 1. California poppy – <i>Eschscholtzia californica</i> | 1.0 |
| 2. Desert globe mallow – <i>Spharalcea ambigua</i> | 0.5 |
| 3. Palmer’s penstemon – <i>Penstemon palmeri</i> | 0.5 |
| 4. Sand verbena – <i>Abronia villosa</i> | 0.5 |
| 5. Arizona lupine – <i>Lupinus arizonica</i> | 0.5 |
| 6. Prickly poppy – <i>Argemone munita</i> | 0.5 |
| 7. Beeplant (rocky mountain) – <i>Clemone serrulate</i> | 1.0 |
| 8. Mohave aster – <i>Aster mohavensis</i> | 0.5 |

Total 20.5 lbs./acre

Site Preparation

Slopes most likely would not require contouring unless there is a steep cut. These droughty sites may require supplemental irrigation for establishment via three sprinkler irrigations. Irrigation most likely would need to be applied after initial seeding for one season. Fertilizers such as an NPK fertilizer (16-16-16), would help for seeding success. Approximately 200 pounds/acre should be applied.

Revegetation specifications

Container-grown species will be difficult to obtain. Shrub seed should be drilled in with a small drill on flat to moderate slopes. The soil should be roughened before and after to create favorable seed sites for grass and forb seeds. Mulches, such as a straw mulch, would help with initial establishment and reduce dust hazards. Mulches should be tackified with light colored netting. Hydromulching may be an option, depending upon costs and the area is susceptible to high dust hazard.

**MOJAVE DESERT –
DESERT RIPARIAN
SITES**

Site Analysis

These sites are found at the lowest elevation in the hot desert, which in Nevada translates to Mojave Desert. Soils may vary and can be quite saline with a high pH



and salt accumulation at the surface. The surface soil horizons are mostly silty, but the lower horizons can have poor physical properties with clays and poor drainage. There may be stagnant water or no water in these drainages during parts of the year. A few have year-round streams, e.g. the Muddy River as it goes under Interstate 15.

Species Selection

| Shrubs | lbs. seed/acre |
|--|----------------------|
| 1. Goodding willow – <i>Salix goodingii</i> | 1.0 |
| 2. Cat claw acacia – <i>Acacia greggi</i> | 1.0 |
| 3. Four wing saltbush – <i>Atriplex canescens</i> | 1.0 |
| 4. Cheese bush – <i>Hymenoclea salsola</i> | 1.0 |
| 5. White bursage – <i>Ambrosia dumosa</i> | 1.0 |
| 6. Desert saltbush – <i>Atriplex polycarpa</i> | 1.5 |
| 7. Desert broom – <i>Baccharis sarothroides</i> | 1.5 |
| 8. Wash willow – <i>Chilopsis linearis</i> | 1.0 |
| | |
| Grasses | |
| 1. Sand dropseed – <i>Sporobolus cryptandrus</i> | 1.0 |
| 2. Giant Bermuda grasses – <i>Cynodon dactylon</i> | 1.0 |
| 3. Tall fescue – <i>Festuca arundinacea</i> | 1.0 |
| 4. Alkali sacaton – <i>Sporobolus airoides</i> | 1.0 |
| | |
| Forbs | |
| 1. Desert marigold – <i>Baileya multiradiata</i> | 1.0 |
| 2. California poppy – <i>Eschscholtzia californica</i> | 1.0 |
| 3. Globe mallow – <i>Sphaeralcea coccinea</i> | 1.0 |
| 4. Sand verbena – <i>Abronia villosa</i> | 1.0 |
| | 1.0 |
| Total | 17.0 lbs/acre |

Soil and Site Preparation

These bottomland sites have a variety of soils as mentioned above. Some washes may be very rocky and thus preclude much in the way of site preparation. Some of the deeper soils may be silty at the surface and prone to wind erosion. A soil stabilizer, such as hydromulch or a matting material, can be applied to reduce a potential dust problem. The soils also may be low in organic matter and may require some fertilization. These sites likely would be able to utilize a nitrogen application (possibly 1 pound of N/1,000 square feet). Prior to seeding contouring may be required if slopes are steeper than 40 percent. If a high pH soil is found, then it will be necessary to add 400 pounds of horticultural grade sulfur.

