PUEBLO OF SANDIA

Pueblo of Sandia Project: 17.01, 17.02, 17.03, 17.04, 17.05, 17.06a and 17.06b

Pre-treatment Monitoring Report

2017

** NOTE: PHOTOS ARE NOT AVAILABLE IN THIS PUBLIC-RELEASE VERSION OF OUR REPORT. PLEASE CONTACT THE PUEBLO OF SANDIA ENVIRONMENT 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 and high-intensity pre-treatment vegetation monitoring assessments performed on non-native vegetation removal projects submitted for the Pueblo of Sandia to the Greater Rio Grande Watershed Alliance in 2017. Following a discussion of the ecological context, and our monitoring methods, we present pertinent background, observations, and assessment results for the projects.

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 range 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 (polygon) 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.

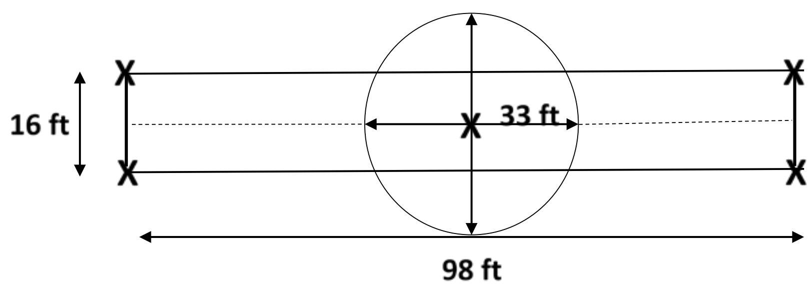
We also assessed soil surface condition, which is a metric typically included in the abiotic section of the NMRAM, as well as the presence of surface fuels, which is not part of the NMRAM. Unlike the other 6 metrics we used, surface fuels were recorded on a rating scale from 0 to 1.0 where 1.0 is a continuous 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 GPS unit and named sequentially by site. Photos were taken facing north, east, south and west at each point. Information about the photopoints was collected according to the methods laid out in David Lightfoot's Forest Thinning Project Repeat Photo Points for Restoration Effectiveness Monitoring (David Lightfoot, 2014).

Prior to entering the field, we created maps 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.

High-intensity Field Methods

High-intensity monitoring was also done, in part, on these projects. We used an adapted Bosque Ecosystem Monitoring Program (BEMP) style plot. These are 16 x 98-foot rectangles, placed approximately parallel to the river. Within these plots, we measure canopy and species, and vegetation and ground cover. We also used Brown's transects to measure surface fuels.



Personnel Involved

2017 New Mexico Forest and Watershed Restoration Institute Monitoring Team:

- Kathryn R Mahan, Ecological Monitoring Specialist
- Ernesto Sandoval, Ecological Monitoring Technician
- Daniel Hernandez, Ecological Monitoring Technician

2017 New Mexico Forest and Watershed Restoration Institute GIS Team:

- Daniel Hernandez, Ecological Monitoring Technician

Other persons contacted:

- Fred Rossbach, Field Coordinator, Greater Rio Grande Watershed Alliance
- Marcos Valdez, East Rio Arriba Soil and Watershed Conservation District

Pueblo of Sandia Projects

The Pueblo of Sandia is a 39 square mile reservation north of Albuquerque and south of Bernalillo, New Mexico, at the base of the Sandia Mountains. The historical western boundary of the Pueblo is the Rio Grande. Today the Pueblo is the steward of one of the largest remaining intact stretches of Rio Grande Bosque in the area. The bosque has a long history of ecological and cultural importance for the Pueblo, but in recent years it has been subject to the same stressors discussed above, especially drought, the impact of the 2011 Las Conchas fire, and fires on Pueblo lands (e.g. the 2012 Romero Fire). Human modifications to the river are easily observed on aerial maps – side channels including the Albuquerque Main Canal, the Corrales Main Canal, the Albuquerque Riverside Drain, the Alameda Drain, the Bernalillo Interior Drain, the Atrisco Feeder Canal, and the Sandia Acequia, among others intersect and diverge from the river throughout the western side of the Pueblo (MRGCD, n.d.).

Particularly in the last decade or two, a number of bosque restoration efforts have been led by the Pueblo's Environment Department in collaboration with agencies and organizations including the Bureau of Reclamation, the Middle Rio Grande Conservancy District, the US Army Corps of Engineers and the Greater Rio Grande Watershed Alliance.

