



Arizona Department of Transportation

Roadside Vegetation Management Guidelines





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Roadside Vegetation Management Guidelines

These guidelines provide an overview of best practices for roadside vegetation management activities for staff across the state. Each guideline contains information on the purpose of the activity, planning the activity, coordination within ADOT and with external agencies ahead of undertaking the work, and best practices for the work. Some of the guidelines also contain information on equipment used for less common activities.

The appendices and associated posters include information that is useful for planning activities. Appendix A and the Recovery Zone Poster illustrate the recovery zone and sightlines and how the recovery zone size varies with design speed. Appendix B defines the roadway prism, which is an important concept for environmental compliance and maintenance work orders. Appendix C and the Vegetation Management Biozone Posters show and explain the different vegetation types across the state (and by district) which require different vegetation management techniques. Appendix D and the Land Ownership Posters show the land ownership across the state (and by district) to help with planning external agency coordination needs ahead of maintenance activities. Contact ADOT Roadside Resources for PDFs or prints of the posters.

The guidelines and appendices were developed by ADOT Roadside Resources with assistance from Logan Simpson and input from agency maintenance, design, engineering and environmental staff. The document was reviewed by Kris Gade, Justin White, LeRoy Brady, Kyle Seisinger, Robert Guevara, John Hucko, David Casselbury, Mark Schalliol, Kirk Kiser, Chris Cooper, Robert Stoner, Laura Nordan, Tyrel Cranford, Tom Engel, and Joshua Fife.

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A blue ink signature of Jesse Gutierrez, written in a cursive style.

Jesse Gutierrez

Deputy State Engineer for Operations

Date

Introduction

The Arizona Department of Transportation (ADOT) manages vegetation along approximately 1,390 miles of highways across Arizona. The primary goals of roadside vegetation management are maintaining traffic safety, preserving highway infrastructure, and maintaining a resilient native roadside plant community. ADOT is required to control weeds that occur in the right-of-way as defined in [Arizona Revised Statutes Title 3](#) and listed in [Arizona Administrative Code Title 3, Chapter 4](#), R3-4-244 and R3-4-245) to comply with state law and to maintain good relationships with adjacent landowners. Executive Orders 13112 and 13751 direct federal agencies to prevent the introduction and spread of invasive species. ADOT has agreements with the US Forest Service and Bureau Land of Management under the Four Agency Partnership in Arizona regarding maintenance of transportation easements on their land ([Guidelines for Highways on BLM and US Forest Service Land](#)). The agreements with the BLM and USFS regarding vegetation management are reviewed annually and posted on the [ADOT Roadside Resources](#) webpage.

In order to manage roadsides with these objectives in mind, ADOT 's goal is to use a system of Integrated Roadside Vegetation Management (IRVM) to establish a plant community that is self-sustaining, resists weed infestations, requires only low maintenance effort, and provides necessary soil stabilization and erosion control. To this end, these guidelines for vegetation management were developed based on input from the maintenance, construction, landscape architecture, design, and environmental groups. Districts will also be developing individual vegetation management plans for each route within their district with an overall goal of establishing self-sustaining, low growing, weed-free vegetation on the roadsides over as much of the state highway system as possible. This system will require a process of removing undesirable species, such as noxious and invasive weeds and replacing them with desirable native species using seasonally-timed control measures.

The guidelines and attachments in this document are tied to activity codes in the Performance Controlled System (PeCoS) and are designed to be used as activities are being planned by supervisors and to guide standard work for staff in the field. A series of graphics and maps were developed to reach a mutual understanding of concepts across the design, construction and maintenance groups within ADOT. Traffic control information for each of the activities is available within the PeCoS activity descriptions. In general, all traffic should be maintained through the work area and protected in accordance with the requirements of the current Manual on Uniform Traffic Control Devices (MUTCD) and Arizona Supplement to the MUTCD. Also, all traffic control and traffic control devices should be in place prior to beginning work and removed once the work activity has been completed.

| Guidelines | PeCos Activities |
|-----------------|---|
| Stabilization | 341, 343, 1400 |
| Cut trees/brush | 311, 315, 321, 324, 1450, 1460, 1461, 1462, 1466 (includes tumbleweed mechanical removal) |
| Chipping | 310, 1463 |
| Herbicide | 351, 353, 354, 363, 1420, 1421, 1430, 1431, 1432, 1433, 1440, 1441, 1492 |
| Mowing | 1410 |
| Revegetation | 314, 323, 1470, 1471, 1472, 1475, 1476 |
| Salvage | 1464 |
| Burning | 1480, 1483 (includes tumbleweed burning) |

This document is intended to be updated frequently to maintain its relevancy. Please direct comments, questions and suggestions to Kris Gade, Roadside Resources Specialist, ADOT Environmental Planning (kgade@azdot.gov, 602-292-0301).

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ADOT Vegetation Management Guidelines - Mowing

1.0 Purpose of Mowing

Because mowing can have opposite effects on plant growth depending on when and how it is done, it's important to have the goal of the mowing in mind when planning when and how to do it. Mowing should be used selectively in roadside vegetation management for specific purposes, such as:

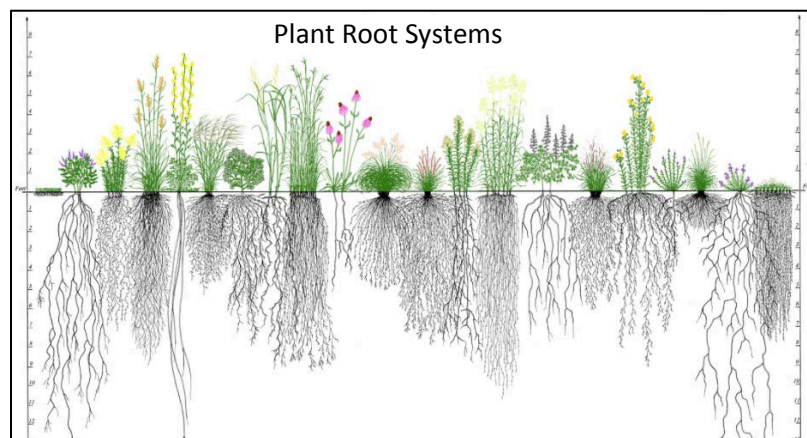
- Improving horizontal sight distance at intersections and cross streets
- Maintaining visibility of hazard markers, guardrails, and delineators
- Controlling weeds and tree/brush seedlings, often coordinated with herbicide use
- Reducing snowdrift
- Reducing summer fire fuels
- Reducing wildlife grazing
- Increasing vegetative growth in native grass species to encourage seed production

| | |
|-----|----------------|
| 1.0 | PURPOSE |
| 2.0 | PLANNING |
| 3.0 | COORDINATION |
| 4.0 | BEST PRACTICES |



Mowing can shorten the lifespan and health of plants depending on the timing, frequency and height at which plants are cut. Wait until late in the growing season and mow at a minimum height of six inches to in areas with desirable plants and grasses. Mowing causes grasses and broad-leaf plants to deplete energy stored in their root systems. If plants are mowed too often, too short (under six inches), or during the growing season before they transfer energy to the roots, they may not live to regrow the next year. Mowing later in the season also allows seeds to fall, leading to more new plants the next year.

Mowing grasses during the active growing season can cause the next growth to be shorter and spread out more. The shorter the grass is mowed, the closer to the ground it will start branching off to grow, creating more spreading growth; Bermuda grass is a good example of this.



The mass of living roots belowground is directly related to the amount of leaves aboveground – plants need leaves to capture energy and don't support the roots if they do not have enough energy. Native plants and bunchgrasses have deeper root systems than shorter non-native grasses.

ADOT Vegetation Management Guidelines - Mowing

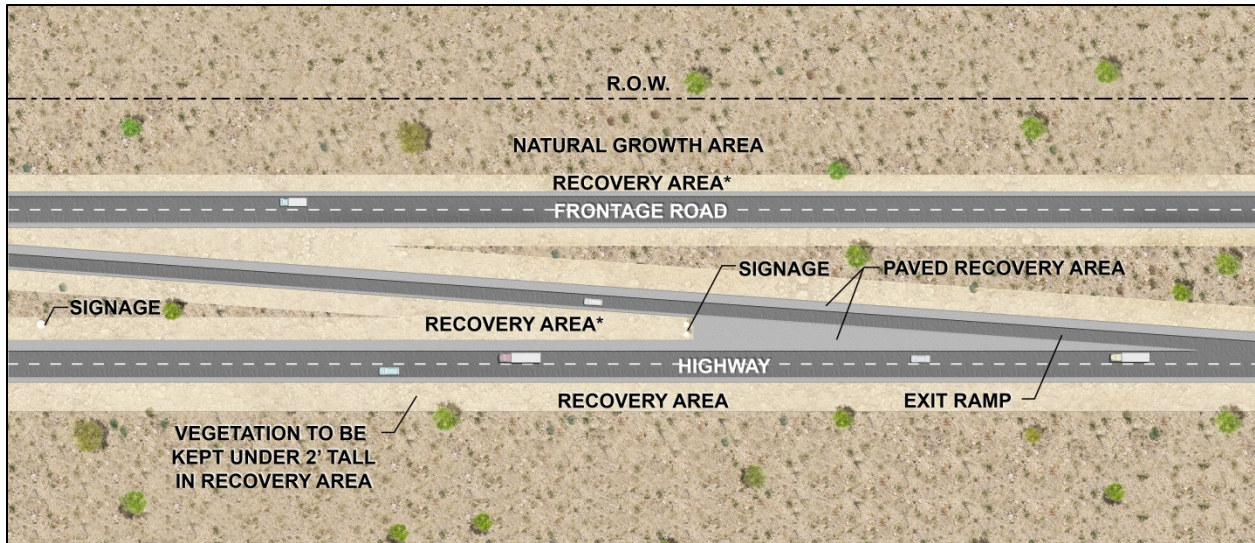


Diagram of highway with frontage road, showing recovery areas

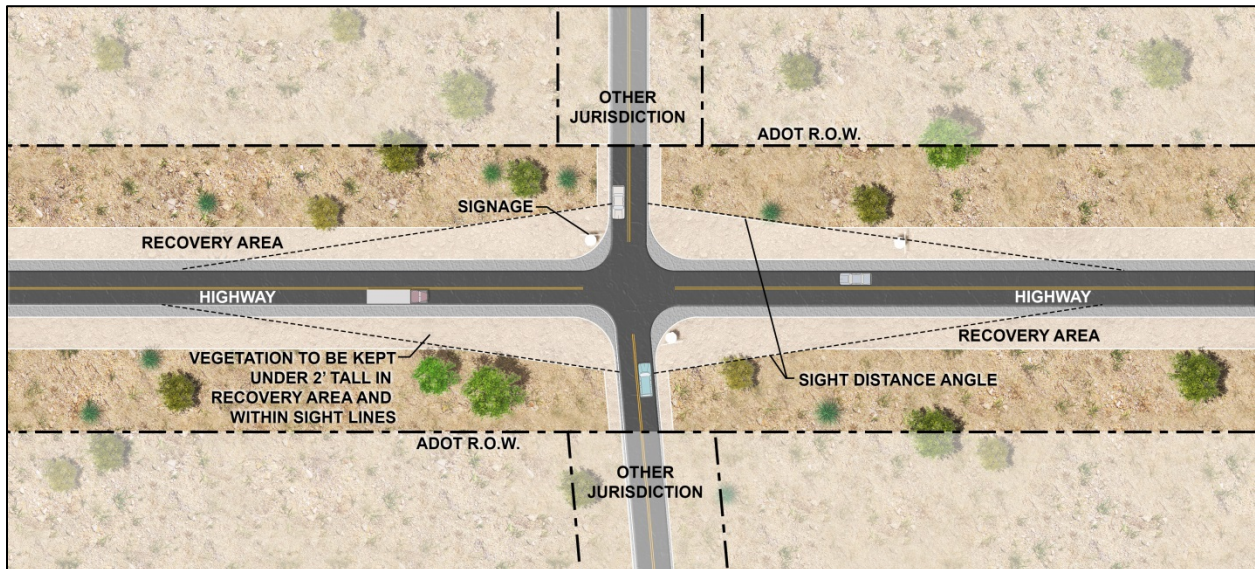


Diagram of highway with intersection, showing recovery areas

2.0 Planning to Mow

Cost vs. Benefits

Reducing the number of annual mowing cycles can have several short and long-term benefits, including:

- Fewer staff hours spent mowing, allowing staff to perform other maintenance activities
- Reduced fuel usage
- Reduced vehicle emissions and dust creation, contributing to improved air quality
- Reduced equipment maintenance
- Habitat conservation for pollinators and other wildlife

ADOT Vegetation Management Guidelines - Mowing

Mowing periodically (but not too frequently) has the following benefits:

- Woody plants such as shrubs and trees are controlled before they become large
- Grasses and forbs, including wildflowers, may be rejuvenated

Seasonality

To make appropriate decisions about when to mow, ADOT vegetation managers must consider the type of vegetation; the overall health of the vegetation; the life cycle of the plants; and environmental conditions including drought and prolonged changes in temperature. There are several things to consider when setting mowing schedules.



Pollinators benefit when more flowers can bloom as a result of reduced mowing.

General considerations:

- Do not mow during high fire-danger periods.
- Do not mow when desirable plants are blooming or before the seed has set so that they can reseed for the next year.
- Use extra caution when mowing during nesting times for local wildlife (typically spring and summer into fall, depending on elevation); avoid mowing during these to the extent possible.

If mowing undesirable vegetation (weeds or vegetation that is too tall or otherwise unwanted):

- Coordinate with District herbicide applicators before mowing. If the weeds have recently been sprayed, mowing too soon will not give the herbicide time to kill the roots. If the weeds are scheduled to be sprayed, mowing before spraying occurs will take away that opportunity.
- Avoid mowing noxious and invasive weeds unless there has been coordination to address those species. Mowing can spread seeds and plant parts to new areas, worsening the problem.
- Where weeds are prevalent and coordination has taken place, the mowing should occur before the weeds flower, to avoid seed set and spread of the seeds to other locations.

If mowing desirable vegetation to reduce height to maintain sightlines, reduce fire danger, or for snow management:

- It is preferable to mow the vegetation ONCE annually or less frequently, during the non-growing season or after the plants have set seed.
- Where the roadside vegetation consists of predominantly native species, mowing should be timed to occur after desirable plants have set seed and the seed has been dispersed.
- Do not mow near the end of the growing season, when plants are nearing dormancy and are less resilient; waiting until the growing season is over is better.
- Mowing should be done as infrequently as feasible: generally, once a year, and possibly only every other year, depending on environmental conditions. Mowing during the non-growing season makes annual or less frequent mowing more effective.

ADOT Vegetation Management Guidelines - Mowing

Recommended Mowing Times by Biozone

Mowing should be used selectively and only where needed, such as in targeted areas to prevent snow drift, to control invasive species, or to maintain sightlines, sign and guardrail visibility.

For 2 to 3 years following seeding, do not mow unless absolutely necessary and do not mow shorter than 6 inches.

| Biozone | | | | | | Highest Temperatures | | | | | | |
|---|-------------|-------------|-------------|-----|-----|----------------------|--------------|--------------|--------------|-----|-------------|-------------|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| Conifer Forest | + (Snow) | + (Snow) | + (Snow) | O* | O* | -- | -- (Rain) | -- (Rain) | + | + | + (Snow) | + (Snow) |
| Great Basin Conifer Woodland | + (Snow) | + (Snow) | + (Snow) | O* | O* | -- | -- (Rain) | -- (Rain) | -- | + | + (Snow) | + (Snow) |
| Chaparral | + | + | + | O* | O* | -- | -- (Rain) | -- (Rain) | -- | + | + | + |
| Plains and Great Basin Grassland | + (Snow) | + (Snow) | + (Snow) | O* | -- | -- | -- (Rain) | -- (Rain) | -- | + | + | + (Snow) |
| Semidesert Grassland & Chihuahuan Desertscrub | + | + | + | + | O* | O* | -- (Rain) | -- (Rain) | O* | + | + | + |
| Great Basin Desertscrub | + (Snow) | + (Snow) | + (Snow) | + | O* | O* | -- (Rain) | -- (Rain) | -- (Rain) | O* | + (Snow) | + (Snow) |
| Sonoran & Mohave Desertscrub | O* | O* | O* | O* | O* | -- | -- (Rain) | -- (Rain) | -- | + | + | + |

Notes:

Colors in table correspond to the colors in the biozones map (see Appendix C)

O = mowing not recommended (during sensitive stages for desirable plants)

-- = mowing okay, follow migratory bird measures

+ = best mowing times

* = mow in targeted locations for weed control only

Rain = highest rainfall; don't mow in muddy conditions; consider waiting since plants will regrow rapidly following rains

Snow = okay to mow if no snow or excessive mud

ADOT Vegetation Management Guidelines - Mowing

- If vegetation needs to be mowed during the growing season, it is best to mow when the vegetation is healthy and actively growing as a result of adequate moisture received during the previous winter as rain or snow, or following the summer monsoon rains.
- Do not mow severely drought-stressed vegetation (if it is desired that it continue growing).