Revegetation Procedures

Shallow slopes may lend themselves to the use of a drill. Steeper slopes should be seeded by broadcasting and mulching. Soils must be roughened in order to provide safe seed sites. This can be done using a disk if machinery can be used. On smaller areas hand-raking will suffice. Shrubs and even ramets of grasses may do best if container-grown and then planted on the contour of the site. Both container-grown and broadcast areas must be mulched and then tackified.

**SALT MARSH ZONE
SITES**

Site Analysis

These sites are found near the edges of playas throughout Nevada with a number of highways crossing them. The osmotic potential is very high and most species, except those native to the area, are difficult to establish and maintain. The terrain is generally flat because of the location. In addition to being very saline, soils often have a high clay content constituting a restrictive layer relative to root growth. The soil structure in the clay horizon is usually columnar and prismatic with a high sodium content. Water often ponds on these sites in the spring. During much of the year, however, they can be very droughty. These sites may also be in close proximity to wetlands associated with the playas, although the wetlands constitute a different set of requirements.



Species Selection

The number of native species adapted to these sites is somewhat limited. Only a few species are highly adapted to these sites because of the requirement for high salt tolerance.

| Shrubs | lbs.seed/acre |
|---|----------------|
| 1. Rubber rabbitbrush – <i>Chrysothamnus naseosus</i> | 2.0 |
| 2. Russian olive – <i>Eleagnus angustifolia</i> | 1.0 |
| 3. Silver buffalo berry – <i>Shepherdia argentea</i> | 2.0 |
| 4. Fourwing saltbush – <i>Atriplex canescens</i> | 2.0 |
| 5. Pickle weed – <i>Allenrolfia sp.</i> | 1.0 |
| 6. Soap weed – <i>Suaeda torreyana</i> | 1.0 |
| | |
| Grasses | |
| 1. Salt grass – <i>Distichlis spicata</i> | 1.5 |
| 2. Alkali sacaton – <i>Sporobolus airoides</i> | 2.5 |
| 3. Common reed – <i>Arundo donax</i> | 1.0 |
| | |
| Forbs | |
| 1. Almu aster – <i>Aster pauciflorus</i> | 1.5 |
| 2. Globe mallow – <i>Sphaeralcea ambigua</i> | 1.5 |
| 3. Alkali mallow – <i>Sida hederacea</i> | 1.0 |
| Total | 18.0 lbs./acre |

Soil/Site Preparation

The high salinity may require the use of soil amendments. High-sodium soils may require the addition of gypsum during establishment of these highly salt-tolerant species. On difficult sites as much as 4,000 pounds per acre might be applied. On some sites it may be important to apply a tackifier to reduce wind erosion. There are a number of products available and the prices vary considerably.

Revegetation Procedures

These sites are generally quite flat and would allow a drill to be used. For some species container-grown material might be recommended. Spring seeding would be recommended, but might present an access problem because ponding of these clay soils. Late fall seeding might be used if a mulch is tackified onto the soil to protect the seed during the winter. The least expensive method would be using certified-clean straw. The potential for weed infestations is always a possibility.

SAMPLE SPECIFICATIONS

In this section we have taken one specific site and described specifications that might be followed in order to improve the aesthetics, dust control and other problems on these sites.

REVEGETATION PROTOCOL FOR THE VALLEY OF FIRE INTERCHANGE EAST OF LAS VEGAS.

Site Analysis

- This is a Mojave Desert site with extremely low rainfall.
- The soils are rocky and most have a hardpan cemented with calcium carbonate or silica. Much of the topsoil has been removed.
- The soil should be analyzed before planting to determine which supplements should be added to assist in revegetation.
- We would recommend that native desert species be planted on this site, possibly merged with a cobble ground cover in a pleasing pattern.
- This site is wind prone, which presents a potential dust hazard that can be ameliorated with vegetation and rock cover.
- This site receives heavy traffic because it is along a major highway, and more importantly, an exit to one of Nevada's premier recreation destinations.