2017 is the fifth year the Pueblo of Sandia has collaborated on nonnative phreatophyte removal projects with the GRGWA. In 2013, project numbers 13-02, 13-03 and 13-04 worked on restoration after the Romero Fire; in 2014, project 14-01 worked at Sandia Lakes; projects 14-03 and 14-04 worked in the Bosquecito, projects 14-05 and 14-06 worked in the Sandia Wash area, and project 14-07 worked in the Riverside Drain. In 2015, projects 15-01 through 15-05 were distributed the length of the Pueblo; in 2016 projects 16-01 through 16-05 took place throughout the bosque. Projects 17-01 through 17-07 were submitted for 2017; many were re-treatments of previous projects in need of maintenance.

The elevation at the Village of Sandia Pueblo is just over 5,000 feet. The area receives an average of 10 inches of rainfall per year, with temperatures ranging from an average high of 91 degrees Fahrenheit in July to an average low of 20 degrees Fahrenheit in January (City Stats, 2016). According to the NRCS Web Soil Survey there are several soil map units in the area of the Pueblo of Sandia, but most soils are sand and clay loams; the dominant ecological sites are R042XA057NM Bottomland and R042XA055NM Salty Bottomland (USDA NRCS, 2013).

The Bottomland ecological site is dominated by either giant sacaton or alkali sacaton. Vinemesquite grass and sideoats grama may also be present. Reduced cover and hummocking of these grasses characterize initial stages of degradation, typically due to overgrazing and/or changes in hydrology. Transitions to first tobosa- and then to burrograss-dominated states may occur in response to the redistribution of run-in water from overgrazing and subsequent erosion and gullying. Shrub invasion is not usually observed (USDA NRCS n.d.)

Salty Bottomland can support a range of plant communities which typically include cottonwood, salt cedar, mixed exotics (dominated by Russian olive/ Russian knapweed/ etc.), saltgrass and saltgrass-sacaton, and bottomland grassland (possibly dominated by saltgrass, giant sacaton, dropseed, muhly, burrograss, alkali sacaton, galleta, vinemesquite, and/or tobosa). Typically, the vegetation consists of a shrub/grass mixture characterized by fourwing saltbush and greasewood. Tall, mid-grass, and short grasses are present. Blue grama, foxtail, sand dropseed, spike dropseed, giant dropseed, New Mexico feathergrass and tansymustard are common. When the plant community deteriorates, there is an increase in amounts of shrubs and short grasses (USDA NRCS n.d.)

