Acoma Pueblo Demo Area 16.14

Pre-treatment Monitoring Report

2021

Prepared by

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**Photos are not available in this public-release version of our report. Please contact the Pueblo of Acoma Forestry Department to request access to monitoring photos if needed.

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Contents

Acronyms and Abbreviations

Acronym, Abbreviation, or Term	Explanation or Definition as used by NMFWRI
AGL	above ground level; GIS term
BBIRD plots	Breeding Biology Research and Monitoring Database, larger circular plot types
BEMP plots	Bosque Ecosystem Monitoring Program, small rectangular plot types
FEAT	Fire Ecology Assessment Tool
FFI	FEAT/ FIREMON Integrated
FIREMON	Fire Effects Monitoring and Inventory System
FSA	Farm Service Agency, a department of the USDA
GIS	Geographic Information Systems
GRGWA	Greater Rio Grande Watershed Alliance
LIDAR	Light detecting and ranging, a remote sensing technique using light to gather elevation data
NAIP	National Agriculture Imagery Program (aerial imagery)
NDVI	Normalized Difference Vegetation Index; GIS term for a band ratio of the visible red and the near infrared spectral bands and is calculated using the following formula: (NIR – Red)/(NIR+Red)
NHNM	Natural Heritage New Mexico
NMDGF	New Mexico Department of Game and Fish
NMED SWQB	New Mexico Environment Department Surface Water Quality Bureau
NMFWRI	New Mexico Forest and Watershed Restoration Institute
NMHU	New Mexico Highlands University
NMRAM	New Mexico Rapid Assessment Method, version 2.0
NRCS	Natural Resource Conservation Service
PC	Plot center
RGIS	Resource Geographic Information System
SWCD	Soil and Water Conservation District
TIFF	Tagged image file format
USDA	United States Department of Agriculture
USGS	United States Geological Survey
WQCC	Water Quality Control Commission
WSS	Web Soil Survey, a soils database of the NRCS

Purpose of Report

This report covers the low-intensity pre-treatment vegetation monitoring assessment performed on a non-native phreatophyte removal project submitted for a drainage basin adjacent to Rinconada Creek on the Pueblo of Acoma, to the Greater Rio Grande Watershed Alliance in 2016. Following a discussion of the ecological context, and our monitoring methods, we present pertinent background, observations, and assessment results for the project.

Ecological Context of Bosque Restoration

Neither the challenges nor the importance of working in the bosque and other riparian areas in New Mexico today should be underestimated. According to the New Mexico Department of Game and Fish Conservation Division, wetlands and riparian areas comprise approximately 0.6 percent of all land in New Mexico (2012). Despite this small percentage, estimates of New Mexican vertebrate species depending on wetland and riparian habitat for their survival ranges from 55% (New Mexico Department of Game and Fish Conservation Services Division, 2012) to 80% (Audubon New Mexico, 2013). These areas also provide flood mitigation, filtration of sediment and pollutants, and water for a variety of purposes including groundwater recharge (Audubon New Mexico, 2013). In addition, native vegetation such as cottonwoods have cultural significance to many communities.

As much as these areas are disproportionately important to ecosystems and human communities, they are equally disproportionately impacted by disturbance. Anthropogenic impacts with major consequences for our riparian areas include dams, reservoirs, levees, channelization, acequias and ditches, jetty jacks, riprap and Gabion baskets, urbanization, removal of native phreatophytes, grazing by domestic livestock, excessive grazing pressure by native ungulate populations absent natural predation cycles, beaver removal, logging, mining, recreation, transportation, introduction and spread of invasive exotic species, groundwater extraction, altered fire and flood regimes drought and climate change (Committee on Riparian Zone Functioning and Strategies for Management, et al., 2002). Statewide, it is estimated that as much as 90% of New Mexico’s historical riparian areas have been lost (Audubon New Mexico, 2013), and approximately 39% of our remaining perennial stream miles are impaired (New Mexico Department of Game and Fish Conservation Services Division, 2012).

New Mexico *is* fortunate enough to have the Middle Rio Grande Bosque, the largest remaining bosque in the Southwest (USDA USFS, 1996). However, over the past two decades, the number of fires in the bosque has been increasing. Historically, the primary disturbance regime in the bosque has been flooding, not fire, which means the system is not fire-adapted. In fact, native species like cottonwood resprout from their roots after floods and need wet soils to germinate from seed. Flooding also promotes decomposition of organic material and keeps the soil moist which reduces the likelihood of fire. Today, overbank flow is uncommon in many areas of the Rio Grande due to the heavy alteration of the channel and flow regimes (two obvious examples are the structures defining the upper and lower extent of the Middle Rio Grande: Cochiti Dam and Elephant Butte Reservoir). This has led to low fuel moisture content and high fuel loads, as well as increased human presence in the riparian area. As a result, bosque fires are more common and more severe: they kill cottonwoods and other native species, creating spaces which are filled by non-native species such as salt cedar, Russian olive, Siberian elm, and Tree-of-Heaven. We are constantly learning more about how these species can exploit and encourage a riparian fire regime, in addition to many other changes they bring to ecosystems.