Suggested Reclamation Steps

- Step 1: Site Preparation
Rip the surface soil in preparation for planting.
- Step 2: Application of Soil Amendments
Determine and apply appropriate additives.

- Step 3: Supplemental Irrigation
Install a 1- to-2 acre portable drip system to ensure establishment of container-grown plants. Determine the appropriate number of emitters needed to irrigate a specific number of shrubs on this site. Water could come from several potential sources, for example, a cooperative plan with the casino located at the site, drilling of a well, or hauling water. Irrigation on these sites would not be continuing, but would only be done to ensure establishment.



Step 4: Seeding/Planting of Native Plants

The excellent plant cover in the wash to the north cannot be repeated on the interchange but suggests some of the species that might be selected.

Step 5: Mulching

A mulch should be applied to provide cover for the new seedlings on the site. A tackifier, such as jute netting, or a spray-on mulch should be used to improve the chances for successful revegetation. This will also help⁴⁴ reduce the dust hazard.

Step 6: Species Selection

Here we have listed a number of species that can be used on this site. This site probably would lend itself to drill seeding but broadcast seeding would be difficult. It is likely that container-grown native shrubs and one or two native grasses and forbs might be useful on this site.

Native Shrubs Species*

Creosote Bush – *Larrea tridentata*
 Bur sage – *Ambrosia dumosa*
 Cattle Spinach – *Atriplex polycarp*
 Purple sage – *Salvia dorii*
 Blader Cenna – *Cassia armata*
 Brittle bush – *Encelia farinosa*
 Fremont dalea – *Psoralea fremontii*
 Wolfberry – *Lycium andersonii*
 Whitethorn acacia – *Acacia constricta*

Native Grass Species

Big Galleta – *Hilaria rigida*
 Desert needlegrass – *Achnatherum speciosum*
 Red brome – *Bromus rubens*
 Six-weeks gramma – *Bouteloua barbata*
 Ring muhly – *Muhlenbergia torreyi*

Native Forb Species

Desert marigold – *Baileya multiradiata*
 Desert globe mallow – *Sphaeralcea ambigua*
 Desert sunflower – *Viguiera deltoidea*
 Desert Lupine – *Lupinus sparsiflorus*

*Container-grown shrubs should be planted in relatively deep containers, at least 8 inches to 10 inches. The native grasses and forbs can be transplanted as either ramets or seedlings if they can be made available. Supplemental irrigation to ensure establishment would be required if a mixture of seed is to be placed on this site.

ADDENDUM

DUST CONTROL

Soil productivity is affected by wind erosion in various ways. Areas of erosion and deposition on disturbed sites require more costly and less efficient soil management practices. Wind removes the smaller clay particles and organic matter from the soil while coarser materials are left behind. The continued loss of fine particles reduces soil quality. In shallow soils and soils with a hardpan layer, wind erosion also results in decreased root zone depth and water-holding capacity. Such changes may occur slowly and go unnoticed for many years. Bare soil can lead to dust that may be detrimental to safe driving and so must be considered. Many of the procedures discussed above will lead to good dust control. An number of emergency control methods are available to reduce damage from wind-induced soil erosion that already has started or is anticipated:

- tillage to produce ridges and clods;
- addition of a mulch;
- irrigation to increase soil moisture;
- temporary, artificial wind barriers;
- soil additives or spray-on adhesives.

Choice of method, or combination of methods, depends on severity of erosion and the relationship to planned remediation procedures that have been prescribed for a site.

MONITORING

Since remediation efforts are somewhat costly, we would recommend that monitoring be done to assess the success and failure of these efforts. This can be done either on an ad hoc basis or by using a more objective methodology to appraise success and/or failure over time. We would strongly recommend that an objective and scientifically based monitoring protocol be adopted to examine revegetated sites for several years after the treatment to assess the success and/or failure of the efforts. A number of excellent monitoring procedures are available. As a minimum we would suggest a series of belt transects where the seeded and volunteer species are counted one, two and five years after the treatment. Each belt should be about 15 meters or 50 feet in length and 1 meter or 3 feet wide. The number of transects would depend upon the size of the disturbed/seeded area. Small areas may require only two or three transects while larger areas may require several more to provide a good statistically valid sample.