3.0 Activity Coordination

Intra-agency Coordination

It is highly recommended to plan the mowing schedule at least 6 months ahead and share the information with the DEC and District herbicide contact to allow time for coordination on environmental concerns and herbicide treatments.

Notify the District Vegetation Manager, Herbicide Contact, or DEC 10 work days prior to mowing for information on site status to avoid damage to plant communities, spreading noxious weeds, or conflicting with herbicide treatments.

Coordinate for litter to be collected prior to mowing to avoid creating more smaller pieces of litter.

Environmental Concerns

Prior to mowing, maintenance staff should consult with their Maintenance Supervisor to ensure that requirements of laws, rules, and regulations have been addressed. In particular, coordination is always required ahead of mowing in the ROW in the following areas:

- National Forests (coordinate with Forest Ranger District)
 - Native American Tribal Communities
 - Environmentally sensitive areas containing endangered species habitat and/or cultural resources.
- The Maintenance Supervisor or DEC may submit an [Environmental Maintenance Work Order](#). The form is available on the ADOT intranet in Construction / Maintenance Essential Documents. Fill out the project information and as much of the rest of the form as possible and email it to: MAINTENANCEWORKORDERS@azdot.gov. An environmental planner will contact you to answer your questions.

COORDINATION



WHO TO CALL

- Maintenance Supervisor
- District Environmental Coordinator
- Environmental Planning Maintenance Planner
(E-mail to MaintenanceWorkOrders@azdot.gov)



ADOT Vegetation Management Guidelines - Mowing

4.0 Best Practices for Mowing

Mowing can affect the vigor of roadside plants, so it is important to follow best practices. To prevent the spread of noxious invasive weeds, mowers should be thoroughly cleaned before mowing and between mowing locations. Sites should be surveyed prior to mowing to look for hazards such as large rocks and features such as check dams that should be avoided.

Mowing Height

If the goal is to mow desirable vegetation to reduce height:

- Mow at the end of the growing season or during the winter (when vegetation is going into dormancy). Avoid mowing when plants are coming out of dormancy.
- Mow only when vegetation height is 17 inches or more.
- The minimum mowing height is six (6) inches. Mowing height may be reduced to a minimum of four (4) inches for winter snowstorm preparation.
- Small saplings and brush (stems up to 2 inches in diameter) within the mowing cut swath should be mowed to the same height as grasses and broadleaf plants.



WHO TO CALL WITH QUESTIONS

Maintenance Supervisor

District Herbicide/Invasive Species Contact (see map [here](#))

District Environmental Coordinator

Design Landscape Architect – ADOT Roadside Development

Construction Landscape Architect –ADOT Construction Group

Mowing Width

- Restrict mowing to one (1) mower width or “swath” (typically 10-12 feet wide) located immediately next to the pavement edge.
- Increase mowing width to meet the requirements of specific conditions, including:
 - Sight line areas at intersections and cross-overs
 - Areas with a narrow right-of-way strip
 - Areas with weed infestations
- Mow cleanly around guardrail out to a distance of 18 inches to reduce potential for trapping sand, snow, and dirt.
- Mow in smooth lines that follow the landform and site features.
- See the Roadside Zones Diagram for additional information.



ADOT Vegetation Management Guidelines - Mowing

General Mowing Practices

- Mowers should be operated only in the direction of normal traffic flow when working within 30 feet of the edge of pavement.
- Mowing equipment should be operated at the optimum speed that safely produces clean cutting results, without digging into the soil, or throwing rocks and debris onto the roadway.
- Vegetation should be mowed cleanly around the bases of traffic signs, milepost/kilometer signs, delineators, guardrail, and other highway fixtures.
- Adjoining pavement should be left free of debris and cuttings.
- During times of drought and high fire danger land managing agencies may require additional fire suppression equipment and tools. Check with the land owner prior to mowing in high fire danger areas.
- When mowing has been done in an area with noxious weeds, the mowers shall be thoroughly cleaned in a designated non-vegetated area by air-blowing or washing to prevent the spread of weeds into the next mowable area.

ADOT Vegetation Management Guidelines - Mowing

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ADOT Vegetation Management Guidelines – Cut Trees and Brush

1.0 Purpose of Cutting Trees and Shrubs

Removing trees and other plants from within the right-of-way that interfere with the safe operation of the highway system is an important element of vegetation management. The reasons for cutting back plants or removing them entirely include:

- Keeping the Recovery Area clear of fixed hazards
- Maintaining sight distance at intersections, cross roads, and along curves
- Removing vegetation that may obscure wildlife with the potential to cross the roadway and cause a collision
- Removing trees that may pose the threat of falling on the roadway under conditions of high winds or unstable soil
- Controlling invasive species
- Removing trees and brush that obscure traffic signs, signals, right-of-way fence, and hazard markers
- Preventing encroachment of plants into guardrails, distress lanes, drainage features, and shoulders
- Removing vegetation prior to herbicide treatment
- Removing and disposing of tumbleweeds and mustard weeds which have accumulated along fences, in cuts, and around drainage structures
- Removing shrubs and groundcovers in over-planted landscape areas which need thinning for irrigation inspection and repair functions
- Trimming trees in landscape areas to facilitate inspection and litter removal
- Trimming shrubs and groundcovers in landscape areas to improve plant barrier density
- Removing plants that are unhealthy or dead due to traffic damage, lightning, disease, or other problems
- Removing weeds growing around landscape plantings of trees, shrubs, and groundcovers by hoeing, cutting, or string trimming
- Preventing snow drifting and reducing ice on the roadway due to shading

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| 1.0 | PURPOSE |
| 2.0 | PLANNING |
| 3.0 | COORDINATION |
| 4.0 | BEST PRACTICES |



ADOT Vegetation Management Guidelines – Cut Trees and Brush

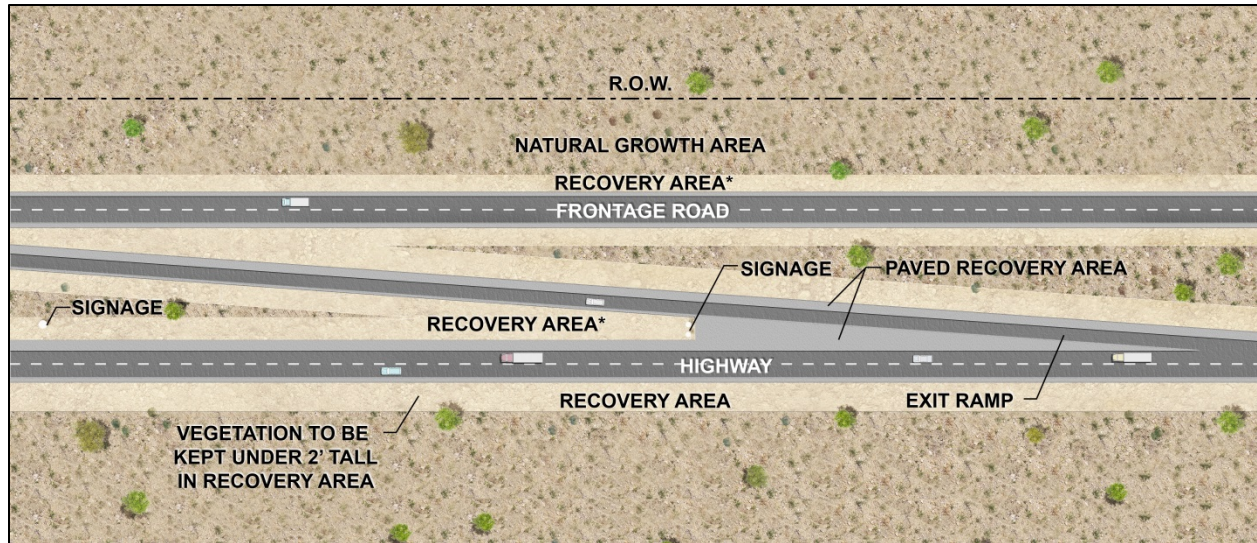


Diagram of highway with frontage road, showing recovery areas

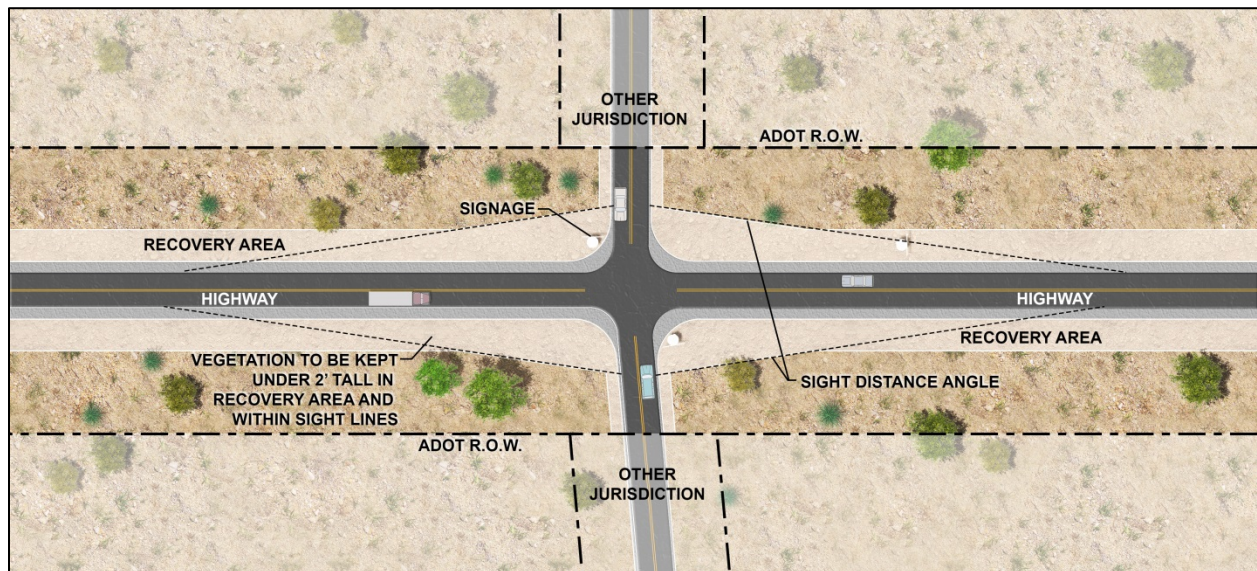


Diagram of highway with intersection, showing recovery areas

2.0 Planning to Cut Trees and Shrubs

Seasonality

The removal of trees and other plants can generally occur at any time of the year, except:

- When soils are excessively wet, which could result in soil compaction or rutting from maintenance vehicles
- When plants are blooming, because removal may upset members of the public as well as reduce food sources available for pollinators
- When birds are nesting in the plants or trees. The Migratory Bird Treaty Act prohibits injuring or killing migratory birds, including eggs and nestling birds.

ADOT Vegetation Management Guidelines – Cut Trees and Brush

If plants require pruning (rather than removal), the activity should be scheduled for the appropriate season relative to the type of plant involved. Generally, deciduous trees (ones that drop their leaves) and conifers (such as pines and firs) should be pruned during the winter, when they are dormant. Trees in the low desert areas can be pruned lightly at any time during the year, but heavier pruning should be restricted to the cooler months. Regardless of tree type, no more than 25% of the biomass should be removed in any year.

Rejuvenation pruning of shrubs and groundcovers in landscape plantings should be done just prior to the beginning of the growing season, which would be late winter through late spring, depending on elevation.

Training

All ADOT personnel participating in vegetation removal should receive appropriate training in the safe use of chainsaws, chippers and the boom axe as well as the proper techniques for pruning.

3.0 Activity Coordination

Intra-agency Coordination

The District Environmental Coordinator (DEC) should be contacted prior to vegetation cutting operations to conduct an inspection to establish and mark the clearing limits.

Roadside Development should be consulted if the proposed vegetation cutting occurs along a parkway, historic, or scenic route.

The herbicide contact should be contacted to schedule simultaneous herbicide treatments to prevent regrowth of the cut vegetation.

The DEC should be contacted if the vegetation proposed for cutting is rooted in drainages, washes, and/or riparian areas to evaluate whether or not a 404 permit is needed.

Contact the District Maintenance Supervisor to determine an appropriate location to place the brush piles that will need to dry in place for six months minimum, prior to burning or the location to haul cut brush for disposal.

Interagency Coordination

Contact the local Forest Ranger District to obtain approval for removing trees on ADOT right-of-way within National Forest lands.

Prior to cutting trees or large cacti on ADOT right-of-way on National Park Service or US Fish and Wildlife Refuge land, coordinate with the park or refuge superintendent's office.

COORDINATION



WHO TO CALL

- Maintenance Supervisor
- District Environmental Coordinator
- Roadside Development - ***Design Landscape Architect***

ADOT Vegetation Management Guidelines – Cut Trees and Brush

Coordinate with the appropriate Tribal representatives prior to cutting trees and shrubs in the right-of-way within Tribal lands.

Environmental Concerns

Consult with the DEC prior to cutting trees and shrubs to determine if protected species occur within the work area.

4.0 Best Practices for Cutting Trees and Shrubs

General

The following best practices apply to vegetation removal, whether involving selective pruning or total plant removal:

- Place safety devices and signs
- Service equipment, including chainsaws, as necessary
- Personnel are required to wear personal protective equipment
- Cut only the amount of vegetative material that can be cleaned up each day



Urban Landscape Areas

The following best management practices are appropriate for urban areas:

- Tree branches shall be trimmed to a minimum four (4) feet above the ground for inspection and litter removal
- Palm fronds shall be trimmed to a minimum of 10 feet above the ground for fire prevention
- Workers should use proper pruning techniques
- Weeds should be placed in piles for pickup and picked up before the end of the shift

ADOT Vegetation Management Guidelines – Cut Trees and Brush

Rural Areas

Vegetation removal in rural areas typically involves cutting plants to ground level and then treating the stumps /stems with an herbicide, including these best practices:

- If not removing the whole tree, limbs should be cut close to the trunk to prevent unsightly “coat-hangers”
- Saw cut brush and trees; limb, lop, and buck stems
- Cut stumps close to the ground, with a maximum height of four (4) inches
- Treat stumps with herbicide within 10 minutes of cutting, or wait until the plants re-sprout and then re-treat (treatment plan depends on plant species)
- Limbs, trunks, stems and slash are to be cut into lengths no longer than six (6) feet
- Chip material and scatter to a maximum depth of two (2) inches or pile slash for burning in piles with a maximum size of 20 feet wide by 20 feet long by five (5) feet high
- Piles are not allowed in urban areas, urban interfaces, non-attainment air quality zones, and scenic vistas
- If trimmings are not chipped on site or piled for burning, load trimmings on truck or trailer and secure load for proper disposal
- Remove limbs from large trees and pile slash
- Haul away the trunk for disposal
- Remove tumbleweeds without disturbing the soil unless work order has been approved to apply a pre-emergent herbicide in the area



ADOT Vegetation Management Guidelines – Cut Trees and Brush

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ADOT Vegetation Management Guidelines – Chipping

1.0 Purpose of Chipping

Chipping is an economical method for disposing of roadside vegetation waste, including stems, limbs and trunks. Chipping allows for:

- The recycling of vegetation material
- Avoids the presence of unsightly debris in scenic or urban interface areas
- Assists in retaining soil moisture
- Enhances soil structure over time
- Provides for erosion control

| | |
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| 1.0 | PURPOSE |
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2.0 Planning to Chip

Prior to chipping, the area of slash should be calculated to estimate the Average Accomplishment for PeCoS reporting (in acres). The maintenance supervisor will make a determination as to whether there is an appropriate location(s) within the work area for the spreading of chipped material. Generally, chips should not be spread more than 2 inches deep to prevent erosion issues from loss of stabilizing plant roots in the area. It is best to fertilize areas after chips are spread with at least 200 lbs/acre of ammonium sulfate. If a large volume of material exists, burning or hauling may be preferable to chipping. Burning, if chosen as the disposal method, requires a burn permit from ADEQ or other applicable authority.



WHO TO CALL WITH QUESTIONS

Maintenance Supervisor

Design Landscape Architect – ADOT Roadside Development

Construction Landscape Architect –ADOT Construction Group

ADOT Vegetation Management Guidelines – Chipping

3.0 Activity Coordination

Intra-agency Coordination

Notify District Environmental Coordinator 10 work days prior to chipping for information on site status to avoid damage to plant communities, spreading noxious weeds, or conflicting with herbicide treatments.

Highway Operations Coordination

Coordinate chipping with thinning, or tree and brush removal operations wherever vegetation removal is proposed.

Environmental Concerns

Prior to chipping in the following areas, the maintenance supervisor shall ensure that all laws, rules, and regulations are adhered to, including:

- National Forest Land
- Native American Tribal Communities
- Environmentally sensitive areas containing endangered species habitat

COORDINATION



WHO TO CALL

- Maintenance Supervisor
- District Environmental Coordinator
- E-mail to MaintenanceWorkOrders@azdot.gov

4.0 Best Practices for Chipping

Chipping can provide an economical means for disposal of slash and can improve roadside aesthetics, but it is important to follow best practices.