Efforts geared toward the removal of these nonnative species can help to reduce fire risk, preserve native vegetation, and be part of a larger effort to restore the bosque and the watershed as a whole to a more natural and functional ecosystem. The Greater Rio Grande Watershed Alliance (GRGWA) has been working on these issues with a variety of collaborating organizations and agencies within the Rio Grande basin for several years. Since 2013, the New Mexico Forest and Watershed Restoration Institute (NMFWRI) has been working with GRGWA and the Claunch-Pinto Soil and Water Conservation District (SWCD) to begin construction of a geodatabase for all of GRGWA's non-native phreatophyte removal projects as well as to perform the formal pre- and post-treatment monitoring, utilizing the field methods explained below as well as LIDAR analysis where appropriate and available.

Monitoring and Field Methods

Low intensity Field Methods

Low intensity pre-treatment vegetation monitoring was done using an adapted version of the biotic portion of the New Mexico Rapid Assessment Method (NMRAM), v 2.1, updating recommendations made in the Field Manual for Greater Rio Grande Watershed Alliance (GRGWA) Riparian Restoration Effectiveness Monitoring and the GRGWA Monitoring Plan, developed by Lightfoot & Stropki of SWCA Environmental Consultants in 2012. (For a brief overview of both low and high intensity monitoring methods used by the NMFWRI on GRGWA projects, please see Appendix III.)

For those not familiar, NMRAM was developed by the New Mexico Environment Department Surface Water Quality Bureau Wetlands Program and Natural Heritage New Mexico as a "cost effective, yet consistent and meaningful tool" (Muldavin, 2011) for wetland ecological condition assessment in terms of anthropogenic disturbance as negatively correlated with quality and functionality. The portions of NMRAM we utilized are Level 2 "semi-quantitative" field measurements taken at less detail than plot level (Muldavin, 2011).

Measurements taken included relative native plant community composition, vegetation horizontal patch structure, vegetation vertical structure, native riparian tree regeneration, and invasive exotic plant species cover. The underlying method for these biotic assessments was a version of the 1984 Hink and Ohmart vertical structure classification system, modified for use in the NMRAM for Montane Riverine Wetlands version 2.0 (see Appendix IV). First, vegetation communities were mapped out by patch (polyon) according to the Hink and Ohmart system. Next, the presence of (state-listed) invasives, wetland species, and the two dominant species in each strata ("tree" >15 ft, "shrub" 4.5-15 ft, and "herbaceous" <4.5 ft) were recorded for each plant community. The native/exotic ratio in each of the patches was scored and weighted based on the percent of the project area each patch comprised. These scores were then combined with the additional biotic metrics of vertical and horizontal diversity, native tree regeneration, and overall (listed) invasive presence. The NMRAM rating system is based, on all levels, on a scale of 1 to 4, where 4 is considered excellent condition, 3 good, 2 fair, and 1 poor.

We also assessed soil surface condition, which is a metric typically included in the abiotic section of the NMRAM, as well as the presence of surface fuels, which is not part of the NMRAM. Unlike the other 6 metrics we used, surface fuels were recorded on a rating scale from 0 to 1.0 where 1.0 is a continuous fuel matrix.

Photopoints were established to capture images where vegetation shifts were observed and/or at representative locations throughout the site. Waypoints were marked with a Garmin GPS unit and named sequentially by site. Photos were taken facing the direction that best represented the vegetation community(ies).

Prior to entering the field, we created a map with the project boundaries as provided by GRGWA. We combined these polygons with recent aerial imagery and identified relevant roads and other landscape features. Once on the ground, the vegetation community polygons (as determined by the modified Hink and Ohmart classification system) were hand-drawn onto this map and served as the basis for other biotic metric assessments. Upon return to the office, this polygon map and the photopoints were digitized by the monitoring technician and/or specialist.

Estimating Vegetation Cover using NAIP and eCognition Software

These projects were also analyzed by our GIS specialist. One analysis tool used for GRGWA project is LIDAR, light detecting and ranging. LIDAR provides elevation data which we use to analyze vegetation and canopy structure in detail as a supplement to field monitoring data. This is especially useful in large or difficult-to-access areas. However, because LIDAR was not available for this projects site for pre treatment assessment, the GIS analysis used eCognition software to analyze NAIP imagery. The goal of this analysis was to estimate vegetation cover in three different classes: Type 5 Tall Shrubs, Type 6S Short Shrubs, and bare ground. To keep the comparison accurate, the same methods were used to assess pre and post treatment vegetation.

