

# **BOSQUE LANDSCAPE ALTERATION STRATEGY (BLAS)**

**June 21, 2005 draft incorporating comments from the May 26, 2005  
Bosque Landscape Alteration Workshop**

## **I. OBJECTIVES**

- 1) To reorganize the Rio Grande bosque's landscape to retain, within current constraints, including institutional and water supply constraints, its historical processes and wildlife communities.**
- 2) To recreate, by doing this, its former patchy mosaic of native trees and open spaces along the present-day river's narrow floodplain, while containing the distribution of invasive species.**

*Comment:* A question was raised about whether the former mosaic should be a goal when it no longer exists and is difficult to define.

*Discussion:* *The former mosaic is a goal, because we believe it will reduce the intensity of bosque wildfires, create habitat diversity and decrease water depletion. See Bosque Landscape Alteration Will Reduce Fires And Conserve Water: A Proposal, the paper on which both workshops were based. The Proposal centers on re-creating a patchy mosaic of native riparian trees and open spaces along the narrow active floodplain of the Middle Rio Grande. Although the present straightened and levee-bordered river will require that the mosaic be somewhat linear, it will otherwise resemble the pattern of scattered cottonwood groves interspersed by open spaces that once characterized the wider historic floodplain. The Proposal addresses the general patterns of change induced in the past by the flood-pulse and now driven more by human influence, especially human-set fires.*

- 3) To reduce, by having created this mosaic, the intensity of bosque wildfires both at the wildland-urban interface and within the rest of the bosque, and water depletion by the bosque landscape.**

*Comment:* Water conservation is the politically-correct objective, but to require that bosque projects achieve water conservation would eliminate many potential projects. It would help to clarify the conservation goal under these guidelines. Perhaps "no net depletions?" Wetlands can be a fire break. The river has already given up a lot.

*Discussion:* *Good idea. The more general statement "to reduce, by having created this mosaic ... water depletion by the bosque landscape," is consistent with the general objective. Perhaps the "no net depletions" concept belongs in requirement #7 below.*

## **II. BASIC REQUIREMENTS**

- 1. Become familiar with the present condition of the bosque landscape (hydrology, soils, flora, fauna), including existing water depletion rates and fire danger in different reaches, and with the management practices that affect it.**
- 2. Develop flexible hydrological management options, including the ability to mimic the natural hydrograph, in order to maintain wet soils at appropriate seasons for native tree recruitment and maintenance.**
- 3. Recognize that historical flooding is being replaced by wildfire as the driving disturbance in bosque landscape dynamics, and implement flexible responses to**

**both flood and fire to maximize the benefits and minimize the damages of these disturbances.**

*Comment:* Combine restoration with fire hazard reduction.

4. **Manage the river and the anticipated patchy riparian mosaic for habitat diversity; biological diversity will follow.**
5. **Adaptively manage the bosque landscape in an ecosystem-based manner that integrates recreation uses with fire protection.**
6. **Construct wetlands inside – and where possible outside – the levee system, (with reference to available wetland models) where hydrologic conditions are likely to support wetlands.**
7. **Maintain the altered bosque landscape with measures that provide for overall reduction in the consumptive use of water by the riparian ecosystem.**

*Proposed change in response to comments shown in italic:*

**Maintain the altered bosque landscape with measures that provide for *a goal of no increase in net depletions of water* by the riparian ecosystem.**

*We suggest this would apply to the whole bosque from Cochiti Dam to the upper end of EB Reservoir, and for any particular analysis it could be tied to a reference or "benchmark" date.*

8. **Ensure a sustained program of bosque research and monitoring.**

### **III. DRAFT GUIDELINES**

#### **A. Describe what is known about the bosque and what additional information is required to implement the Bosque Landscape Alteration Strategy (BLAS)**

*From Habitat Diversity breakout group:* Each site needs to take into account existing conditions. The language “become familiar with existing conditions” is insufficient to describe the details that are needed. It is these details that will drive a project. Existing conditions need to be documented in great detail before deciding on what a patch might look like.

In Albuquerque, the burned areas vary quite a bit depending upon the location and how it burned. Some are close to the water table, the topography varies, and the salt content varies. There also may be remaining cottonwood sprouts or remnants of the dominant vegetation. We can't have a one-size-fits-all approach.

*Other Comments:* Since these are guidelines for implementation—presumably implementation of a project—this step might be clearer if cast in terms of a project implementing BLAS. The reader/user of the guidelines might be asked to set out the elements of a generic description

- Identify area that will be impacted by size and location;
- Describe how the project site relates to the bosque overall;
- Describe how the project's objectives relate to the objectives of BLAS
  1. Retain historical processes
  2. Retain wildlife communities
  3. Recreate former patchy mosaic
  4. Contain distribution of invasive species
  5. Reduce intensity of bosque wildfires
  6. Reduce water depletion by bosque landscape;
- nature of surrounding lands;

- census of vegetation community types and acreages;
- depth to groundwater;
- seasonal fluctuation of water table (helps determine appropriate species and the most effective stock type (container depth or pole length) for revegetation);
- soil types –for selection of species and stock types for revegetation;
- soil salinity (electrical conductivity, EC);
- overbank flooding—at what levels of river flows?

**1. Use the historical vegetation community types and acreages from the Bosque Biological Management Plan, the updated Hink & Ohmart vegetation classifications, and other sources of information as a basis for landscape mosaic planning.**

*From Habitat Diversity breakout group:* The Hink and Ohmart study is difficult to use. We need updated tools that are more useful. We need more options to choose from and tools up front as to how to evaluate existing conditions. We need more detailed descriptions of vegetation community types.

*Discussion:* MRGCD, State Forestry, and others are now collaborating to produce an updated Bosque Prescription Guide. Information on how to access the new Guide will be sent to all BLAS Workshop participants when it is ready.

**2. Collect and periodically review data on pre and post-treatment fuel loads, the effects of fire, and the results of other ecosystem monitoring, so that prescriptions for thinning exotics and the dead/down/mulch component can be revised to incorporate current knowledge.**

*From Information Needs Breakout Group and plenary:*

Additional types of data that should be reviewed in a BLAS project include

**Effects of fire:** Data on regrowth, stem and root sprouting, animal effects. The type of data needed should be clarified.

**Wildlife:** It is difficult to monitor vertebrate wildlife, but information is available from both the public and the wildlife agencies [Wildlife Rescue, USFS Rocky Mountain Research Station (RMRS)]. Details of Wildlife Rescue data are often not collected because rescuers don't know what information other groups need. A form is filled out that covers *how* the animal was found, which helps to determine *why* the injury occurred, but doesn't locate the site, nor is the observation data related to bosque-clearing events. While it is difficult for the public to tell exactly where they found animals that are brought in, better-trained volunteers and clarification of data management might be able to identify site locations and other significant information.

**Post-treatment monitoring:** Data exist (through BEMP and others) on: vegetation, birds, arthropods, fish, depth and quality of ground and surface water, fire intensity, fuel load. This needs to be supplemented with site-specific detail.

**Discussion:** It is this type of site-specific data that is envisioned by this Guideline.

**Also needed:** Depth and ecological effects of mulch; revegetation/reseeding success (grasses), weed monitoring (pepperweed, foxtail), herbicide treatment, regrowth/resprout.

