New Mexico
Non-Native Phreatophyte/Watershed Management Plan

A Joint Effort by:

Interagency Workgroup
New Mexico Department of Agriculture (lead agency)
New Mexico Energy, Minerals and Natural Resources Department
New Mexico Environment Department
New Mexico Indian Affairs Department
Office of State Engineer
In consultation with New Mexico's
Soil and Water Conservation Districts

Prepared by:

Tamarisk Coalition
Under contract #P455567 with New Mexico Department of Agriculture
Pursuant to 2004 Legislative direction in House Bill 2

[DATE]

Agreement

The contents of the New Mexico Non-native Phreatophyte/Watershed Management Plan, specifically the findings, vision, guiding principles, and recommendations were prepared by the following participating State agencies. Approval of this plan by the parties named herein in no way limits any agency's existing legal authority or responsibilities.

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The New Mexico Forest and Watershed Health Planning Committee. *The New Mexico Forest and Watershed Health Plan*, December 15, 2004.

New Mexico Interagency Weed Action Group (IWAG). *Strategy for Long-term Management of Exotic Trees in Riparian Areas for New Mexico's Five River Systems, 2005-2014,* March 2004.

New Mexico Office of State Engineer/Interstate Water Commission. *New Mexico State Water Plan,* December 23, 2003.

Saltcedar Task Force. *Final Report,* April 14, 2004.

The Department of Game and Fish and the Energy, Minerals and Natural Resources Department, December 2004. *Funding Conservation for New Mexico: Providing for Future Generations, A Study To Investigate Sustainable Alternative Funding Sources To Protect New Mexico's Unique Landscapes, Natural Areas, Recreation Areas and Wildlife Habitats,* as directed in House Joint Memorial 37 of the 46th Legislature, 2nd Session.

Tamarisk Coalition, *New Mexico Options for Non-native Phreatophyte Control*, March 2005.

Southwest Strategy, *New Mexico Interagency Rangeland Monitoring Handbook.*

Federal Interagency Stream Restoration Working Group, *Stream Corridor Restoration: Principles, Processes and Practices,* August 2001.

Taylor, J.P., and McDaniel, K.C. 2004. *Revegetation Strategies after Saltcedar (Tamarix spp.) Control in Headwater, Transitional, and Depositional Watershed Areas*. Galley proof, Weed Technology.

McDaniel, K.C., DiTomaso, J.M., Duncan, C.A. 2004. *Tamarisk or Saltcedar (Tamarix spp.)* Galley proof for Allen Press.

Tamarisk Coalition February 28, 2005. *Draft Public Participation Plan New Mexico Statewide Policy and Strategic Plan for Non-Native Phreatophyte/Watershed Management Prepared*.

Public comments received on the Interim Final New Mexico Non-native Phreatophyte/Watershed Management Plan; May 1 through July 19, 2005.

Executive Summary

Riparian lands in New Mexico have been seriously impacted by the infestation of non-native phreatophytes. The two of most concern are tamarisk (a.k.a. saltcedar) and to a lesser extent Russian olive. Tamarisk is a tenacious shrub or tree that has a deep root system (up to 100 feet) and leaves a salt residue on the soil surface; it has no natural enemies in the United States. These characteristics have resulted in it quickly replacing valuable native vegetation. Tamarisk thickets now exist along large portions of the rivers, streams and lakes in New Mexico. These thickets provide poor habitat for livestock and wildlife, increase the intensity of wildfires, and greatly restrict the recreational activities available along the State's waterways. New Mexico's desire to control these infestations is directly linked to these adverse impacts and to tamarisk's reputation for consuming more water than native species. For New Mexico's 10,810 miles of rivers and streams in the State's five principle watersheds, the Interagency Weed Action Group (IWAG) roughly estimated that 500,000 acres are infested with non-native phreatophytes. Throughout the West, the estimate is approximately 1,500,000 acres for tamarisk alone.

New Mexico is the recognized leader in tamarisk research and the implementation of tamarisk control measures in the West. Activities include research efforts at New Mexico State University (NMSU) and the University of New Mexico and major State funded tamarisk control projects. The NMSU Cooperative Extension Service and the U. S. Departments of Interior and Agriculture have also done considerable work and research at Bosque del Apache National Wildlife Refuge near Socorro. The New Mexico Department of Agriculture (NMDA) currently has the fiduciary and oversight responsibility for all State funded non-native phreatophyte programs and allocates funds for specific projects through coordination and collaboration with the soil and water conservation districts (SWCD's). The SWCD's then coordinate control efforts with private landowners; federal, Tribal, and local governments; and non-profit organizations as appropriate. This relationship between the NMDA and the SWCD's has been effective in accomplishing control activities; however, New Mexico recognizes the need for a comprehensive set of priorities to guide tamarisk control efforts including revegetation and rehabilitation, long-term management and maintenance, and monitoring the progress of these efforts.

In House Bill 2 (HB-2), the 2004 New Mexico State Legislature tasked the Departments of Agriculture; Energy, Minerals, and Natural Resources; Environment; Indian Affairs; and the Office of the State Engineer in consultation with the SWCDs to develop a statewide policy and strategic plan for non-native phreatophyte and watershed management. The purpose of this Plan is to provide guidance for control of non-native phreatophytes and to further identify the necessary templates and protocols for monitoring, revegetation, rehabilitation, and long-term watershed management activities. It was developed by the HB-2 Work Group which included representatives from the above organizations in response to the direction given in HB-2.

The HB-2 Work Group supports this vision for New Mexico:

New Mexico will become the national model for conservation and restoration of healthy functions to its ecosystems and watersheds through landscape-scale management of its watersheds, including invasive plant species.

This vision was the foundation upon which a set of guiding principles were developed to provide a common ground for directing future actions and activities. These guiding principles included those developed in the New Mexico Forest Watershed Health Plan (FWHP) and at the U. S. Department of Interior's spring 2004 Team Tamarisk Conference held in Albuquerque. Two additional guiding principles were added to include the Tribal governments' unique relationships in New Mexico and a hydrologic principle that may afford increased opportunity for rehabilitation success. These principles resulted in the formulation of the following recommendations that represent the best path forward for achieving this Plan's vision. They fall within the broad categories of management, planning, funding, education, monitoring, research, and government action that will aid New Mexico in achieving the HB-2 Work Group's vision. These recommendations represent a significant set of actions that must be taken, in some cases over decades, to achieve the vision.

Although there are a number of recommendations contained in this Plan, below are those that the HB-2 Work Group identified as being of critical importance over the next 12-18 months. The following recommendations ensure that the actions and efforts by appropriate State agencies and the SWCD's will continue to be performed in a responsible and cost effective manner that satisfies stakeholder concerns.

- We support the concept of an office of forest and watershed health in State government whose primary function could be to identify and coordinate resources, and to facilitate cooperation between State agencies and other partners in support of this Strategic Plan and other related statewide policy documents.

- NMDA will provide the administrative and contract oversight, in cooperation with the Soil and Water Conversation Commission and SWCD's, for the non-native phreatophyte management program. NMDA will refine performance measures to ensure accountability and report the results on a timely basis. NMDA will continue to retain the primary leadership for implementation of this Strategic Plan, as described in the Implementation of Recommendations section.

- Appropriate State agencies will identify current and future efforts for non-native phreatophyte control. NMDA will take the lead to consolidate this information and develop with State and federal agencies, Tribal governments, and the SWCDs watershed plans to control these non-native plants and restore lands with desirable vegetation.

- NMDA will develop, in consultation and collaboration with other State agencies and the SWCDs, specific criteria for determining funding priorities for State funded projects. This should include the degree of resource leveraging, competition with other projects, meeting watershed goals, and possible partnerships, to mention a few.

- Monitoring will be performed on all watershed projects, and requested funding levels should be adequate for supporting activities from baseline data establishment through long-term monitoring.

- The importance of the existing non-native phreatophyte programs to New Mexico cannot be overstated. It is recommended that the Legislature and Governor consider creating continuous, sustainable funding for these efforts.

In order to carry out the activities associated with the various aspects of the non-native phreatophyte control, revegetation/rehabilitation, monitoring, and long-term management and maintenance, control templates and protocols were developed. The templates define what actions need to be taken, and the protocols define how the actions will be performed. These templates and protocols help to ensure that the selected actions and measures are effective, efficient, well documented, and that proper oversight is in place. Comments for developing these templates and protocols were solicited from numerous New Mexico experts in the areas of control, revegetation and rehabilitation, monitoring, and long-term watershed management and maintenance. Their comments were appropriately considered and incorporated into this Plan.

Public participation activities occurred during May, June, and July in 2005 to gain additional input to achieve informed consent on this Strategic Plan by State, Tribal, and local governments; organizations; private landowners; federal agencies: and other potentially affected interests.

Foreword

This Plan provides a path forward for management and implementation of future control practices and rehabilitation efforts in New Mexico's watersheds with special reference to riparian areas. This Plan was developed by the HB-2 Work Group comprised of senior representatives from the following New Mexico Agencies: Department of Agriculture; Energy, Minerals and Natural Resources Department; Environment Department; Indian Affairs Department; and Office of State Engineer, in consultation with the soil and water conservation districts, represented by the Chair of the New Mexico Soil and Water Conservation Commission. Within this Plan there are numerous terms that may not be familiar and, therefore, the reader is directed to the Definitions section in the back of this Plan for clarification on their meanings. Throughout the document the term "Tribes" is used to collectively represent New Mexico's 22 individual Tribes, Indian Nations, and Pueblos.

New Mexico's riparian lands have been severely impacted by many of man's activities and actions, but perhaps the most dramatic are the hydrologic changes that have aided the rapid infestations of the non-native invasive plant tamarisk (*Tamarix spp.*, also known as saltcedar). Tamarisk is a tenacious shrub/small tree with a deep root system (up to 100 feet) and leaves a salt residue on the soil surface. Under the right conditions, these characteristics enable it to quickly replace native cottonwoods, willows, grasses, and forbs. The resulting tamarisk thickets invade the banks and floodplains of our rivers and streams; provide poor habitat for flora and fauna; increase fire hazards; limit human use of the waterways, and generally consume more water than native vegetation. Russian olive is another non-native phreatophyte that has infested New Mexico's riparian lands and is beginning to cause similar impacts.