Object based image classification systems, such as eCognition software, allow for a semi-automated analysis of high resolution images. This approach divides the image into meaningful homogenous regions, known as image objects. These image objects are groups of pixels that are adjacent to each other and are spectrally similar. Once image objects are created, they provide a great deal of information from which an image classification can be developed. In large areas where more detailed vegetation surveys are cost prohibited, eCognition provides a means to characterize a landscape using readily available NAIP aerial photography.

For the 16.14 Pueblo of Acoma area, 2020 and 2014 NAIP (National Agriculture Imagery Program) imagery were acquired. NAIP is a USDA/FSA program to acquire 'leaf on' aerial imagery during the peak growing season. NAIP imagery for New Mexico can be downloaded by Quarter Quadrangle extent in an uncompressed TIFF format via RGIS –Resource Geographic Information System (http://rgis.unm.edu/). NAIP was collected in 2014 with the near infrared (NIR) spectral band. The 4 band imagery (Red, Green, Blue, and NIR) at 1 meter cell size is available statewide. Having the Near-InfraRed band is very important for vegetation assessments and necessary to calculate the Normalized Difference Vegetation Index (NDVI). This index is widely used to assess vegetation health and leaf structure. NDVI takes into account the amount of red energy that is absorbed by chlorophyll and the amount of near-infrared energy that is reflected by the cellular structure of the leaf (because the red and near infrared measurements are normalized in an indirect measure of vegetation health). The formula is (NIR – Red)/(NIR + Red), where NIR is the Near Infrared Band, and Red is the Red Band (Carson and Ripley, 1997)

To identify dominate vegetation types, the image was first classified to identify vegetated areas based on image object properties of Hue, Saturation, and Intensity and NDVI values of the image objects. The classification was based on finding the right threshold values for each feature. To determine specific threshold values, information about each image object could be displayed and tested to determine if those values were appropriate for the given land cover feature. The resulting classification was converted to an ArcGIS shapefile and acreage totals could be estimated.

Personnel Involved

2021 New Mexico Forest and Watershed Restoration Institute Monitoring Team:

- Kathryn R Mahan, Ecological Monitoring Program Manager
- Alex Makowicki, Monitoring Technician

2021 New Mexico Forest and Watershed Restoration Institute GIS Team:

- Patti Dappen, GIS Program Manager

Other persons contacted:

- Fred Rossbach, Field Coordinator, Greater Rio Grande Watershed Alliance
- Shirley Piqosa, Pueblo of Acoma Forester
- Ray Vicente, Pueblo of Acoma Forester Assistant

Pueblo of Acoma Riparian Demo Project

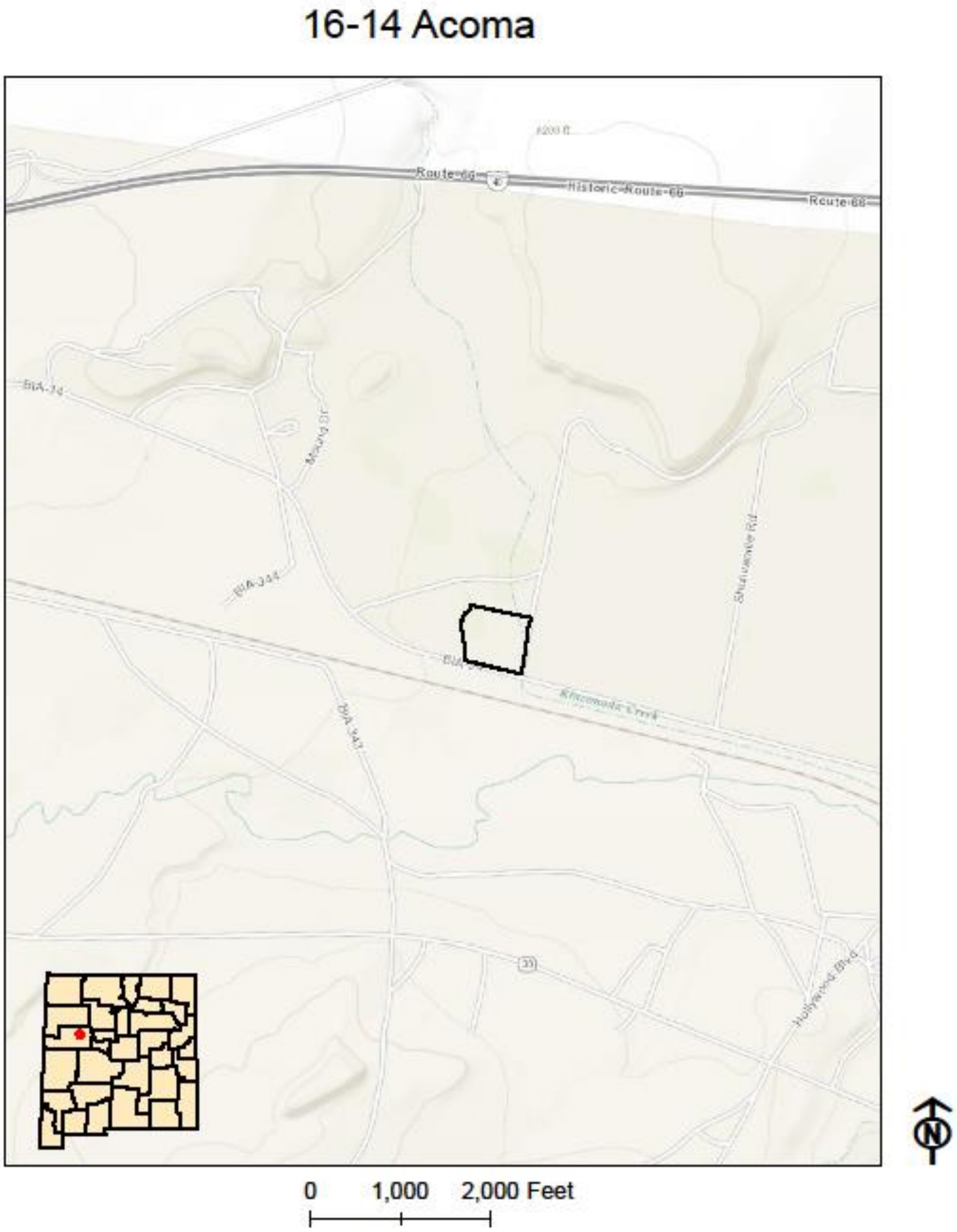
Project 16-14 is located in Cibola County, NM on the Pueblo of Acoma, approximately 2 miles east of the community of McCarty, north of Fatima Hill Road.