**Discussion:** These categories are or will be monitored by through the Bosque Fuels Reduction Study and other agencies like SWCDs, State Forestry and Corps of Engineers.

**Program Evaluation data:** Funders require data showing degree of success in restoration programs. Non-profits should apply for money to monitor.

***In general little data exists for:***

- Soil composition and chemistry—Jan Hendrix at New Mexico Tech; recent graduate student work in UNM Hydrogeocology Program; Bosque Fuels Reduction and Fire Effects Studies (Debbie Finch, Forest Service RMRS).
- Mammals—Pueblo of Santa Ana has some of this, along with birds, as does Bosque of Apache NWR, Albuquerque Open Space, UNM Biology, Bosque School, U.S. Fish and Wildlife Service.
- Amphibians/reptiles—Heather Bateman, RMRS.

***Questions to be answered:***

Identify *ecosystem models*—what can we restore to? What is a sustainable community?

How much of what sorts of native vegetation are needed to replace food and shelter now provided by exotics; need to know this *before* eliminating the exotics.

*Discussion: The Bosque Fuels Reduction Study (RMRS) addresses this question.*

What is the effect on wildlife of closing the bosque to the public after fires?

**3. Define a target range of vegetation patch sizes and optimal stem densities within patches to leave or create for wildlife.**

*Habitat Diversity Breakout Group:* Regarding the Draft Guidelines, the group discussed the approach to patches. There was a sense that patch size will need to vary reach by reach, site by site. A 300-acre wetland at Santo Domingo was described that has historic remnants of floodplain wetlands, beaver dams and high biologic diversity. It could be used as a reference model for wetland restoration and creation within the MRG. The patch sizes in the Guidelines could be read to be minimum sizes.

Patch sizes are oftentimes shrunk by political imperatives and the need for water. It is important in choosing the species for a patch to know what is adjacent to it. Patches have developed as a default due to fire. There needs to be a determination if the patch is in the right place – will it stay wet if it is intended to be a wet species patch?

There should be three levels of analysis.

- 1) Where are the opportunities for a patch and what size patch do the opportunities provide?
- 2) Where are the next habitat patches in relation to the site being restored?
- 3) What does the wildlife need at that particular location?

There was consensus that we have never really looked at all of these issues simultaneously. It is also important to determine what is most sustainable at a particular site with low maintenance or no maintenance required.

*All forums:* Several practitioners suggested it would be helpful to develop a decision-key to guide planners in choosing a type of patch. The guide would lead the reader through questions such as:

- 1) How do you choose the type of patch?
  - A description of each common type of patch;
  - Selection criteria, related to project objectives, constraints.
- 2) How to establish a particular type of patch?
  - Relate to project objectives;
  - Relate to reach and site characteristics.
- 3) How to maintain a particular patch type?
  - Relate maintenance to project objectives.
  - Include location, frequency, timing, intensity, type of activity.
- 4) What needs to be monitored during maintenance for this type of patch/this project?

5) What are the successional expectations for this type of patch?

*Other comments about patch sizes:*

Can't have same standards across all reaches.

Shouldn't have a standard patch size because we're going for diversity. Patches of vegetation are rarely uniform anyway.

Choice of patch size will be based on opportunity, what is adjacent, wildlife needs, and what can be sustained at an acceptable level of maintenance.

Guidelines should provide some background on what to leave/what to plant

Target range will vary by reach – it is different in Belen where *yerba* will grow and other places where it won't.

*Discussion: "...target range..." is not a "standard size", but is rather a range of sizes. This concern arises from the need to provide good wildlife habitat. Target range is important when planning fuels reduction with variable thinning or revegetation projects to benefit wildlife.*

Will depend on soil type, ground water, density.

Funding will never be sufficient for all projects—for a mosaic/patchwork throughout the Rio Grande Valley—so you have to pick your choice spots where there is adequate groundwater depth for cottonwoods, non-uniform soil texture, and advance knowledge of a site's potential for vegetation. The benefit of being unable to do everything at once is that we can implement what we learn (this adaptive management objective should motivate data collection approaches).

*From Habitat Diversity Breakout group, on bird habitat:*

Hawks Aloft has one year's data on different types of habitats. In Corrales there is a medium density patch that was hand cleared. There are very high numbers of birds. The islands in the river and the drains are also important to habitat diversity.

New Mexico is important as habitat for birds in winter. This type of habitat is almost more important than new spring breeding habitat for songbirds. We need a mix. Grasslands support fewer species but the species it supports are important species.

*Process issues:*

There are reaches, particularly Tribal reaches, where data gaps exist. Tribes are adjudicating unquantified prior rights and cannot afford an open door policy about data. We need to look for ways to protect Pueblos to enable them to share their data when it is safe to do so—Pueblos need to maintain control over the data collected on their lands.

There is a need for a protocol for working with tribes regarding data sharing, etc., founded on the principle of recognizing and respecting Tribal decisions. (May also need this for working with the Hispanic community). Might consider a workshop/conference on data sharing, and asking Tribal staff to address this topic.

How can we collect "anecdotal" data from the diverse groups of bosque users and students? "I saw a flicker at X location on May 12<sup>th</sup>." (A Bosque Natural History Guide is being written with BIG support.)

*How to Share Information?*

A **central source** for all the bosque information is needed, but

- it's difficult to get people to share
- everyone has different types of information
- this would be a very expensive project

Information **sources** could be **linked through websites**.

- Tribes are seeking ways to share information, but must maintain control of their data.

- Many data sets are already available on websites, but it's hard to find them.
- Web access is cheaper and a better format for most users than print.
- There will never be an entity to host all data sets—the form, content, degree of precision, is very different from source to source.
- Perhaps organizations with data could just create mutual links with a coordinating website.
- The data-collecting organization would list the information they have, and post whatever data on its own website it wishes to post. If the data-user needs more, they will have to discuss that with the organization.
- Consider means to support this relatively low-level decentralized effort, and how to enable each entity to transfer its information if its funding is lost.

***Distinguish types of information and data:*** It is important to distinguish raw data versus reports with summarized and analyzed data, and the different restrictions on distribution of each.

Who should ***host the linkage?***

Some felt *not* the MRG ESA collaborative program—its focus is on the listed species only. It has access to larger funding sources, but would have a hard time connecting with the very diverse and often small and informal data sources on the bosque.

Others felt that in terms of data sharing, the MRG ESA Collaborative Program would likely be doing much of it anyway and that it is the most likely entity to have significant funding to take on the huge data task.

BIG has the beginning of a clearinghouse and could link to all data sources. BIG already has relationships with many of these information-generating projects.

Individual information sites should link back to BIG as well, so the user will be connected with the full body of data sources.

Over the last two years there have been rumors that BIG will not be funded beyond FY2005. If that is true, another host may be more appropriate.

Many information sources may not know what people need (Wildlife Rescue; Steve and Nancy Cox, Rio Grande Bird Research)—there should be some communication about the uses of data and forms for data storage—educational, not authoritative.

Funding is a big issue, particularly finding ways to distribute the money to individual organizations so they can afford to post the information.

