

Technical Appendix

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SECTION ONE: Potential Community Funding Sources

STATE AND FEDERAL GRANT PROGRAMS

The sources and structure for funding sources within NDOT are described in the *Program Development Manual*. Numerous State and Federal funding programs exist for use by communities for highway and community improvements. The following list provides a summary of a few funding sources communities may consider as they develop projects. Additional funding opportunities are available when other issues are present, such as a brownfield site located along a highway, tribal land influences, and the presence of historic structures. A list of federal grants is also located at <http://www.grants.gov>.

Communities should review each grant and determine its applicability for a specific project. Separate projects addressing the same issue may be combined and submitted as a single grant application. Many programs overlap, and proponents may use a combination of the funding and organizational resources listed below, as well as others that might not be shown.

Nevada Grant Programs

Nevada Division of Forestry

Nevada Urban and Community Forestry Southern Region Grant Project and Northern Nevada Urban and Community Forestry Grant Program

Funds education and outreach related to the urban forest, including planning, management, restoration, and sustainability improvements. A tree planting component must be not more than 50% of the project.

http://www.forestry.nv.gov/docs/summary2_012204.pdf

<http://www.forestry.nv.gov>

Nevada Department of Cultural Affairs

Nevada Arts Council

Provides a quarterly grant program to assist artists, support exemplary art projects, and support a variety of other art related efforts.

<http://dmla.clan.lib.nv.us/docs/arts/programs/grants/grantsfororgs.htm>

NDEP – Nevada Brownfields

Agency provides access to funding for brownfield redevelopment. Administered through the US Environmental Protection Agency (EPA), the program allows communities to establish their own brownfields program by designating an area where redevelopment is to be targeted. Additional funds may be awarded for projects categorized as Demonstration Pilots and have a greenspace component. These monies can be accessed through the Brownfields Assessment Demonstration Pilots and Supplemental Assistance for Demonstration Pilots application processes.

http://www.ndep.nv.gov/bca/brownfld_2.htm

ARCO Foundation

Foundation grants are made in five program categories (education, community, arts and humanities, the environment, and public information). (213) 486-3342 or www.arco.com/init/foundation/index2.html

ArtsREACH

Provides modest grants to partnerships of cultural, business, social, government, civic, and religious organizations. ArtsREACH is a National Endowment for the Arts (NEA) pilot program designed to increase the level of direct NEA grant assistance to arts organizations in underserved areas. <http://arts.endow.gov>

Clorox Company Foundation (Reno)

The Clorox Company Foundation is dedicated to improving the quality of life in communities where Clorox employees live and work. The Foundation makes grants, mobilizes employee volunteers, and works with community leaders and other funders. <http://www.thecloroxcompany.com/community/index.html>

Grantmakers in Nevada

Lists a variety of potential grants within Nevada. <http://www.fundsnetsservices.com/nevada.htm>

Federal Grant Programs

Federal Grant Program information can be found by accessing the Catalog of Federal Domestic Assistance (CFDA) at www.cfda.gov. The CFDA is a database of all Federal programs available to State and local governments; federally-recognized Indian tribal governments; domestic public, quasi-public, and private profit and nonprofit organizations and institutions; specialized groups; and individuals. The grant programs can be found by selecting the “Search for Assistance Program” on the CFDA website and entering the provided “Program Number”.

USDA Rural Development

Provides services to further economic development in rural communities. Grants.gov provides information on more than 1,000 Federal government grant programs, totaling about \$400 billion in funding each year. Rural communities can access funding opportunities at www.grants.gov and then type “rural” in the search section of the website. <http://www.rurdev.usda.gov/nv/offices/offices.htm>

National Park Service

Tribal Preservation Program

Assists tribes in preserving historic properties. The grants provide much needed assistance to tribal communities interested in protecting their cultural heritage.

<http://www.cr.nps.gov/hps/tribal/index.htm>

Historic Preservation Fund

Provides funding support to State Historic Preservation Offices who administer state grants for historic preservation.

<http://www.cr.nps.gov/hps/hpf/hpfquest.htm>

**US Department of Housing and Urban Development
Community Development**

Provides a grant program to support community development.