The average annual precipitation in the nearby city of Grants, NM is 10.5 inches. The average high temperature is 91° F in July, and the average low is 15° F in December and January. (U.S. Climate Data, 2017) According to the NRCS Web Soil Survey, the project area is comprised of 84.4% Sparham clay loam, 0 to 2 percent slopes, and 15.2% Sparank sandy clay loam, saline, sodic, 1 to 3 percent slopes. Ecological sites within this project include R035XA126NM Salt Flats, and R036XB009NM Salt Meadow (USDA NRCS, 2016).

The Salt Flats ecological site type is typically dominated by alkali sacaton along with western wheatgrass, blue grama, vinemesquite grass, galleta, inland saltgrass, and spike muhly. Dominance of grass species is determined by salt; salty sites are dominated by alkali sacaton while areas with less salt tend to have more blue grama and galleta. Shrubs include fourwing saltbush, shadscale, and greasewood and are typically scattered when grass is dominant. However, a shrub-dominated state is possible with overgrazing and/or drought. A gullied state is also possible as a site deteriorates and changes in cover lead to changes in hydrology resulting in increasing surfaces salts and downcutting. In this state, shrubs and salt-tolerant forbs are dominant while grasses are absent (USDA NRCS n.d.).

The Salt Meadow ecological site typically supports a grassland state dominated by alkali sacaton and inland saltgrass; fourwing saltbush is the dominant shrub. In a deteriorated state, the site supports a plant community dominated by inland saltgrass, seepweed, iodinebush, salt cedar and bare ground. Other common grasses could include saltsedge, foxtail barley, mat muhly, western wheatgrass, nuttall alkaligrass and alkali cordgrass (USDA NRCS N.M. n.d.).

Monitoring was conducted at this 10-acre site on September 9, 2016 as part of an initial treatment as part of a restoration project targeting non-native phreatophytes scheduled for 2016-2017. The project is located on the Pueblo of Acoma in Cibola County, NM, and spans the Riconada Creek. The Lava Soil and Water Conservation District (LSWCD) sponsored the project. This is an initial treatment to remove salt cedar, Russian olive, and Siberian elm trees, preferably through extraction and mastication. Restoration goals include improving public awareness of bosque restoration efforts; the site is considered a “demonstration area” due to the visibility to the Pueblo of Acoma tribal members. Other goals include returning the riparian area to a more natural state, promoting native plant species, reducing fire hazard and continuing to long-term watershed health and ecosystem function.



16-14 Acoma is located on the Pueblo of Acoma in Cibola County, NM, and spans the Riconada Creek. This is an initial treatment to remove salt cedar,Russian olive, and Siberian elm trees.

Figure 1. Project 16.14 in geographic context.

Figure 2. 16.14 Pueblo of Acoma project outline.

The project can be accessed off Fatima Hill Road following trespass permitting by the Pueblo of Acoma. Exotic species observed in abundance during the site visit included salt cedar and kochia. In 2016 native plants observed in abundance included fourwing saltbush and greasewood. A grass understory was mostly absent; bare ground and kochia dominate. In 2021 because of time constraints the monitoring crew was not able to revisit the site and remote sensing was done to monitor the vegetation cover. Figures 3 and 4 display vegetation cover observed in 2016 as well as the percentage of cover by vegetation type, respectively.