***People*** Information

Develop contact lists for who is doing what, perhaps on the BIG linkages.

***Catalog*** of specific information being collected—see pp. 20-22. Feel free to add to this list. Wherever you have better contact information, please pass it along.

## **B. Implement bosque landscape alteration with adaptive management**

*Comments on the structure of the Guidelines:*

The implementation section (Section B) needs to tier off Section A. Depending upon the conditions you find, *then* certain actions are taken.

Land managers need the historic information that was laid out in the Bosque Biological Management Plan. The basic requirements of the Guidelines are acceptable, but we need to decide if we are using a landscape or a landscaper approach. People did not feel the Guidelines are suggesting a landscape approach. The Guidelines are focused on creating patches of isolated vegetation. They are too general and too prescriptive at the same time.

Coordinate these guidelines on both the project and the landscape level. Need to look at the work on the larger scale (think globally, act locally).

Need qualitative guidelines

*Comments on the need for reach-specificity:*

Express and accept limitations/varying objectives by reach. Overbank flooding will not occur in the upper one-third of the 45-mile Socorro reach. In the Albuquerque reach where there is high human contact, potential for appreciation and education is high. Perspective on what is desirable is different in different reaches—configurations that are sustainable in some reaches are not in others.

The decision forum must also span reaches. The upstream Pueblos cannot permit flows as high as the downstream overbank strategies require.

*Discussion:* One of the desired uses for the Guidelines is to provide guidance to the implementation of existing, or development of, reach-specific or larger scale restoration plans in the MRG, even though it does not include the level of detail to be found in a rehabilitation plan. We acknowledge and agree that creating a mosaic has to be thought out on a landscape scale, and this approach needs to be defined for this and other efforts in the MRG bosque.

*Comments on the Objectives of the Guidelines:*

The Guidelines are a good start on the fuels reduction piece of the mosaic. But the mosaic for wildlife purposes needs to be further thought out.

There is a sense that the MRGCD wants a prescription for restoration for fire control. Section B, adaptive management, is geared for areas where the intent is to control for fire and conserve water. We need an introductory statement that says this.

Who is this document for? It appears to have a fire-management emphasis.

*Discussion:* The intended audience is any person or agency or government planning or doing work in the bosque. The paper that generated the first workshop (May 25, 2004) was titled “Bosque Landscape Alteration Will Reduce Fires And Conserve Water: A Proposal” This establishes an emphasis on fire management and reduction of water depletions, especially focused on how to achieve those objectives while protecting and enhancing habitat diversity.

## 1. Remove dead-and-down and invasive trees to meet the established goals.

*Comments:* What are the established goals? The guidelines might offer the user a process for identifying a project’s goals early on, providing some context for when these goals are likely to be complementary and when they might be at odds. Then when an explicit action is stated, as here, it would have some context. “Objectives” gives a menu of possible goals.

- Retain historical processes  
(Comment: Historical botanical info needed: Dan Scurlock, others.)  
*Discussion:* Historically, removal was accomplished in part by flooding, which carried litter out and into the river as biologically relevant ‘coarse woody debris.’ It was also buried in place by sediment deposition, and its decomposition was accelerated by prolonged exposure to water.
- Retain wildlife communities  
(Comment: Identify species of concern, not just listed species. Leave their habitat as needed.)
- Recreate former patchy mosaic
- Contain distribution of invasive species  
(Comment: Some of those invasive species are important to wildlife.)
- Reduce intensity of bosque wildfires
- Reduce water depletion by bosque landscape.

*Discussion: Good comments. These issues should be addressed up-front, and that is where development of a "decision key" or "decision matrix" could be a useful tool to identify appropriate goals for a particular project, and to determine if those goals complement or conflict with each other, and, at the most detailed level of planning, to guide the selection of specific rehabilitation actions. Goals for a particular rehabilitation project or reach of bosque may vary according to land tenure, reach characteristics, ecosystem conditions, funding, and possibly other considerations. (See further discussion under III. Implementation Guidelines, Section A.3).*

- 2. Depending upon the width of the bosque, site conditions and management objectives, leave or create a buffer strip of relatively dense vegetation along the river, of 5 to 15 m in width, for habitat. Water availability and animal use is generally higher in this zone, making it harder to maintain and better suited for riparian shrubs.**

*Comments:* 'Landscape' is (or at least includes) the interface of the river and the bosque. We should think about when to avoid armoring the banks with vegetation.

*Habitat diversity breakout group:* This sometimes can be great for birds, and sometimes it is better to destabilize the bank. The question is, where do we intentionally want to destabilize? The MRGCD may not want to destabilize banks. This will set the stage for succession and will allow the river to move. Islands and bars sometimes contain the best opportunities for habitat.

*Fire management and water depletions breakout group:* Can willow buffers be located near bridges? Here is a case where it is important to define objectives for the particular site. Riverbanks are important to Pueblo families, and need to be accessible. Bridges are access areas; people may want access to the water and to the riverbank.

5-15 meters is about a 45-foot buffer zone. The desirable size of this buffer depends on the vegetation. Leave shrub densities that won't create crown fires. Different shrub species have different crown specs—ladder fuels and touching crowns should be avoided. Leave some exotic shrubs. Near bridges, use willow, low shrubs.

*Question:* "Is there support for leaving exotics?" *Response:* "There is an overall resistance to exotics among members of the breakout group, but the major concerns raised by leaving 'relatively dense' remnant patches are the potential for crown fires and running fires. Fires in touching-crown shrubs and mature trees may be difficult to control. Should make the density of the 'relatively dense patches' one that will prevent these fires—50-70 shrubs per acre, or densities where the crowns aren't touching.

- 3. In river reaches where the hydrology does not support periodic flooding or water tables to create sufficient size or number of young dense stands of native vegetation, leave relatively dense remnant patches of cottonwoods and exotic understory (especially Russian olive), not to exceed 20 hectares in extent, as controls for monitoring the effects of landscape alteration. First priority sites in this category would be sites designated as suitable or potentially suitable habitat for the southwestern willow flycatcher.**

*Comments:* Stands of Russian olives are a very important food source for the flycatcher as well as the northern flickers. They retain their berries until the end of the winter.

*Discussion:* Should this Guideline's directive to "leave relatively dense remnant patches of cottonwoods and exotic understory (especially Russian olive)" be expanded to include, for example, locust, mulberry, juniper as stated in some existing prescriptions?. The bosque revegetation lists developed and refined by the MRGCD, Los Lunas Plant Materials Center, Corps of Engineers and others could also be reviewed for habitat and other objectives.

Bird rescue notes that woodpeckers are missing in places where all the good stands of exotics are gone.

*Discussion: This needs to be verified by examining the results of recent bird surveys, some of which have indicated the presence of woodpeckers throughout the bosque.*

*Fire management and water depletions breakout group:* ‘Not to exceed 20 hectares’—that’s about 50 acres, and that’s a pretty big patch. We might consider a 10-20 acre patch.

Where winds come from the southwest a high dense overstory above the dense shrubby patch reduces the exposure to wind.