The New Mexico Legislature has taken positive steps to solve this problem. Over the past three years it has authorized more than $11,000,000 for non-native phreatophyte control on the Canadian, Rio Grande, and Pecos River systems. During the 2004 legislative session, the Legislature expanded the program in House Bill 2 (HB-2) to include a revegetation component and the development of a Statewide Non-native Phreatophyte/Watershed Strategic Plan. [1]

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[1] 2004 House Bill 2 excerpts:

(140) New Mexico State University: $2,400,000
For expenditures through fiscal year 2006 for the restoration and revegetation of native species on the Canadian river, the Pecos river and the Rio Grande including monitoring, revegetation, rehabilitation, and long-term strategic planning. Up to five hundred thousand dollars ($500,000) will be available to an interagency work group comprising the department of agriculture; energy, minerals and natural resources department; state engineer; department of environment; and office of Indian affairs, in consultation with the soil and water conservation districts. The work group shall develop a statewide policy and plan to guide future treatment and to provide templates and protocols for monitoring, revegetation, rehabilitation and long-term watershed management.

(141) New Mexico State University: $2,400,000
For expenditures through fiscal year 2006 for a non-native phreatophyte eradication and control program on the Canadian river, the Pecos river and the Rio Grande river contingent upon a statewide phreatophyte/watershed strategic plan to be developed by the departments of agriculture, energy, minerals and natural resources, state engineer, environment and Indian affairs.

This Plan relies heavily on the *New Mexico Forest and Watershed Health Plan – an Integrated Collaborative Approach to Ecological Restoration, December 15, 2004* (FWHP)*;* work performed by the New Mexico Interagency Weed Action Group (IWAG) in their *Strategy for Long-Term Management of Exotic Trees in Riparian Areas for New Mexico, Five River Systems, 2005-2014;* Section C.8 of the New Mexico Office of State Engineer/Interstate Stream Commission's *State Water Plan, December 23,* 2003 that "Promotes river riparian and watershed restoration . . ."; findings of the Saltcedar Task Force, *Final Report, April 14, 2004*; and the National Invasive Species Council Management Plan, *Meeting the Invasive Species Challenge, 2001*. This HB-2 Plan includes many of the recommendations found in the FWHP because it identifies the need for a landscape scale/watershed approach to the problems found in New Mexico's watersheds. The issues of forest and watershed health cross political and landownership boundaries making the scale for planning especially important. This Plan establishes complementary policy connections between the FWHP but concentrates on templates and protocols for control, revegetation and rehabilitation, monitoring, and long-term management of non-native invasive plant species in New Mexico's watersheds.

Since non-native invasive plant species do not respect political boundaries, successful resolution of these problems necessitates extensive multi-agency and landowner coordination and cooperation. The HB-2 Interagency Work Group has developed this Plan and its recommended actions with full recognition of the importance of the cooperation required among the State's departments and offices, federal agencies, affected landowners, Tribal governments, soil and water conservation districts, and concerned environmental groups.

A benefit of this Plan is that it will provide the framework within which New Mexico will interact with its adjoining states, Mexico, and federal partners in the implementation of national policies and programs governing watershed and ecosystem health.

Public Participation

Public participation activities occurred during May, June, and July in 2005 to gain additional input on the Plan. Fourteen public meetings in seven different locations throughout the State were conducted. 170 interested citizens attended these meetings and provided input/comments regarding the Interim Final New Mexico Non-Native Phreatophyte/Watershed Management Plan. These meetings were held on May 26th in Truth of Consequences, May 27th in Albuquerque, June 8th in Roswell, June 9th in Albuquerque/ Pueblo Cultural Center, June 10th in Tucumcari, June 23rd in Farmington and June 24th in Taos. Additionally, 23 written comments were received through the NMDA website, postal mail, hand delivered, and e-mail. Based on the public comments received, the HB-2 Work Group has recommended that these comments be posted on the NMDA website and be used to inform the implementation of the Plan.

Background

Overview – Non-native phreatophytes, principally tamarisk and Russian olive, have invaded a wide range of areas throughout New Mexico and much of the West, including riparian habitats, ephemeral streams, and adjacent agricultural lands and uplands. In general, the following adverse impacts are widely recognized:

- Tamarisk populations develop into dense thickets that can prevent establishment of native vegetation such as cottonwoods, willows, grasses, and forbs.

- As a phreatophyte, tamarisk invades riparian areas, potentially leading to extensive degradation of habitat and water quality, and loss of biodiversity in the stream corridor.

- Salts drawn from the groundwater by tamarisk are excreted through leaf glands and are deposited on the ground and water surface with the leaf litter. This increases surface soil and water salinity to levels that can prevent the germination of many native plants and negatively impact water quality.

- Tamarisk seeds and leaves are of little value to most wildlife and livestock as a food source.

- Leaf litter and dead and senesced woody material from tamarisk tends to increase the frequency and intensity of wildfires that kill native cottonwood and willows but not tamarisk. The Rio Grande bosque has experienced numerous wildfires over the past several years due to this situation.

- Dense stands on stream banks may gradually cause narrowing of the channel and an increase in flooding. Channel narrowing along with tamarisk-induced stabilization of stream banks, bars, and islands leads to changes in stream morphology that can impact habitat for aquatic species.

- Dense stands affect livestock by reducing forage and blocking access to surface water.

- Aesthetic values of the stream corridor are degraded, and access to streams for recreation (e.g., boating, fishing, hunting, bird watching) is lost.

Each of these points is important to one or more constituencies. However, tamarisk's reputation of using significantly more water than the native vegetation that it displaces may be the single most scientifically debated critical problem raised in connection with this plant. The drought over the past five years (2000 - 2004) in New Mexico has elevated this concern. Research shows a wide variation in water consumption based on density, age, mix of vegetation, water quality, depth to groundwater, and climate. Although there is no specific value that can be applied because of theses many variables, water consumption for tamarisk can generally be assumed to be about 25% more than a cottonwood/willow community and several times that of a dry land plant community.[2] This user of New Mexico's limited water resources has been reported to dry

[2] Joint USDA and Interior pending technical report on the economic impacts of tamarisk, 2004.

up springs, wetlands, and riparian areas. Although not scientifically evaluated for changes in the water balance, anecdotal evidence at Spring Lake near Artesia and Cejita Creek in Harding County near Rosebud has shown increases in water availability after tamarisk removal. [3] [4] One purpose of this Plan is to provide a scientific approach to address this question through the monitoring templates and protocols provided later.

For New Mexico's 10,810 miles of rivers and streams in the five principle watersheds of the Rio Grande, Pecos, Canadian, Gila/San Francisco, and San Juan rivers, the Interagency Weed Action Group (IWAG) roughly estimated that 500,000 acres are infested with non-native phreatophytes. An excellent reference on tamarisk taxonomy, botanical characteristics, distribution and occurrence, environmental and economic impacts, and its value and use has recently been prepared and is included, with permission, among the Supporting Documents to this Plan. [3]

New Mexico's Past Practices – New Mexico is a leader in tamarisk research and the implementation of tamarisk control measures. This is evidenced by ongoing research efforts at the State's universities; research, control, and revegetation activities by the NMSU Cooperative extension Service and the U.S. Departments of Interior and Agriculture at Bosque del Apache National Wildlife Refuge near Socorro; and in the large allocation of funds provided by the Legislature for tamarisk control. The NMDA provides the leadership, administrative oversight, and assistance for State funded non-native phreatophyte programs. It allocates these funds for specific projects through coordination and collaboration with the Soil and Water Conservation Commission, the soil and water conservation districts (SWCDs), and the New Mexico Association of Conservation Districts (NMACD). The districts, in turn, coordinate control efforts with private landowners; federal, Tribal, and local governments; and non-profit organizations across jurisdictional boundaries on a watershed basis; e.g., the Canadian River. However, New Mexico needs to produce a comprehensive set of priorities and guidelines for its tamarisk efforts within and among watersheds for control, revegetation/rehabilitation, long-term management and maintenance, and the monitoring of all of these efforts.

This relationship between NMDA and the SWCDs has been effective in accomplishing the past directives of the Legislature to "control saltcedar". The primary approach has been the use of aerial herbicide application using helicopters on large contiguous stands and, to a lesser extent, the use of mechanical equipment, hand labor, and biological control with goats. The basis for choosing control methods takes into consideration several factors such as: type of stand, mono-typic or mixed; landowner goals and objectives; proximity to urban areas; economy of scale; and other factors.

The public and policy makers have expressed concerns about large-scale herbicide use and the lack of comprehensive revegetation planning. Problems encountered thus far typify start-up issues common with new programs. The control program using aerial applied herbicide and other

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[3] McDaniel, K.C., DiTomaso, J.M., Duncan, C.A. 2004. Tamarisk or Saltcedar *(Tamarix spp.)* Galley proof for Allen Press.

[4] US Department of Agricultural, Natural Resource Conservation Service tamarisk control project on Triangle Ranch, Harding County. Personal communications, Debbie Hughes, New Mexico Association of Conservation Districts, January 2005.

methods has had some drawbacks. A few landowners have been dissatisfied with the results. Out of approximately 500 landowners, 6 landowners expressed dissatisfaction with the initial results. Project managers are now more responsive to landowner complaints because of the experience they have gained since the program's inception. The templates and protocols included in this Plan will help guide future programmatic decision-making, provide more accurate information to project participants, and take advantage of adaptive management to ensure improvements are made as new knowledge becomes available.

Findings – The following items represent a general consensus of the scope and issues associated with the non-native phreatophyte problem found in New Mexico:

1. Riparian lands and adjacent uplands throughout New Mexico have and continue to be seriously damaged by non-native phreatophytes through their impact on water resources, wildlife habitat, agricultural lands, and recreational activities on the State's water resources.

2. There are concerns over the manner in which prior control efforts have been conducted, especially in the area of herbicide use and application. Using valuable insights derived from project experiences, adjustments are being made to improve the process. This "adaptive management" strategy must be incorporated into all future projects.