Chipping Practices

- The size of material that can be chipped as a result of thinning, or tree and brush removal, is dependent on the capacity of the equipment and the manufacturer's recommendation; most ADOT chippers will handle 10-inch diameter material
- Only responsible and trained personnel are allowed to operate the chipper
- Work in pairs for safety
- Place safety devices and signs per current edition of the MUTCD
- Inspect chipper and cutters as required
- Ensure personnel are wearing proper personal protection equipment (hard hat, double hearing protection, eye protection, face shield, safety shoes, reflective clothing, gloves with narrow cuffs)
- Secure loose clothing and hair
- Do not attempt to operate chipper on uneven ground
- Operate equipment in a manner that minimizes soil disturbance and impacts to existing vegetation
- Allow enough room around the chipper for the operator to feed brush and material, and keep the area clear of obstacles
- Commence dragging stems, limbs or slash to chipper and begin feeding from the side of the chipper, not the rear

ADOT Vegetation Management Guidelines – Chipping

- Feed the base of the limb or material first, not the branches
- Observe chipping material to ensure that it does not contain rocks, metal, or other objects that could damage the chipper or become dangerous projectiles
- Ensure chipped material will not discharge onto the roadway or into watercourses
- Adjust discharge chute to scatter chipped material
- Ensure depth of chipped material does not exceed two (2) inches or per land owner requirement
- If the chipper becomes plugged, turn off the unit before clearing the obstruction
- Remove safety devices and signs after the completion of activity

ADOT Vegetation Management Guidelines – Chipping

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ADOT Vegetation Management Guidelines - Herbicides

1.0 Purpose of Herbicide Use

Herbicide use is one of the primary methods for managing roadside vegetation, protecting roadway integrity, and improving motorist safety. Herbicide application is used in coordination with physical methods to control vegetation in the right of way and should be used as part of an integrated roadside vegetation maintenance program.

| | |
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| 1.0 | PURPOSE |
| 2.0 | PLANNING |
| 3.0 | COORDINATION |
| 4.0 | BEST PRACTICES |

Herbicides are used to:

- Help maintain a clear recovery zone
- Protect roadside infrastructure and pavement integrity
- Control vegetation around roadside features such as guardrails, sign structures, delineators, gores, and headwalls to maintain visibility of hazard markers and reflectors
- Preserve sight lines
- Remove fire fuel accumulations
- Selectively target vegetation that disrupts desirable vegetation communities
- Remove invasive weeds
- Inhibit/retard invasive seedling trees and shrubs



Herbicide Regulations

Herbicide use is regulated by the US Environmental Protection Agency (EPA), which administers the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). FIFRA dictates the sale, distribution, and use of herbicides. FIFRA requires that herbicides must only be applied according to label directions and by licensed herbicide applicators or operators when working on public lands.

ADOT Vegetation Management Guidelines - Herbicides

The EPA also has jurisdiction over herbicides through the Endangered Species Act (ESA), which is designed to conserve threatened and endangered plants, animals and habitats. EPA evaluates the effect of herbicides on endangered species and habitats and takes this into account in the decision about whether the agency will register a pesticide.

Personnel who apply herbicides along roadways must be licensed by the Arizona Department of Agriculture's (Agriculture) Pesticide Management Division (PMD). Agriculture also enforces federal and state laws governing pesticide use and storage.

The safety of both the applicator and the public is of paramount importance when applying herbicides. Refer to Section 4.0, Safety for additional information.

Approved Vegetation Control Chemicals

Herbicides can be selective (i.e. targeted to specific species) or nonselective (affect any vegetation they come into contact with). They can be applied as broadcast or "blanket" applications or as spot treatments, and can be sprayed directly onto plant foliage or onto bare soil. The active ingredients in herbicides work in different ways:

- **Foliar contact** – herbicide affects only the portion of the plant's foliage it comes into contact with
- **Foliar systemic** – plant foliage absorbs the herbicide and moves (translocates) it around the plant's system; may kill the entire plant
- **Soil active** – applied to the soil, this herbicide moves to the root zone through rainfall, where it is absorbed in the plant's system; may kill the entire plant. Does not affect seeds.
- **Soil active pre-emergent** – this herbicide is applied to the soil and prevents germination of seeds.



WHO TO CALL WITH QUESTIONS

Roadside Resources Specialist –ADOT Environmental Planning
Design Landscape Architect – ADOT Roadside Development
Construction Landscape Architect –ADOT Construction Group

District Herbicide and Invasive Species Contacts – see map on the Roadside Resources webpage (<http://azdot.gov/business/environmental-planning/biology/roadside-resources>)

Selecting Herbicides

Attachment 1 is a list of herbicides commonly used on ADOT ROW. Herbicides may be added or not recommended for use based on new research, agency requirements, or pesticide laws such as groundwater reporting. The list includes notes on which herbicides are approved for use on BLM and Forest Service land. Other federal agencies and tribal nations have restrictions on the herbicides that may be used on their land. Consult your District Invasive Species/Herbicide Contact (DIS/HC) regarding herbicides to use for specific projects.

Adjuvants

Adjuvants are chemicals that are added to an herbicide spray mix to help the chemical do a better job. Adjuvants include:

ADOT Vegetation Management Guidelines - Herbicides

- **Surfactants** – help emulsify herbicide so that it mixes well with water; also helps improve the wettability of an herbicide mixture
- **Penetrants** – help the herbicide get through the outer surface of the plant
- **Wetting agents** – help herbicide mixtures cover plant surfaces more thoroughly
- **Spreading and sticking agents** – help make the herbicide spread evenly over the treated surface of the plant and stay there in spite of rain, wind, or inclement weather
- **Drift control agents** – used to create larger droplets to prevent spray drift; used when applying herbicide with winds between 5 and 10 mph, depending on sprayer height, nozzles, pressure, etc.

2.0 Planning to Use Herbicides

Determining if an Herbicide is Appropriate

The number one rule for using herbicides is to **Follow the Label**. Do not apply herbicide in a manner that is inconsistent with the label, including application site, method, quantity, and weather conditions. It is against the law to apply herbicide outside the label directions.

Herbicides are a useful tool for vegetation maintenance, but they do have drawbacks. They can:

- Endanger applicators if not properly applied
- Have adverse effects on the environment, crops, livestock, fish, wildlife, and water quality

As a result, herbicide use must be carefully coordinated with land management agencies and private landowners.

On the positive side:

- Use of herbicides rather than mowing or string trimming can increase traveler and worker safety by limiting how often and how long vegetation management staff must be in the right of way or occupying travel lanes.
- Targeted spraying of herbicides is generally less expensive than mowing or other forms of manual vegetation removal.

Whenever herbicides are used, it should only be to the extent necessary to achieve the desired result. Spot spraying should be used over broadcast spraying whenever possible. Careful attention should be paid to the time of the year, plant lifecycles, and weather. If the right herbicides are not applied to the right plants in the right way and at the right time, they will work poorly or not at all—wasting the time, effort, and money required for application.

Cost vs. Benefits

The benefits of using herbicides include:

- Helps limit the need for costly mowing and/or mechanical vegetation maintenance
- Helps control erosion that can damage roadway integrity
- Helps strengthen desirable vegetation communities through selective application
- Helps control invasive weeds

ADOT Vegetation Management Guidelines - Herbicides

- Reduces fire fuels

Seasonality

To make appropriate decisions about when to apply herbicides, roadside vegetation managers must consider the season of the year, the lifecycle of the plants, and the surrounding ecosystem, in addition to environmental conditions at the time of application, including temperature, anticipated rainfall, and wind. Several considerations relative to applying herbicides include:

- **Vegetation lifecycles.** Foliar herbicides, for example, enter the plant primarily through the leaves, and so must be applied after leaves have emerged (or are “post-emergent”). Some foliar herbicides are best applied immediately after leaves emerge (early POST); some can be applied to established plants (late POST) with good results. Pre-emergent herbicides must be applied to the soil before seeds have germinated to be effective. It is important to understand how herbicide active ingredients work in order to determine at which point in a plant’s lifecycle they should be applied.
- **Blooming and seed set.** Blooming plants should not be sprayed with herbicides due to the likely presence of pollinating insects. Herbicide is best applied prior to blooming and seed set. Once a plant has set seed, mechanical methods of control and maintaining seed in the existing area by cleaning machinery is often the best strategy.
- **Temperature.** Warmer temperatures tend to intensify the effect of some herbicides.
- **Anticipated rainfall.** Rain can wash foliar herbicides off plant foliage if the proper adjuvant, like a sticking agent, has not been applied. Soil active and pre-emergent herbicides depend upon rainfall or irrigation to move into the root zones/germination zones of targeted species.
- **Wind.** In some ecozones, windy conditions are seasonal. Wind can cause herbicide to drift outside of the targeted area. An anti-drift agent can help reduce drift under medium wind conditions. Herbicides should not be sprayed when winds are over 10 mph.

3.0 Activity Coordination

Pest Management Division Business License

ADOT has a single statewide PMD Business License (Number 9286). The Roadside Resources Specialist is the primary contact person for ADOT; the District Invasive Species/Herbicide contacts are the primary contact persons for each district. They coordinate herbicide activities and review and approve the e-forms for the applicators within their districts. They are required to demonstrate the following to PMD:

- Where herbicide application records are retained;
- Where personal protective equipment is located;
- Where pesticides are stored; and
- That all applicators are properly certified.

ADOT staff involved in planning, approving, and implementing herbicide use include:

- Maintenance Supervisors
- District Invasive Species/Herbicide Contacts (DIS/HCs)
- District Environmental Coordinators (DECs)
- Landscape Architects
- Roadside Resources Specialist
- Environmental Planning staff

ADOT Vegetation Management Guidelines - Herbicides

Interagency (ADOT) Coordination

- Vegetation removal and management activities have the potential to damage plants, wildlife, and/or soils; cause the spread of noxious weeds; or may require analysis due to regulations on the use of herbicides. Federal land-managing and regulatory agencies must be consulted when herbicide use is planned on their land.
- The District Invasive Species/Herbicide Contact (DIS/HCs) or Construction/Maintenance Landscape Architect coordinates with land-managing agencies, tribal nations, utilities, and private landowners prior to herbicide applications.
- ADOT Roadside Resources provides support for roadside vegetation management and manages NEPA requirements for vegetation management activities, including the use of herbicides, with external agencies. Roadside Resources provides assistance with obtaining Pesticide Use Proposals (PUPs), which are required for herbicide applications on ADOT ROW across any federal land (including National Parks and Wildlife Refuges as well as BLM and National Forests).
- ADOT Environmental Planning assists with coordination with tribes as part of the Maintenance Work Order process for herbicide treatments.

Pre-Application Activities

- Coordination between the Maintenance Supervisor, the District Invasive Species/Herbicide Contact (DIS/HC); District Environmental Coordinator (DEC); Landscape Architect and/or Roadside Resources should occur as described in the “Before Applying Herbicides” section of Section 3.0, Activity Coordination.
- Coordinate with land-managing agencies, tribal nations, utilities, and private landowners as described in Section 3.0 and Attachment 2, Agency Coordination.
- Survey as needed to determine:
 - Weed density
 - Existing vegetation communities
 - Potential for federal, state, or tribal threatened, endangered, or special-status species (typically performed by a biologist, such as the DEC or Environmental Planning staff)
 - Presence of washes and Waters of the U.S. as designated by the Clean Water Act
- Compliance with required permitting processes, such as:
 - Currently approved Pesticide Use Permit (PUP) if applying herbicide on federal lands
 - Submitting a Notice of Intent under the Clean Water Act Pesticide General Permit spraying within Waters of the U.S.
 - Reporting use of groundwater active herbicides to Agriculture.

4.0 Best Practices for Herbicide Use

Applicator Certifications

ADOT staff who will be applying herbicides are required to pass the National Pesticide Applicator Core and Right-of-Way Category tests offered by PMD and become certified applicators. To earn a National Pesticide Applicator Certification, individuals must submit a completed application, an application fee, a statement and evidence of lawful presence, and pass the Core and at least one category-specific

ADOT Vegetation Management Guidelines - Herbicides

examination with a score of 75% or higher to become certified in that specific category. Per ARS Section 3-3612, ADOT staff registered with PMD may apply herbicides under the direct supervision of a certified applicator for 90 days before obtaining their own certification. If the certification is not obtained within 90 days of registering with PMD, the person must cease applying herbicides.

In addition, all staff that purchase, use, or supervise the use of restricted-use pesticides (RUPs) as identified by the EPA must be certified applicators. EPA classifies herbicides as RUPs if they pose unreasonable risks to the applicator, other people, or the environment. Picloram and atrazine are both on the RUP list and the PeCoS materials list as of May 2017; however, both lists can be updated annually so it is important to check periodically if any RUPs are being used by ADOT personnel. It is best to avoid use of RUPs and remove them from ADOT inventory. The RUP list can be found on the EPA website.

Training

Staff members are encouraged to study on their own or in study groups with other ADOT employees ahead of taking the PMD test. ADOT has posted training resources for studying for the core and ROW category exams on the Roadside Resources webpage.

There are external 1 and 2-day training courses, such as those offered by Federal agencies, the Southwest Vegetation Management Association, the Arizona Professional Pest Organization and the Southwestern Noxious/Invasive Weed Short Course in Farmington, New Mexico, which may be useful to those studying for the test and also provide Continuing Education Units for those with certifications.

ADOT has internal training courses on use of Herbicide/Spray Trucks (TCH4825 and TCH4826). These courses are only open to certified applicators.

Safety

Before Applying Herbicides

If the pre-application survey indicates the presence of federal threatened, endangered, or state, federal or tribal special-status species, consult ADOT Environmental Planning to determine if an environmental review is needed.

General steps to follow before applying herbicides include:

1. **Notify the District Invasive Species/Herbicide Contact (DIS/HC) at least 10 work days prior to the planned herbicide application.** They will review the following:
 - Current site status to avoid damage to plant communities, spreading noxious weeds, or conflicts with planned mowing
 - Need for coordination with federal, state, agency, and tribal entities
 - Guidance on federal, state, agency, and tribal requirements for herbicide application
 - Whether a PUP is already approved for applications on federal land
2. **Check that weather conditions are acceptable** for applying herbicides
3. **Notify the Maintenance Unit Supervisor** prior to beginning work.

ADOT Vegetation Management Guidelines - Herbicides

Prior to Application

- Learn, keep current with, and strictly adhere to laws and regulations regarding use and disposal of all herbicides
- Inventory and inspect safety equipment before application
- Inspect truck and sprayer for proper operation; check calibration and adjust, if necessary, before leaving yard
- Ensure proper chemical labels and Safety Data Sheets (SDSs)—formerly Material Safety Data Sheets (MSDSs)—are in truck
- Do not transport herbicides in the cab or passenger compartment
- Place safety devices and signs

During Application

- **Follow all label instructions**
- Wear personal protection equipment (PPE), including full-face respirators, rubber boots, gloves, impervious overalls or aprons, and goggles or face shields
- Stop work if weather/environmental conditions change and herbicide drift is occurring.
- Do not allow herbicide to drift into waterways, irrigation canals, and ditches. Do not spray into these areas unless an NOI has been submitted under the Pesticide General Permit.
- Carry spill kits/containment materials in spray vehicle
- Keep a minimum of five gallons of clear water at the work area for emergency cleaning and rinsing
- Keep a detergent at the work site
- If the applicator is contaminated by direct contact with an herbicide, stop all work immediately and initiate first aid and/or clean-up measures



Following application

- Remove safety devices and signs.
- Wash all safety equipment with a detergent solution at the end of each day of use.

Material Storage

- Store herbicides in a locked, secure enclosure such as:
 - Closed vehicle toolbox
 - Closed trailer
 - Building or room
 - Fenced area with a solid fence at least six feet high
 - Truck or trailer with solid sideracks and secured tailgate at least six feet above ground level

ADOT Vegetation Management Guidelines - Herbicides

- Post warning signs that comply with local ordinances around all storage areas.
- Do not store herbicides for more than 18 months; rotate stock to use the oldest material first.
- Rinse empty containers at least three times, pouring the rinsate into the mix tank. Punch holes in top and bottom of the containers to prevent reuse.
- Dispose of empty containers in secured trash containers. Secure the empty containers if they are transported in a vehicle prior to disposal so that they do not blow out.
- Do not use herbicide containers for any other purpose.

Recordkeeping

All required paperwork, including the PeCoS Crew Work Report and Pesticide eForm Spray Log for maintenance or an Herbicide and Pesticide Application Log for construction, must be completed for every application. Records must include all herbicides applied, including brand name, formulation, EPA registration number, amount and date applied, exact location of application, vehicle calibration, and name, address, and certification number of applicator. Records must be maintained for at least three years.