**Some removal of dead-and-down can occur within these stands if dead-and-down fuel loads exceed 10 tons/acre, leaving sufficient accumulations of dead-and-down wood to provide wildlife cover.**

*Comments, Fire management and water depletions breakout group:* For fire-management as well as for habitat, *arrangement* is more important than tonnage. Very heavy large-diameter logs may be safely left for habitat. A guideline should include diameter, as in “Remove 20 tons/acre of x diameter,” or “leave 2 logs/acre that are 15” at the large end.

But tonnage is an element of the BIA FIREMON monitoring criteria and for smoke management in prescribed burns, so it shouldn’t be abandoned.

This guideline will vary ‘depending on objectives....’

*Proposed change in language above in response to workshop comments, shown in italics:*

**Some removal *or rearrangement* of dead-and-down can occur within these stands if dead-and-down fuel loads exceed 10 tons/acre, *or where conditions such as fuel depth warrant.* Dead-and-down wood, *as well as snags and decomposing logs greater than 12 inches in diameter,* should be left for wildlife cover.**

**Dead-and-down wood removal should be focused on the edges of *dense* patches. These patches should be surrounded by thinned woodland, shrub/grasslands, or other areas defensible against fire.**

*Comments Fire management and water depletions breakout group:* What should surround these dense patches? A 200’ defensible space created by feathering along the edges, removing heavy fuel, thinning from below—but if the fire can jump the river, 200’ is not enough.

Consider spotting distances, which depend on the type and height of the vegetation (spotting is when winds pick up burning material and move it ahead of the fire, spreading it horizontally across firebreaks). Keep heavy patches away from homes.

The ladder fuels south of Montano had been recently chipped, but crown fire still happened. With the right conditions, the fire overcomes preventative measures.

**Defensible space areas should have vegetation that supports only low intensity fires (flame lengths less than 8 feet) that allow direct attack using ground crews and heavy equipment, where required.**

*Comments, Fire management and water depletions breakout group:* The purpose of the feathering is to reduce fire intensity. How far from edge? That depends on what you’re removing.

From the firefighter’s standpoint the most important factor is crown configuration. If there’s a high canopy, the surface is more controllable; makes for low intensity; allow low intensity fires back in.

The bosque has three tiers – the layer of shrubs, the intermediate layer, the crown.

[Something] slows growth of fire intensity; maybe isolates smaller crown fires.

If the goal is manageable fires, you’ve got to manage it.

Depends on water table, etc; patches of unusual species might be appropriate.

**Dense patches should not be retained adjacent to (within 150 feet of) bridges or other structures, or designated recreation access points, unless requirements for wildlife habitat or flood control dictate otherwise.**

*Comments, Fire management and water depletions breakout group:* Removal of dense patches near bridges may destabilize banks.

Here the fire-management objective would jibe with other objectives (access to homes).

Be careful in project design that you don't build in conflicting objectives; i.e. separate habitat areas and firebreaks, etc. in space.

**4. Thin existing stands of native trees, while retaining sufficient dense young-growth native forest patches for habitat, leaving enough standing dead trees for wildlife.**

*Comments:*

Albuquerque Open Space doesn't necessarily agree with the removal of natives. This has to do with the succession. We need to look at where we are in the succession process. We have become the agent of disturbance for succession. We are practicing "disturbance ecology" and we are new at it and we need to learn.

We need to identify the species of concern and be sure we are surveying to note where there are good stands of this type of habitat and then leave those stands alone.

The Corrales site has buffaloberry, which produces well-known bird food. . We need to learn if this is a plant species that is attractive for bird habitat . We need to find out what species occurred here 300 years ago that we could put back in. For example, box elder. Even though conditions for germination and seedling growth are no longer optimal for many species, people are surprised how vegetation can thrive once it gets established.

*Discussion: Generally speaking, the more species diversity the better, but site conditions may restrict what is sustainable at a given site.*

Develop islands of suitable vegetation, not necessarily of high density. Drains may provide excellent bird habitat. New Mexico is an important winter habitat for birds.

**First priority is to convert burned areas to desirable vegetation communities, depending on site conditions and potential, leaving sufficient dead-and-down wood and snags for wildlife.**

*Comments, Fire management and water depletions breakout group:* Important to treat sites that have burned before they burn again. A burned site with heavy residual dead-and-down can regenerate quickly—but a hot second fire fueled with the residual dead-and-down will be much more destructive.

In leaving snags for wildlife, leave trees with a crown that is not sail-shaped—these present hazards when they fall. Leave those along the water's edge; larger trees if possible.

**In patches of decadent stands of cottonwoods greater than 20 hectares, where growth is stagnant, thin cottonwoods to a minimum distance of 40 feet between trunks. Thin decadent trees in recreation areas.**

*Comments, Fire management and water depletions breakout group:* What is optimal? Perhaps 25-30 trees/acre? The optimal basal area is 120 ft<sup>2</sup> of growing space for a large tree. This is what gives the 40' between trunks rule, which works for fire—it also promotes tree health.

20 hectares is a large patch. There aren't many 20 hectare stands. Maybe 10-20 would be better.

Identify the more decadent trees. Look for conks – they are a fungal growth; very little is visible but the rot goes to the heart of the tree. These are often empty inside.

## **5. Create uneven-aged stands of native trees by overbank flooding, pole planting, selective watering, landscape lowering, side-channel construction, and/or other appropriate techniques.**

*Comments, Habitat Diversity Breakout group:* The Corps of Engineers asked “How reliant are these restoration projects on overbank flooding?” The Corps is being asked to reduce water releases from the 6,500 cfs currently flowing. In the southern Socorro reach, overbanking is expected to be part of the process, and is occurring at the current water levels. According to the Corps, for overbanking to occur at 4,000 cfs, we need more connectivity between the river and the low areas. The HEC-RAS Model shows areas where you can break down banks to allow connectivity. We have to maintain the stability of the levees, that’s why back channels are a good technique.

The Albuquerque overbank project was discussed. They took out Russian olives and graded the site down so that it floods at 4,000 cfs. It is not reliant on continued attention for maintenance.

*Discussion: Need to review techniques in the MRGESACP Habitat Restoration Plan for their compatibility with the existing levees.*

Russian olives help with bank stability. Native vegetation can also be used. We need to decide where bank instability is desired; it can benefit the silvery minnow and can have other benefits.

Overbanking in the Socorro reach is not just sub-flow (which is the type of overbanking that’s occurring in most of the Albuquerque reach). Good connectivity allowing wetting of most of the soil column occurs in parts of the bosque at BEMP sites with high flows that don’t overbank at those sites

Some places in the Middle Rio Grande have banks that are just too high to shave down. Where overbanking can’t happen, supplemental watering can be used for plant establishment. Many of them will be fine on their own after a few years. For the silvery minnow, even if we can’t achieve overbanking, the erosion that occurs helps create habitat for the minnow.

*Other Comments:* Will need to account for any water depletion. Must be prepared to justify depletions. There’s no ability for controlled flooding.