3. Success in managing the non-native phreatophyte problem will include the reestablishment of desired vegetation that meets the needs of the State as a whole, as well as specific program participants.

4. Continued involvement by Tribal governments is essential for meeting this goal.

5. Soil and water conservation districts should continue to be the primary mechanism for site-specific project contracting. Other legal entities such as State agencies, cities, counties, and Tribal governments could also be used where appropriate.

6. Close cooperation with the U.S. Fish and Wildlife Service and the New Mexico Game & Fish Department can benefit wildlife, including threatened and endangered species (e.g. the endangered Southwestern Willow Flycatcher) through a well-planned tamarisk control and revegetation program.

7. The long-term management of the non-native phreatophyte problem will require that:
    - ✓ A comprehensive watershed-scale approach is coordinated at the State level.
    - ✓ Each project reflects the objectives and goals of comprehensive watershed planning or, in the absence of a comprehensive plan, is prioritized to maximize benefits to its watershed.
    - ✓ Planning includes the development of total costs, annual budgets, and estimates of impacts to meet the desired goal of rehabilitation, long-term management, and maintenance.

- ✓ New Mexico's nationally recognized academic and scientific community should be utilized to create and continuously improve these templates and protocols for control, revegetation and rehabilitation, monitoring, and long-term maintenance. This expertise should be used to monitor, quantify, and report the changes to water availability, water quality, wildlife habitat, and biodiversity.
- ✓ The program must conform to the rigorous accountability and oversight protocols as required by all State funded projects.
- ✓ State funding, leveraged with other sources, should continue.

Vision

New Mexico will become the national model for conservation and restoration of healthy functions to its ecosystems and watersheds through landscape-scale management of its watersheds, including invasive plant species.

Guiding Principles

Guiding principles provide the common ground that can direct solutions into the future. These guiding principles reflect broad agreement between New Mexico and regional stakeholders and have been developed through significant participation at the Team Tamarisk conference and the generation of the FWHP. This Non-native Phreatophyte/Watershed Management Plan fully adopts these guiding principles to express the commitments made by the broad and diverse groups that participated in these previous efforts. Therefore, these are presented in their entirety. Two additional guiding principles that were deemed essential emphasize Tribal governments' unique relationships with New Mexico, and a hydrologic principle that affords increased opportunities for rehabilitation success.

Tribal Guiding Principles – New Mexico's 22 Tribes, Indian Nations, and Pueblos have unique differences among themselves and with other New Mexico entities. As such, Tribal sovereignty and their decision-making authority will be respected; participation through proactive communication with each Tribal government will be ensured; Tribal economic development and employment opportunities will be supported; and equal access for funding will be afforded to Tribal governments to perform planning, management, monitoring, control, rehabilitation, and research on Tribal lands.

Hydrologic Guiding Principle – Restoration of hydrologic processes which support native plant restoration will be incorporated in the design of rehabilitation projects where possible and within the constraints of New Mexico water law.

Team Tamarisk Guiding Principles – In April 2004, the National Invasive Species Council, through the U.S. Departments of Interior and Agriculture, sponsored a three-day conference in Albuquerque on developing a regional approach to tamarisk infestations. Nearly 400 people

attended, of which 40 percent were from New Mexico. They represented federal, State, and Tribal governments; universities; environmental organizations; soil and water conservation organizations; restoration companies; and private landowners – collectively referred to as "Team Tamarisk". The outcome of this conference was this position statement – ***Tamarisk and associated non-native invasive plants cause economic and environmental harm, affect the public health and welfare, and require active long-term management programs with sustainable funding. Team Tamarisk subscribes to the following guiding principles, in no particular order of importance:***

A. To facilitate prevention and control of tamarisk and associated non-native invasive plants with the ultimate goal of restoring healthy, productive ecosystems, leadership at all levels should maximize cooperation; foster sharing of information, strategies, tools, and research; leverage funding; and coordinate actions.

B. Public and private partnerships across jurisdictional and watershed boundaries should maximize on-the-ground efforts, while respecting private property rights, Tribal rights, and local customs and cultures.

C. Actions will comply with established federal, State, Tribal, and local laws, regulations, and policies.

D. Existing frameworks of funding, technical assistance, and expertise should be identified, used, and publicized to optimize resources and maximize local effectiveness.

E. Funding should be directed to proposals and mechanisms that maximize resources on-the-ground while minimizing overhead.

F. Objective criteria must be developed at all levels – local, State, and regional– for control, restoration, and monitoring projects based on best available science and economics, local community involvement, cultural and traditional values, cost benefit analysis, and urgency.

G. Diverse interest groups should be organized and mobilized to manage the control of tamarisk and non-native invasive plants for the benefit of healthy, productive ecosystems and the greater public.

H. To improve management decisions, data from inventories, monitoring, and control actions should be comparable and shared at all levels through a web-based clearinghouse.

I. Performance measures for control of tamarisk and associated non-native invasive plants should include quantifiable units (e.g., water quantity and quality, acres treated and restored, fuel reduction) leading to the long-term recovery of healthy, productive ecosystems.

J. The policy makers and public should be informed about tamarisk and associated non-native invasive plant issues through the development of comprehensive educational and outreach efforts.

K. Research efforts should develop innovative tools and technologies to aid in the management and monitoring of tamarisk and associated non-native invasive plants in a variety of environments.

L. Proactive management and control strategies for tamarisk and associated non-native invasive plants should be developed at multiple scales in accordance with recognized planning principles and guidelines, including consensus-based goals and objectives.

New Mexico Forest and Watershed Health Plan (FWHP) Guiding Principles – The FWHP established guiding principles based on broad agreement as to how ecological restoration efforts should take place in New Mexico and addresses important ecological principles, socio-cultural concepts, and economic issues. The integration of these pillars toward the renewal and long-term stewardship of the natural landscape is at the heart of the FWHP.

I. Ecological: Promoting ecological integrity, natural processes, and long-term resiliency is the primary goal of the FWHP.

Landscape Approach: Landscape integrity and sustainability are achieved by working at multiple scales. Ecological restoration efforts will be managed using a landscape approach in order to encompass the full range of natural processes and interactions between ecosystems. Ecosystems will be restored to health by addressing the interconnectedness of the landscape across scales and by including the full diversity of biological and physical components.

Ecological Capacity: Statewide ecological restoration and maintenance efforts will be consistent with the region's inherent natural character, i.e., disturbance regimes, the mineral and water cycles, energy flow, and ecosystem dynamics that characterize ecological processes and that support diverse native plant and wildlife populations and habitat. Restoration will take into account the overall condition of ecosystems, including vegetation diversity and structure; water quality and quantity; soil stability; and wildlife diversity and habitat.

Adaptive Management: Current ecological conditions demand immediate and proactive action, yet the magnitude and complexity of the challenge will require a sustained effort and diverse practices over a period of decades. Best available science will be used as the basis for this effort, and as improved science develops, practices will be updated. Statewide ecological restoration and maintenance efforts will be evaluated on an on-going basis to ensure effectiveness.

II. Social-Cultural: The values of New Mexico's diverse human communities will be supported and sustained by ecological restoration.

Collaboration: The responsibility for achieving and maintaining ecological health is shared among all land ownerships within a given community, whether they be State, federal, Tribal, municipal, or private. While the roles and needs of private land owners, government land managers, and stakeholders are distinct, broadly inclusive collaboration will ensure that the best possible solutions are being developed and put into practice.

Respect for Diverse Social and Cultural Values: The relationship between communities and the land is embodied in the social and cultural values and traditions of New Mexico, including the Land Grant and Acequia systems, Tribal and Pueblo traditional uses, agricultural uses, and other long-established as well as more recent land use practices. The collaborative process will respect these diverse values and practices, while considering the natural character of the landscape so as to achieve and maintain healthy functioning of the ecosystem for future generations.

Communication and Education: The current level of awareness and understanding of ecological principles by the general citizenry, policy makers, and stakeholder groups creates the public will to affect ecological health. Communication and education will be integral and constant parts of the process.

III. Economic: Economic productivity is dependent on healthy ecosystems and will be leveraged to full advantage in support of long-term ecological health.

Natural Resource Use and Capacity: Economic benefit flows from a healthy ecosystem. The inherent natural character of the landscape and its ecological functionality will guide the use of natural resources.

The Role of the Private Sector: The roles of private land and the private sector are integral to New Mexico's ecological restoration effort. Public/private partnerships in restoration work and utilization of forest and watershed resources will be required to make restoration possible at the scale needed to achieve ecological health.

Local Economies: New Mexico's rural and urban communities rely upon amenity-based, product-based, and agricultural economies. These economies will be strengthened by sustainable local businesses related to ecological restoration and long-term maintenance activities.

Recommendations

New Mexico faces many challenges in its quest to restore health to the State's watersheds and alleviate the negative impacts that non-native phreatophytes cause along its river systems and lakes. If no action is taken to resolve these problems, they most certainly will get worse. The HB-2 Work Group believes that it is appropriate for bold recommendations that emphasize the coordination of all projects, large and small, on a statewide basis. Non-native phreatophyte control and attendant revegetation, monitoring, and long-term maintenance and management of project areas will be most successful as a subset of landscape-level ecosystem rehabilitation. The HB-2 Work Group therefore makes the following recommendations that focus on management, planning, funding, education, monitoring, research, and government actions that will aid New Mexico in becoming the recognized national leader in watershed management and ecosystem rehabilitation.

I. Management

Management and the administration of the non-native phreatophyte program at the State level should not be confused with the day-to-day management of individual projects by the SWCDs. For the purposes of this Plan, partners are considered to be any State, federal, local, Tribal, non-governmental, individuals, or private entities that cooperate in the non-native phreatophyte program.

Recommendations

1. We support the concept of an office of forest and watershed health in State government whose primary function could be to identify and coordinate resources, and to facilitate cooperation between State agencies and other partners in support of this Strategic Plan and other related statewide policy documents.