PMD requires quarterly reporting of use of soil applied pesticides that have been found as contaminants in Arizona streams. The list of pesticides can be found on the PMD website. Use of these herbicides must be reported through the “My PMD for Businesses” section of the PMD website at the same time as the ADOT herbicide e-form is completed.

Additional Best Practices

- Select herbicides and adjuvants based on the target plants to be controlled, extent of the problem, and site considerations
- Use herbicide in coordination with other management techniques, such as mowing
- Always apply in accordance with product labeling
- Use proper application techniques to ensure that herbicides are not applied to non-target or sensitive areas
- Do not apply herbicides if rainfall that will cause runoff is forecast within 12 hours
- Minimize spray drift by applying according to herbicide labels; using nozzles and low pressure; adding an adjuvant when needed, and spraying only when the wind is below 10 mph
- Do not apply herbicides during high temperatures or frozen ground conditions
- Spot-spray weeds rather than broadcast spray in areas where desirable vegetation is also present
- Apply herbicides during the seedling stage and before flowering
- Do not spray when noxious weeds or brush become too mature or tall for satisfactory results; if necessary, mow the infested area and treat the regrowth with herbicide
- Spraying perennial weeds in the fall is more effective for long-term control since the plant is more likely to relocate herbicide to the roots in the fall than in the spring when it is first growing

ADOT Vegetation Management Guidelines - Herbicides

- Inspect the route ahead of time and flag cross culverts, streams, and wetlands so that the sprayer can be shut off with a 30 foot buffer around sensitive areas.
- If applying in or within 30 feet of aquatic habitat, use herbicides and adjuvants approved for aquatic use and follow the requirements of the Pesticide General Permit.
- Clean equipment following use.
- Do not wash herbicide equipment or containers in ditches, streams, ponds, or wetlands; do not allow wash water to flow into any surface waters, including wetlands. The best place to dispose of rinse water from herbicide containers is into the tank. Equipment should only be rinsed in yards with drains connected to a sewer system.
- Clean up spills immediately. For minor herbicide spills notify ADOTWater@azdot.gov or contact the ADOT Water Resources Manager at (602) 712-7947. For major spills in a waterway, contact ADEQ Emergency Response immediately at (602) 771-4163.
- Minimize off-road vehicle travel. Off-road vehicle travel is not allowed during herbicide application on BLM easement unless special permission has been obtained.

ADOT Vegetation Management Guidelines - Herbicides

Attachment 1: Herbicide List

| Active Ingredient | BLM ¹ | USFS ² | Selective? | Controls | Pre-Emergent | Post-Emergent | Stream Concern | Mode of Action | Trade Names |
|--|------------------|-------------------|----------------|-----------------------------|--------------|---------------|----------------|----------------------------------|-------------------------|
| 2,4-D | Y | Y | Selective | broadleaf | | y | n | hormone mimic | Clean Amine |
| Aminocyclopyrachlor | | | Selective | broadleaf, grasses | | y | y | growth regulator | Perspective, Streamline |
| Aminopyralid | | Y | Selective | broadleaf | | y | n | growth regulator | Milestone |
| Bromacil | Y | | Non-Selective | broadleaf, grasses | y | y | | photosynthesis inhibitor | Hyvar X |
| Chlorsulfuron | Y | Y | Selective | broadleaf | y | early | y | mitosis inhibitor | Telar |
| Clopyralid | Y | Y | Selective | broadleaf | | y | y | growth regulator | Stinger, Transline |
| Dicamba | Y | Y | Selective | broadleaf | | y | y | growth regulator/hormone mimic | Vanquish, Weedmaster |
| Diflufenzopyr | Y | | Non-Selective | broadleaf | | y | | auxin transport inhibitor | Overdrive |
| Diquat | Y | | Non-Selective | aquatic broadleaf | | y | n | photosynthesis inhibitor | Spectracide |
| Diuron | Y | | Non-Selective | broadleaf | y | y | y | photosynthesis inhibitor | Karmex, Diuron |
| Fluridone | Y | | Non-Selective | submerged aquatic broadleaf | | y | n | carotenoid synthesis inhibitor | Sonar, Avast |
| Fluroxypyr | | Y | Selective | broadleaf | | y | n | hormone mimic | Vista |
| Glyphosate | Y | Y | Non-selective | all | | y | n | protein inhibitor | Roundup, Honcho, Rodeo |
| Hexazinone | Y | | Non-selective | woody | | y | | photosynthesis inhibitor | Velpar |
| Imazapic | Y | Y | Rate Selective | all | m | y | | amino acid inhibitor | Plateau |
| Imazapyr | Y | Y | Non-selective | all | y | y | n | protein inhibitor | Habitat, Arsenal |
| Indaziflam | | | Selective | broadleaf, grasses | y | y | y | cellulose biosynthesis inhibitor | Esplanade |
| Isoxaben | | Y | Selective | broadleaf | y | | n | disrupts root development | Gallery |
| Metsulfuron-methyl | Y | Y | Selective | broadleaf | | y | | protein inhibitor | Escort, Ally |
| Pendimethalin | | Y | Non-selective | broadleaf, grasses | y | | n | mitosis inhibitor | Pendulum |
| Picloram | Y | Y | Rate Selective | broadleaf | | y | y | growth regulator | Tordon |
| Prodiamine | | | Selective | broadleaf, grasses | y | | | seedling growth inhibitor | Evade |
| Sethoxydim | | Y | Selective | grasses | | y | n | amino acid inhibitor | Poast |
| Sulfometuron-methyl | Y | Y | Non-selective | broadleaf, grasses | y | y | y | amino acid inhibitor | Oust |
| Tebuthiuron | Y | Y | Selective | woody vegetation | y | y | y | photosynthesis inhibitor | Spike |
| Triclopyr | Y | Y | Selective | woody, perennial broadleaf | | y | n | growth regulator | Garlon, Remedy, Redeem |
| Notes ¹ Approved in the BLM-ADOT Herbicide Environmental Assessment (2015) ² Approved in the USFS Region 3-ADOT Vegetation Management Environmental Assessment (2003); not all National Forests have approved this full list of herbicides in their separate Forest herbicide NEPA documents | | | | | | | | | |

ADOT Vegetation Management Guidelines - Herbicides

Attachment 2: Emergency Contacts

Herbicide Spills

- Contact ADOT Emergency Response through the Traffic Operations Center.
- See Policy SAF 18.03 for general response guidelines.

Poisoning Concerns

- Association of Poison Control Centers 800-222-1222
- National Pesticide Info. Center 800-858-7378

Attachment 3: Agency Coordination

Federal Agency Coordination

Herbicide use on federal lands requires an approved Pesticide Use Proposal (PUP). In addition, some federal agencies require the use of specific herbicides on their land. Herbicide use on federal lands may be subject to:

- Conditions of easement deeds
- Memoranda of understanding (MOUs) between the agency in question and ADOT
- Agency guidelines, such as Guidelines for Highways on Bureau of Land Management and U.S. Forest Service Lands
- Agency pesticide use policies
- Planning documents, such as maintenance plans or noxious weed management plans
- NEPA documents

State Agency Coordination

Herbicide use on state lands is subject to the requirements of the Arizona Department of Environmental Quality's Pesticide General Permit. Herbicide use on state land may also be subject to:

- Arizona Native Plant Law
- Agency guidance
- Easement conditions
- Partnering agreements

Table 1 below identifies regulations, requirements, and guidelines that apply when applying herbicides on federal, state, and tribal land. Links to many of these resources are available through the ADOT Roadside Resources webpage. Please contact the DIS/HC or Roadside Resources Specialist for additional information and guidance.

ADOT Vegetation Management Guidelines - Herbicides

Table 1. Relevant Regulations, Requirements, and Guidelines for Applying Herbicides

| Regulations, Requirements, and Guidelines | Federal Agencies | | | | | State Agencies | | | | Tribal Nations * |
|---|-----------------------|-----|-----|------|-------|------------------------|---------------------------|------------------------------------|--------------------|------------------|
| | National Park Service | BLM | BIA | USFS | USFWS | AZ Dept of Agriculture | AZ Dept of Enviro Quality | AZ Dept of Forestry and Fire Mngmt | AZ State Land Dept | |
| Pesticide Use Permit (PUP) | • | • | • | • | • | | | | | |
| ADOT-specific NEPA documents completed for herbicide use | | • | | • | | | | | | |
| Guidelines for Highways on BLM and USFS Lands | | • | | • | | | | | | |
| Easement Deeds | • | • | • | • | • | | | | • | • |
| ADOT – BLM Annual Maintenance Plan | | • | | | | | | | | |
| ADOT – Forest Service Annual Maintenance Plan | | | | • | | | | | | |
| USFS Pesticide Use Policy | | | | • | | | | | | |
| BIA Western Region Integrated Noxious Weed Management Plan | | | • | | | | | | | |
| Pesticide General Permit | | | | | | | • | | | |
| Water Resources | | | | | | | • | | | |
| AZ Dept of Ag, PMD – Licensing for ADOT Herbicide Applicators | | | | | | • | | | | |
| AZ Dept of Ag, PMD – Reporting Use of Soil-Applied Pesticides | | | | | | • | | | | |
| Forest Health and Invasive Species Coordination | | | | | | | | • | | |
| Partnering Agreements* | | | | | | | | | | • |
| Tribal Ordinances* | | | | | | | | | | • |
| Tribal Environmental Protection Agency Requirements* | | | | | | | | | | • |
| * Requirements differ for each tribal nation; Environmental Planning can help with coordination and contacts. | | | | | | | | | | |

ADOT Vegetation Management Guidelines - Herbicides

Non-Routine Maintenance Activities

Certain non-routine maintenance activities on federal land may have an impact on environmental resources and therefore require NEPA clearance. Check with the appropriate DEC and ADOT Environmental Planning to confirm whether NEPA is required. Examples include projects that might:

- Have a visual impact
- Disturb cultural resources
- Affect a threatened, endangered, or agency-listed species or its habitat

Coordinating with Tribal Nations

Some plants have particular significance in Native American tribal culture, so it's important to coordinate with tribal nations when planning herbicide applications on tribal lands. ADOT will ensure compliance with laws that protect natural and cultural resources. ADOT will coordinate with federal land management and tribal natural resources specialists at the local level when appropriate. Activities on tribal lands may be subject to:

- Conditions of easement
- Partnering agreements
- Tribal ordinances

Land management agencies and Tribes have expectations that certain actions off the pavement will be reviewed by qualified environmental staff such as biologists and cultural resource professionals. When considering herbicide applications on tribal land:

- Consult resource and land management agency maps as needed
- Check with your DEC if planning maintenance actions off the pavement such as vegetation removal or ground-disturbing activities to see if additional environmental review is required

Coordinating with the Public

All public inquiries should be referred to ADOT Constituent Services at (602) 712-8111 or the "Contact ADOT" web form at https://apps.azdot.gov/contact_adot/. It can be helpful for the Herbicide Coordinator to provide a monthly spray schedule to their ADOT District Public Information Officer in case of questions. Spraying may be taking place as a result of either maintenance or construction work.

ADOT Vegetation Management Guidelines - Herbicides

Attachment 4: Herbicide Conversion Info

* Always read and follow label information for any herbicide being used *

How to use this reference guide: The below chart gives amount of herbicide needed to obtain different commonly used solution strengths for many of the standard sprayer sizes. Each row represents a different mix amount (in gallons) with each column representing different solution strengths (given in % solution).

Mixing the herbicide: Be sure to wear proper safety gear (usually eye protection, chemical gloves, and long sleeves, but read label information for exact safety gear requirements) when handling, mixing, or applying herbicide.

To mix herbicide, add one-third to one-half of water needed for mix, then add the amount of herbicide denoted in chart and add the remaining amount of water needed to reach desired mix amount. Read the label for information on necessity and rates for additives, such as surfactants and penetrants.

| Fluid ounces of herbicide needed for desired solution | | | | | | | |
|---|----------------|----------------|-----------------|------------------|------------------|-------------------|------------------|
| Mix amount | 1% | 2% | 3% | 5% | 10% | 15% | 20% |
| 1 gallon | 1.25 | 2.5 | 4 | 6.5 | 13 | 19 | 26 |
| 2 gallons | 2.5 | 5 | 8 | 13 | 26 | 38 | 51 |
| 3 gallons | 4 | 8 | 12 | 19 | 38 | 58 | 77 |
| 4 gallons | 5 | 10 | 15 | 26 | 50 | 77 | 102 |
| 5 gallons | 6.5 | 13 | 19 | 32 | 64 | 96 | 128 |
| 10 gallons | 13 | 25 | 38 | 64 (2 qt) | 128 (1 gal) | 192 (1.5 gal) | 256 (2 gal) |
| 15 gallons | 19 | 38 | 58 | 96 (3 qt) | 192 (1.5 gal) | 288 (1.75 gal) | 384 (3 gal) |
| 30 gallons | 38 | 77 | 115 | 192 (1.5 gal) | 384 (3 gal) | 576 (4.5 gal) | 768 (3.6 gal) |
| 100 gallons | 128 (1 gal) | 256 (2 gal) | 384 (3 gal) | 640 (5 gal) | 1280 (10 gal) | 1920 (15 gal) | 2560 (20 gal) |
| 300 gallons | 384 (3 gal) | 768 (6 gal) | 1152 (9 gal) | 1920 (15 gal) | 3840 (30 gal) | 5760 (45 gal) | 7680 (60 gal) |

Conversion reference chart

1 gallon = 128 ounces

1 quart = 32 ounces

1 pint = 16 ounces

1 cup = 8 ounces

1 gallon = 4 quarts = 8 pints = 16 cups

1 quart = 2 pints = 4 cups

1 pint = 2 cups

ADOT Vegetation Management Guidelines – Prescribed Burning

1.0 Purpose of Prescribed Burning

Prescribed burning is used for removing unwanted plant material or waste such as brush, tumbleweeds, and forest litter to reduce fuel sources for wildfires, or to control brush by non-chemical means. It is also an economic way to dispose of vegetative material when a landfill is far away.

Prescribed burning may be done as a controlled broadcast burn in the right-of-way (ROW), or piles of vegetative waste may be burned either in the ROW or at an ADOT maintenance yard. ADOT uses prescribed burning on a limited scale as a management tool. Due to air quality issues in the Phoenix and Tucson metropolitan areas, prescribed burning is used primarily in the northern regions of the state.

- | | |
|-----|----------------|
| 1.0 | PURPOSE |
| 2.0 | PLANNING |
| 3.0 | COORDINATION |
| 4.0 | BEST PRACTICES |
| 5.0 | EQUIPMENT |



Prescribed burns along highway corridors are used mainly for slash (tree) pile disposal, elimination of unwanted plants, destruction of seed beds, and reducing combustible fuels that may start or exacerbate wildfires during the dry season. A side benefit of burning in a grassland biozone is the stimulation of new vegetative growth and the recycling of soil nutrients. Pile burning is more common and entails stacking cut vegetation that is burned when dry. Broadcast burning entails manipulation of fire so that it burns everything within a pre-designated area such as a highway ROW.

2.0 Planning to Burn

Consider the condition of the roadside vegetation and seasonal weather variations, such as temperature and precipitation. Supervisors must also ensure that staff who participate in prescribed burning activities have the appropriate training and personal protective equipment (PPE).

ADOT Vegetation Management Guidelines – Prescribed Burning

Vegetation Condition

Burning is effective in the following situations:

- To reduce thatch in fire-adapted grasslands (Plains and Great Basin Grassland; Semidesert Grassland and Chihuahuan Desertscrub)
- To remove accumulated tumbleweeds from roadside areas
- To control woody plants in the recovery zone before they become large
- To dispose of brush piles from the previous year's vegetation clearing (minimum 6 months old so they burn cleanly)
- To clear weed-infested areas as an alternative to herbicide application



Seasonality

The timing of a prescribed fire can have a significant impact on roadside vegetation. Several considerations relative to burning schedules include:

- Burning during hot, dry, windy conditions should be avoided due to wildfire risk.
- Burning during wet conditions should be avoided because excessive smoke can be created.
- Avoid burning during nesting times for local wildlife or critical life cycle periods of pollinators

Frequency

- Burn as infrequently as possible while still accomplishing reduction of fuel loads and weed control.
- Suggested frequency of burning is a minimum of three years between burns and desirably five years.
- Burn sections should be isolated in a patchwork fashion so that refuge areas are nearby for recolonization of the burn area.

Training

All ADOT personnel participating in prescribed burn activities must receive specialized training. Several sources provide training, including federal agencies, the Arizona Division of Forestry and Fire Management (DFFM), and local fire service jurisdictions.

ADOT Vegetation Management Guidelines – Prescribed Burning

The Prescribed Fire Manager must complete the following training:

- Firefighter Training (Wildland)
- Introduction to Wildland Fire Behavior
- Introduction to the Incident Command System
- Intermediate Wildland Fire Behavior
- Ignition Operations

In addition, the Prescribed Fire Manager should attend the ADEQ Air Quality Smoke Management meeting and participate in the DFFM and Arizona Division of Emergency Management Annual Wildland Fire Exercise if available.