Within each belt, a plant density count should be accomplished, counting the number of individual plants per unit area. Density should be determined for both seeded

and volunteer species. The purpose for looking at the density of the volunteer native species is to have some idea of the level of competition with the seeded species. For some superabundant species, i.e., cheatgrass, it would be necessary to use a subsample to obtain a reliable but feasible density count. Plant vigor should also be measured. Vigor can be determined in several ways, e.g. measuring the height of grass culms, leader length in seeded shrubs, and the height and number of leaves of both grasses and forbs. For grasses, a simple count of the number of seed heads signifying reproductive culms would be appropriate. These determinations should be done for all species but especially for seeded species. This can be accomplished in several ways such as by counting the number of seed heads, measuring the height of the plant, and counting the number of new tillers for the perennial grasses. In many cases, a mixture will be used to revegetate and it would be valuable to know which of these species established best and exhibited the greatest vigor on a particular site.

NOXIOUS AND INVASIVE WEEDS

Table 4 is a list of noxious weeds that have been designated by the Nevada State Department of Agriculture. There are a few other species that can be classified as invasive weeds. These might include cheatgrass (*Bromus tectorum*) and halogeton (*Halogeton glomeratus*) in the north and red brome (*Bromus rubens*) and Mediterranean Grass (*Schismus barbatus*) in the south. In some areas species of mustard (*Descurainia spp.* and *Sisymbrium spp.*) are invasive and can contribute to fire hazard. Our assessment of these weeds along Nevada highways is summarized in Table 5 where we have listed those species that we encountered and the location of populations found along Nevada highways. It would be important for those involved in remediation to have a working knowledge of these plant species and be able to identify them in the field. We have examined the records of the State Department of Agriculture. They have documented the location of a number of weeds at specific points along the highways. We have these records and they are available in the offices of the State of Nevada Department of Agriculture, Division of Plant Industry.



Table 4 Nevada's noxious weeds listed by common name and scientific name as of 4/02

(alphabetical by common name)

| Common Name | Scientific Name |
|--|---|
| African Rue | <i>Peganum harmala</i> |
| Austrian fieldress | <i>Rorippa austriaca</i> |
| Austrian peaweed | <i>Sphaerophysa salsula / Swainsona salsula</i> |
| Black henbane | <i>Hyoscyamus niger</i> |
| Camelthorn | <i>Alhagi camelorum</i> |
| Common crupina | <i>Crupina vulgaris</i> |
| Dyer's woad | <i>Isatis tinctoria</i> |
| Eurasian water-milfoil | <i>Myriophyllum spicatum</i> |
| Goats rue | <i>Galega officinalis</i> |
| Hemlock: (a) Poison | <i>Conium maculatum</i> |
| (b) Water | <i>Cicuta maculata</i> |
| Horse-nettle: (a) Carolina | <i>Solanum carolinense</i> |
| (b) White | <i>Solanum elaeagnifolium</i> |
| Houndstongue | <i>Cynoglossum officinale</i> |
| Hydrilla | <i>Hydrilla verticillata</i> |
| Klamath weed | <i>Hypericum perforatum</i> |
| Knapweed: (a) Diffuse | <i>Centaurea diffusa</i> |
| (b) Russian | <i>Acroptilon repens</i> |
| (c) Spotted | <i>Centaurea maculosa</i> |
| (d) Squarrose | <i>Centaurea virgata Lam. Var. squarrose</i> |
| Leafy spurge | <i>Euphorbia esula</i> |
| Mayweed chamomile | <i>Anthemis cotula</i> |
| Mediterranean sage | <i>Salvia aethiopsis</i> |
| Medusahead | <i>Taeniatherum caput-medusae</i> |
| Perennial pepperweed | <i>Lepidium latifolium</i> |
| Puncturevine | <i>Tribulus terrestris</i> |
| Purple loosestrife | <i>Lythrum salicaria, L. virgatum & cultivars</i> |
| Rush skeletonweed | <i>Chondrilla juncea</i> |
| Saltcedar (tamarisk) | <i>Tamarix ramosissima</i> |
| Sorghum species, perennial, including, but not limited to: (a) Johnson grass; (b) Sorghum alum; and (c) Perennial sweet sudan | |
| Sulfur cinquefoil | <i>Potentilla recta</i> |
| Thistle: (a) Canada | <i>Cirsium arvense</i> |
| (b) Musk | <i>Carduus nutans</i> |
| (c) Scotch | <i>Onopordum acanthium</i> |
| (d) Sow | <i>Sonchus arvensis</i> |
| (e) Iberian star | <i>Centaurea iberica</i> |
| (f) Purple star | <i>Centaurea calcitrapa</i> |
| (g) Yellow star | <i>Centaurea solstitialis</i> |