Proposed quagmire project – remove salt cedar, flood, open salt grass area, attract cranes

- Not old growth salt cedar; 6-10’ high, patchy
- Removing the salt cedar might improve water regime
- Flood during the low demand months, Nov-March

*Discussion: Revegetation that requires supplemental watering needs to consider agency resources or funds to contract this task before implementing projects.*

### **Take advantage of flood prone areas and higher runoff periods.**

*Comments, Habitat Diversity Breakout group:* How do you get succession when major natural influences (i.e. flooding) are removed<sup>1</sup>? When do humans intervene? This week we are finding out where flooding occurs. If these guidelines are moving towards increased water conservation, then we should be looking at where high flows (7,000 cfs or greater) are achieving overbank flooding. Even if it only happens every ten years, it will increase diversity. High flows are cheap, easy-to-use water.

We need to identify the areas where the highest potential exists for flooding during high flows. The Socorro reach is not having overbank flooding through the upper one-third of its 45 mile reach (due to incision of the channel bed below San Acacia Diversion). We need to accept this and not try to push

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<sup>1</sup> Succession is generally considered to be a gradual change in plant communities following disturbance. Thinning and clearing are disturbances that even without further human intervention will create some form of succession. Flooding induces succession too, but its critical effects in the Bosque are to make cottonwood seedling establishment possible and to greatly accelerate nutrient cycling.

habitat installation in areas that aren't going to be sustainable. We need to look at the long term. That way we won't overstep in terms of sustainability

*Plenary:* High flows allow for greater diversity.

**Choose areas with water tables less than 2<sup>2</sup> meters below the surface to create willow swales, for tree and shrub plantings, and for landscape lowering or side channel construction.**

*Comments:* Some bosque areas are being wetted from rising groundwater at 6,500 cfs.

**Where feasible, use alternate sources of water such as drains and wasteways for seasonal artificial flooding.**

*Comments:* Connect with backchannels.

Flows high enough to cause downstream overbank flooding are too high for the upstream Pueblo riparian lands. Need to look at other ways to achieve flooding that do not destroy Pueblo riverbanks.

**Wetlands can be created in seasonally flooded areas and areas with water tables sufficient to support hydric soils.**

*Comment:* Wetlands will need to account for any water depletion. The "no net depletion" version of the water conservation objective should be explored.

*Discussion:* *Good suggestion. We have suggested language to incorporate this change into II. Basic Requirements 7*

**6. Create an irregular and internally thinned woodland patch mosaic of varying density with relatively large, interspersed open spaces of native grasses and shrubs.**

*Comment:* The expression 'thinned from below' is more descriptive than 'internally thinned.'

**Variables that determine optimal patch size include, but are not limited to: Access, nearest similar patch, corridors/connections with other patches, wildlife habitat requirements, fire risk, and water depletions.**

**Native grass and shrublands should be prioritized for dry terraces where flooding occurs only with higher flows (greater than 10,000 cfs.), as well as at bridges and recreation/emergency access points.**

*Comments:* Flows greater than 10,000 cfs are hardly ever going to happen. So should we write off native grass and shrublands?

*Discussion:* *We would like (as in the SOBTF Conceptual Restoration Plan) to target areas that flood infrequently as candidates for establishing native grass and shrublands.*

Incorporate 40' spacing here? Could bring item #3 together with Items #6 and #7, perhaps in a catalog of elements of the "mosaic" appropriate to particular sites?

*Discussion:* *Items #6 and #7 should at least be treated as separate paragraphs.*

*A catalog is ok so long as discretion is left to those establishing the mosaic. Until we know where mosaics will be created, we don't know the local limiting factors.*

[Changes proposed, in response to Workshop comments, shown in italic.]

**Native grass and shrublands should be prioritized for dry terraces where flooding occurs only with *infrequent, high* flows, as well as at bridges and recreation/emergency**

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<sup>2</sup> Modified from the original "3" meters in response to Workshop comments.

**access points.** *Flood potential and levels must be determined for different river reaches. For example, areas that flood in the bosque south of San Acacia above 5660 cfs would generally support a more open bosque with grasses and grass/shrublands depending on groundwater and other factors.*

**Salt grass meadows can be prioritized for areas where an open vegetation community is desired and the hydrology supports it.**

[Changes proposed, in response to Workshop comments, shown in italic.]

**Salt grass meadows can be prioritized for areas where an open vegetation community is desired and the hydrology *and soils* support it – *generally where water tables are less than 1-1.5 meters below the soil surface.***

**7. Create grasslands with sparse, low growing shrubs (approximately 4 feet or less in height), or a thinned cottonwood canopy of 5 to 15 hectares in extent, adjacent to bridges and recreation/emergency access areas.**

*Comment:* Concern about the expression ‘create grasslands’—know your site, don’t force it.

**Create a 100-foot-wide buffer zone adjacent to powerlines where trees and shrubs over 4 feet are removed. Treat dead-and-down fuel loads in these areas to < 10 tons per acre.**

*Comments:* 100’ wide buffer is outside the clearing limits of power lines—running power determines how much clearance PNM must do.

The importance of clearing is not just to keep the flames from arcing between the lines, but to keep smoke at an acceptable level as well. Smoke can arc as well—it was smoke that shut down the power in the Farmington fires. Perhaps 100’ on the south side, 50’ on north?

In lots of areas there are trees close to lines.

Don’t need this buffer zone clear-cut. Could propose 40’ spacing between trees and some understory removed for 150’ around the power lines.

Is our target to create a cleared area beneath the power lines? That really fractures the system.

*Discussion:* Any disturbance can “fracture” the system, depending on its scale. The term can rouse emotions when in fact the bosque ecosystem is a product of disturbance (originally flooding).

If it’s opened, we have to keep it open.

Changes proposed, in response to these comments, shown below in italic:

**Create a buffer zone *150 feet wide* adjacent to powerlines where *overstory is thinned to 40 feet between trees, and shrub canopies are not touching or forming ladder fuels.* Treat dead-and-down fuel loads in these areas to < 10 tons per acre.**

**C. Describe how the altered bosque landscape will be maintained and monitored**

***Major issues identified by the break-out group:***

- Monitoring objectives – widely varying objectives dictate monitoring methods; define a monitoring strategy to encompass different objectives (e.g., ground/surface water, vegetation); water and vegetation are most basic and important parameters to monitor
- Consistency counts in frequency and method of data collection.
- Data should be shareable and comparable.
- Decision matrix approach – tie a list of objectives to monitoring methodologies and to ongoing and past projects.

- Implementation – minimum protocols; package of methods; scale
- Costs – costs limit projects; money drives scale; money drives objectives.
- Contrast between ecosystem monitoring and pre/post alteration monitoring
- Ecological services are provided by riparian ecosystems.

**1. Utilize controlled grazing/browsing animals, and/or other maintenance tools, seasonally to meet established goals.**

*Comments:* This is a strikingly brief mention of maintenance techniques and maintenance planning. Perhaps because it is so brief, this topic did not draw comments in the plenary and was not addressed by the Fire management/Water Depletions breakout group.

*Discussion: Good comment. Maintenance should be part of the "decision key" (see A.3 above), and should address location, frequency, timing, intensity, and type of maintenance activity, as determined by rehabilitation objectives associated with each site.*

*From the Habitat Diversity breakout group:* With the removal of the Albuquerque under-story, the birds are gone but the Russian olives will grow back. The City was mandated to clear the forest for fire prevention. You can see Russian olives coming back. Without maintenance they will all be back in five years. There is a need for long term planning.