All other crew members must complete the following training:

- Introduction to Wildland Fire Behavior
- Introduction to the Incident Command System
- Firefighter Training (Wildland) is required for crew members participating in controlled broadcast or pile burning in the ROW, and recommended for crew members participating in ROW tumbleweed and yard pile burning.

The ADOT Emergency Management intranet page contains more information on policies and training: <https://adotnet.az.gov/our-agency/tsmo/traffic-management-group/emergency-management>.

3.0 Activity Coordination

Interagency Coordination

Prescribed burning activities must comply with environmental laws and regulations, which may vary depending on the location and type of burning activities. Compliance with environmental laws requires coordination with District Environmental Coordinators (DEC), and/or Environmental Planning.

For controlled broadcast or ROW pile burning, the Prescribed Fire Manager shall:

- Provide a scope of work and submit a maintenance work order request through the DEC for environmental review at least six (6) weeks prior to the burn
- Submit a burn plan to ADEQ 14 days before planned ignition and forward a copy of the ADEQ burn plan to the DEC who can work with the Emergency Coordinator and/or Environmental Planning if necessary to meet the environmental clearance requirements; obtain written approval of the plan from ADEQ (burn permit)
- Contact the county in which the burn is to take place to determine if a burn permit is required
- If the burn is located within a municipal boundary or Tribal Nation, the jurisdiction must be contacted to determine if a burn permit is required
- Submit an ADEQ Daily Burn Form to ADEQ Smoke Management by 2 p.m. of the business day before the date of the planned ignition
- Notify the State Forestry Dispatch Center of the burn (800-309-7081)

ADOT Vegetation Management Guidelines – Prescribed Burning

- Notify the Arizona State Land Department and local fire departments prior to ignition and after the burn/fire has been extinguished
- Submit an ADEQ Daily Burn Accomplishment Form to ADEQ Smoke Management by 2 p.m. of the business day following the date of an approved ignition

For tumbleweed burning, the Maintenance Supervisor or designee shall:

- Obtain District permission for the activity
- Consult and complete any documentation and permits with assistance from the DEC
- Notify the State Forestry Dispatch Center of the burn (800-309-7081)
- Follow the terms and conditions in the ADEQ Normal Open Burn Permit and/or county and local permits

For maintenance yard pile burning, the Maintenance Supervisor or designee shall:

- Consult and complete any documentation and permits with assistance from the DEC
- Follow the terms and conditions in the ADEQ Normal Open Burn Permit and/or county and local permits



Tumbleweed burning from gathering tumbleweeds (upper left) through completion of burning (bottom right).

ADOT Vegetation Management Guidelines – Prescribed Burning

4.0 Best Practices for Burning

Burning can have far-reaching consequences, so it is important to follow best practices.

- Verify that pre-burn prescription parameters have been met
- For controlled broadcast and right-of-way prescribed fires, establish and discuss LCES before firing: establish lookouts (L), confirm communication (C) methods, define escape (E) routes, and establish safety (S) zones
- In most cases, the paved or milled shoulder of the highway should be used as a safety zone; however, highway travel lanes cannot be identified or used as a safety zone unless the lane is blocked
- Set up safety devices and signs per the current edition of the MUTCD
- Ensure equipment is operational
- Take weather readings; calculate fuel moisture
- Protect traffic signs, milepost/kilometers signs, delineators, guardrails and other highway fixtures
- Apply water to sensitive areas just prior to ignition
- Surfactants or wetting agents may be used with water for wet lines (if approved)
- While burning, a water truck with a minimum of 200 gallons will be present on job location in ADOT yards and a minimum of 1000 gallons for job locations on ADOT ROW for control purposes.
- Brush piles must not be higher than five (5) feet, no longer than 20 feet, and no wider than 20 feet
- When burning maintenance yard piles, do not burn materials most likely to produce toxic smoke such as chemically treated wood, tires, batteries, hazardous waste product, asphalt shingles, asbestos, explosives, or ammunition
- Ensure water trucks are fully functional before igniting fire
- Test fire a small pile and monitor the smoke plume
- Burn out line and set strip fires
- Manage smoke to prevent visibility issues for the traveling public
- Completely extinguish or control fire before leaving site each day
- Remove safety devices and signs



ADOT Vegetation Management Guidelines – Prescribed Burning

5.0 Equipment

Vehicles

- Heavy Dump Truck 10 yd
- Grader
- Dozer
- Loader
- Pickup ¾ ton with 200 gallon spray skid
- Truck: Herbicide 3 axle 6 x 4 with 300 gallon spray skid
- Chipper
- 2,500-gallon large spray truck
- Trailer, Large
- Skid steer
- ATV

Personal Protective Equipment (PPE) for Controlled Broadcast or Right-of-way Pile Burn

- Nomex pants and shirt
- Hardhat
- Wildland firefighting boots
- Leather gloves
- Goggles or other protective eyewear
- Daypack (optional)
- Face/neck shroud or visor (optional)
- N95 respirator (optional)

Hand and Power Tools

- McLeod
- Pulaski
- Combination-tool
- Shovel
- Pitchfork
- Axe
- Chainsaw
- Rake
- Portable or two-way radios

Personal Protective Equipment (PPE) for Piled Tumbleweeds or Yard Pile Burning

- Normal work clothing including long work pants with long-sleeved shirt
- Protective footwear
- Leather gloves
- Goggles
- Nomex pants and shirt (optional)
- Hardhat (optional)
- Wildland firefighting boots (optional)
- Face/neck shroud or visor (optional)
- N95 respirator (optional)



ADOT Vegetation Management Guidelines – Soil Stabilization

1.0 Purpose of Soil Stabilization

Soil stabilization is one of the basic methods for temporarily controlling erosion until roadside vegetation is able to protect slope integrity. Stabilization methods are used to repair rills and gullies both in natural areas and in areas finished with granite mulch. Erosion and other damage resulting in the need for soil stabilization can be caused by storms, concentrated water flow, broken water lines or errant vehicles. Refer to the [Erosion and Pollution Control Manual for Highway Design and Construction](#) on the ADOT Roadway Roadside Development website for more detailed information.

| | |
|-----|----------------|
| 1.0 | PURPOSE |
| 2.0 | PLANNING |
| 3.0 | COORDINATION |
| 4.0 | BEST PRACTICES |

Two key areas are vulnerable to erosion.

- 1) The shoulder area adjacent to the pavement experiences sheet flow that is proportional to the width of the roadway and can experience significant erosive stormwater flows. Roadside guardrail is especially vulnerable; an eroded slope may compromise the effectiveness of the guardrail system.
- 2) The back slope of a cut section is often steeper than the natural slope it ties into resulting in rills and a steady migration of material from the slope into the roadside ditch.



2.0 Planning to Stabilize Soil

When planning to perform stabilization activities, consider the appropriate work method for the area needing attention. Temporary erosion control should be installed within 14 days of disturbance. More information is presented in the [Erosion and Pollution Control Manual](#). Standard scenarios include the following:

- Replacing and compacting soil from eroded areas
- Placing compacted millings around guardrail posts
- Repairing granite mulch at slopes and medians
- Using polymeric/acrylic, psyllium, starch or guar soil stabilizers to reinforce soil characteristics for resisting erosion on slopes and drainages, providing stability until plants emerge

ADOT Vegetation Management Guidelines – Soil Stabilization

Note that when placing material in an eroded area the new material must not be excavated from the roadside. Roadside excavation often disrupts the existing vegetative cover to the detriment of the overall management plan.

Seasonality

The potential for erosion damage is greatest during high intensity rainstorms. Routine repairs should be scheduled as soon as practical after damage has been identified to give the best opportunity for vegetation reestablishment and to prevent further degradation.

Frequency

Soil stabilization activities are generally performed as needed to repair damage. Areas that are repeatedly damaged by storms may need additional action to more permanently prevent damage. Significant reshaping of slopes or alteration of drainage patterns are generally outside the scope of maintenance activities and a standalone construction project to effectively correct a chronic problem should be considered.

3.0 Coordination Ahead of Activity

Environmental Concerns

Prior to stabilization activities in the following areas, maintenance staff shall ensure that all laws, rules, and regulations are adhered to, including requirements specific to:

- National Forest, Bureau of Land Management, or other Federal land
- Native American Tribal Communities
- Environmentally sensitive areas containing endangered species habitat
- Areas with air quality regulations (a dust control permit must be obtained for work in Pima, Pinal, and Maricopa Counties prior to commencing activities); work must minimize generation of dust
- Clean Water Act compliance
 - Care should be taken to remove material from ditches that may result in sediment flow into drainage ways but to leave in place all other existing soils.
 - Material to fill rills requires importation from a suitable borrow source if such sediment is unavailable on site.
 - Only minimal soil disturbance is allowed with this practice. If five (5) or more acres will be disturbed, a SWPPP must be prepared and an NOI must be submitted.

Intra-agency Coordination

The Maintenance Supervisor will notify District Environmental Coordinator or Landscape Architect 10 work days prior to slope stabilization activities for information on site status to avoid damage to sensitive areas.

4.0 Best Practices for Stabilization

Soil stabilization should generally be done with an eye towards supporting revegetation for a more permanent erosion solution.

General

- Investigate to determine the source/cause for the erosion
- If possible, correct the source/cause to prevent future erosion occurrences prior to repair

ADOT Vegetation Management Guidelines – Soil Stabilization

- Install storm drain inlet protections, as appropriate, prior to commencing activities
- Repair rills and gullies to re-establish slope to near original condition to minimize erosion of top soil and vegetation
- Use water to eliminate dust and enhance limited soil compaction
- In severely damaged areas additional temporary erosion control measures may be needed. Refer to the ADOT Erosion and Pollution Control Manual.

Rock mulch and rip rap

- Apply pre-emergent herbicide per the manufacturer's recommendations
- Use rock mulch or riprap that matches the existing rock material in color and size
- Ensure that the depth of repair is consistent with the as-built plans (typically 2 inches deep for rock mulch)
- Water-settle the new rock material



Acrylic/polymeric, psyllium, guar

- To stabilize slopes steeper than 3:1, apply acrylic/polymeric, psyllium, or guar soil stabilizers to slopes and drainages by spraying from water tenders or hydroseeders.
- Pre-wet the soil with surfactant treated water, then apply stabilizer.
- Avoid over spray onto the roadway or traffic signs.

Tacked straw or hydraulically-applied straw

- Use certified weed-free straw.
- Apply straw and spray a liquid tackifier into a prepared seedbed to provide temporary soil stabilization



Tag for certified weed-free straw.

ADOT Vegetation Management Guidelines – Soil Stabilization

Hydraulically-applied straw

- Use certified weed-free straw.
- Apply straw and tackifier by means of hydroseeder to seeded sites in order to provide a mulch cover to a seedbed for germination and erosion control
- Do not use wood fiber alone or bonded matrix fiber for hydromulching. ADOT research shows it prevents moisture penetration to the soil which inhibits germination of seeds.
- Refer to the seeding special provisions for a recent nearby construction project or consult Roadside Development to determine the application rate for straw and tackifier, which varies with the slope.
- Load tank no more than 15 minutes before spraying
- Avoid wind drift of hydromulch spray onto roadway
- Spray in even swaths

ADOT Vegetation Management Guidelines – Native Plant Salvage

1.0 Purpose of Native Plant Salvage

Salvaging protected native plants prior to roadway construction or maintenance earthwork helps to preserve valuable natural resources. The benefits of incorporating salvaged plants into the right-of-way vegetation include:

- Mature specimens of plants that take many years to develop from seed are saved, such as saguaros and barrel cacti
- Visual quality is improved
- Habitat is provided for pollinators and other wildlife
- Diversity of vegetative life stages is increased

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| 1.0 | PURPOSE |
| 2.0 | PLANNING |
| 3.0 | COORDINATION |
| 4.0 | BEST PRACTICES |
| 5.0 | EQUIPMENT |



Transplanted, braced saguaro in revegetation area

2.0 Planning to Salvage Native Plants

Costs vs. Benefits

Mature cacti and succulents, such as saguaro, barrel, and yucca, may be costly to purchase from a nursery, so salvaging them from the right-of-way may be the most cost-effective approach. If the plants can be salvaged using a “move-once” process, the cost of transplanting and the potential stress to the plants may be less than if the salvaged plants are stored in a temporary nursery before being replanted.

In certain situations, native trees with excellent health and form may warrant salvage by boxing, but in general, smaller nursery-grown trees are a better choice for revegetation.

ADOT Vegetation Management Guidelines – Native Plant Salvage

Seasonality

Cacti and other succulents can generally be salvaged during any time of the year, if handled properly. The greatest success in plant salvage may be influenced by the following factors:

- Transplanting during late spring and early summer, prior to monsoon season, is the least desirable time due to the combination of extreme heat and low rainfall
- Cool temperatures and increased moisture during the winter rainy season may promote decay in fresh transplants
- Often mistaken for a cactus, ocotillo is a spiny, woody shrub that is best transplanted in the spring
- Trees native to the desert regions typically have the best transplant survivability when salvaged during the warm season, generally April through September

3.0 Activity Coordination

Intra-agency Coordination

Due to seasonal considerations related to some native plants, the DEC should be consulted at least six months and preferably one year, prior to construction or maintenance earthwork in areas where protected native plants occur.

Compliance with Arizona Native Plant Law

Cacti, agaves, yuccas, and many other native plants are protected by the Arizona Native Plant Law. The DEC should be contacted to assist with preparing a Notice of Intent to Clear Land (NOI), if protected native plants occur within the area where earthwork is planned.

Information needed for the NOI form includes:

- Property description and location
- Number of acres to be cleared, which determines the length of notice period required (20, 30, or 60 days)
- ADOT's intention for disposition of the plants
- Approximate starting date of earthwork

FOR MORE INFORMATION:

Lists of protected plants may be accessed at
<https://agriculture.az.gov/protected-native-plants-categories>

Additional guidance on plant salvage may be obtained from ADOT's Roadside Development Section

4.0 Best Practices for Native Plant Salvage

When salvaging native plants, the highest success rate will be achieved by following these best practices:

- Mark the north side of saguaros and barrel cacti, and replant at the same orientation
- Excavate the lateral roots of cacti and succulents by starting to dig three (3) feet out from the plant base
- Roots greater than three (3) inches in diameter should be a minimum length of 24 inches
- Roots between one (1) inch and three (3) inches in diameter should be a minimum length of 12 inches
- Roots less than one (1) inch in diameter should be a minimum length of three (3) inches
- Damaged roots should be clean cut with a lopping shears or similar tool, and dusted with sulfur
- Limit the size of the disturbed area

ADOT Vegetation Management Guidelines – Native Plant Salvage

- Determine if runoff from the site can enter a watercourse or storm drain, and if so, install the necessary protection prior to commencing activities
- Cuttings of prickly pear pads (*Opuntia* species) or cholla stems (*Cylindropuntia* species) may be taken as an alternative to digging the entire plant
- Trees or other plants to be boxed shall be side-boxed, allowed to remain in place for two to three weeks, and then bottom-boxed
- Replant at the same depth as the plant was growing naturally, or in the case of large saguaros, no more than three (3) inches deeper
- Provide bracing in a triangulated configuration using wood or rope for saguaros eight (8) feet and taller
- Following transplanting of bare-root cacti and succulents, withhold irrigation for two weeks, then irrigate as necessary depending on temperature, soil type, plant type and size, and other factors
- Boxed plants shall be irrigated from the time of side-boxing through replanting, and until establishment
- Adequately prepare seedbed and reseed disturbed areas and temporary nursery as soon as possible after completion of salvage activity
- Projects on which plants were salvaged during the construction phase should have a Salvage Plan, which can provide additional information about best practices



Salvaged cacti in a temporary nursery

ADOT Vegetation Management Guidelines – Native Plant Salvage

5.0 Equipment

- Salvage of smaller plants may be accomplished with standard equipment, such as pickup (1/2 ton) and trailer
- Specialized equipment such as hydraulic lifts or cranes will be necessary for transplanting large saguaros and trees; typically this equipment is provided by a contractor specializing in plant salvage



ADOT Vegetation Management Guidelines - Revegetation

1.0 Purpose of Revegetation

A healthy cover of native vegetation, established through various revegetation techniques, provides these benefits:

- Helps to stabilize soil and prevent erosion from wind or water.
- Helps to control weeds
- Fills in areas after weed removal or repair of erosion damage
- Contributes to the visual quality of the roadside and natural native plant succession
- Provides habitat for pollinators and other wildlife (in the taller vegetation past the recovery zone)

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| 1.0 | PURPOSE |
| 2.0 | PLANNING |
| 3.0 | COORDINATION |
| 4.0 | BEST PRACTICES |

Revegetation may be accomplished by seeding, planting of salvaged or nursery-grown plants, or a combination of both. During maintenance activities, seeding is the main revegetation technique outside urban areas. In landscaped areas associated with urban roadways, revegetation with container plantings is done to replace trees, shrubs, and groundcovers that are dead or severely damaged due to disease, lightning, traffic damage, or other problems. In rural areas, containerized or bare root plantings may be planted to replace plants removed for repairs, provide habitat, create a living snow fence, control blowing dust, and/or provide sand abatement.