2. NMDA will provide the administrative and contract oversight, in cooperation with the Soil and Water Conservation Commission and soil and water conservation districts, for the non-native phreatophyte management program funded by State appropriations. They will further refine appropriate performance measures for program outcomes in order to ensure accountability and to report results. These actions will be directly tied to the Templates and Protocols found in this Plan and other elements deemed necessary by NMDA (i.e., NMDA's conformance with State accountability in government requirements). NMDA internal program accounting functions will continue to track appropriation expenditures.

3. NMDA and the Soil and Water Conservation Commission will convene the project proponents, relevant technical advisors, and partners to review this Plan and its action items on an annual basis. This will ensure incorporation of elements of adaptive management as new knowledge and information becomes available from on-the-ground project implementation and new research. This will also allow the program to take advantage of coordinating opportunities at the statewide landscape scale.

4. Independent assessment of projects will be performed to verify how well objectives identified at the start of projects are being achieved. This activity will require additional resources and may be performed by either NMDA or its subcontractor.

5. Agencies, including NMDA, that fund and/or implement forest and watershed health related programs will retain autonomy in programmatic decision making and funding, but will, where relevant, ensure project management plans conform to the templates and protocols contained within this Plan. NMDA will assist with coordination of related activities among and between partners.

6. Information will be shared among partners for the present and future benefit of statewide landscape-scale forest and watershed health improvements identified in this Plan and the FWHP. To support this information exchange, a centralized clearinghouse will be established for planning, monitoring, and project related information.

II. Planning

Overview

Planning is critical for the effective and efficient use of limited funds for non-native phreatophyte control and overall watershed management. Planning information will better inform decision makers on total costs, existing impacts, and future impacts for all aspects of control, rehabilitation, and maintenance at a landscape level.

Recommendations

1. Since the FWHP recommendations provide much of the overall rehabilitation perspective for watersheds, it is recommended that these be adopted. In addition, the recommendations from the State Water Plan, as found in Section C-8 promoting river riparian and watershed rehabilitation, should be supported.

2. Respective State, Tribal, federal, and local agencies should work together to identify all forest and watershed planning efforts currently underway. In collaboration with program partners, these agencies should make recommendations for statewide forest and watershed health planning. Existing frameworks should be used to accomplish this level of planning and/or create a new level of planning. Ideally, this framework would identify resources necessary for each activity, and list a priority schedule for this level of planning. Specifically, watershed-scale plans should be developed for the five principle watersheds (Rio Grande, Pecos, Canadian, San Juan, and Gila/San Francisco), and one additional planning study should be performed for the remaining smaller watersheds (Little Colorado, Central Closed, Tularosa and Huerco, Salt, Southwest Closed, and Southern High Plains Basin). This level of planning would not replace site-specific planning required at the local level for specific projects. State-level funding should be provided for these planning activities in the near future, with completion of these planning studies accomplished within two to three years.

3. Local and regional site-specific planning will continue and will consider recommendations (as they become available) originating from State, federal, Tribal, and local agencies to incorporate statewide landscape-scale priorities for specific projects. Development of local/regional site-specific planning activities will continue as a collaborative effort and build upon past recommendations to incorporate new information and priorities.

4. Prioritization of future projects will be based on objective criteria for control, rehabilitation, maintenance, and monitoring of projects as identified in this Plan. Best available science, economics, local community involvement, cultural and traditional values, cost-benefit analysis, and urgency will play a role in this prioritization process as data and issues emerge.

5. Planning for the activities discussed in this Plan will mature in response to adaptive management strategies. Close coordination among partners will ensure that individuals at different levels of interest are involved in the policy making process.

III. Funding

Recommendations

1. Significant federal and private foundation funding is available to match State funding for tamarisk control/revegetation and watershed improvement projects; e.g., USDA, Interior, Bureau of Reclamation, EPA, Corps of Engineers, National Fish and Wildlife Foundation, and the National Forest Foundation. Typically, these funding sources will provide from 50 to 75 percent of the overall project costs, and can go as high as 90 percent. It is recommended that future State funding strive for a minimum match of 25 percent from one or more of the following non-State sources: federal, private foundations, in-kind support by the landowner, and/or in-kind support by local communities. This approach is familiar to the agricultural and conservation community through programs such as WHIP (Wildlife Habitat Incentives Program) and EQIP (Environmental Quality Incentives Program). Most importantly, this cost sharing approach engages the landowner in the ownership of the rehabilitation effort. NMDA and the N.M. Energy, Minerals, and Natural Resources Department (EMNRD) will be developing a comprehensive list of non-State funding sources for tamarisk control/revegetation assistance, and their associated submittal requirements, eligibility, deadlines, required deliverables, cost share, and other general information.

2. New Mexico is the national leader in its support for non-native phreatophyte control and rehabilitation projects. This support should continue, with emphasis placed on rehabilitation for those sites previously controlled that need active revegetation actions. Secondary priorities should be new projects that have developed sufficient planning documentation to identify the priorities for control, monitoring, maintenance, and rehabilitation.

3. Specific criteria for establishing funding priorities must be developed. These would include degree of resource leveraging, completion of prior projects, meeting watershed planning goals, quantifiable partnerships, etc. NMDA and partner State agencies in consultation with the SWCDs would develop these criteria.

IV. Education

Recommendations

1. Comprehensive educational and outreach efforts are necessary to maintain continued public involvement on watershed planning and rehabilitation efforts. It is recommended that NMDA, SWCDs, and the NMSU Cooperative Extension Service provide expanded resources in educational outreach, rehabilitation training, and general educational materials, including publications. This effort can be supported by expertise from federal USDA and Interior agency partners. An example of information that is urgently needed is a "Best Management Practices" manual. Currently, word of mouth and public meetings are the primary means of conveying information. [5]

2. Each control and rehabilitation project should include project specific education, outreach, and landowner training to improve the success rate of rehabilitation activities and to maintain and increase the public's understanding of the project and its importance to overall watershed health.

3. University programs are encouraged to prepare and maintain a cadre of experts, including faculty and students involved in all aspects of watershed management and rehabilitation efforts. Additionally, NMDA, New Mexico universities, and the NMSU Cooperative Extension Service should offer classes, internships, and special projects as part of a "Living Laboratory" for training and education of the workforce for the next generation. This university level educational component is essential to fill the growing demand for natural resource management expertise in collaboration with New Mexico universities, including Highlands where a federally funded ecological restoration institute is being established.

V. Monitoring

Recommendations

1. Monitoring is critical to long-term success of any watershed management action. It allows decision-makers to understand how the ecosystem is being altered and the benefits or disadvantages of those alterations. This requires that baseline information, as well as future changes are monitored. It is recommended that monitoring be required for all watershed projects and that funding for baseline through long-term activities be required prior to project implementation. These monitoring activities should be funded separately from control, remediation, and long-term management funds.

[5] Kirk McDaniel, New Mexico State University, Professor, Animal and Range Sciences. Personal communications, November 23, 2004.

2. Each control and revegetation project should consider the involvement of local secondary schools in a program of long-term monitoring, using the Bosque Ecosystem Monitoring Program (BEMP) model to engage students in performing basic monitoring tasks. The BEMP model would enable each community to become involved in restoring desirable conditions to local impacted lands, and students would develop skills in natural resource management. This would ensure that each site would have a consistent, comprehensive collection of data to guide on-going adaptive management of the projects, leading to more successful outcomes.

VI. Research

Recommendations

1. Currently, there is no national program, consortium, institute, or lab that is focused on non-native phreatophytes and watershed rehabilitation. Although there are a large number of people working in this field, this lack of a coordinated research approach is a drawback to gaining the scientific input necessary to improve the effectiveness and efficiency of these activities. Therefore, New Mexico should take this leadership position for the region and use the State's universities to partner with key federal agencies (i.e., USDA, Agriculture Research Service, Interior, Bureau of Reclamation, Bureau of Indian Affairs, Corps of Engineers, Forest Service, U.S. Fish and Wildlife Service, etc.) along with leading universities in other states to form a non-native phreatophyte/watershed rehabilitation consortium similar to that formed for saltcedar bio-control efforts. This approach will focus resources for specific problems, bring together the best researchers (from New Mexico and other western states), prevent undue duplication of effort, and will be more desirable to funding sources. The three Ecosystem Restoration Institutes, authorized under recent federal legislation (Public Law 108-317), in New Mexico, Arizona, and Colorado, would be important components of this consortium.

2. A central database for information resulting from planning, monitoring, and research activities should be established and maintained to ensure full dissemination of critical information.

VII. Government Actions

Recommendations

1. *Rehabilitation efforts require funding that is substantial, continuous, and long-term to solve the serious problems that New Mexico faces with its watersheds.* The New Mexico Legislature and Congressional delegation are to be commended for taking the lead in the West for supporting funding for continuing and expanding the non-native phreatophyte control program and watershed rehabilitation. Current federal funding is available from a number of agencies and departments (e.g., EPA, Interior, Corps of Engineers, and USDA).

The State should continue to take its proactive role in supporting existing programs and the passage and authorization of pending legislation.

2. Invasive species do not respect jurisdictional boundaries, nor do most other watershed issues; therefore, it is imperative that actions, to be effective, gain cooperation of adjacent political jurisdictions. This cross border cooperation in New Mexico is required at the local level as well as at more expansive levels. The SWCDs have been coordinating much of the local cooperation, but more is needed at the State level. It is recommended that the Governor and his Cabinet actively work with the State's Tribal governments, Mexico, adjacent states, and the Western Governors Association to foster Tribal, interstate, and international cooperation for solving the non-native phreatophyte problem and reaching a consensus on watershed management priorities.

We recommend the Legislature and Governor consider providing continuous, sustainable funding for non-native phreatophyte programs in New Mexico. We direct readers to the referenced State study, which identifies important conservation initiatives and options for their sustained funding. [6]

[6] The Department of Game and Fish and the Energy, Minerals and Natural Resources Department, December 2004. *Funding Conservation for New Mexico: Providing for Future Generations, A Study To Investigate Sustainable Alternative Funding Sources To Protect New Mexico's Unique Landscapes, Natural Areas, Recreation Areas and Wildlife Habitats,* as directed in House Joint Memorial 37 of the 46th Legislature, 2nd Session.