2020 NAIP Imagery Comparison

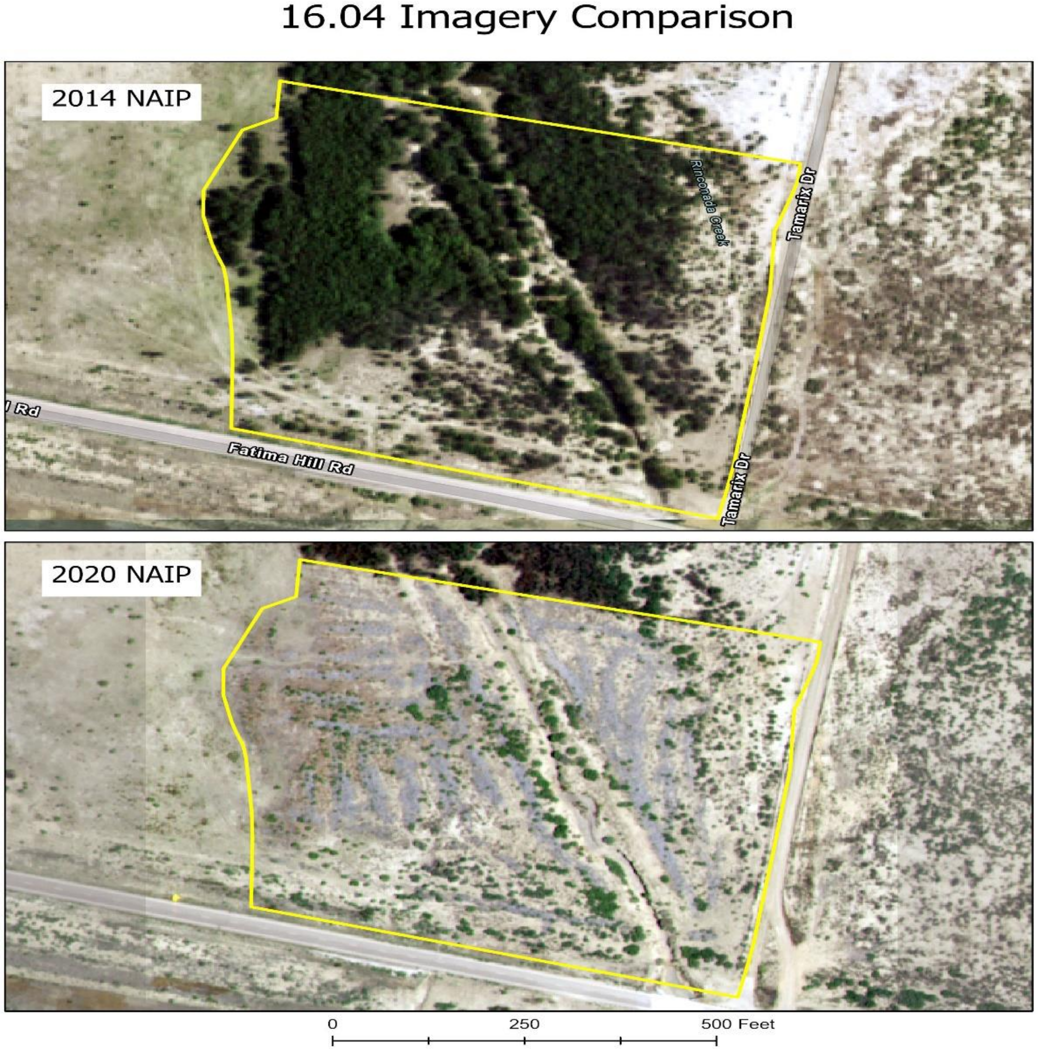


Figure 3. 2021 16.14 Pueblo of Acoma Riparian Demo project vegetation

2020 Vegetation Classification Results

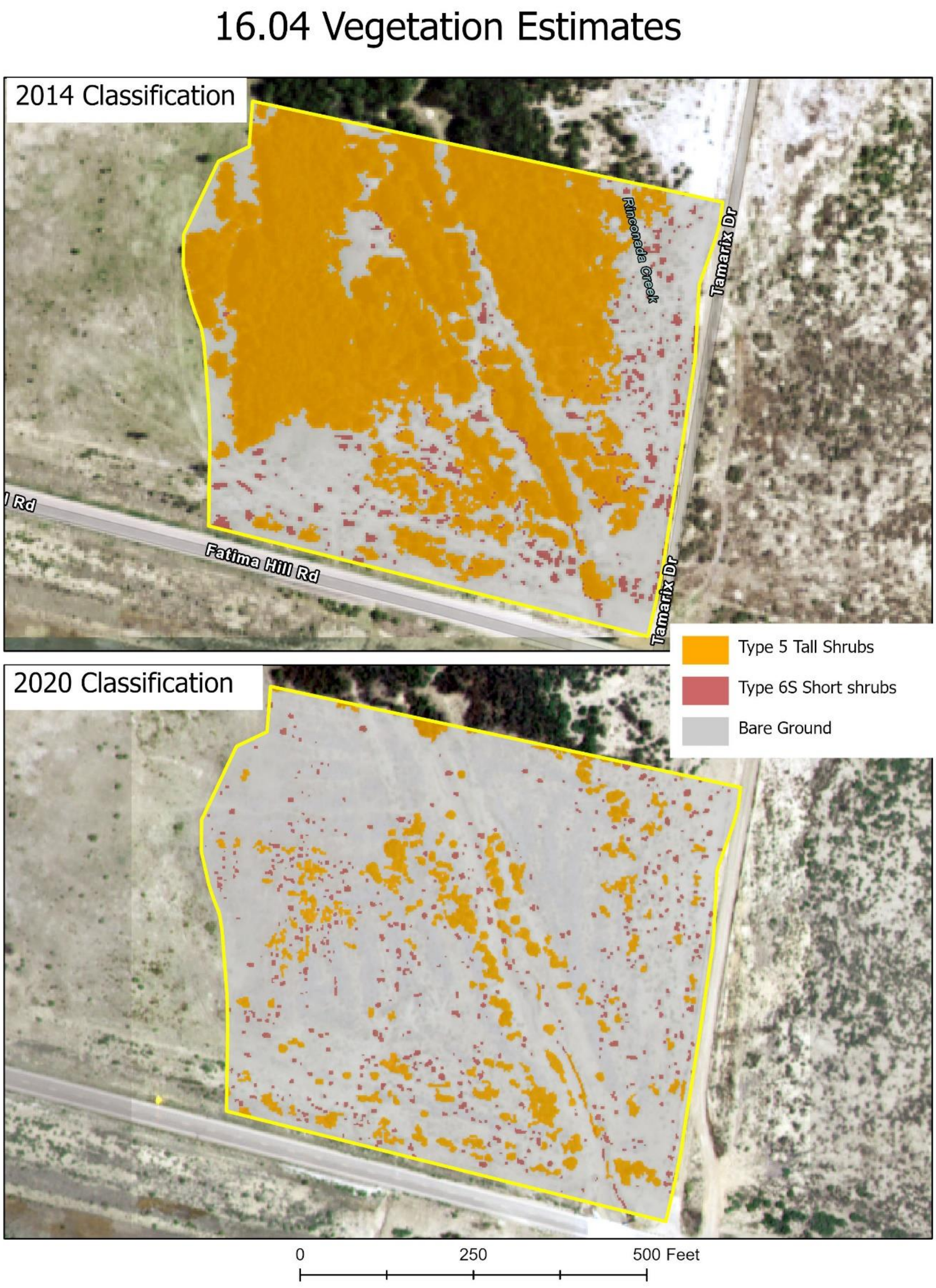


Figure 5. Imagery showing vegetation structure classification based on Hink and Ohmart classification system.

Vegetation structure changed dramatically after the project was complete. The site lost many of its tall shrubs due to the removal of invasive species such as Tamarisk and Russian Olive that normally occupy the Tall Shrub vegetation