Benefits of roadside revegetation include soil stabilization, weed control, habitat for pollinators, and improved visual quality.

ADOT Vegetation Management Guidelines - Revegetation

2.0 Planning for Revegetation

Seed Mixes

ADOT seed mixes contain both grasses and forbs (broad-leaf annual and perennial plants) that germinate in cool and warm season conditions. It is important to include species of forbs which establish and provide soil cover more quickly than grasses and have long-lived seed that can survive in the soil seed bank until weather conditions are ideal for germination. Established forbs also tend to survive extended drought conditions better than many grass species. Consult ADOT Roadside Development or refer to the Special Provisions for seeding from a recent nearby construction project to establish an appropriate seed mix for maintenance projects.



WHO TO CALL WITH QUESTIONS

District Environmental Coordinator

Design Landscape Architect – ADOT Roadway Engineering

Construction Landscape Architect –ADOT Construction Group

Roadside Development webpage

<https://www.azdot.gov/business/engineering-and-construction/roadway-engineering/roadside-development>

The best timing for container plantings depends on the species and location. Contact an ADOT landscape architect for advice and consult ADOT standard drawings for the species installation. Generally, plants should be planted in the early fall or spring for best results. In the low desert areas, wintertime planting is also feasible for some species. Except in situations where supplemental irrigation is available, summertime planting should be avoided because of the additional stress that high temperatures place on the new transplants.

3.0 Activity Coordination

Intra-agency Coordination

The Maintenance Supervisor will coordinate with the DEC prior to maintenance earthwork in order to prepare a storm water pollution prevention plan if the area is greater than five (5) acres.

The Maintenance Supervisor will also coordinate with the ADOT landscape architect to determine the location of plantings in accordance with recovery area standards, snow fence configuration, prevailing wind direction, and sight distance parameters.

Contact Roadside Development for seeding and site preparation guidelines for hydroseeding, hydromulching, tillage, and broadcast seeding.

ADOT Vegetation Management Guidelines - Revegetation

4.0 Best Practices for Revegetation

General

- Refer to the original construction documents to determine what the original landscape plants (in an urban situation) or revegetation practices (in a rural situation) were specified
- Final Record Drawings for completed construction projects are available from ADOT's ROAD Portal (<https://road.azdot.gov/>);
- The ADOT special provisions for seeding in the bid package from a previous construction project - found in the Arizona Information Data Warehouse (<http://aidw.aidw2/>) - can provide guidance on appropriate revegetation techniques
- Install erosion control features, as necessary, prior to commencing revegetation activities
- Stay within the disturbed area and minimize creation of additional access roads to reduce ground disturbance
- Place safety devices and signs prior to revegetation work
- Personnel are required to wear proper personal protective equipment
- Remove safety devices and signs upon completion of work

Tillage

- Till to a minimum depth of six (6) inches
- Follow natural contours
- Avoid tilling soils that are either very dry or saturated
- Leave seedbed in roughened condition
- Till with a chisel plow or ripper bar, with chisels no more than 12 inches apart
- Seed as soon as possible after tilling using site-specific native seed specifications



Tilled seedbed

ADOT Vegetation Management Guidelines - Revegetation

Hydroseeding

- Hydroseed with a slurry of seed, fertilizer, mulch, and water, at a rate specified by the Special Provisions or as recommended by the ADOT landscape architect, onto a prepared and roughened site.
- Service the pump and engine as necessary
- Load tank no more than 15 minutes before spraying
- Check pipes and valves after each load
- Spray in even swaths
- Avoid wind drift of hydroseed spray into watercourses or onto roadway, traffic control signs or plants



Hydroseeding

Broadcast Seeding

Broadcast seed with hand held or electric broadcast seeder into prepared seedbed or onto roughened soil surface

- When necessary, add vermiculite as a carrier for fine and fluffy seeds
- Broadcast seed onto roughened soil to prevent seed loss
- Avoid broadcasting onto very dry or saturated soils
- Include dry timed-release fertilizer and other amendments as needed
- Rake or drag seedbed after seeding

ADOT Vegetation Management Guidelines - Revegetation

Hydrostraw mulching

- Use weed-free straw
- Apply straw and tackifier by means of hydroseeder to seeded sites in order to provide a mulch cover to a seedbed for germination and erosion control
- Do not use wood fiber for hydromulching. ADOT research shows it prevents moisture penetration to the soil which inhibits germination of seeds.
- Refer to the seeding special provisions for a recent nearby construction project or consult Roadside Development to determine the application rate for straw and tackifier, which varies with the slope.
- Load tank no more than 15 minutes before spraying
- Avoid wind drift of hydromulch spray onto roadway
- Spray in even swaths



Tag for weed-free straw



Hydromulching

ADOT Vegetation Management Guidelines - Revegetation



Hydrostraw mulch and tackifier applied to slope

Tacked Straw Mulch and Crimping

- Apply straw and spray a liquid tackifier into a prepared seedbed to provide temporary soil stabilization until germination of seeds
- Use weed-free straw



Roadside revegetation

ADOT Vegetation Management Guidelines - Revegetation

Container Plantings – Rural Areas

- Contact an ADOT Landscape Architect – either Roadside Development or Construction - for a planting plan
- Use native plant species
- Excavate holes to the proper depth per ADOT standard drawings for the plant species
- Plant according to accepted standards for the plant species

Container Plantings – Urban Landscapes

- Refer to the original landscape plans for appropriate plant species and placement
- Prepare planting pits
- Add amendments to backfill as needed
- Set trees, shrubs, groundcover at proper depth and backfill per ADOT specifications and details
- Install stakes, guys (for trees) and drip irrigation emitters
- Adjust irrigation schedule to establish new plants
- Clean and rake area

ADOT Vegetation Management Guidelines - Revegetation

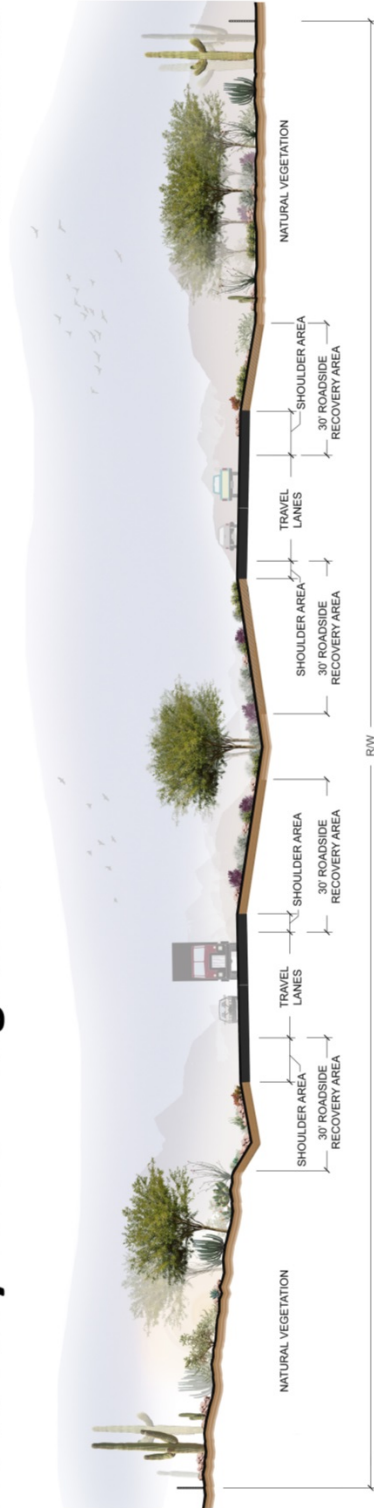
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Appendix A: Recovery Area

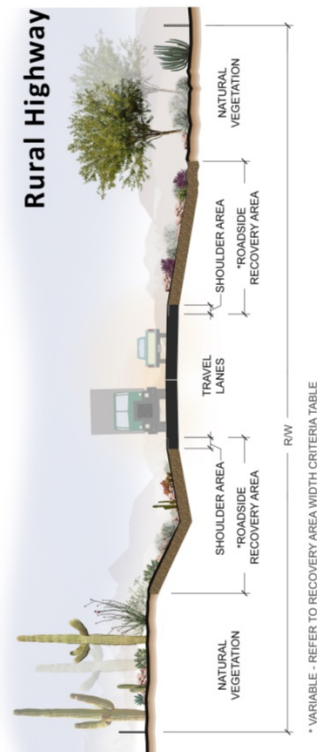
The recovery area is an area outward from the outer travel lane that is free of obstructions and non-traversable slopes. The width is determined based on speed, traffic volume and embankment slope as shown below. Contact Roadside Resources to receive a poster if your office does not have one available.

Recovery Area Diagrams

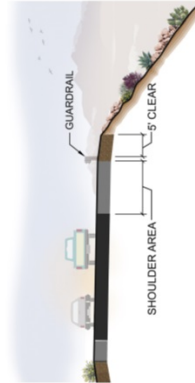
Rural Interstate



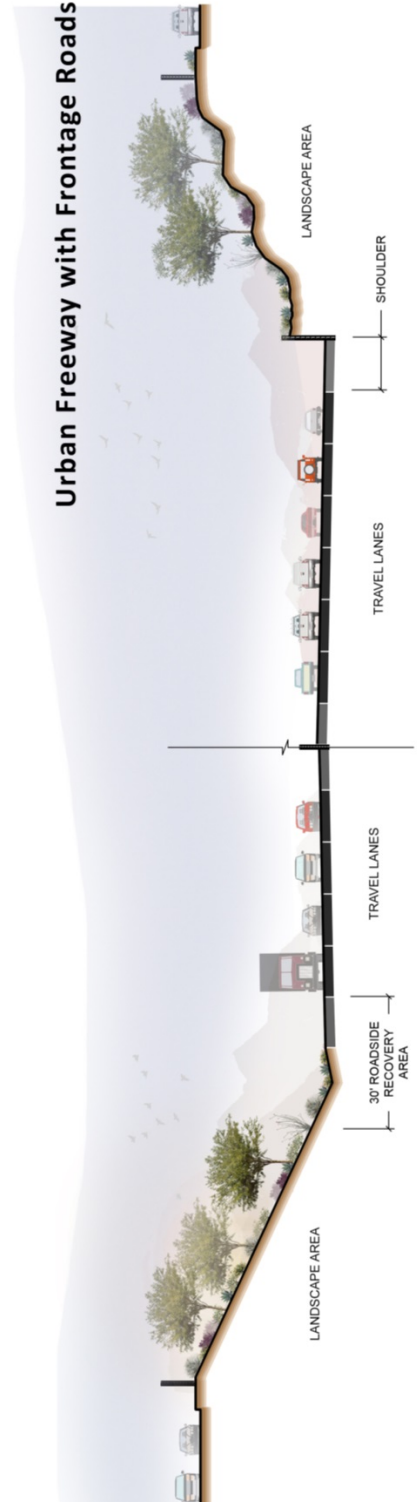
Rural Highway



Guardrail Treatment



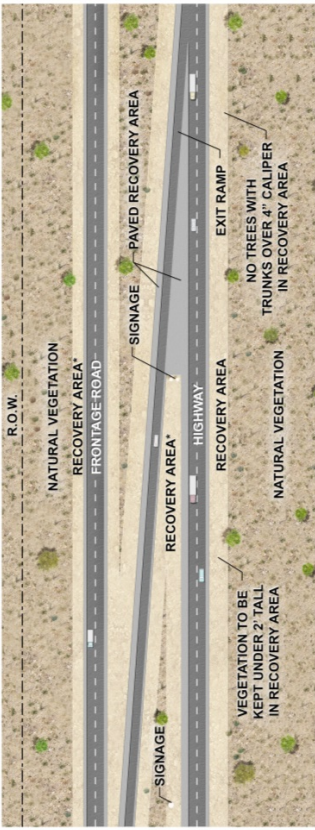
Urban Freeway with Frontage Roads



* VARIABLE - REFER TO RECOVERY AREA WIDTH CRITERIA TABLE

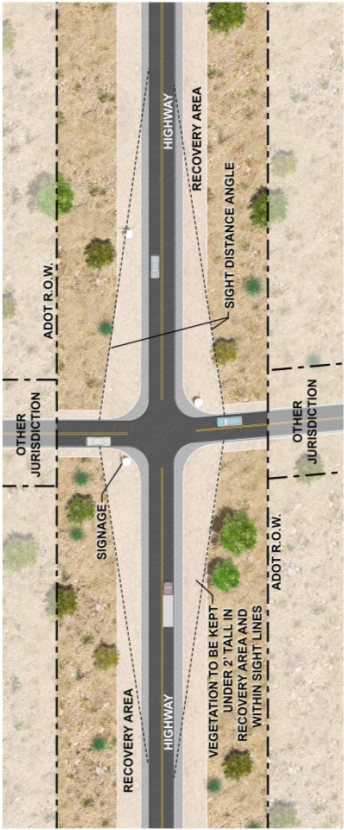
Sight Line Diagrams

Frontage Road



Not to Scale

Intersection



Not to Scale

Recovery Area Information

Width Criteria

| DESIGN SPEED | DESIGN ADT* | FILL SLOPES |
|----------------|-------------|-----------------|
| 40 MPH OR LESS | Under 750 | 6:1 OR FLATTER |
| | 750-1500 | 5:1 TO 4:1 INCL |
| | 1500-6000 | 10 |
| | Over 6000 | 10 |
| 45-50 MPH | Under 750 | 12 |
| | 750-1500 | 14 |
| | 1500-6000 | 16 |
| | Over 6000 | 18 |
| 55 MPH | Under 750 | 12 |
| | 750-1500 | 14 |
| | 1500-6000 | 18 |
| | Over 6000 | 20 |
| 60 MPH | Under 750 | 14 |
| | 750-1500 | 18 |
| | 1500-6000 | 22 |
| | Over 6000 | 24 |
| >85 MPH | Under 750 | 18 |
| | 750-1500 | 24 |
| | 1500-6000 | 30 |
| | Over 6000 | 30 |
| | Under 750 | 20 |
| | 750-1500 | 26 |
| | 1500-6000 | 30 |
| | Over 6000 | 30 |

CUT SLOPES: Where fixed object obstructions are placed on cut backslopes, the recovery area width requirement should meet the table shown utilizing the foreslope of the cut as the appropriate fill slope rate.

*ADT: Average Daily Traffic

NOTE: For additional information see the ADOT Roadway Design Guidelines

Notes

- Maintain Roadside Recovery Area (RRA) using Integrated Vegetation Management (IVM) techniques for errant vehicle recovery and weed control.
- Keep RRA free of all vegetation that will reach a cumulative trunk diameter of 4" before the next scheduled maintenance.
- Prune or remove vegetation as needed to provide visibility of signs and guardrail and maintain ample sight distance on curves and at intersections.
- Includes brush, tree and tree seedling removal with the potential to impair visibility.
- Vegetation maintenance activities should reinforce the existing/designed topography and should not impact erosion control features.
- Where noxious weeds or oversize vegetation is removed, encourage growth of native or well-adapted perennial grasses, forbs, succulents, cacti and shrubs to promote a healthy ecosystem, suppress unwanted vegetation and provide a fireguard.
- Where mowing is necessary, restrict to one mower-width along shoulders with a minimum mowing height of 4 to 6 inches except as needed to maintain visibility or sight distances.
- Please Refer to ADOT Roadway Design Guidelines figure 306.2 for more information about recovery areas and roadway design.