Some Russian olive may need to be intentionally left for wintering bird feed.

The highest maintenance areas are scrublands and open meadows. These are also the hardest to get going from scratch. You can mow willows, but how do you help shrubs along? Santa Ana is said to have successfully mowed salt cedar instead of ripping it and helped establish native grasses as a result.

Bosque del Apache has had success in establishing salt grass next to wetlands in moist soils. They do a shallow disc every year to break up the rhizomes of salt cedar and after three years the salt grass has become self sufficient and will not allow the growth of salt cedar.

**2. Conduct periodic reviews and external evaluations of the ecological outcomes of bosque landscape alteration, as determined by monitoring.**

*Comments:* Monitoring is an important topic that could benefit from a forum of its own in the near future.

How to measure success for landscape alteration programs? There are lots of individual projects each with its own monitoring.

When using monitoring to gage whether a project is reaching its objectives, we have to be pretty adaptive about what we hope to achieve. The project has its basic objectives, but the land will dictate what's going to occur there. We set the stage and then monitor what's going on. As long as we're not encouraging the invasive species that we just removed, and we're within our water rights, etc., our role is to observe succession and let it happen. If habitat is created, even though it isn't exactly the habitat we had in mind, we go with the flow.

Monitoring may usefully include judgment. There are targets you would be disappointed not to reach. Consider the wetlands mitigation projects that created wetlands, planted them, seeded them, etc. and went back five years later and there was no wetland. Monitoring can help you better understand that. Judging success on the landscape level may make more sense than on the site level. Suppose we want 10% wetlands across the river, but we have 0% wetlands. landscape-level monitoring may be critical to telling us why that didn't happen.

There are two approaches, the centralized approach, 'We who sit up here know what you folks down there ought to have;' and the decentralized, libertarian approach. To what extent are we going to be libertarian, to what extent centralized?

Before you do a heck of a lot to a site, it's well to know something about it, and to use the monitoring to learn *more* about it.

Money drives objectives. There are problems of access to information and time schedules.

### **3. Establish and implement regular monitoring protocols soon after, if not before, landscape alteration activities occur.**

*Comments:* Begin with a list of the project's basic questions. What do you want to get out of the data?

- Identify the needs monitoring should address.
- What objectives do others have?
- Identify methods. How is monitoring done?
- Need practical management tools.

Lots of agencies don't want to do research; they want to do work. For them, monitoring is not a research tool, but a means of answering the question "Did the project achieve its result?" Not all processes are obvious.

**Recommendation** – Establish a list of objectives tied to a list of appropriate monitoring techniques, which can be hyperlinked to a data source with references.

*Consistency:* How consistent should the measuring be? Want to be able to compare monitoring data and communicate comparisons, which means sharing and moving information easily between places, projects and agencies.

Consistency is tied into how the money moves. Collaboration results in sharing information—and if a diverse group of applicants are working together, it might be easier to get grants.

Begin with objectives, then look at techniques and choose those that most efficiently address the objectives. It's not overly-prescriptive, but would help go to the decision.

Preparing decision matrices for the URGWOPS EIS, teams found it hard to identify the thresholds for when objectives were achieved. Overbank flooding is great for regeneration of cottonwoods but the timing might not be right for minnow spawning. Decision matrices are helpful when all the teams can look at them, but probably very site-specific.

Primary Objectives

- Ground water data, vegetation data, precipitation data, ET, etc.
- Small mammals and birds are important
- Fire hazard
- Recreation – hunting, birding, sight seeing

Secondary data are also wanted. There are grant proposal considerations.

Establishing the monitoring protocol think about

- *Scale* (Use sections, although boundaries are debatable—You can monitor a little project more intensely than if you want to monitor a large landscape.)
- *Water relationships* (How is the groundwater moving? What's the hydrologic connectivity of surface and ground water? Want to describe the region's flow net with your monitoring data.)
- *Water conditions* (Monitor precipitation through rain gages. Where is the water table?—if ground water is below 3 meters, cottonwoods suck air creating cavitations – branches break, trees die. Trees suffer in anoxic conditions, stagnant water. Water quality is also important.)
- *Frequency and timing of measurement* (Measurement at different intervals depicts a different river. Data cannot easily be compared if there is not overlap. How to make agreement?)
- The *food web* is important.

- Look for *commonality* – *water and vegetation*. Soils are important but vary greatly within small areas.

**With additional financial support, the BEMP (Bosque Ecosystem Monitoring Program) model could be used to establish additional monitoring sites. BEMP sites are currently monitored for fuel loading, ground and canopy cover, vegetation diversity and other biotic and abiotic variables, including groundwater depth and chemistry, but they are not specifically monitored for resprouting woody native and non-native vegetation.**

*Comments:* Can a minimum set of protocols be agreed on?

*Discussion:* At a minimum, a basic monitoring protocol should address changes in the vegetation community, including changes in fuels and fire intensity, as well as changes in surface and ground water hydrology.

Is the BEMP protocol packagable/divisible? What's the cost of implementation? A shared basic protocol would be very beneficial to us all.

*Discussion:* Note that there is a contrast between ecosystem monitoring (BEMP) and monitoring pre/post treatment.

BEMP is packagable. Data should be shareable—an information network would be useful for planning. The information is there and is flexible (with constraints). BEMP data is regularly recorded, updated, crunchable, processed, and made available through BEMP's website (which needs work).

The costs of BEMP-style monitoring are not determined – it requires lots of labor, and BEMP fills that need with K-12 students. The materials are not expensive. If others conduct research similar to BEMP, then data can be shared/compared.

BEMP is not restoration, but restoration can be monitored with BEMP-like model. Want to know groundwater information and trajectory of succession.

Bosque Ecosystem Monitoring Program (BEMP) is a simple set of monitoring activities

- Groundwater change
- Productivity – leaf fall
- Plant species diversity and cover
- Precipitation
- Groundwater chemistry—pH, turbidity, nitrates, phosphorous, dissolved carbon (recent addition)
- Fuel loading and woody debris (recent addition).

BEMP provides continuous measurement. For each site data is recorded several times a year; for some, monthly. The monitoring sites give a picture of a small portion of riparian zone and show large variation. They are 100 x 200 meters, between the river and the levee. Each station is divided into ten 20 x 100 meter units. Each has a 5 x 30 meter vegetation plot.

One aspect of the value of the BEMP protocol as a model for monitoring is its consistency. Consistency is important for comparison and sharing of data.

**Support and expand efforts to monitor all water depletions associated with bosque landscape alteration.**

#### **4. Evaluate monitoring programs for effectiveness.**

*Comments:* Decision-making matrices that align monitoring techniques with objectives would be useful for choosing and evaluating monitoring technologies.

*Question:* Where are the gaps in our information?

- There's a big hole in our knowledge of the interaction between the shallow groundwater system, the drains, and the deep aquifer.
- Another gap is 'What's the vegetation potential of the bosque?' We don't have a clue and we should have at least a clue if we're going to do a lot of revegetation.
- Are we monitoring invasive weeds? (There's a weed-management task force using Soil and Water Conservation District staff doing weed monitoring.)