Implementation of Recommendations

The implementation of the recommendations section of this Plan requires that NMDA, in collaboration with key partners, executes the essential elements of the above recommendations. Partners include the member agencies of the of the HB-2 Work Group, Tribes, the Soil and Water Conservation Commission, soil and water conservation districts, New Mexico's universities and national laboratories, and federal agencies, as their interests, expertise, and missions dictate. Clearly, a strategic plan only has meaning in the actions it compels. Implementation of these recommendations will define outcomes, progress, and future program direction. NMDA will provide the necessary resources and commitment to ensure the accountability, continuing evaluation, and enactment of these recommendations. NMDA will require increased resources in order to complete total implementation. Resources can be expressly defined as financial and human. Resource constraints may alter specific dates for deliverables. Other relevant partners will examine resource needs related to implementation of this Strategic Plan and report to their funding sources accordingly.

Wherever NMDA is named below, the leadership at NMDA will include its partners in collaboration, coordination, and execution of these actions. Partners will be encouraged to participate in accomplishing these actions. Expertise will be defined and tasks undertaken by partners.

The following numbered items reflect actions NMDA is taking and will be taking over the next five years to implement the recommendations of the New Mexico Non-native Phreatophyte/Watershed Management Plan.

2005 Actions for NMDA:

1. NMDA's resource needs will be evaluated to determine increases necessary to provide technical assistance in areas such as contract administration, plant ecology, riparian rehabilitation, and funds procurement (federal and other non-State sources).

2. Current policies will be expanded for the oversight of non-native phreatophyte control projects. These will use specific metrics to assess performance.

3. A prioritization framework will be established for new non-native phreatophyte projects, and priorities will be set for 2006 projects based on critical habitat, fire threat, cultural significance, containment strategy, and other factors. This prioritization framework will to be determined by spring 2006.

4. Tactical plans for each watershed will be developed by summer 2007 using the newly developed templates and protocols.

5. A broad-based technical advisory panel will be established from State, federal, Tribal governments, universities, environmental organizations, and other sources by the fall of

2005. Members will serve primarily in a voluntary capacity. The function of this technical advisory panel is to:

- Provide input to processes for independent scientific review of watershed planning, local site-specific planning, monitoring, performance evaluation, and identification of critical research needs.
- Review the inventory of infestations on a watershed scale and determine geographic information system (GIS) to provide a statewide landscape scale resource review.
- Review Best Management Practices for all aspects of control/rehabilitation.
- Review projects for achievement of performance objectives and milestones.
- Evaluate and update Templates and Protocols as necessary to achieve objectives.

6. A cost-sharing policy will be established by fall 2005 that will identify the recommended in-kind match from landowners participating in these efforts.

7. The potential for federal agencies to be actively engaged to access matching funds for the non-native phreatophyte program will be explored through the development of a central point of contact.

NMDA Actions Within the Next 5 Years (in collaboration with its partners)

1. Over the next 2 years, NMDA will encourage current educational outreach programs that target expansion of watershed health and riparian rehabilitation. These educational initiatives may be through NMSU Cooperative Extension Service, NRCS, and/or the SWCDs.

2. Through efforts with the technical advisory panel, NMDA will develop a draft *Handbook of Best Management Practices* for non-native phreatophyte control and revegetation by spring 2007.

3. By fall 2007, NMDA will encourage NMSU and other New Mexico universities to develop a living demonstration laboratory for teaching and training purposes on Best Management Practices.

4. NMDA, in collaboration with partners, will provide the leadership with New Mexico universities in the formation of a Western States Non-native Phreatophyte/Watershed Research Consortium that will perform critical research on all aspects of control, revegetation, and monitoring to increase efficiency and effectiveness.

5. NMDA will work with other State agencies to interact with their counterparts in adjacent states and Mexico to develop cooperation on solving the non-native phreatophyte problem and other watershed management priorities.

Templates and Protocols – General

For the purposes of this Plan the term *template* defines what actions need to be taken, and the term *protocol* defines how the actions will be performed. The templates and protocols are intended as guidance and criteria for decision making while carrying out the activities associated with various aspects of the non-native phreatophyte control, revegetation and rehabilitation, monitoring, and long-term management. Thus, the intent is to ensure that selected approaches are effective and efficient, and decisions are well documented. They do not include technical details required for carrying out each specific action. A list of individuals that participated in the development and/or review of these templates and protocols is provided at the end of this section. As the program matures, these templates and protocols will be continuously updated to improve the efficiency and effectiveness of the control, revegetation and rehabilitation, monitoring, and long-term management and maintenance.

Control
Templates and Protocols

The control of invasive species such as tamarisk and Russian olive requires an overall approach that looks at the long-term objective as the central component for selecting an appropriate control strategy. For New Mexico, this objective is the *return of riparian areas to healthy productive states*. This objective may include the reduction in wildfire potential, increased habitat diversity, and controlling the spread of non-native plant species. To reach this objective requires that each site-specific project define the full range of actions that are necessary to accomplish this objective, including their costs and their impacts. This includes the control technology, rehabilitation efforts, and maintenance requirements. Thus, the templates and protocols developed for control have an interactive relationship with the revegetation/rehabilitation and long-term maintenance sections. Specific technologies for control are presented in some detail in the supporting document *New Mexico Options for Non-native Phreatophyte Management*, March 2005.

Table 1: Control Templates and Protocols

Templates	Protocols
1. Identify the historic and existing setting – This baseline and historic information is essential in order to identify the reasonable approach(s) for control and will provide a point from which to compare and measure future changes.	Gather the following information: o Does the project adhere to the State and watershed plans and their priorities? o Terrain type o Land ownership o Adjacent land use o Size and shape of parcel identified for control o Type of existing and historic vegetative stand including density and diversity o Susceptibility to erosion o Hydrologic integrity, floodplain connectivity, water table depth, and availability of irrigation water or periodic flood waters

Templates	Protocols
	o Soil characteristics especially texture, depth, and salinity o Threatened or endangered species habitat and other species of concern o Local landowner attitudes and desires o State, local, and Tribal community attitudes and desires o Other legal and physical considerations/constraints
2. Identify the objective for each site – This information is critical so that all parties understand and accept the desired end condition.	Determine the objective that is acceptable by each landowner and the respective control technique(s) to use in series with revegetation and rehabilitation efforts. Landowners may have different land use objectives for the rehabilitation of infested lands. These land uses typically could include pasture land, crop land, wildlife habitat, recreational, cultural, and/or aesthetic uses.
3. Identify control alternatives – At least three alternatives should be considered as well as the "No Action" alternative.	Select appropriate alternatives based on the existing setting and objectives for each site. o Hand labor using chainsaws with herbicide applied to the cut stump o Hand applied herbicide to basal bark o Foliar herbicide application: ➢ Spraying from the ground ➢ Spraying with helicopters or fixed wing aircraft. o Mechanic removal: ➢ Root plow ➢ Extraction ➢ Mulching followed by cut stump herbicide application ➢ Roller chopping followed by cut stump herbicide application o Approved biological control
4. Identify alternatives for dead vegetation management – Each control alternative must be linked to at least one alternative for handling the dead vegetative mass.	Select alternatives for the dead vegetation management: o Stack and burn o Burn in place o Mulch in place o Mulch in discrete areas o Remove from site for disposal o Utilize as a resource such as fuel, commercial commodity, or to support sustainable local businesses that generate a value-added product o Leave in place; i.e., no further action required
5. Identify alternatives for revegetation – The success of revegetation efforts may be aided or hampered by the alternative selected for control; thus it is critical that revegetation be considered when selecting the control option.	Select specific revegetation alternatives as described in detail in the "Revegetation and Rehabilitation Templates and Protocols" section.

Templates	Protocols
6. Perform necessary maintenance – Depending on the control and revegetation alternatives selected, maintenance costs and efforts can be significantly different.	Perform the following maintenance as required over a period of several years: o Monitor the success of control and revegetation measures o Perform resprout treatment o Reestablish desired vegetation o Irrigate, only if necessary, to maintain vegetation until self supporting
7. Develop cost estimates and schedule for each alternative – This will include the complete set of anticipated costs and their associated schedules to meet the objective of returning a riparian area to a healthy productive state.	Develop estimates of costs, schedules, and impacts for the following activities: o Control o Dead vegetation management o Revegetation o Landowner monitoring and maintenance o Administration
8. Develop impacts associated with each alternative	Quantify the potential impacts associated with each fully developed alternative for the following: o Community and landowner support o Re-infestation from adjacent un-controlled sources o Other noxious weeds or other undesirable plant infestations o Increase in water availability and water quality based on the establishment of the desired vegetative state o Wildlife habitat o Biodiversity o Herbicide use, both short-term and long-term impacts o Increase in sediment loads to rivers and streams and other erosional impacts o Local employment and business potential o Tribal employment and business potential o Fire and its consequential impacts o Long-term value for the State and for the specific watershed
9. Develop mitigation plans for negative impacts – Where negative impacts will result because of some action, it is important to know what action can be taken to mitigate these impacts.	Include mitigations measures and their costs in the development of control alternatives. Examples might include: o Erosion protection o Smaller demonstration plots to establish refined approaches for new technologies o Tours of restored sites to increase public understanding
10. Compare each combined alternative and select the preferred control approach	Determine the preferred approach based on costs and impacts associated with the full range of activities related to each control alternative.
11. Negotiate contracts with landowners	Obtain contracts with landowners that provide written confirmation on the specific control approach(s) selected, land

Templates	Protocols
	area that is to be controlled, anticipated outcome of control, dead vegetation management, revegetation approach, and monitoring and maintenance requirements. State any specific mitigation measures required, identify cost share and responsibility, provide an anticipated schedule, and identify method for resolving complaints. Coordinate Request for Proposal process with the landowner and establish responsibilities for contract supervision, training, monitoring, etc.
12. Provide education and public outreach	Provide education and public outreach efforts. These may include: o Public notification on the specifics of the control project; such as method, dates, participation, etc. o Development and dissemination of valuable insights derived from project experiences to NMDA, other New Mexico agencies, and the public. o Signage explaining the stage of control/revegetation. o Tours of sites in various stages of control and revegetation. o Annual landowner training through NMSU Cooperative Extension Service and/or NRCS o Historic photo record of existing setting before, during, and after control and revegetation.