Appendix B: Roadway Prism

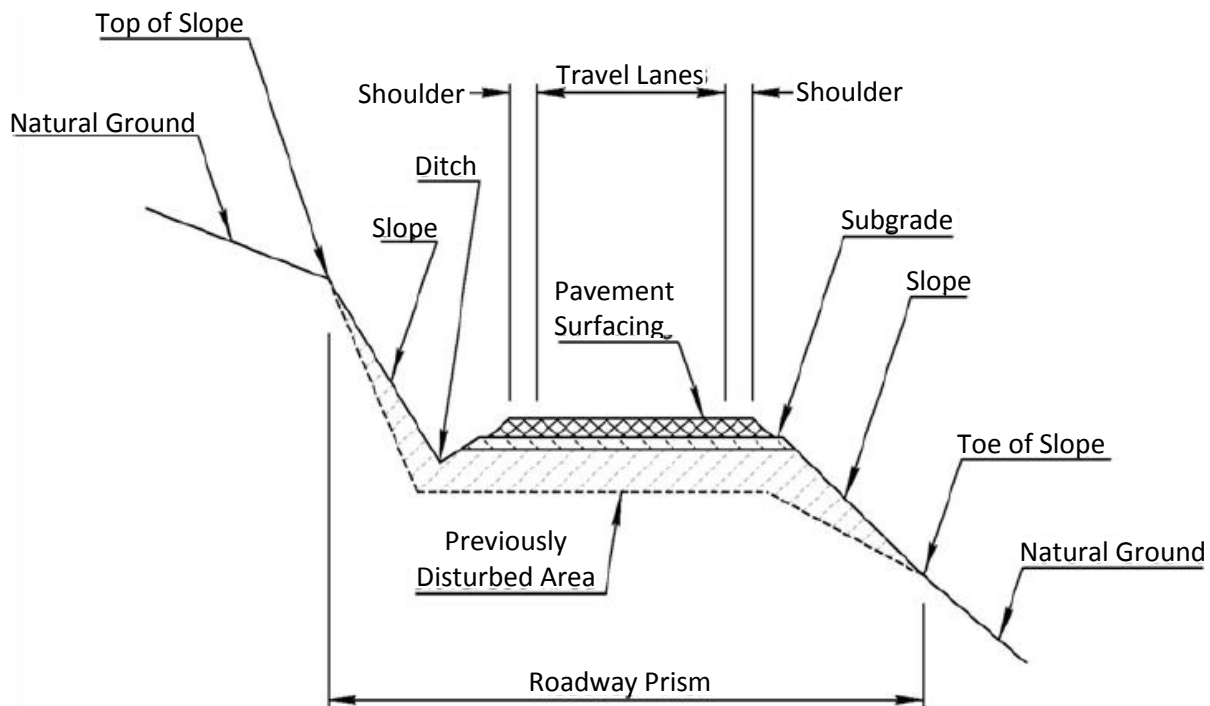
The roadway prism is the area previously disturbed during road construction. There is little chance of disturbing environmental resources while working within the roadway prism unless there is a resource nearby, such as nesting birds, which may be disturbed by noise, night-time light, or the unexpected presence of people. The width of the road prism can vary widely depending on factors including the age of the road, construction techniques, and slope. On older roads in flat or very rocky areas, the roadway prism may extend as little as 1 foot past the edge of pavement, while on more modern roads and areas with more slope, the disturbed prism may extend 20 feet or more to the edge of a fill slope or cut ditch (Figure 1). The median may or may not have been disturbed during construction.

Ways to determine the width of the disturbed road prism:

- 1) Look for the edge of the road subgrade in the field. This is definitely part of the road prism and should be free of environmental resources.
- 2) Look for cut/fill edges in the field. If the road is in a cut, the area within the cut is considered disturbed.
- 3) Look for the edge of existing natural vegetation to show the boundary of the previously disturbed area (Figure 2).
- 4) Review aerial images, such as Google Earth, to determine if the previously disturbed area is evident.

Working outside the road prism without going through environmental review risks disturbing unrecognized cultural or biological resources or hazardous materials.

Figure 1. Illustration of Roadway Prism



Appendix B: Roadway Prism

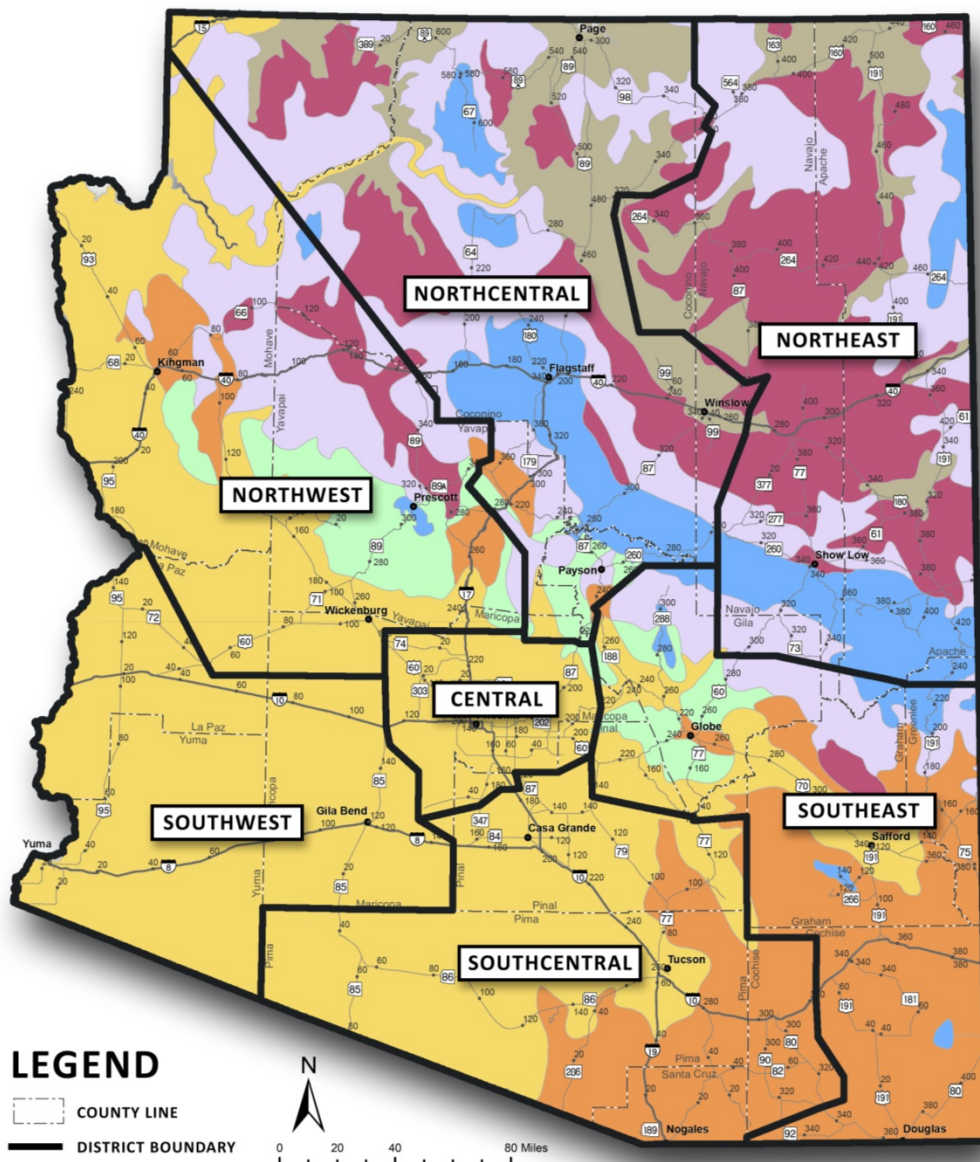
Figure 2. The person in this photo is outside of the previously disturbed roadway prism. The fill slope for the road, as well as the presence of desert pavement and creosote bushes which pre-date construction of the interstate are all indicators of the location of the road prism. The road prism ends near the base of the fill slope, as indicated by the yellow line.



Appendix C: Vegetation Management Biozones

See District-specific posters for more detailed biozone location information. The following pages give details on each biozone. Contact Roadside Resources to receive a biozone poster if your office does not have one available.

ADOT VEGETATION MANAGEMENT BIOZONES

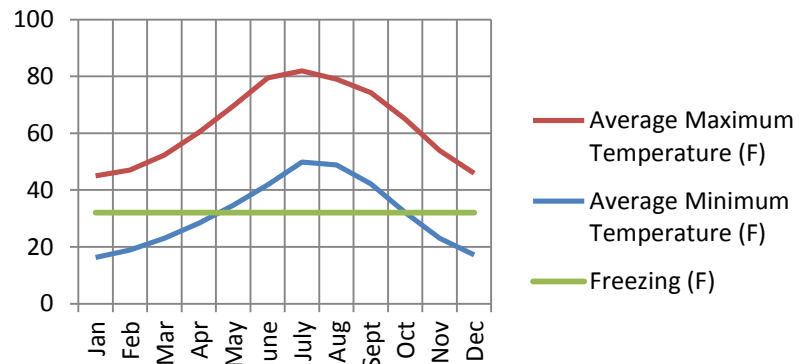


CONIFER FOREST

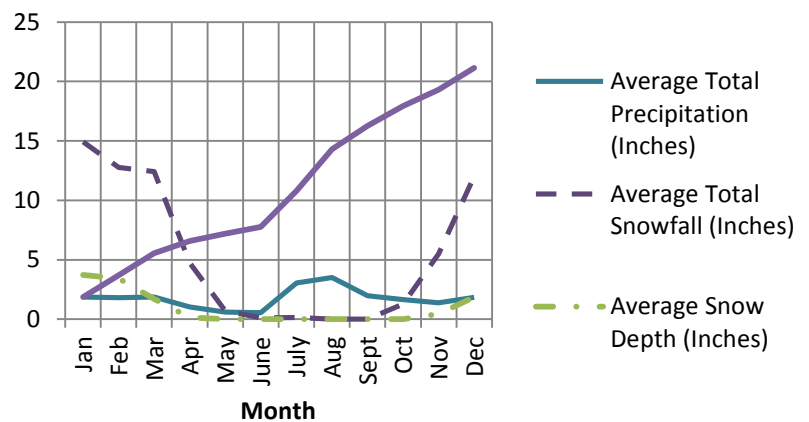
- Needleleaf evergreen trees dominate in this biozone
- Ponderosa pine (*Pinus ponderosa*) is the most common tree species, occurring at the lower elevations
- Occasionally found at the lower elevations are the deciduous trees Gambel oak (*Quercus gambelii*) and New Mexico locust (*Robinia neomexicana*).
- The most common mid-elevation conifer is Douglas-fir (*Pseudotsuga menziesii*).
- Engelmann spruce (*Picea engelmannii*) and other spruces are found at the higher elevations of the conifer forest.
- Quaking aspen (*Populus tremuloides*) fills a niche role in vegetational succession, appearing after fire or other forest disturbance
- Shrubs, grasses, and forbs are not common in the understory, but may occur in natural openings and at the edge of the forest
- Mountain slopes, high plateaus, as well as canyons, support conifer forest vegetation
- Soils found within this biozone include andesite, basalt, granite, limestone, and sandstone
- Elevations range from 3,900 to 8,300 feet
- Summer precipitation (July, August, September) accounts for nearly half of the yearly average of 21 inches
- Snowfall amounts vary widely, from 24 inches at the lower elevations to 90 inches at the higher elevations
- Below-freezing temperatures are typical from November through April
- Temperatures in the summer are mild, with the average maximum temperature peaking at just over 80 degrees F during July, the hottest month



Temperature



Precipitation

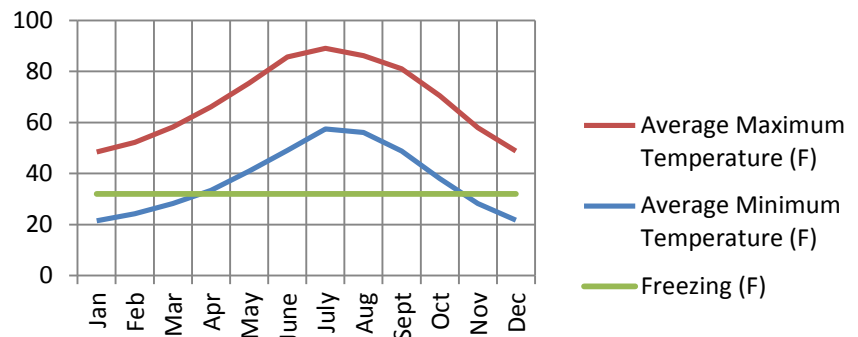


GREAT BASIN CONIFER WOODLAND

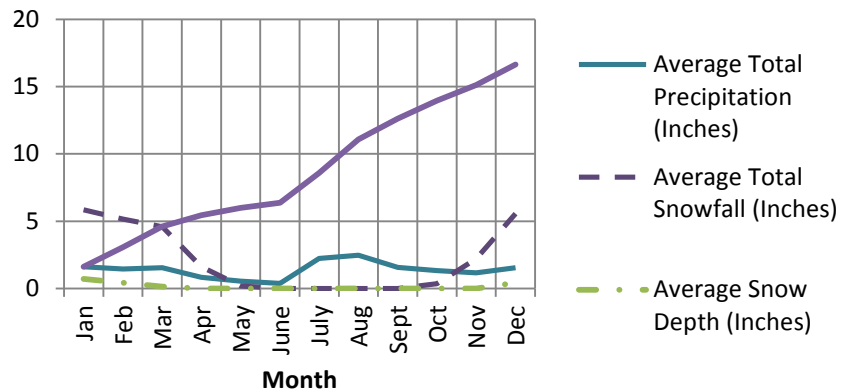
- The two dominant species of tree: pinyon (*Pinus* species) and juniper (*Juniperus* species) are the basis for the nickname often applied to this biozone, Pinyon-Juniper Woodland
- Junipers are generally dominant although either species can occur as a nearly pure stand
- Junipers tend to occur at lower elevations than pinyons
- The shrub-like form of the needle-leaf evergreen trees is typically no more than 35 feet tall
- The plant canopy is open, hence the term “woodland” versus a “forest” in which canopies touch
- Open areas are typically vegetated with grasses, and, to a lesser extent, shrubs
- Small cacti are well represented in this biozone, ranging from hedgehog (*Echinocereus* species) and beehive cactus (*Coryphantha* species) to prickly pear (*Opuntia* species) and cholla (*Cylindropuntia* species)
- Characteristic topography includes mesas, slopes, and ridges; habitats tend to be rocky, with thin soils predominating
- Elevations range from 4,400 to 7,000 feet
- Summertime maximum temperatures are moderate, with the hottest month (July) averaging 89 degrees F
- Winters are cold and snowy: from November through March, the average minimum temperature is well below freezing, and an average of 25 inches of snow falls each year
- The two driest months (May and June) are followed by the two wettest months (July and August)
- Annual precipitation averages 16 inches



Temperature



Precipitation

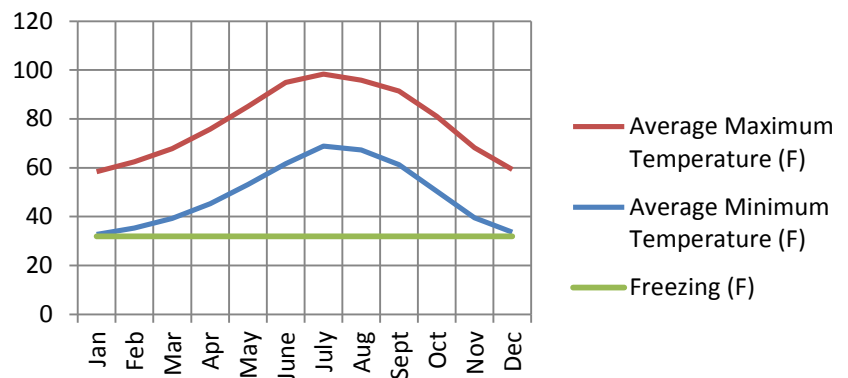


CHAPARRAL

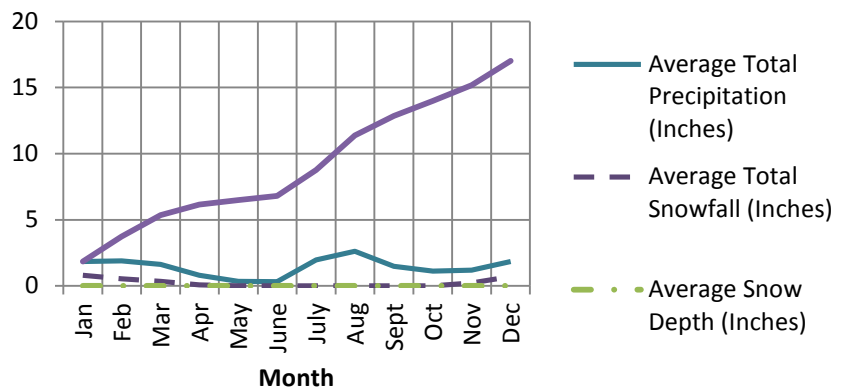
- Vegetation is comprised predominantly of shrubs with small, leathery leaves
- Typical height of the shrub canopy is 4 to 7 feet
- The plants are deeply rooted and most species quickly regenerate after burning
- The most widespread shrub species is shrub live oak (*Quercus turbinella*)
- Leafy succulents such as yucca (*Yucca baccata*) and sotol (*Dasylirion wheeleri*) occur sporadically
- Trees are typically limited to drainages
- Grasses and forbs are not abundant (except following fires) due to the dense shrub canopy, typically 70% cover or greater
- This biozone is found in foothill, mountain slope, and canyon habitats between 3,400 and 6,000 feet in elevation
- Soils are typically derived from granite and limestone parent material
- Maximum temperatures in the summer months can reach into the high 90's F
- Below-freezing temperatures occur in the winter, with December and January being the coldest months
- Average annual precipitation is 17 inches