<http://www.hud.gov/local/nv/community/cdbg/index.cfm>

<http://www.hud.gov/grants/index.cfm>

**US Department of Agriculture
Business and Industrial Loans**

Assists rural areas in obtaining quality loans for the purpose of improving the economic and environmental climate in rural communities including pollution abatement and control.

Search: Program Number 10.768

Intermediary Re-lending Program Loans

Provides loans for business facilities or community development in rural areas.

Search: Program Number 10.767

Empowerment Zones Program

Provides for the establishment of empowerment zones and enterprise communities in rural areas to stimulate the creation of new jobs, particularly for the disadvantaged and long-term unemployed, and to promote revitalization of economically distressed areas.

Search: Program Number 10.772

Rural Business Enterprise Grants

Facilitates the development of small and emerging private business, industry, and related employment for improving the economy in rural communities.

Search: Program Number 10.769

Small Business Innovation Research Grants

Provides monies to stimulate technological innovation in the private sector and strengthen the role of small businesses in meeting Federal research and development needs.

Search: Program Number 10.212

Fund for Rural America: Research, Education, and Extension Activities Grant Program

Supports unique, innovative, and high-impact research education, and extension projects to aid farmers, ranchers, and rural communities to address changes and challenges facing agriculture and rural communities as a result of fundamental reforms to Federal farm programs.

Search: Program Number 10.224

US Department of Commerce

Economic Adjustment Program Grants

Assists State and local interests design and implement strategies to adjust or bring about change to an economy.

Search: Program Number 11.307

Public Works and Development Facilities Grants:

Promotes long-term economic development and assists in the construction of public works and development facilities needed to initiate and support the creation or retention of permanent jobs in the private sector in areas experiencing substantial economic distress.

Search: Program Number 11.300



National Technical Assistance Program

Provides funds to 1) enlist the resources of designated university centers in promoting economic development, 2) support innovative economic development projects, 3) disseminate information and studies of economic development issues of national significance, and 4) finance feasibility studies and other projects leading to local economic development.

Search: Program Number 11.303

US Department of Defense**Community Economic Adjustment Funding:**

Alleviates serious economic impacts that result from Defense program changes.

Search: Program Number 12.600

Community Economic Adjustment Planning Assistance

Responds to military base closures and realignments.

Search: Program Number 12.607

Department of Housing and Urban Development**Community Development**

Awards grants to entitlement community grantees to carry out a wide range of community development activities directed toward revitalizing neighborhoods, economic development, and providing improved community facilities and services.

<http://www.hud.gov/local/nv/community/cdbg/index.cfm>

Rural Housing and Economic Development

Expands the supply of affordable housing and access to economic opportunities in rural areas.

Search: Program Number 14.250

US Department of Interior**Historic Preservation Fund**

1) Provides matching grants to States for the identification, evaluation, and protection of historic properties; 2) provides matching grants to States to expand the National Register of Historic Places, assist in carrying out historic preservation activities; and 3) provides grants to Indian Tribes and Alaskan Native Corporations to preserve their culture.

Search: Program Number 15.904.

Rivers, Trails and Conservation Assistance

Provides staff assistance to support partnerships between government and citizens to increase the number of rivers and landscapes protected and trails established nationwide.

Search: Program Number 15.921

Federal Highway Administration (FHWA)**Scenic Byways Discretionary Program**

Provides funds to accomplish projects on national scenic byways, all American roads, America's byways, state scenic byways, and Indian tribe scenic byways. Selected projects recognize state priorities and should benefit the byway traveler's experience, whether it will help manage the intrinsic qualities that shape the byway's story, interpret the story for visitors, or improve facilities along the byway used by visitors.

<http://www.bywaysonline.org/grants/>

Ferry Boats Discretionary Program

Provided funding for water-taxi studies as well as construction of facilities.

<http://www.fhwa.dot.gov/discretionary/fbmemos.htm>

Public Lands Highways Discretionary Program

Provides funds to improve access to and within the nation's federal lands. Monies have been used for adjacent vehicular parking areas; interpretive signage; acquisition of necessary scenic easements and scenic or historic sites, provision for pedestrians and bicycles; construction and reconstruction of roadside rest areas (including sanitary and water facilities), transit facilities, and appropriate public road facilities such as visitor centers as determined by the Secretary. The replacement of the federally owned bridge over the Hoover Dam in the Lake Mead National Recreation Area between Nevada and Arizona was funded through the program.