Revegetation and Rehabilitation Templates and Protocols

The HB-2 Work Group developed the following Revegetation and Rehabilitation Templates and Protocols. For the purposes of this document, *revegetation* refers to the restoration of vegetation to a site. This is not confined to native vegetation and may occur naturally through regeneration or through induced means. Rehabilitation is . . . *making the land useful again after a disturbance. It involves the recovery of ecosystem functions and processes in a degraded habitat. Rehabilitation does not necessarily reestablish the pre-disturbance condition, but does involve establishing geological and hydrologically stable landscapes that support the natural ecosystem mosaic.* [7]

Costs for non-native phreatophyte control, revegetation, and long-term maintenance can often be quite high, and specific treatment areas should be evaluated and prioritized based on revegetation potential. [8] This referenced work is included as a supporting document to this Plan and is based on years of experience at the Bosque Del Apache National Wildlife Refuge on the Rio Grande near Socorro. It explains revegetation issues and is attached, by permission, to this document.

Please note that templates 1, 2, 6, and 7 and their associated protocols are very similar to those identified for control actions.

Table 2: Revegetation and Rehabilitation Templates and Protocols

Templates	Protocols
1. Identify the historic and existing setting – This baseline and historic information is essential in order to identify the reasonable approach(s) for revegetation and rehabilitation and will provide a point from which to compare and measure future changes.	Gather the following information: o Terrain type o Land ownership o Adjacent land use o Size and shape of parcel to be revegetated o Type of existing and historic vegetative stand including density and diversity o Susceptibility to erosion o Hydrologic integrity, floodplain connectivity, water table depth, and availability of irrigation water or periodic flood waters o Soil characteristics especially texture, depth, and salinity o Threatened or endangered species habitat and other species of concern o Local landowner attitudes and desires o State, local, and Tribal community attitudes and desires

[7] *Stream Corridor Restoration: Principles, Processes and Practices,* 1988, Federal Interagency Stream Restoration Working Group

[8] Taylor, J.P. and McDaniel, K.C. 2004. *Revegetation Strategies after Saltcedar (Tamarix spp.) Control in Headwater, Transitional, and Depositional Watershed Areas*. Galley proof, Weed Technology.

Templates	Protocols
2. Identify the objective for each site – This information is critical so that all parties understand and accept the desired end condition.	Determine the objective that is acceptable by each landowner and the respective revegetation and rehabilitation technique(s) to use in series with control efforts. Landowners may have different objectives for the use of rehabilitated lands. These typically could include pasture land, crop land, wildlife habitat, recreational, cultural, and/or aesthetic values.
3. Identify revegetation and rehabilitation alternatives and impacts – At least two alternatives should be considered as well as the "No Action" alternative. Criteria for review would include costs, environmental impacts, acceptability, effectiveness, as well as others that may be appropriate.	Select appropriate alternatives based on the existing setting and objectives for each site. o Natural revegetation o Irrigation and seeding o Flooding with native seed dispersal o Pole plantings of cottonwood and willows o Nursery stock plantings o Use of livestock to facilitate seeding establishment
4. Develop a preliminary revegetation and rehabilitation plan	Produce a preliminary revegetation and rehabilitation plan using information developed in the baseline survey and the landowner's desires consistent with express State limitations on expenditures of rehabilitation funds. This would include costs, timing, and long-term maintenance requirements. The plan would also define responsibilities for cost share, work efforts, and expected outcomes.
5. Identify the post-control plant inventory and adjust revegetation and rehabilitation plan accordingly	After a suitable rest period following control efforts, perform an inventory of available plant resources that are acting as seed sources adjacent to and within the control area. Refine the revegetation and rehabilitation plan based on this knowledge. Seek advice, as appropriate, from NMSU Cooperative Extension Service, NRCS, and other specialists.
6. Negotiate contracts with landowners	Obtain contracts with landowners that describe the proposed revegetation and rehabilitation measures that are anticipated and any monitoring and maintenance requirements. This includes schedules, any mitigation measures required (e.g., erosion control), cost share responsibility, and method for resolving complaints if they arise.
7. Provide education and public outreach	Provide education and public outreach efforts which may include: o Development and dissemination of valuable insights derived from project experiences to NMDA, other New Mexico agencies, and the public. o Signage explaining the revegetation/reclamation efforts. o Tours of sites in various stages of revegetation. o Annual landowner training through NMSU Cooperative Extension Service and/or NRCS Historic photo records of existing setting before, during, and after control and revegetation.

Templates	Protocols
8. Use adaptive management techniques	Demonstrate flexibility in revising revegetation and rehabilitation practices to improve efficiency and effectiveness based on valuable insights derived from project experiences.

Monitoring
Templates and Protocols

For watershed and non-native phreatophyte remediation activities, "monitoring" is the act of observing changes that are occurring with, or without, remediation actions. The purpose of monitoring is to provide information for making informed decisions on the initiation, continuation, modification, or termination of specific remediation activities or programs. Two monitoring regimes are important to the understanding of changes within New Mexico's ecosystems – landscape-scale monitoring and landowner monitoring.

Landscape-scale monitoring is essential for policy makers and the public to evaluate the potential impacts of remediation on the State's water resources, vegetation, wildlife habitat, biodiversity, economic health, society, and culture – these are essential considerations for determining what level of funding should be committed to non-native phreatophyte control. "However, most impacts (e.g., increased fire frequency, declines in water availability or native plant and animal populations, and soil erosion) are caused by a complex array of factors, only one of which is non-native phreatophytes. Accurately determining the relative contribution of these infestations to a particular impact parameter may be difficult. In addition, these invasive species may have impacts that have not been identified yet and/or may become quantifiable only after long periods." [9]

Landowner monitoring provides useful information on the effectiveness of control and remediation activities to allow modifications, if necessary, to achieve the remediation goals. This is the essence of adaptive management.

Landscape-scale Monitoring – The approach for monitoring landscape-scale changes to the environment includes a number of well-developed methods that are, in some cases, specific to New Mexico. These include:

- Using appropriate techniques that best achieve the objectives of monitoring to ensure that monitoring approaches are efficient, economical, and relatively easy to implement and maintain.

- Adopting monitoring protocols agreed to by State, federal, and Tribal governments so that monitoring data from disparate projects is compatible and easily stored in a single database.

- Adopting monitoring techniques that utilize New Mexico's highly regarded academic and scientific community (NMSU, UNM, NM Tech, NM Cooperative Extension Service, NRCS, ARS, national laboratories, and private contractors).

[9] National Invasive Species Council, *Draft Guidelines for Ranking Invasive Species Projects in Natural Areas*, August 2004.

- Creating and maintaining a centralized database for storing compatible monitoring data from remediation projects across the State. This database formation will require a concerted effort to resolve appropriate access issues, funding for maintenance, interpretation, and other issues of use and control.

Monitoring at the landscape scale can require significant resources and is, therefore, most appropriately carried out through a State agency in collaboration with local project managers.

Landowner Monitoring – Monitoring at the landowner level is needed primarily for adaptive management purposes to assure compliance with funding agreements, to identify maintenance needs, and to document ecological response to controls and remediation actions. In general, landowner monitoring criteria should include simple and inexpensive monitoring techniques based on the needs of the landowner's management objectives. These monitoring results can be incorporated into a central database that will aid in the overall understanding of actions on a landscape scale. Landowners should use the Southwest Strategy's *New Mexico Interagency Rangeland Monitoring Handbook* for specific guidance in addition to information provided in Table 4.

The monitoring protocols identified are for future projects and cannot necessarily be applied retroactively to past projects. They are intended to be simple and straightforward. Basically, they are intended to provide an understanding of the baseline condition, the success of controls, the success of revegetation, and any necessary modifications to improve success. Much of this can be accomplished through fixed photo points and paced transects. NRCS, and NM Cooperative Extension Service, and/or the SWCDs are good sources for providing training and assistance in any of these areas that are beyond the capabilities of individual landowners.

The determination of what parameters to measure and how they will be measured is critical so that the attainment of objectives can be properly evaluated. "Both quantitative (e.g., percent reduction in water lost to evapotranspiration), and qualitative (e.g., visitor satisfaction at a riparian area) assessments may be used. Data concerning the impacts of various actions (e.g., control operations) must also be collected, evaluated, and used to guide the adaptive management of invasive species." [10] As such, templates and protocols are presented in the following tables for landscape-scale and landowner monitoring levels.

It is important to note that monitoring in all places for all components would be extremely expensive. It is also important to recognize that a degree of error exists for every type of monitoring and that measurable changes may be within the margin of error for that component. It may not be cost effective to monitor some parameters, and these issues need to be considered in the design of a monitoring program to take into account all the factors that may be influencing a change. For instance, streamflow measurements may be too costly to monitor if non-native phreatophyte removal represents a very small percentage of the total watershed area. Scientific knowledge must be used to define monitoring requirements that match best with the monitoring objective. Determining objectives is the most critical aspect of developing a successful monitoring program. Basically, the key question is – "how is a particular monitoring activity

[10] National Invasive Species Council, *Draft Guidelines for Ranking Invasive Species Projects in Natural Areas*, August 2004.

going to improve decision making?" This process must be performed prior to developing any data gathering activity. For instance, for the Legislature to make a decision on tamarisk control funding, is there sufficient information in the literature on water consumption from past scientific efforts to justify continued funding, or is it necessary to initiate scientific efforts on evapotranspiration rates? If so, what approach will provide the necessary quality and quantity of data?