layer. Figures 6 and 7 display the percentage of each vegetation class occupying the project area pre and post-treatment respectively. As seen in the aerial imagery in figure 5, the percentage of bare ground drastically increases with the decrease in tall shrubs. The loss of vegetation was to be expected after treatment, but the hope of restoration is to see a return of native species in the Short and Tall Shrub vegetation classificiation.

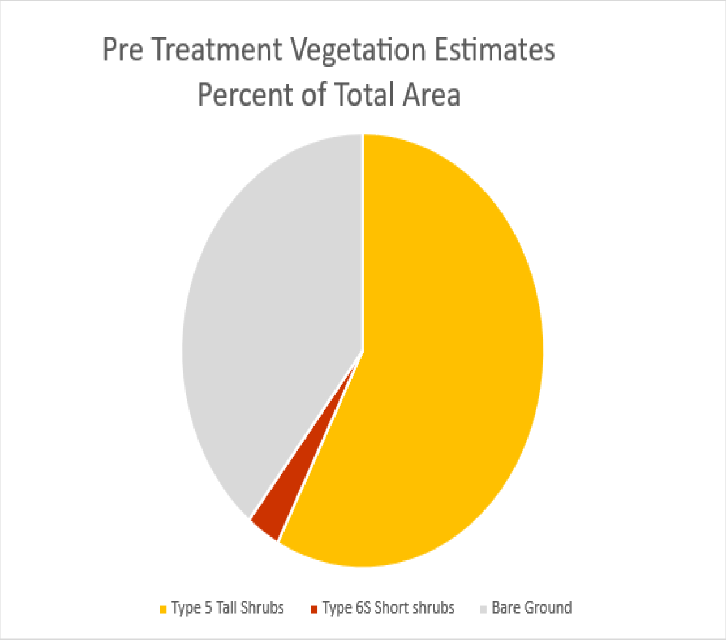


Figure 6. Shows the pre-treatment percentage of vegetation structure by classification