| | |
|-------------------------|--------------------------|
| Toadflax, Dalmation | <i>Linaria dalmatica</i> |
| Toadflax, yellow | <i>Linaria vulgaris</i> |
| Whitetop or hoary cress | <i>Cardaria draba</i> |

(alphabetical by scientific name)

| Scientific Name | Common Name |
|---|----------------------------|
| <i>Acroptilon repens</i> | Knapweed: (b) Russian |
| <i>Alhagi camelorum</i> | Camelthorn |
| <i>Anthemis cotula</i> | Mayweed chamomile |
| <i>Cardaria draba</i> | Whitetop or hoary cress |
| <i>Carduus nutans</i> | Thistle: (b) Musk |
| <i>Centaurea calcitrapa</i> | Thistle: (f) Purple star |
| <i>Centaurea diffusa</i> | Knapweed: (a) Diffuse |
| <i>Centaurea iberica</i> | Thistle: (e) Iberian star |
| <i>Centaurea maculosa</i> | Knapweed: (c) Spotted |
| <i>Centaurea solstitialis</i> | Thistle: (g) Yellow star |
| <i>Centaurea virgata</i> Lam. <i>Var. squarrose</i> | Knapweed: (d) Squarrose |
| <i>Chondrilla juncea</i> | Rush skeletonweed |
| <i>Cicuta maculata</i> | Hemlock: (b) Water |
| <i>Cirsium arvense</i> | Thistle: (a) Canada |
| <i>Conium maculatum</i> | Hemlock: (a) Poison |
| <i>Crupina vulgaris</i> | Common crupina |
| <i>Cynoglossum officinale</i> | Houndstongue |
| <i>Euphorbia esula</i> | Leafy spurge |
| <i>Galega officinalis</i> | Goats rue |
| <i>Hydrilla verticillata</i> | Hydrilla |
| <i>Hyoscyamus niger</i> | Black henbane |
| <i>Hypericum perforatum</i> | Klamath weed |
| <i>Isatis tinctoria</i> | Dyer's woad |
| <i>Lepidium latifolium</i> | Perennial pepperweed |
| <i>Linaria dalmatica</i> | Toadflax, Dalmatian |
| <i>Linaria vulgaris</i> | Toadflax, yellow |
| <i>Lythrum salicaria</i> , <i>L. virgatum</i> & cultivars | Purple loosestrife |
| <i>Myriophyllum spicatum</i> | Eurasian water-milfoil |
| <i>Onopordum acanthium</i> | Thistle: (c) Scotch |
| <i>Peganum harmala</i> | African Rue |
| <i>Potentilla recta</i> | Sulfur cinquefoil |
| <i>Rorippa austriaca</i> | Austrian fieldcress |
| <i>Salvia aethiopsis</i> | Mediterranean sage |
| <i>Solanum carolinense</i> | Horse-nettle: (a) Carolina |
| <i>Solanum elaeagnifolium</i> | Horse-nettle: (b) White |
| <i>Sonchus arvensis</i> | Thistle: (d) Sow |
| <i>Sorghum</i> species, perennial, including, but not limited to: (a) Johnson grass (b) Sorghum alum (c) Perennial sweet sudan | |

| | |
|--|----------------------|
| <i>Sphaerophysa salsula</i> / <i>Swainsona salsula</i> | Austrian peaweed |
| <i>Taeniatherum caput-medusae</i> | Medusahead |
| <i>Tamarix ramosissima</i> | Saltcedar (tamarisk) |
| <i>Tribulus terrestris</i> | Puncturevine |