Table 3: Landscape-scale level monitoring templates and protocols

Templates	Protocols
1. Water Quantity -- What is the baseline situation and the changes in water quantity that New Mexico is experiencing from non-native phreatophytes and what changes to the water inventory are occurring due to control and remediation actions?	Note: For the purposes of this protocol the identification of long-term potential changes to water quantity resulting from replacing non-native phreatophytes with desired vegetation requires an understanding of the extent and type of infestation, and the water usage of both the non-native phreatophytes and the desired vegetation that would replace it. Actual changes in water quantity are determined from stream flow and groundwater measurements over time. These later changes may take years or even decades to determine. Thus, the importance of monitoring to determine both potential as well as actual water quantity changes. The following steps are required to make these determinations. A. Determine potential and actual changes in water quantity associated with both the non-native phreatophytes and the desired replacement vegetation through a combination of: o Existing data to establish the baseline conditions o Evapotranspiration measurements o Stream flow measurements o Depth to groundwater and changes occurring over time o Meteorological and hydrologic data Note that the degree of uncertainty must be considered in judging whether a monitoring activity is going to be worthwhile. Actual changes in water quantity are determined from stream flow and groundwater measurements, changes in groundwater pumping, offsite changes in the watershed, changes in precipitation, and changes in runoff over time. All of these factors that may be contributing to an observed change must be considered. B. Determine the aerial extent, maturity, and density of infestation by non-native phreatophytes and the topographic regime it is located within. Methods used can involve a combination of: o Existing data o Personal knowledge of land managers o Photography o Remote sensing C. Determine the type of replacement vegetation likely to occupy the land area currently infested. Information to be collected could include: o Existing native vegetation type (e.g., phreatophyte,

Templates	Protocols
	upland), density, maturity, and aerial extent o Soil characteristics; i.e., texture, depth, and salinity o Depth to ground water o Availability of irrigation water o Frequency of overbank flooding D. Develop a conceptual model and/or water budget based on current and future vegetative states and their water usage, and baseline conditions of stream flow and groundwater depths.
2. Water Quality – What is the baseline situation and the impacts to water quality in New Mexico from non-native phreatophytes and what changes are occurring due to control and remediation actions?	Measure appropriate surface and groundwater parameters that will allow direct comparison with published results of NM Environmental Department monitoring and analyses. These may include but are not limited to: A. Surface water measurements of: o Total dissolved solids o Herbicides o pH o Alkalinity o Sediment load (surface water only) B. Groundwater measurement of: o Total dissolved solids o Herbicides o pH
3. Wildlife Habitat and Biodiversity – What is the baseline situation and the impacts to wildlife habitat and biodiversity in New Mexico from non-native phreatophytes and what changes are occurring due to control and remediation actions?	Measure appropriate aquatic and terrestrial habitat parameters that are consistent with published data from the NM Department of Game & Fish and the U.S. Fish and Wildlife Service. These may include but are not limited to: A. Aquatic habitat: o Stream temperature, pH, turbidity, etc. o Stream flow o Invertebrate species richness o Stream morphology o Vertebrate species richness B. Terrestrial habitat: o Vegetation – aerial extent, diversity, and density o Invertebrate species richness o Vertebrate species richness
4. Soils – What is the baseline situation and the impacts to soils from non-native phreatophytes and what changes are occurring due to control and remediation actions?	A. Salinity B. Soil moisture C. Erodability D. pH

Templates	Protocols
5. Economic -- What is the baseline situation and the impacts to New Mexico's economy from non-native phreatophytes and what changes are occurring due to control and remediation actions?	Measure the economic impact of the cost of control and rehabilitation versus economic impacts to water, wildlife habitat, endangered species, etc.
6. Sociological and Cultural -- What are the impacts to New Mexico's society and culture from non-native phreatophytes and what changes are occurring due to control and remediation actions?	Measure the impacts of non-native phreatophytes on society (e.g., bird watching) and New Mexico's unique cultural diversity (e.g., Tribal use of native plants). This study would look into the future to identify positive and negative impacts associated with control and remediation actions.

These protocols are only guidelines to help identify information that is typically important to collect and should not be considered as absolutes. For instance, there are numerous ways to measure evapotranspiration, and it is up to the scientific community to determine which technique(s) to use. Additionally, there may be additional parameters that a project manager must evaluate, and these protocols should not be viewed as a hindrance to do so. It is also clear that many of these protocols overlap and will support different monitoring objectives.

Table 4: Landowner monitoring templates and protocols

Templates	Protocols
1. How effective are the control measures?	Provide a photo history of pre-control and the post-control situation.
2. To what extent have treated areas revegetated without human intervention?	A. Visually identify natural revegetation and document with photos. B. Over a period of 3 to 5 years, photograph, identify, and document regrowth of invasive plants and the success of any additional control actions as a component of long-term maintenance.
3. How successful has active remediation to the desired vegetative state been?	A. Visually assess the effectiveness of active revegetation and document with photos. B. Note areas for additional active revegetation and develop adaptive management plan and future monitoring needs. C. Identify and document success of any additional control and revegetation actions as a component of long-term maintenance.

Long-term Management and Maintenance
Templates and Protocols

Long term watershed management and maintenance is the dynamic process, carried out over time (years to decades to centuries), to achieve social, economic, and ecological goals associated with a watershed or part of a watershed. The process of management involves the strategic implementation of actions to identify, maintain, remediate, improve, and monitor the ecological processes of the watershed. Actions, and the tools required to accomplish them, are chosen because they are consistent with and likely to achieve the watershed goals, and because they address the results of monitoring. Watershed management is necessarily adaptive because actions or tools may need to be changed or replaced to adapt to any unexpected results of monitoring.

Table 5: Templates and Protocols for Long-term Management and Maintenance

Templates	Protocols
1. Develop comprehensive watershed plans – For New Mexico this would include, at a minimum, the Rio Grande, Pecos, Canadian, Gila/San Francisco, and San Juan river watersheds.	Comprehensive watershed planning is a 4-step process. Step 1: Determine the appropriate entity to develop the watershed plan and the cost to prepare it. Step 2: Secure funding and contract for services to develop the plan. Step 3: Gather information to be used in the development of the comprehensive watershed plan. This may include, but is not limited to: o Federal, State, local, Tribal community desires for: ➢ Water resource protection and development ➢ Wildlife enhancement ➢ Economic and cultural goals o Identification of the existing ecological setting of the watershed including, but not limited to: ➢ Forest health such as wildfire and disease potential ➢ Water resources such as river and stream water quality and quantity, and future demands ➢ Groundwater quality ➢ Invasive plants such as riparian non-native phreatophytes and rangeland herbaceous plants ➢ Economic uses of watershed resources such as timber, hunting, fishing, mining, etc. ➢ Landowner considerations Step 4: Develop alternatives, including "No Action", and select a course of action. This is accomplished by: o Defining short and long-term goals (i.e., 5, 10, 20, and/or 50 years) and objectives based on State and local community desires and the existing ecological setting. o Developing short, intermediate, and long-term alternatives to reach the stated goals and objectives.

Templates	Protocols
	o Selecting the preferred long-term watershed management alternative through public involvement.
2. Provide funding to carry out the preferred long-term watershed management plan	Determine funding sources for watershed management that is consistent from year to year and can be provided over a long time period. Sources that may be available include State, local, federal, foundations, and/or private landowner funds derived form taxes, user fees, bonds, incentives, grants, etc.
3. Implement the watershed management plan	Select actions could include efforts such as: o Water resources development such as enhancing water supplies o Non-native phreatophyte control o Forest thinning and other fuel reduction efforts o Improvements in agricultural practices o Erosion control and stream/river rehabilitation o Conservation easements o Wildlife habitat improvement o Endangered/sensitive species habitat management o Economic development
4. Monitor actions and adjust as needed	Measure appropriate parameters for each major action to determine if the goals and objectives are being met. This information will allow informed decisions on the continuation, modification, or termination of the specific action or program; i.e., adaptive management.

General Prioritization Approach

The following information has been adopted from the support document developed by the New Mexico Interagency Weed Actions Group entitled *Strategy for Long-term Management of Exotic Trees in New Mexico's Five River Systems.*

A long-term management strategy for non-native phreatophytes in New Mexico's river systems must address all types of riparian areas: (1) those not yet infested; (2) those with light infestations; (3) areas with special considerations; and (4) areas of extensive infestation. At the same time, the strategy must be designed to result in a progressive reduction of overall infestation levels. Each river system needs to be addressed as a whole. Management objectives will vary based on the level of infestation and the location of a site within the river system. All management efforts should contribute to the overall reduction of infestation levels. It is important to note that implementation of this strategy does not preclude local managers from initiating projects to achieve local objectives, although policy makers must understand that management of infestations at the top of the watershed will improve sustainability of programs downstream. The following are varying levels of infestation within a river system and priorities for their management:

- **Uninfested Headwaters and Other Sites:** The priority is to protect these sites from infestation, prevent upstream seed sources, and maintain or improve the health of existing native plant communities.

- **Riparian Sites with Light Infestations:** The priority is to remove exotic trees, reduce upstream seed sources, and protect and enhance existing native plant communities.

- **Areas of Special Concern:** The priority is to identify riparian areas or wetlands that have a special focus (recreational uses, cultural significance, wildfire potential, or critical habitat) and to preserve, create, or enhance the unique attributes on such sites.

- **Densely Infested Sites:** The priority is to remove dense or monotypic stands of exotic trees and restore desirable plant species to achieve specific objectives.

Headwaters and Other Uninfested Sites: Preventing new infestations from forming is extremely important as it helps to maintain desirable plant community structure and function. Prevention includes limiting dispersal of seeds and plant parts from nearby areas, minimizing soil disturbance, and maintaining or improving the health of competitive plant species. Generally, regeneration will not be required if natural processes enable desirable plant maintenance and recruitment.

Riparian sites that have not yet been infested by exotic trees and have relatively healthy native and desirable plant communities must be conserved. Invasion of riparian sites can be a slow process, and healthy native plant communities can generally offer competition to invasion by exotic trees. Although a detailed inventory of New Mexico's river systems has not been conducted, many uninfested areas are present in the upper reaches of drainages, especially for the Rio Grande, Pecos, and Gila/San Francisco Rivers. Periodic surveillance of these sites will need to be done, and exotic trees discovered during surveys will need to be immediately removed.

Riparian Sites with Light Infestations: Riparian areas with relatively light infestations and relatively healthy native plant communities can usually be treated and restored in a cost effective manner. Early detection will also minimize management costs and negative impacts these exotic trees impose on the system. Per acre costs for control increase as densities of exotic trees increase. The main economic advantage to early treatment of these areas is avoiding costly rehabilitation efforts.