There's potential to fill the big holes in our understanding through cooperation. BIG has worked with BEMP on their network, water quality, and what BEMP data says about the connection between the river the bosque and the drains. The Corps work will add to this understanding. We need to get on the ball and start talking to each other. The funding sources are coming, it's happening.

**5. Expand the use of citizen volunteers with training, supervision, and management, to assist with various aspects of bosque landscape alteration, monitoring, and maintenance.**

**Create communication and teamwork opportunities among the many groups working on the bosque.**

*Comment:* The new WRDA allocates \$20 million to projects along the MRG in which the Corps of Engineers needs only a 35% local cost share. It has good prospects for passage.

These projects are for working with BIG and the Collaborative Program—coordinating. Applicants can be counties, small communities (no private lands except through Soil and Water Conservation Districts with conservation easement). There's a \$5 million cap. An advisory group is necessary to put these together, as well as financial help from the state.

**Create a bosque advisory committee to coordinate and review plans and projects and advise managers.**

*Comments from the Habitat Diversity Breakout Group:*

A frequently heard theme in this group was the need to look at the Middle Rio Grande from a regional perspective. This began a discussion of an advisory group/ overview group. One idea was to hold an annual meeting to exchange information. Someone needs to keep track of the bigger picture, and be sure we are moving in the right direction with restoration efforts. Each agency is doing its own thing and oversight is needed at a larger scale. There is a question about whether the Middle Rio Grande ESA Collaborative Program can handle the larger scale oversight, because the Program is focused on two endangered species.

A bosque advisory committee would tie all the management agencies together at a landscape level. A wide range of prototypes have been discussed in a preliminary survey of 15 managers, ranging from a loose structure to a very bureaucratic structure.

There was agreement that any advisory council must be just that—advisory. What we are reviewing today are “guidelines” and should not cause too much friction. Once a council were to move into the realm of “management” it would become problematic. The name of a council is a critical issue. “Team” might be a more palatable word than advisory council.

The State Watershed Management Plan is a more top-down approach. It says that if you get money from the state, you will be required to do a project in a certain way. An advisory council would need to be very broad and include a cross section of those interested in river systems.

*Response:* A bosque advisory council should, at the least, include scientists expert in the major scientific disciplines relevant to bosque rehabilitation.

Information needs to be centrally gathered and kept. A central body could do this. It could look at the whole 170-mile reach to see how monotypic or diverse the habitat is progressing. We don't have a good

sense of where the Middle Rio Grande is going. The advisory council would not need to have the role of deciding where money goes. It could track the success of projects. It would need to be staffed. At a minimum, there would have to be somebody to answer the phone.

The Kissimmee River restoration is a good prototype. The South Florida Water Management District is the place where the advisory council is housed, but the money comes from the federal government. The make-up of the council is very broad; it is advisory only.

The issue with having the MRG ESA Collaborative Program take on this role, is that it may not be interested in some of the habitats, such as grasslands. The Program could take on the data management part of the task. It has money to do that. In the Bosque Biological Management update, the interviewees were not comfortable with the Collaborative Program housing the advisory council.

The question was asked, "What about the Middle Rio Grande Conservancy District? What if the MRGCD Board offered to create a council?" There was concern expressed about stakeholder agencies with their own agendas controlling an advisory council (not specific to the MRGCD).

There are 35 agencies that claim some jurisdiction in the bosque. Membership on a council would have to be open. It would be advisory only. Bosque landowners may object to a top-down authority to dictate management practices for the bosque. Again, the Kissimmee River restoration model was put forward as a possible structure.

A bosque advisory could support an integrated approach to bosque management.

This issue came up again in the plenary session. The issues that surfaced included

- The need for an advisory council to oversee restoration efforts on a broad scale;
- It should not move beyond advisory;
- It should be a broad, full spectrum group and open to all interested parties;
- Where would the Council be housed or funded?;
- Use other entities as examples.

### **Develop outreach programs that will enhance decision-makers' understanding of bosque processes.**

#### *Comments:*

People are part of the ecosystem.

We have to go beyond pragmatism. Basic services are important.

Focus is on people, where the money comes from. Show how tax money is spent and improves lives.

Direct vs. indirect benefit.

Monitoring answers political questions regarding good use of public money. We have to balance resource needs with public needs. If a concern about fires is paying the bill, that sets objectives which guide monitoring methods.

Ideally work can be supportive and cooperative of research and money. Cooperation itself is an argument to win middle Rio Grande funding.

Congress requires monitoring or we don't get funded. Monitoring is relevant and important to the continuation of the budget. Air quality in prescribed burns, constraints that come down on the allocation of funds to do restoration.

**Utilize forums and workshops such as the Arid Lands Research Station at Bosque del Apache National Wildlife Refuge and the Bosque Hydrology Group to publicly discuss bosque management issues at least twice a year, including such topics as fire season updates and planning.**

**Invite agency heads and policy makers to workshops and forums or hold special update sessions for policymakers on bosque management.**

*A CATALOG OF SPECIFIC INFORMATION PRESENTLY BEING COLLECTED*

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**Vegetation & Soils:**

**Access:**

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|---|---|
| 1. Hink & Ohmart with update <sup>3</sup>                                 | URGWOPS/USACE Shapefiles<br>(Hawks Aloft transects provide a good comparison)   |
| 2. NMNHP, H&O river bars <sup>4</sup> , wetlands                          | <a href="http://nmnhp.unm.edu/publications/pub_nhnm.php">http://nmnhp.unm.edu/publications/pub_nhnm.php</a> .   |
| 3. Albuquerque Overbank Project final report <sup>5</sup>                 | BOR, Nancy, NMNHP   |
| 4. BEMP Excel files for cottonwood, litterfall                            | <a href="http://www.bosqueschool.org/Environmental%20Science%20Programs/data_sets.htm">http://www.bosqueschool.org/Environmental%20Science%20Programs/data_sets.htm</a> |
| 5. Save Our Bosque Task Force   | San Acacia to San Marcial Reach<br><a href="http://mrgbi.fws.gov/Projects/2004/Table/Index.html">http://mrgbi.fws.gov/Projects/2004/Table/Index.html</a>                |
| 6. Other BIG projects   | Tree, NM; Sandia Pueblo, etc. <a href="http://mrgbi.fws.gov/Projects/2004/Table/Index.html">http://mrgbi.fws.gov/Projects/2004/Table/Index.html</a>                     |
| 7. Pueblo of Santa Ana  | Brian Bader   |
| 8. Mosaic grass study   | Rio Grande Nature Center, Doug Shaw (505) 345-0364  |
| 9. Seeding/Monitoring Study   | Ciudad S&WCD See 2001 Report by R. Garner @ Plant Materials Center, (505) 865-4684.   |
| 10. Friends of Rio Rancho Open Space                                      | <a href="http://www.forros.org/restoration.html">http://www.forros.org/restoration.html</a> .   |
| 11. Typical seed mix, varying soil types                                  | USACE   |
| 12. Fuel Reduction and Wildfire Effects Studies                           | <a href="http://www.fs.fed.us/rm/">http://www.fs.fed.us/rm/</a><br>USFS Rocky Mountain Research Station (505) 724-3660  |
| 13. Rio Grande Valley State Park veg studies                              | <a href="http://www.cabq.gov/openspace/">www.cabq.gov/openspace/</a> Open Space (505) 452-5210  |
| 14. New Mexico Rare Plants Technical Council<br>(NMRPTC, Robert Sivinski) | <a href="http://nmrareplants.unm.edu/index.html">http://nmrareplants.unm.edu/index.html</a>   |
| 15. N.M. Natural Heritage Program   | See reports by Muldavin and others <a href="http://nmnhp.unm.edu/publications/pub_nhnm.php">http://nmnhp.unm.edu/publications/pub_nhnm.php</a>                          |
| 16. NRCS comprehensive soil mapping project:                              | <a href="http://www.nm.nrcs.usda.gov/technical/fotg/section-1/maps.html">http://www.nm.nrcs.usda.gov/technical/fotg/section-1/maps.html</a> .                           |

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<sup>3</sup> Callahan, Deb. 2004. *Hink and Ohmart Vegetation Classification Map Update – Velarde to Elephant Butte Dam, NM.*, U.S. Bureau of Reclamation, Denver, CO.