WILDFIRE HAZARD

Wildfire is of considerable concern to all Nevadans. Unfortunately many sites along Nevada highways possess vegetation characteristics that have a high potential for wildfire ignition. In this report we are attempting to promote plants that do not constitute high fire hazard. Reference here must be made to the USDA Fire Effects Information System, which has useful information about most of the plants we have listed as possible revegetation species in this report. The FEIS can be accessed at the following Web site (<http://www.fs.fed.us/database/feis/>). Areas of high fire hazard have been identified on the vegetation maps. Those areas with the highest fire hazard are sites with pure stands of cheatgrass (*Bromus tectorum*), various sagebrush species with understories of cheatgrass, sites with other weeds such as mustards, and other areas where weeds have become commonplace along the rights-of-way. Cheatgrass is the most common fire species found along Nevada highways. These sites can generally be identified by examining the various vegetation polygons on the vegetation maps. Of course, under very dry conditions a wildfire can start anywhere. On especially high fire hazard sites, it may be wise to attempt to establish fire-resistant species along the highways. However, the cost of such endeavors might be prohibitive. It then becomes a situation where the users of the highway system must be informed about fire hazard. While the U. S. Forest Service and Bureau of Land Management are handling this, perhaps the NDOT could somehow add to the message, or work with them to help get the message out.

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Appendices

Appendix #1 Species selection

The species listed in the general ecosystem specifications are those that we selected from advertised seed sources. These species are thought to be adapted to the ecosystems in question. Species selection is of paramount importance and requires several steps. The first step is to evaluate the environment where the revegetation effort is to take place. This would require examining the soil and climatic conditions, topography and microtopography, and competing vegetation which may or may not be native species. Then someone familiar with the natural vegetation would begin the selection process. This would require going to various seed companies and determining just what seed is available and what might best fit into a mixture, considering cost and the desirability to include a species in the mixture. Some western seed companies are listed in Appendix #2. Others are available. For each site there would be a number of species that would be appropriate and desirable. For the major ecosystems along Nevada highways we have listed some of the appropriate species. After the selection process is complete, purchase and delivery can be requested. The species finally selected will be a function of availability and cost. In some cases the cost will preclude the inclusion of a species in the mixture even though it may be desirable. Also the cost and availability of container-grown plants must be carefully considered.

Seeding rates will vary from site to site depending upon the soil, the species used, the price and availability of the selected seed. A reasonable rule of thumb would be to seed at a rate of 19 pounds to 20 pounds/acre of pure live seed. In one of the appendices we have included information on how to convert the acre seeding rates to the weight of seed per square foot or per square meter. In addition, it is important to calculate, based on seed germination percentages, the pounds of bulk seed required to yield one pound of pure live seed. This information is also included in Appendix #3.

Appendix #2 Sources of native seeds

We have listed here only a few of numerous seed companies with emphasis on those who provide seed adapted to Nevada conditions. There certainly may be others that could be used.

Applewood Seed Co., 5310 Vivian Street, Dept. D., Arvada, CO 80002, Phone (303) 431 7333, Fax (303) 467 7886, e-mail applewoodseed@worldnet.att.net.

Comstock Seed, 917 Highway 88, Gardnerville, NV, 89410, Phone: (775) 746-3681, Fax: (775) 746-1701, e-mail cd@comstockseed.com. Web site www.gardenwatchdog.com

Granite Seed, 1697 West 2100 North, Lehi, UT 84043. Phone: (801) 768-4422 Fax: (801)-768-3967, e-mail info@graniteseed.com, Web site www.graniteseed.com.

Lawyer Nursery, Inc., 950 Highway 200 West, Phone (800) 551 9875, Fax (406) 826 5700, e-mail trees@lawvernursery.com, Web site www.lawvernursery.com

Pacific Coast Seed, 6144-A Industrial Way, Livermore, CA 94550. Phone (925) 373 4417 Fax (925) 373 6855, e-mail pcseed@worldnet.net.