<http://www.fhwa.dot.gov/discretionary/plhcurrsola3.htm>

National Recreational Trails Fund

Funds trails and trail-related projects such as urban trails, maintenance, restoration, easement acquisition, and trail-side and trail-head facilities.

<http://www.off-road.com/4x4web/land/nrtfaq.html>

http://environment.fhwa.dot.gov/ecological/eco_app_b.asp

SECTION TWO: Mapping Ecosystems



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

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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. Bladder cenna – <i>Cassia armata</i> | 0.5 |
| 6. Brittle bush – <i>Encelia farinosa</i> | 1.0 |
| 7. Fremont dalea – <i>Psoralea 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>Bouteloua 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 sparsiflorus</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 Lutz/Amdt 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 ramossissima*)



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 speciosum*) 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 ramossissima</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>Covania 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> | 1.0 |

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>Sphaeralcea ambigua</i> | 0.5 |
| 3. Palmer's penstemon - <i>Penstemon palmeri</i> | 0.5 |
| 4. Sand verberna - <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 verbenas – <i>Abronia villosa</i> | 1.0 |
| | <u>1.0</u> |
| | 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 nauseosus</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</i> sp. | 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.

SPECIFIC EXAMPLE SPECIFICATIONS

In this section we have taken three specific sites 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 fertilizers.

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 sparciflorus*

*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 fieldcress | <i>Rorippa austriaca</i> |
| Austrian peaweed | <i>Sphaerophysa salsola / Swartzia salsola</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>Myricophyllum spicatum</i> |
| Gouty rue | <i>Galega officinalis</i> |
| Hemlock: (a) Poison (b) Water | <i>Conium maculatum</i> <i>Cicuta maculata</i> |
| Horse-nettle: (a) Carolina (b) White | <i>Solanum carolinense</i> <i>Solanum elaeagnifolium</i> |
| Houndstongue | <i>Cynoglossum officinale</i> |
| Hydrilla | <i>Hydrilla verticillium</i> |
| Klamath weed | <i>Hypericum perforatum</i> |
| Knapweed: (a) Diffuse (b) Russian (c) Spotted (d) Squarrose | <i>Centaurea diffusa</i> <i>Acroptilon repens</i> <i>Centaurea maculosa</i> <i>Centaurea virgata Lam. Var. squarrose</i> |
| Leafy spurge | <i>Euphorbia esula</i> |
| Mayweed chamomile | <i>Anthemis cotula</i> |
| Mediterranean sage | <i>Salvia aethiops</i> |
| Medusahead | <i>Tuoniatherum 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 sorghum | |
| Sulfur cinquefoil | <i>Potentilla recta</i> |
| Thistle: (a) Canada (b) Musk (c) Scotch (d) Saw (e) Iberian star (f) Purple star (g) Yellow star | <i>Cirsium arvense</i> <i>Carduus nutans</i> <i>Onopordium acanthium</i> <i>Sanctus arvensis</i> <i>Centaurea iberica</i> <i>Centaurea calcitrapa</i> <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 Lam. 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, L. virgatum & cultivars</i> | 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 |
| Sorghum species, perennial, Including, but not limited to: (a) Johnson grass (b) Sorghum alum (c) Perennial sweet sudan | |

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

Attempts were made to record noxious and invasive weeds at mile markers visited along Nevada Highways as a part of this project. They are summarized as to location by Highway number and mile-marker and further summarized by numbers of occurrences along each highway (Table 5). This data is by no means complete and requires further inventory and monitoring. We also are aware of a number of other species as listed in this report that were not seen at the mile-markers that we visited.

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 ed@comstockseed.com. Web site: www.gardenwatchdog.com.