<sup>4</sup> Milford, E and E. Muldavin. 2004. *River bars of the Middle Rio Grande, A comparative study of plant and arthropod diversity*. Natural Heritage New Mexico, University of New Mexico.. 74 p. and Milford, E., E. Muldavin, and T. Neville. 2003. *Middle Rio Grande river bar vegetation map: The Albuquerque reach*. 22 p.

<sup>5</sup> Muldavin, E, C. S. Crawford, and N. Umbreit. 2004. *The Albuquerque overbank project, A model for large river riparian restoration in the southwest*. Natural Heritage New Mexico, Albuquerque, NM.. 55 p.

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**Wildlife:**

1. Songbird study, raptor study
2. Wildlife rescue acquisition
3. Bird banding
4. Rio Grande Bird Research
5. Fuel Reduction and Wildfire Effects Studies:  
birds, herps, bats, arthropods
6. WFFL Surveys
7. BEMP, arthropods
8. Arthropods
9. NM Herp. Society
  
10. Partners in Flight.  
NM Bird conservation plan
11. Rio Grande Valley State Park  
mammals & birds studies
12. N.M. Department of Game and Fish  
Share with Wildlife
13. UNM/NM Tech studies
14. Collaborative Forest Restoration Program
15. USFWS & BOR 2002-2003 Fish data collection
16. Fish Health Assessment
17. MRG Endangered Species Collaborative Program
18. UNM/Sevilleta National Wildlife Refuge
19. Bosque del Apache National Wildlife Refuge

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**Access:**

- Hawks Aloft <http://www.hawksaloft.org/>
- <http://www.wrinm.org/>
- Steve and Nancy Cox  
[lgorbet@unm.edu](mailto:lgorbet@unm.edu)
- [www.fs.fed.us/rm/albuq/](http://www.fs.fed.us/rm/albuq/) ; USFS Rocky Mountain Research Station (505) 724-3660
- <http://arizonaes.fws.gov/> ;Nancy Baczek USFWS (505) 346-2525
- [http://www.bosqueschool.org/Environmental%20Science%20Programs/data\\_sets.htm](http://www.bosqueschool.org/Environmental%20Science%20Programs/data_sets.htm).
- Hubbel Oxbow Farm, Candelaria Farm preserve, Ondrea Hummel USACE, (505) 342-3375
- New Mexico Herpetological Society, Department of Biology, University of New Mexico  
Albuquerque, NM 87131
- <http://www.partnersinflight.org/WatchListNeeds/default.htm>
- [http://www.blm.gov/wildlife/pl\\_85sum.htm](http://www.blm.gov/wildlife/pl_85sum.htm)
- [www.cabq.gov/openspace/](http://www.cabq.gov/openspace/)  
Open Space (505) 452-5210.
- [http://www.wildlife.state.nm.us/conservation/share\\_with\\_wildlife/](http://www.wildlife.state.nm.us/conservation/share_with_wildlife/)
- Search by type of animal or author, e.g., Hira Walker, Peter Stacy
- <http://www.fs.fed.us/r3/spf/cfrp/index.shtml>
- <http://www.usbr.gov/uc/albuq/envprog/mrg/index.html>
- <http://mrgesacp.fws.gov/>
- <http://mrgesacp.fws.gov/>
- <http://sev.lternet.edu/>
- <http://www.fws.gov/southwest/refuges/newmex/bosque/>

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<b>Water:</b>	<b>Access:</b>
1. BEMP, GW quantity, precipitation	<a href="http://www.bosqueschool.org/Environmental%20Science%20Programs/data_sets.htm">http://www.bosqueschool.org/Environmental%20Science%20Programs/data_sets.htm</a>
2. USGS/sponsors	<a href="http://water...usgs.gov">http://water...usgs.gov</a>
3. Groundwater data, ABQ reach	<a href="http://www.cabq.gov/openspace/">www.cabq.gov/openspace/</a>
4. NM Interstate Stream Commission (ISC)	<a href="http://www.ose.state.nm.us/">www.ose.state.nm.us/</a>
5. Upper Rio Grande Water Operations	<a href="http://www.spa.usace.army.mil/urgwops/">http://www.spa.usace.army.mil/urgwops/</a>
6. NMED Surface Water Quality Bureau for TMDL (Total Maximum Daily Load)	<a href="http://www.nmenv.state.nm.us/swqb/links.html#TMDL_Library">http://www.nmenv.state.nm.us/swqb/links.html#TMDL_Library</a>
7. USFWS Water Quality data, 2002-2003	<a href="http://mrgesacp.fws.gov/">http://mrgesacp.fws.gov/</a>
8. Bosque Evapotranspiration Research	Description on J. Cleverly's website, <a href="http://sevilleta.unm.edu/~cleverly/bosqueET.html">http://sevilleta.unm.edu/~cleverly/bosqueET.html</a> ; ET Toolbox at <a href="http://www.usbr.gov/pmts/rivers/awards/Nm/riogrande.html">http://www.usbr.gov/pmts/rivers/awards/Nm/riogrande.html</a>
9. Weather station data for bosque	<a href="http://www.mrgcd.com">http://www.mrgcd.com</a> ; <a href="http://www.usbr.gov/pmts/rivers/awards/Nm/rg/RioG/indexhour.html">www.usbr.gov/pmts/rivers/awards/Nm/rg/RioG/indexhour.html</a> ; <a href="http://raws.wrh.noaa.gov/cgi-bin/roman/raws_ca_monitor.cgi?state=SWCC&amp;rawsflag=2">http://raws.wrh.noaa.gov/cgi-bin/roman/raws_ca_monitor.cgi?state=SWCC&amp;rawsflag=2</a>
10. River flow data	<a href="http://nm.water.usgs.gov">http://nm.water.usgs.gov</a>
11. Fuels Reduction and Wildfire Effects Studies	<a href="http://www.fs.fed.us/rm/">http://www.fs.fed.us/rm/</a> USFS Rocky Mountain Research Station (505) 724-3660
12. ISC/NM Tech Socorro Reach Groundwater Study	<a href="http://www.ees.nmt.edu/bowman/research/RioGrandeProject/">http://www.ees.nmt.edu/bowman/research/RioGrandeProject/</a>