Plants of the Southwest On-Line, Aqua Fria Rt. 6. Box 11-A, Santa Fe, NM 87507. (800)-788-SEED (7333), Web-site www.plantsofthesouthwest.com.

Appendix #3 Bulk pure live seed requirements for seed with specified germination rates.

Percent Germination

| % Purity | 100 | 95 | 90 | 85 | 80 | 75 | 70 | 65 | 60 | 55 | 50 | 45 | 40 |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| 100 | 1.0 | 1.1 | 1.2 | 1.2 | 1.3 | 1.4 | 1.5 | 1.6 | 1.7 | 1.9 | 2.0 | 2.3 | 2.5 |
| 95 | 1.1 | 1.2 | 1.2 | 1.3 | 1.4 | 1.5 | 1.6 | 1.7 | 1.8 | 2.0 | 2.2 | 2.4 | 2.7 |
| 90 | 1.2 | 1.2 | 1.3 | 1.4 | 1.4 | 1.5 | 1.6 | 1.8 | 1.9 | 2.1 | 2.3 | 2.5 | 2.8 |
| 85 | 1.2 | 1.3 | 1.4 | 1.4 | 1.5 | 1.6 | 1.7 | 1.9 | 2.0 | 2.2 | 2.4 | 2.7 | 3.0 |
| 80 | 1.3 | 1.4 | 1.4 | 1.5 | 1.6 | 1.7 | 1.8 | 2.0 | 2.1 | 2.3 | 2.5 | 2.8 | 3.2 |
| 75 | 1.4 | 1.5 | 1.5 | 1.6 | 1.7 | 1.8 | 2.0 | 2.1 | 2.3 | 2.5 | 2.7 | 3.0 | 3.4 |
| 70 | 1.5 | 1.6 | 1.6 | 1.7 | 1.8 | 2.0 | 2.1 | 2.2 | 2.4 | 2.6 | 2.9 | 3.2 | 3.6 |
| 65 | 1.6 | 1.7 | 1.8 | 1.9 | 2.0 | 2.1 | 2.2 | 2.4 | 2.6 | 2.8 | 3.1 | 3.5 | 3.9 |
| 60 | 1.7 | 1.8 | 1.9 | 2.0 | 2.1 | 2.2 | 2.4 | 2.6 | 2.8 | 3.1 | 3.4 | 3.8 | 4.2 |
| 55 | 1.9 | 2.0 | 2.1 | 2.2 | 2.3 | 2.5 | 2.6 | 2.8 | 3.1 | 3.4 | 3.7 | 4.1 | 4.6 |
| 50 | 2.0 | 2.2 | 2.3 | 2.4 | 2.5 | 2.7 | 2.9 | 3.1 | 3.4 | 3.7 | 4.0 | 4.5 | 5.0 |
| 45 | 2.3 | 2.4 | 2.5 | 2.7 | 2.8 | 3.0 | 3.2 | 3.5 | 3.8 | 4.1 | 4.5 | 5.0 | 5.6 |
| 40 | 2.5 | 2.7 | 2.8 | 3.0 | 3.2 | 3.4 | 3.6 | 3.9 | 4.2 | 4.6 | 5.0 | 5.6 | 6.3 |
| 35 | 2.9 | 3.1 | 3.2 | 3.4 | 3.6 | 3.9 | 4.1 | 4.4 | 4.8 | 5.2 | 5.8 | 6.4 | 7.2 |
| 30 | 3.4 | 3.6 | 3.8 | 4.0 | 4.2 | 4.5 | 4.8 | 5.2 | 5.6 | 6.1 | 6.7 | 7.5 | 8.4 |
| 25 | 4.0 | 4.3 | 4.5 | 4.8 | 5.0 | 5.4 | 5.8 | 6.2 | 6.7 | 7.3 | 8.0 | 8.9 | 10.0 |
| 20 | 5.0 | 5.3 | 5.6 | 5.9 | 6.3 | 6.7 | 7.2 | 7.7 | 8.4 | 9.1 | 10.0 | 11.2 | 12.5 |
| 15 | 6.7 | 7.1 | 7.5 | 7.9 | 8.4 | 8.9 | 9.6 | 10.3 | 11.2 | 12.2 | 13.4 | 14.9 | 16.7 |
| 10 | 10.0 | 10.6 | 11.2 | 11.8 | 12.5 | 13.4 | 14.3 | 15.4 | 16.7 | 18.2 | 20.0 | 22.3 | 25.0 |