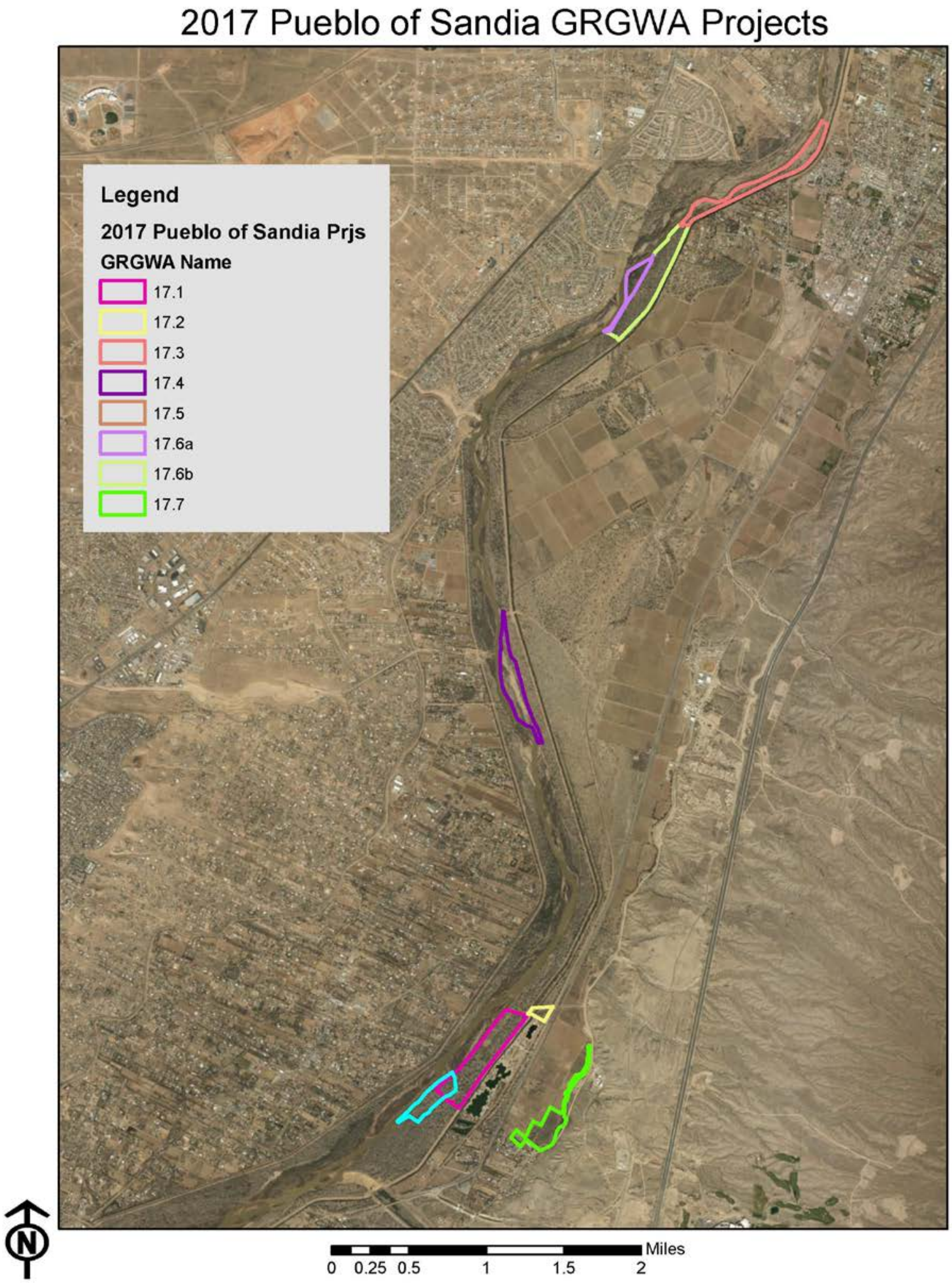
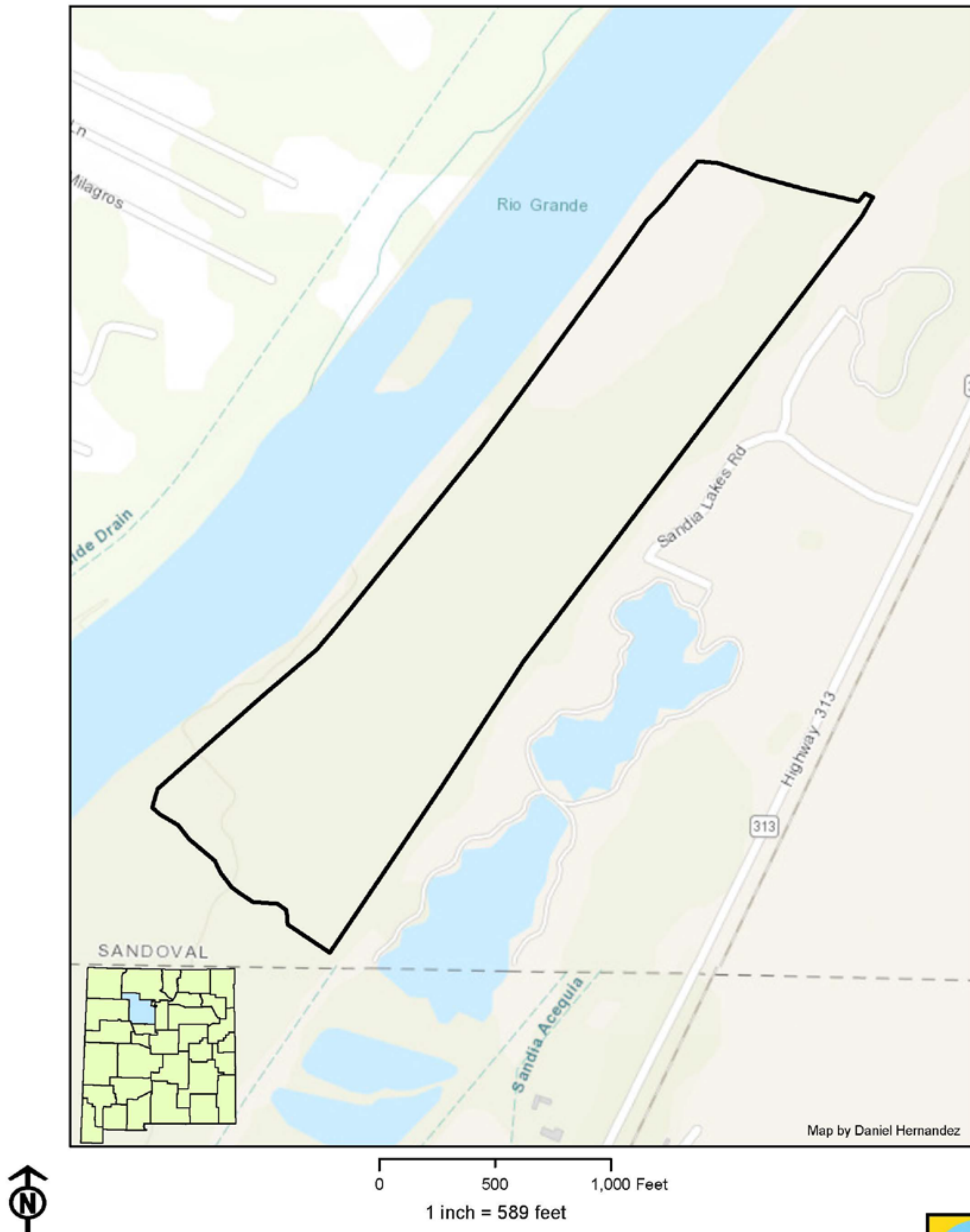