Temperature



Precipitation

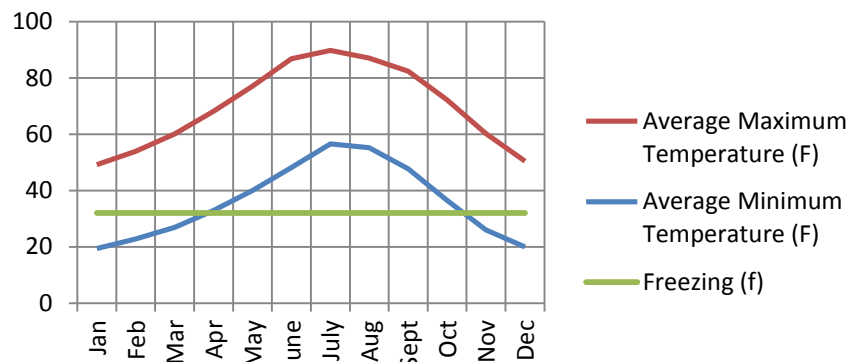


PLAINS AND GREAT BASIN GRASSLAND

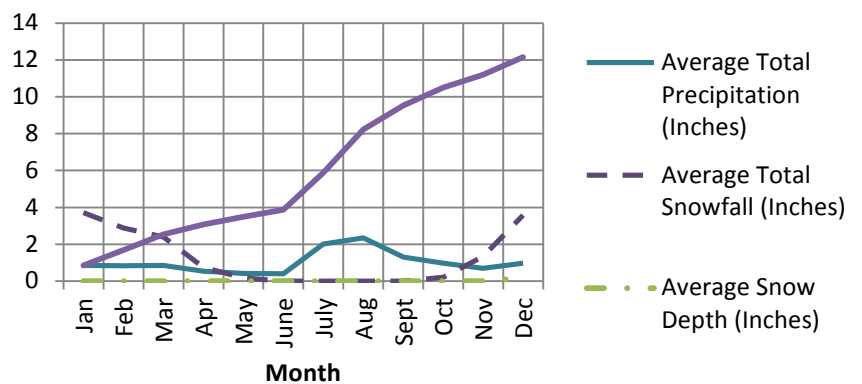
- Vegetation is dominated by perennial, sod-forming grasses, including blue grama (*Bouteloua gracilis*) and other grammas
- Shrubs such as fourwing saltbush (*Atriplex canescens*) and snakeweed (*Gutierrezia sarothrae*) may be scattered throughout the grassland, or due to grazing or soil conditions, may be abundant
- Several species of prickly pear (*Opuntia* species) and cholla (*Cylindropuntia* species) as well as smaller types of cacti may occur, though usually not in large numbers
- Junipers (*Juniperus* species) are common invaders of grassland, particularly on rocky, thin soils
- Characteristic topography of this biozone includes plains, mesas, and rolling hills. Elevations range from 4,500 to 7,000 feet
- Summertime high temperatures are relatively moderate, with the average maximum in the hottest month (July) just under 90 degrees F
- Below-freezing temperatures occur consistently from November through April
- An average of 15 inches of snow falls each year
- More than a third of the 12 inches of average annual precipitation occurs in July and August
- Long windy periods are common, particularly during winter and early spring



Temperature



Precipitation

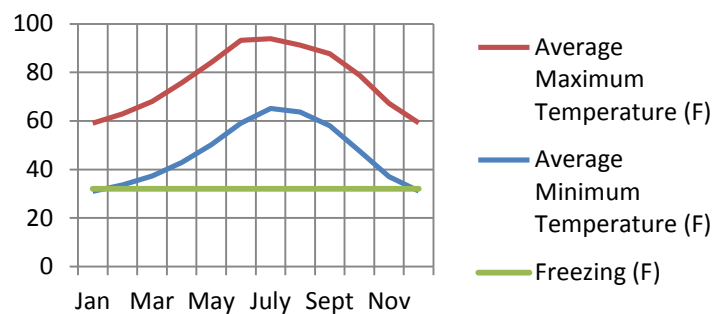


SEMIDESERT GRASSLAND AND CHIHUAHUAN DESERTSCRUB

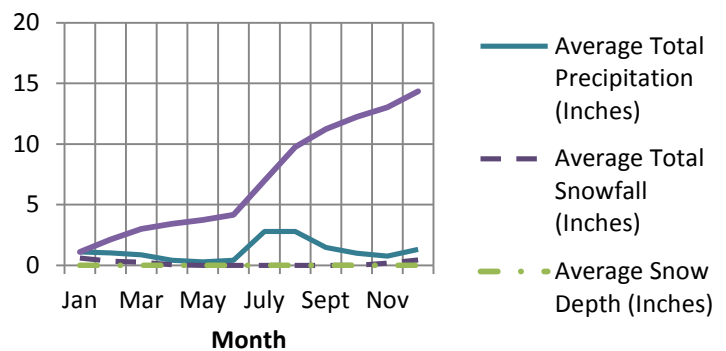
- Grasses and shrubs are the dominant vegetation types, varying in composition as influenced by soils, elevation, and precipitation
- Common grasses include the perennial bunchgrasses tobosa (*Hilaria mutica*) and black grama (*Bouteloua eriopoda*), as well as other gramas.
- In some areas where heavy grazing has occurred, the shrubs, trees, cacti, and forbs outnumber grasses
- Shrubs such as creosote bush (*Larrea tridentata*), tarbush (*Flourensia cernua*), and viscid acacia (*Acacia neovernicosa*) and subshrubs such as burrowed (*Isocoma tenuisecta*) and snakeweed (*Gutierrezia sarothrae*) often form mosaics within the grasslands
- Leaf succulents are particularly well-represented within this biozone: yucca (*Yucca* species), beargrass (*Nolina* species), sotol (*Dasylirion* species) and agave (*Agave* species)
- Common cacti include barrel cactus (*Ferocactus* species), prickly pear (*Opuntia* species), and cholla (*Cylindropuntia* species), as well as numerous types of smaller cacti.
- Trees such as mesquite (*Prosopis* species) and juniper (*Juniperus* species) are typically restricted to drainages
- Basin and range topography is characteristic of this biozone
- Much of the region's drainage is internal, resulting in enclosed basins, or playas
- Many of the soils are derived from limestone
- Elevations range from 3,300 to 4,800 feet
- Winters are relatively mild, although freezing temperatures commonly occur, particularly in December and January
- Summers are hot, with the average maximum temperature reaching between 91 and 94 degrees F in June, July, and August
- About half of the annual rainfall of 14 inches occurs from July through September
- The months of April, May, and June are very dry, with total rainfall of just over an inch, on average



Temperature



Precipitation

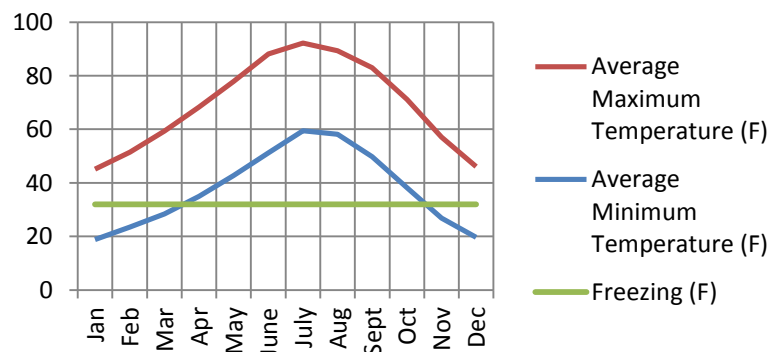


GREAT BASIN DESERTSCRUB

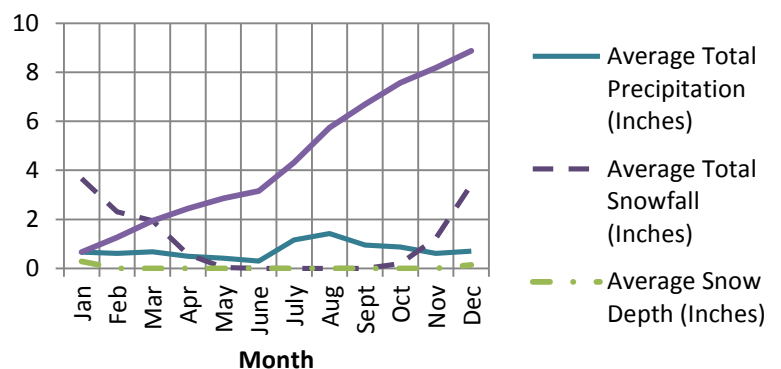
- The vegetation is dominated by shrubs, commonly sagebrush (*Artemisia* species), saltbush (*Atriplex* species), winterfat (*Krascheninnikovia lanata*) and other small- to medium-sized species
- Few grass species occur, due to low amount of precipitation
- Cacti are not abundant and tend to be low growing; common species are pricklypear (*Opuntia* species) and cholla (*Cylindropuntia* species)
- Elevations range from 4,100 to 6,400 feet
- Basin and range topography is typical, with north-south trending mountain ranges separated by flat valleys or basins
- Many basins do not drain, so salts accumulate in the soil
- The basins are often dominated by plants in the goosefoot family (*Chenopodiaceae*) because of their salt tolerance
- Summers are warm, with maximum temperatures in the high 80's and low 90's F
- Minimum temperatures in the coldest months of January and February are typically 20 degrees F
- Total annual precipitation averages 9 inches, with July and August being the wettest months, and May and June the driest
- On average, 13 inches of snow falls each year



Temperature



Precipitation

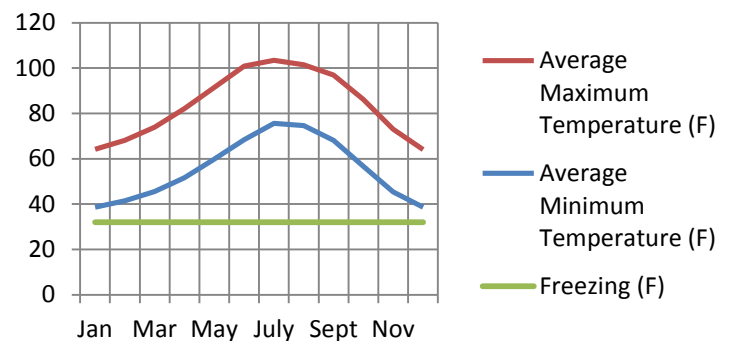


SONORAN AND MOHAVE DESERTSCRUB

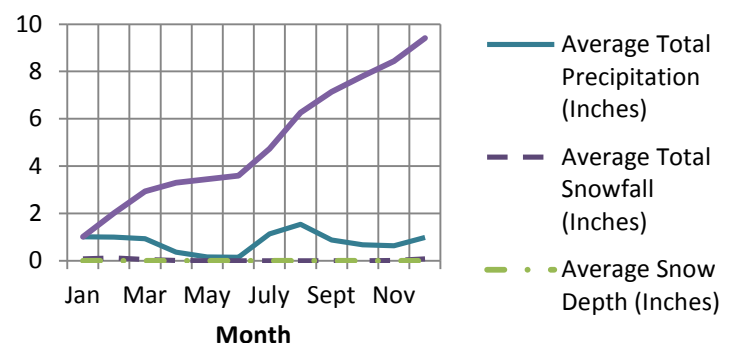
- Palo verde (*Parkinsonia* species) is one of the most common trees of this biozone
- Ironwood trees (*Olneya tesota*) thrive in the warmest, nearly frost-free areas, and mesquite trees (*Prosopis* species) are commonly found along drainages and in lowlands
- Large cacti, most notably saguaro (*Carnegiea gigantea*), are common in the Sonoran Desert, their existence enabled by the lack of hard frosts
- A rich assortment of small and medium-sized cacti such as barrel cactus (*Ferocactus* species) and prickly pear (*Opuntia* species) occurs in both the Sonoran and Mohave Deserts
- The tree-like yucca nicknamed Joshua tree (*Yucca brevifolia*) represents the largest succulent in the Mohave Desert
- Common shrubs include creosote bush (*Larrea tridentata*), bursage (*Ambrosia* species), saltbush (*Atriplex* species), and acacia (*Acacia* species)
- Depending on seasonal rainfall, annual wildflowers may be a showy, though short-lived, element of the desert vegetation
- Landforms range from broad plains to rocky hillsides, with bajadas forming the intermediate topography; canyons bisect the mountainous areas and dry lakes are common, especially in the Mohave Desert
- Soils are primarily of granitic and volcanic origin
- Elevations range from near sea level to 3,000 feet
- Extreme summer heat defines the climate of this desert region, with three months of average maximum temperatures above 100 degrees F
- Freezing temperatures are uncommon, and when they do occur, are typically of short duration
- Annual rainfall varies significantly across the region, from less than four inches in the west (the Mohave) to greater than twelve inches in the east (the Sonoran)
- The Mohave Desert receives most of its annual rainfall from winter storms that originate in the Pacific Ocean, while in the Sonoran Desert, a bimodal pattern of rainfall brings moisture in both winter and summer, the Gulf of Mexico being the source of the latter storms



Temperature

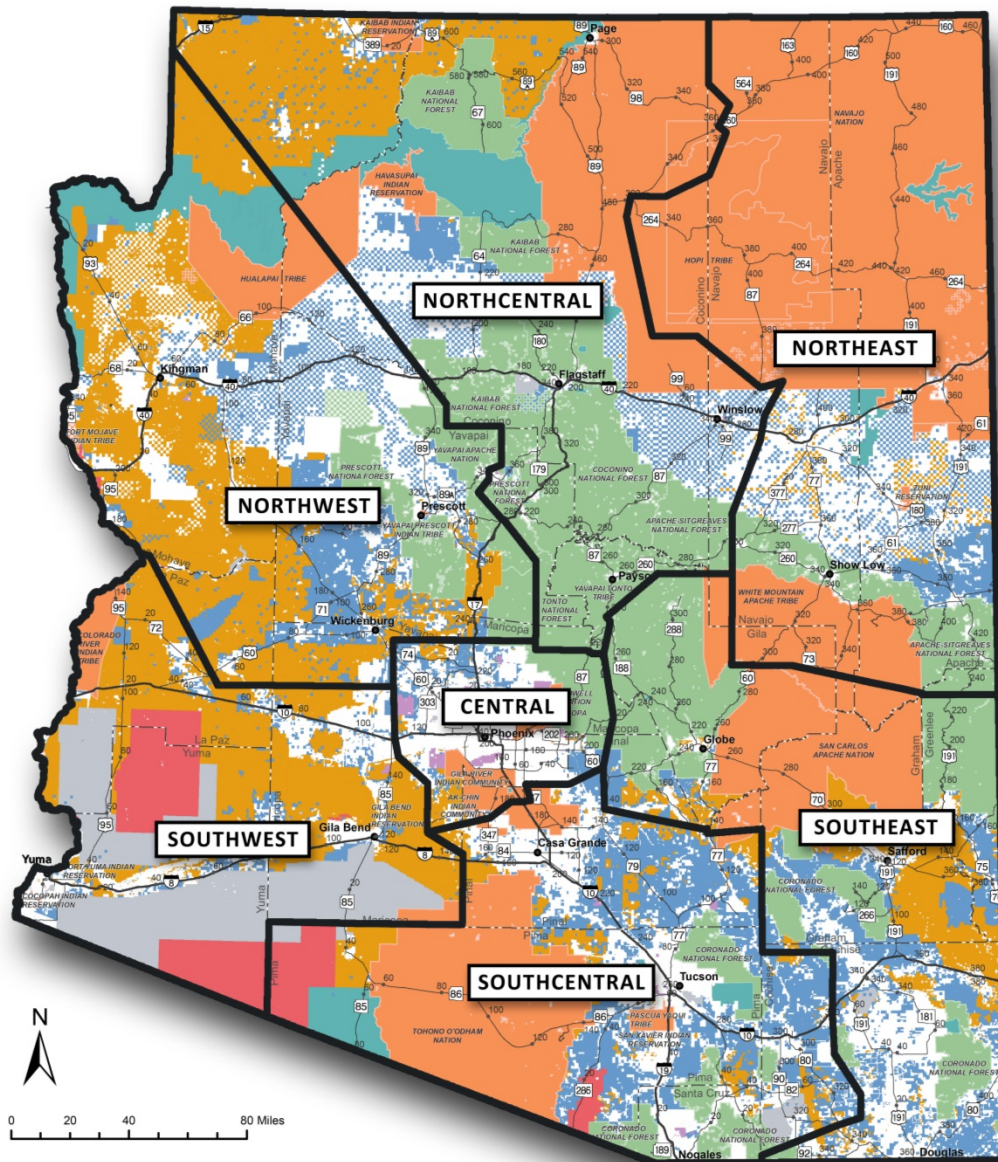


Precipitation



Appendix D: Land Ownership

Land ownership is important for determining whether additional coordination is needed ahead of vegetation management activities. See District-specific posters for more detailed land ownership information. Contact Roadside Resources to receive a poster if your office does not have one available.



LEGEND

- COUNTY LINE
- DISTRICT BOUNDARY

LAND OWNERSHIP

- | | | |
|---|--|---|
| PRIVATE | STATE AND LOCAL PARK | WILDLIFE REFUGE |
| STATE TRUST LAND | NATIONAL FOREST | MILITARY |
| INDIAN RESERVATION | NATIONAL PARK | BUREAU OF LAND MANAGEMENT |