Prepared by Graig Plummer, Soil Conservation Service

Appendix #4 Soil Samples

The following soil sampling suggestions were included from the "Objectives and Guidelines for Revegetation Success Under the Tahoe Bond Act" by Michael Hogan. These methods are necessary to assess the soil properties vital to the success of the establishment and vigor of plant species used in remediation efforts.

Pre-project soil sampling

Soil samples must be taken from the project site and from an adjoining native or well-vegetated reference site, where possible, in order to establish nutrient needs and nutrient status.

- Soil samples must be taken by a qualified and trained individual using an approved method.
- Soil samples can be analyzed by a qualified soil lab using specific testing methodology. This methodology is that which was used by Claassen and Hogan (Caltrans Report RTA53X461) in collecting data referenced previously. Using this methodology, meaningful analysis can be accomplished. The analysis protocol has been developed for wildland soils analysis and is additional to any agronomic tests that may be required. These tests will be available from Plant and Soil Laboratories, Laurie Littleford, (408) 727-0330. Other labs may be able to perform these tests. Inquiries should be made to the Nevada Tahoe Bond Act TAC or the Tahoe Natural Resources, Conservation Service office (530) 541-1496.
- Soil samples must be analyzed by a soils laboratory using appropriate methods.

Appendix #5 Soil amendments, mulches and soil stabilizations materials including blankets and tackifiers.

This list is not complete but it does refer to many of the materials available on the market for soil stabilization and to facilitate revegetation.

Southwest Environment Services, Inc., 2400 E. Erwin, P.O. Box, Tyler, Texas 744710. Phone (903) 531-2211, Fax (903) 532-2312, e-mail dmarch@southwestenvironment.com, Web site www.southwestenvironment.com.

Quattro Environmental, Inc., 649 'I' Ave., Coronado, CA 92118. Phone (619) 522-0044, Fax (619) 522-0055, Web site www.kiwipower.com.

Terra Firma, Phone (800) 908-9222 or (505) 994-0846, Fax (505) 892-7702, Web site www.terra-firma-ind.com.

Nilex Corporation, 15171 E. Fremont Drive, Englewood, CO 80112. Phone (303) 1766-2000, Fax (303) 766-1110, e-mail Denver@nilex.com, Web site www.nilex.com/nlx_usa.html.

Western Sere, P.O. Box 10610, Casa Grande, AZ 85230. Phone in Phoenix (602) 268-8811, in Tucson: (520) 884-7111, or (888)-448-7373, e-mail email@westernsere.com, Web site www.westernsere.com

Aqua-Shed Echnologies, Inc., P.O. Box 505, 11304 Missouri St., South Houston, TX 77587. (800)-661-6646, Fax (713) 947-9885, e-mail fkramer@aqua-shed.com, Web site www.aqua-shed.com.

Golden Gate Products, P.O. Box 106, Davis, CA 95617. Phone & Fax (707) 678-6798, Web site www.goldengateproducts.com

National Seed Pellet, LLC, P.O.Box 10136, Reno, Nevada 89510. Phone (775)324 1737, Fax (775) 324 5131. E-mail svonderheide@msm.com

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PERSONAL COMMUNICATION

Chuck O'Neil, Planner of Clark County, April 6, 2004.

Doug Smith, Citizens for Scenic Nevada, April 1, 2004.

Eddie Richter, City of Las Vegas Planner, April 6, 2004.

Mike Bennett, Code Enforcement Officer with City of Mesquite, April 12, 2004.

Scott Majewski, City of Henderson Planner, April 5, 2004.

Toni Ellis, City of North Las Vegas Planner, April 6, 2004.

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