Surveys are needed to inventory the location and size of infestations as well as other plant species present within the area. Ideally, surveys should be done annually to allow for detection of new infestations and allow for prompt management. Areas with a high risk of infestation may need to be surveyed more frequently to ensure early detection.

Information can be mapped, which will aid in establishing priorities and developing or adjusting local management of the infestation. Once an area is mapped, goals will be established for management of individual infestations to provide for sustainable, long-term control. These goals should be specific and have measurable outcomes that are realistic. Prioritization of programs based on the level of infestation and potential for natural rehabilitation will optimize the area to

be treated with existing resources. Since water dispersal of seeds is significant for saltcedar and Siberian elm, treatments, whenever possible, should begin at the upper reaches of a drainage area and progress downstream. Treatment of Russian olive infestations is similar, but the long-range dispersal of seed by birds reduces the effectiveness of the watershed approach.

Treating Areas of Special Concern: Special areas of concern include the following: (1) habitat for threatened, endangered, and sensitive species; (2) dense stands of saltcedar and riparian sites with heavy fuel accumulations that increase the risk of wildfire; (3) historical cottonwood gallery forests; (4) areas of religious and cultural significance; and (5) areas where perennial water could be restored. Treatment methods for such sites should be based on management objectives and existing conditions. As with areas with light infestations, selective methods would be most appropriate where a remnant of native or desirable plants is present. However, some sites may need extensive tree removal and rehabilitation to achieve specific objectives, and may involve a variety of control methods. Presently, the species of concern most closely associated with management of exotic trees in New Mexico include the endangered Southwestern willow flycatcher (*Empidonax trailii extimus*) and the yellow-billed cuckoo (*Coccyzus americanus*). In late 2005, the U. S. Fish and Wildlife Service is scheduled to complete the designation of critical habitat for the endangered Southwestern willow flycatcher. It is also considering listing the yellow-billed cuckoo as a threatened species. Within these areas, specific treatments can be designed to maintain and improve vegetative conditions for these species by applying selective exotic tree removal within breeding areas. Treatments could occur in the fall or winter outside of the breeding season.

Treating Monotypic Stands: Large reaches of the Rio Grande, Pecos, Canadian, San Juan, and Gila River systems currently have monotypic stands of saltcedar and Russian olive with only a few remnants of native plant communities. Russian olive and Siberian elm appear to be more abundant at higher elevations, especially in the northern parts of the State. Without intervention, an increasingly larger area will be permanently modified by these exotic tree infestations. Eradication is an unrealistic objective for such large, dense infestations. Containment and annual density reduction is more practical. Russian olive infestations can develop under dense stands of saltcedar and could become more dominant in some riparian areas. Removal of one species would provide an opportunity for the spread and intensification of the other species, including the potential for invasion by herbaceous exotics. Rapid revegetation following control can provide competition against such invasions and lead to lasting, sustainable control that is resistant to invasion. Control of dense infestations is often done for a variety of objectives. Monotypic stands of saltcedar are at high risk from wildfire, which is of particular concern to nearby residential communities. In some instances, saltcedar can alter ground water hydrology as water tables decline and sites become more xeric (dry). Control of large, monotypic stands may increase water in some areas.

Rehabilitation

Rehabilitation is intended to return sites to plant communities dominated by native species. This protects and enhances hydrologic functions, wildlife habitat, and discourages reinvasion of non-native species. Rehabilitation objectives must be a component of any successful management

plan. In dense infestations, areas cannot be restored until control methods have been implemented and allowed to take effect. Rehabilitation objectives should be site specific and based on site potential. Treatments will vary from areas with sufficient native vegetation to inhabit the site to areas where intense disturbance requires planting and seeding to restore native plant communities.

Individuals who participated in development of Templates and Protocols

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Definitions

Adaptive management is a natural resources management process under which planning, implementation, monitoring, research, evaluation, and incorporation of new knowledge are combined into a management approach that 1) is based on scientific findings and the needs of society, 2) treats management actions as experiments, 3) acknowledges the complexity of these systems and scientific uncertainty, and 4) uses the resulting new knowledge to modify future management methods and policy.

Avian means of, relating to, or derived from birds.

Basal bark herbicide application refers to the application of herbicides to the smooth bark at the base of non-native phreatophytes usually through a spray.

Best available science is defined as the most appropriate science that can be applied to projects to structure control, revegetation and rehabilitation, monitoring, long-term maintenance and management, and adaptive management activities, taking into account each particular setting with respect to economic, environmental, cultural, and social considerations.

Biodiversity refers to biological diversity in an environment as indicated by numbers of different species of plants and animals.

Biological control is the use of specific organisms to control an undesirable organism.

Collaboration means involving all affected stakeholders in a set of decisions that guide how ecological rehabilitation and maintenance is undertaken, supported, and evaluated.

Coordination means making sure that those involved are aware of what other related activity is taking place. Coordination helps to maximize the efficient use of resources, promote consistency in process and standards where appropriate, and sequence efforts to achieve the greatest impact.

Disturbance regimes are the range of events, natural to an ecosystem, that temporarily change the structure and function of the systems, such as wildfire, drought, floods and insect or disease outbreak, to which the system is adapted.

Ecological capacity is the overall ability of an ecosystem to maintain its natural, original, or current condition and to produce goods and services. This includes both the current stock and the ability of an ecosystem to produce more of a specific resource. This includes surface and subsurface renewable resources.

Ecological processes refer to the natural cycles, disturbances and interactions of all parts of an ecosystem, such as nutrient and mineral cycles, fire or flood incidence, and species interactions.

Ecological restoration refers to a broad framework of activities for returning ecosystems to healthy functioning. Ecological restoration activities are based on specific landscapes and

objectives, and should incorporate past experience as a guide to sustainable futures. These activities include, but are not limited to: reducing overly-dense woody vegetation, re-establishing native vegetation, repairing erosion and soil condition, restoring hydrological function, and monitoring all these activities for effective long-term maintenance.

Ecosystem is the complex of a community of organisms interacting with one another and with the chemical and physical factors of their environment. In New Mexico, the pinion-juniper forest is an example of an ecosystem.

Ecosystem functions are the collective life activities of organisms in an ecosystem and the corresponding effects these natural activities have on the physical and chemical conditions of their environment.

Economies in New Mexico take many forms, and include those that are amenity-based, such as tourism, recreation, real estate and other like industries; product-based, which refer to forest products, mining and other extractive industries; as well as those that are agriculturally based such as farming and ranching.

Ephemeral streams are streams that flow only during or immediately after periods of precipitation.

Evapotranspiration is the combined diffusion of water vapor to the atmosphere from transpiration from plants and evaporation from soil and water surfaces.

Foliar herbicide application refers to the application of herbicides to the leaves of a plant usually through a spray.

Forb is a small, herbaceous (non-woody), broad-leaved vascular plant (excluding grasses, rushes, sedges, etc.). For example, wild flowers are a type of forb.

Forest refers to areas of land covered mostly by trees, and includes woodlands, riparian communities, shrub land, and other areas with woody plants, interspersed with meadows and grasslands.

Health refers to a condition where the system's parts and functions are sustained over time and where the capacity for ecological self-repair is maintained within a natural range of variability, allowing goals for sustainable uses, values and services to be met.

Hydrologic processes refer to that part of the hydrologic cycle that includes the amount and timing of stream flow, which in turn influences ecological functions in the stream corridor.

Hydrologic cycle describes the continuum of the transfer of water from precipitation to surface water and ground water, to storage and runoff, and to the eventual return to the atmosphere by transpiration and evaporation.

Implementation refers to the development of teams and specific action items to address the recommendations of this Plan. This is distinguished from implementation efforts at the local level, which are referred to here as "local on-the-ground efforts."

Integration means considering the other initiatives taking place as well as the impacts of these on the larger ecosystem over the long term, and having this consideration inform the effort.

Landscape means a spatial mosaic of several ecosystems, landforms, watersheds and plant communities that are repeated in similar form across a defined area irrespective of ownership or other artificial boundaries.

Landscape approach refers to the way the State will coordinate and manage ecological restoration and maintenance activities across New Mexico. The approach will be based on the scale at which natural processes (such as wildfire and flooding) occur, will encourage collaboration across jurisdictions and ownerships, and will consider causes of degradation to the specific ecosystem. This approach is intended to replace the isolated, smaller-scale, symptom-specific projects of the past.

Landscape scale refers to the size of landmass in which an action is taking place. Landscapes can vary in size from a few to several thousand square miles and may continue across drainage divides to where the consistent pattern ends.

Partners are considered to be any State, federal, local, Tribal, non-governmental, individuals, or private entities that cooperate in the non-native phreatophyte program.

Phreatophyte refers to a deep-rooted plant that obtains its water from the water table or the layer of soil just above it.

Rehabilitation is making the land useful again after a disturbance. It involves the recovery of ecosystem functions and processes in a degraded habitat. Rehabilitation does not necessarily reestablish the pre-disturbance conditions, but does involve establishing geological and hydrologically stable landscapes that support the natural ecosystem mosaic.

Restoration is reestablishment of the structure and function of ecosystems. The restoration process reestablishes the general structure, function, and dynamic but self-sustaining behavior to as closely as possible to pre-disturbance conditions and functions.

Riparian is the geographically delineated areas with distinct resource values that occur adjacent to rivers, streams, lakes, ponds, wetlands, and other water bodies.

Stakeholder refers inclusively to all those interests involved in ecological restoration and maintenance, including federal, State, Tribal, and local governments, private landowners, academia, public interest groups, citizens and others.

State refers to New Mexico state government and its agencies.

Statewide refers to the entire State, which is inclusive of all geographic areas and all stakeholders.

Sustainable refers to a level of human use of a natural resource that can continue through time without diminishing the resource's productivity or resilience.

Tribes or Tribal is used to collectively represent New Mexico's 22 individual Tribes, Indian Nations, and Pueblos and their respective governments.

Watershed refers to a region or land area that is drained by a single stream, river or drainage network, and includes all of the land within the entire drainage area. An example of a large watershed would be the Rio Grande valley from Colorado to Texas. Examples of smaller watersheds within the larger watershed are the Chama River valley and the Rio Puerco valley.