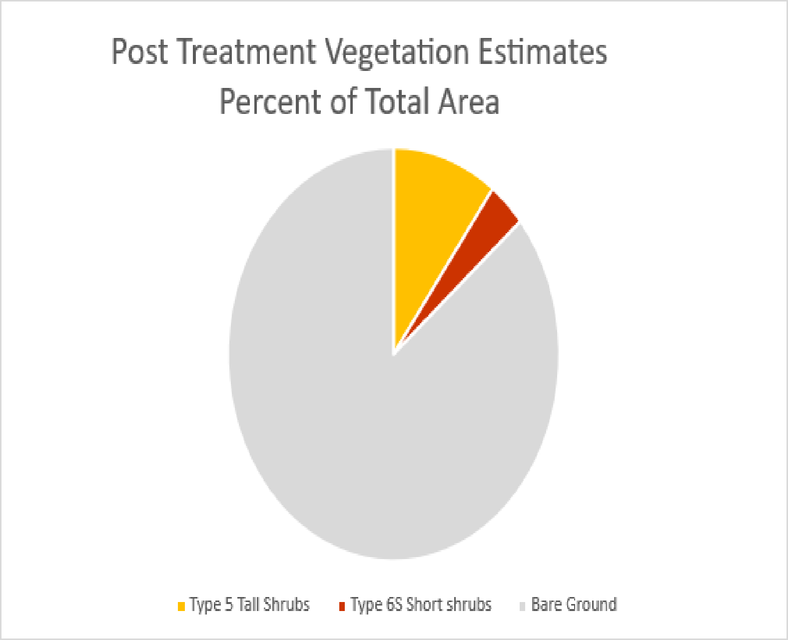


Figure 7. Shows the post-treatment percentage of vegetation structure by classification

Vegetation Structure Type	Pre-Tx Acres	Post-Tx Acres	Pre-Tx % of Total Area	Post-Tx % of Total Area
Type 5 Tall Shrubs	5.82	1.00	57.82%	9.96%
Type 6S Short shrubs	0.30	0.36	3.02%	3.59%
Bare Ground	3.95	8.71	39.24%	86.46%

Discussion

We would like to clarify that we are adapting these NMRAM metrics for our own purposes. That is, we are using them both inside and outside their intended site ranges, including on larger sites (NMRAM is designed to handle a site around 100 x 200 meters), sites further from the river (NMRAM is currently in use primarily for assessing riverine wetlands), and sites defined by exotic vegetation presence rather than hydrologic boundaries and upland vegetation indicators/apparent wetland extent. Site delineation and size is likely to be variable for a number of other reasons, including landowner participation, available funds, proposals received from contractors, etc – many of which cannot be directly correlated to site disturbance or ecological function. For this reason, we do not use the entire NMRAM assessment, or place confidence in the weighted score roll-ups that are typically part of an NMRAM report. Should one be interested, rationale for the weighting in the NMRAM score roll-up can be found in the yet-to-be-published field manual for version 2.1. For more information, contact Maryann McGraw of the NMED or NMFWRI.

While we provide a biotic site score and rating for your reference, we recommend comparisons be done with individual metrics from pre-treatment and post-treatment assessment from the same site, rather than across multiple sites. Also of note is that statistical analysis is not appropriate for NMRAM, or other low intensity, rapid field methods.

Please note that should the project area change significantly from what was originally proposed and monitored, all metrics will lose some amount of confidence on comparison as it is impractical to re-examine the original site assessment scores using new boundaries. This is an issue of concern of which GRGWA should be aware. We recommend that GRGWA attempt to minimize alterations in project boundaries once pre-treatment monitoring data has been approved for collection. Another, somewhat alternative, recommendation is that the initial monitoring regime include high-intensity modified BEMP-type plots which could be repeated in their exact initial locations, allowing collection of comparable data regardless of boundary change. We recognize that this is not always practical: boundaries change for a number of reasons and time and cost constraints can necessitate the sole use of a rapid assessment method for monitoring. We have reason to hope our outlined assessment method will still be a satisfactory indicator for site function improvement or degradation primarily because metrics in rapid assessment methods such as this are set up to have relatively low sensitivities (i.e. for a change to be reflected in the metrics, either positive or negative, disturbance on site has to be significantly altered).

From here on out, the goal of the GRGWA/ NMFWRI is that all sites will be revisited for post-treatment monitoring in 5-year intervals. It is our intention and expectation that the data collected in these intervals will reflect any significant changes in disturbance and ecological function of the site.