Granite Seed, 1097 West 2100 North, Lehi, UT 84043; Phone: (801) 768-4422 Fax: (801) 768-3967, e-mail julie@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@lawyernursery.com, Web site www.lawyernursery.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

| % Purify | 100 | 95 | 90 | 85 | 80 | 75 | 70 | 65 | 60 | 55 | 50 | 45 | 40 |
|----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 100 | 1.0 | 1.1 | 1.2 | 1.3 | 1.5 | 1.6 | 1.8 | 1.9 | 2.1 | 2.3 | 2.5 | 2.7 | 2.9 |
| 95 | 1.1 | 1.2 | 1.3 | 1.4 | 1.6 | 1.7 | 1.9 | 2.0 | 2.2 | 2.4 | 2.6 | 2.8 | 3.0 |
| 90 | 1.2 | 1.3 | 1.4 | 1.5 | 1.7 | 1.8 | 2.0 | 2.1 | 2.3 | 2.5 | 2.7 | 2.9 | 3.1 |
| 85 | 1.2 | 1.3 | 1.4 | 1.5 | 1.6 | 1.7 | 1.9 | 2.0 | 2.2 | 2.4 | 2.6 | 2.8 | 3.0 |
| 80 | 1.3 | 1.4 | 1.5 | 1.6 | 1.7 | 1.8 | 2.0 | 2.1 | 2.3 | 2.5 | 2.7 | 2.9 | 3.1 |
| 75 | 1.4 | 1.5 | 1.6 | 1.7 | 1.8 | 1.9 | 2.1 | 2.2 | 2.4 | 2.6 | 2.8 | 3.0 | 3.2 |
| 70 | 1.5 | 1.6 | 1.7 | 1.8 | 1.9 | 2.0 | 2.1 | 2.2 | 2.4 | 2.6 | 2.8 | 3.0 | 3.2 |
| 65 | 1.6 | 1.7 | 1.8 | 1.9 | 2.0 | 2.1 | 2.2 | 2.4 | 2.6 | 2.8 | 3.0 | 3.2 | 3.4 |
| 60 | 1.7 | 1.8 | 1.9 | 2.0 | 2.1 | 2.2 | 2.4 | 2.6 | 2.8 | 3.0 | 3.2 | 3.4 | 3.6 |
| 55 | 1.8 | 1.9 | 2.0 | 2.1 | 2.2 | 2.3 | 2.5 | 2.7 | 2.9 | 3.1 | 3.3 | 3.5 | 3.7 |
| 50 | 1.9 | 2.0 | 2.1 | 2.2 | 2.3 | 2.4 | 2.6 | 2.8 | 3.0 | 3.2 | 3.4 | 3.6 | 3.8 |
| 45 | 2.0 | 2.1 | 2.2 | 2.3 | 2.4 | 2.5 | 2.7 | 2.9 | 3.1 | 3.3 | 3.5 | 3.7 | 3.9 |
| 40 | 2.1 | 2.2 | 2.3 | 2.4 | 2.5 | 2.6 | 2.8 | 3.0 | 3.2 | 3.4 | 3.6 | 3.8 | 4.0 |
| 35 | 2.2 | 2.3 | 2.4 | 2.5 | 2.6 | 2.7 | 2.9 | 3.1 | 3.3 | 3.5 | 3.7 | 3.9 | 4.1 |
| 30 | 2.3 | 2.4 | 2.5 | 2.6 | 2.7 | 2.8 | 3.0 | 3.2 | 3.4 | 3.6 | 3.8 | 4.0 | 4.2 |
| 25 | 2.4 | 2.5 | 2.6 | 2.7 | 2.8 | 2.9 | 3.1 | 3.3 | 3.5 | 3.7 | 3.9 | 4.1 | 4.3 |
| 20 | 2.5 | 2.6 | 2.7 | 2.8 | 2.9 | 3.0 | 3.2 | 3.4 | 3.6 | 3.8 | 4.0 | 4.2 | 4.4 |
| 15 | 2.6 | 2.7 | 2.8 | 2.9 | 3.0 | 3.1 | 3.3 | 3.5 | 3.7 | 3.9 | 4.1 | 4.3 | 4.5 |
| 10 | 2.7 | 2.8 | 2.9 | 3.0 | 3.1 | 3.2 | 3.4 | 3.6 | 3.8 | 4.0 | 4.2 | 4.4 | 4.6 |

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 Classsen 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 jlmarch@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.kfwpower.com.

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

Nilex Corporation, 15171 E. Fremont Drive, Englewood, CO 80112. Phone (303) 766-2000, 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 flurmem@aquashed.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@nspp.com.