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Appendix III – Current monitoring methods available

Low-intensity methods

- Where: happens on all sites with GRGWA projects
- Method name: NMRAM (New Mexico Rapid Assessment Method v 2.1)
- Time required: 3 hours – half day/ site
- Repeat: done once pre-treatment and in 4-5 year intervals post-treatment
- Basics: mapping vegetation communities (by vertical and horizontal structure), recording dominant vegetation in each strata (trees, shrubs, herbaceous), assessing fuel load, noting soil surface condition and native/exotic ratio at all vegetation levels, photo points
- Any on-site impacts or materials: none

High-intensity methods

- Where: happens on select sites, in addition to low-intensity monitoring

Submethod name 1: BBIRD or BEMP vegetation plots (depends on treatment area size)

- Time required: approx. 2 hours/site
- Repeat: both pre-treatment and in 4-5 yr intervals post-treatment
- Basics: larger plots and transects documenting vegetation, photo points
- On-site impacts or materials: rebar and cap

Submethod name 2: Brown's transects

- Time required: 1-1.5 hours/site
- Repeat: both pre-treatment and in 4-5 yr intervals post-treatment
- Basics: transects to calculate fuel loading and fire behavior, photo points
- On-site impacts or materials: rebar and cap

Submethod name 3: BEMP-adapted Groundwater Well Monitoring

- Time required:
  - Initial installation: 1-2 hours/ well (ideally 2+ wells/site)
    - Repeat: maintenance as needed, should be minimal
  - Data offloading: 10-20 minutes/well
    - Repeat: at least annually (this is when we anticipate datalogger will be full and batteries will need to be changed)
- Basics: install a well with a sensor which records groundwater level and temperature once an hour year round; this will reflect changes due to seasonal variation, vegetation growth, irrigation, etc.
- On-site impacts or materials: shallow monitoring well (consists of capped PVC pipe extending into the ground about 3 feet below the water table and above ground approx. 2 feet (can be painted earth tones); well contains a datalogger (pressure transducer) suspended on a cable into the water); well should be protected from cattle grazing (so may require rebar around pvc visible above ground)

Appendix IV - Modified Hink and Ohmart categories, from NMRAM

The following is pages 39-41 in Muldavin et al.'s 2014 NMRAM for Montane Riverine Wetlands v 2.0 Manual (draft, not yet published)

Vegetation Vertical Structure Type Definitions for NMRAM

Multiple-Story Communities (Woodlands/Forests)

Type 1- High Structure Forest with a well-developed understory.

Tall mature to intermediate-aged trees (>5 m [>15 feet]) with canopy covering >25% of the area of the community (polygon)and understory layer (0-5 m [0-15 feet]) covering >25% of the area of the community (polygon). Substantial foliage is in all height layers. (This type incorporates Hink and Ohmart structure types 1 and 3.) Photograph on Gila River by Y. Chauvin, 2012.

Type 2 -Low Structure Forest with little or no understory.

Tall mature to intermediate-aged trees (>5 m [>15 feet]) with canopy covering >25% of the area of the community (polygon) and understory layer (1-5 m [3-15 feet]) covering <25% of the area of the community (polygon). Majority of foliage is over 5 m (15 feet) above the ground. (This type incorporates Hink and Ohmart structure types 2 and 4.) Photograph on Diamond Creek by Y. Chauvin, 2012.

Single-story Communities (Shrublands, Herbaceous and Bare Ground)

Type 5 -Tall Shrub Stands.

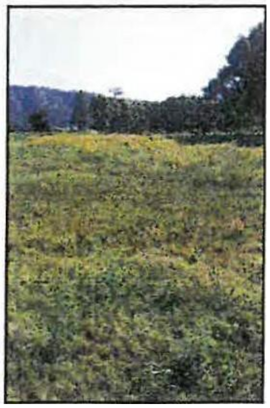
Young tree and shrub layer only (15-5 m [4.5-15 feet]) covering >25% of the area of the community (polygon). Stands dominated by tall shrubs and young trees, may include herbaceous vegetation underneath the woody vegetation. Photograph on San Francisco River by Y. Chauvin, 2012.

Type 6S-Short Shrub Stands.

Short stature shrubs or very young shrubs and trees (up to 1.5 m [up to 4.5 feet]) covering >10% of the area of the community (polygon). Stands dominated by short woody vegetation, may include herbaceous vegetation underneath the woody vegetation. Photograph on Lower Pecos River by E. Lindahl, 2008.

Type 6W-Herbaceous Wetland.

Herbaceous wetland vegetation covering >10% of the area of the community (polygon). Stands dominated by obligate wetland herbaceous species. Woody species absent, or <10% cover. Photograph of *Carex nebrascensis* meadow on upper Rio Santa Barbara by Y. Chauvin, 2009.



Type 6H- Herbaceous.

Herbaceous vegetation covering >10% of the area of the community (polygon). Stands dominated by herbaceous vegetation of any type except obligate wetland species. Woody species absent or <10% cover. Photograph on Diamond Creek by Y. Chauvin, 2012.

Type 7–Sparse Vegetation/Bare Ground.

Bare ground, may include sparse woody or herbaceous vegetation, but total vegetation cover <10%. May be natural in origin (cobble bars) or anthropogenic in origin (graded or plowed earth) Photograph on Lower Gila River by Y. Chauvin, 2012.