Figure 1. 2017 Pueblo of Sandia Projects

Project 17-01- Retreat-Sandia Lakes

Pre-treatment monitoring was conducted at this 66-acre site on September 14, 2017 as part of a restoration project targeting non-native phreatophytes. The project was proposed in 2017. The project is located on the Pueblo of Sandia in Sandoval County, three miles south of Bernalillo. The Coronado Soil and Water Conservation District (CSWCD) and the Pueblo of Sandia Environment Department Bosque Program sponsored the project. The project is bounded by the Rio Grande and previous GRGWA project 16-03 to the west, and a levee road on the east. According to the Pueblo of Sandia, the area has been treated with extraction and mastication twice in the past, once between 2000-2005, and again in 2015 (see GRGWA project 14-01). Seeding and planting of cottonwood poles occurred in 2000-2005, and floodplain features and ponds have been created in the area. Jetty jacks have also been removed. Planned (re)treatment includes cut-and-spray of Siberian elm, Russian olive, and salt cedar. Mulberry is present on-site but is not considered a target species. Restoration goals include returning the site to native bosque and wetlands, and allowing established native vegetation to compete/expand.

17-01 Pueblo of Sandia



Project 17-01 Pueblo of Sandia, is located in Sandoval County in the Pueblo of Sandia. The project area is bordered on the west by the Rio Grande and on the east by the Sandia Lakes. Access to the project area is via NM hwy 313. The project is considered a Re- treatment with Siberian Elm as the target species.

Figure 2. Project 17-01 in geographic context.

According to the NRCS Web Soil Survey, the project area is comprised of about 39.6% Gilco loam, 1 to 4 percent slopes, unprotected, 33.8% Trail loamy sand, 1 to 3 percent slopes, unprotected, 18.0% Trail loam, 1 to 3 percent slopes, unprotected, 5.4% Trail loam, 1 to 3 percent slopes, 3.0% Gilco loam, 1 to 4 percent slopes and 0.2% water. This information is included only for reference, as the soil survey may not be accurate at this scale. Ecological sites within this project include R042XA057NM Bottomland, and R036XA005NM Riverine Riparian (USDA NRCS, 2016).

The Bottomland ecological site is dominated by either giant sacaton or alkali sacaton. Vinemesquite grass and sideoats grama may also be present. Reduced cover and hummocking of these grasses characterize initial stages of degradation, typically due to overgrazing and/or changes in hydrology. Transitions to first tobosa- and then to burrograss-dominated states may occur in response to the redistribution of run-in water from overgrazing and subsequent erosion and gullying. Shrub invasion is not usually observed (USDA NRCS n.d.).

The Riverine Riparian ecological site is made up of sediments adjacent to perennial streams and vegetation is determined largely by local hydrology. Examples of typical species at different strata include Fremont cottonwood, sandbar willow, Western wheatgrass, and Nebraska sedge (USDA NRCS n.d.).

Native vegetation on this site at the time of the monitoring crew visit included some younger Rio Grande cottonwoods, coyote willows, Virgin's bower, Virginia creeper, purple aster, New Mexico olives, yerba mansa, currant, globemallow and sunflowers. Caged cottonwoods seem successful here, in contrast to plantings at the northern end of the bosque. Exotic species observed included ravennagrass, salt cedar, cheatgrass, Tree-of-Heaven and an abundance of Russian thistle (tumbleweed), Siberian elm, and Russian olive. Some jetty jacks were also present at this site.

Table 1. NMRAM Scores for 17-01.

Metric 17-01, 14 Sep 17	**Score**
Relative Native Plant Community Composition	2
Vegetation Horizontal Patch Structure	2
Vegetation Vertical Structure	3
Native Riparian Tree Regeneration	2
Exotic Invasive Plant Species Cover	1
Project Biotic Score (based on above ratings)	2
Project Biotic Rating	C/ Fair
Soil Surface Condition	3
Surface Fuels	0.75

The lowest score for this project is from the Exotic Invasive Plant Species Cover metric, due to the high percentage of invasive plants (estimated at around 25% of the site). The high Surface Fuels score is due largely to the large amount of Russian thistle, and the amount of leaf litter on the soil surface. The project scored best in the Vegetation Vertical Structure metric, due to the dominance of Type 1 and Type 2 communities. This site scored a 2 out of 4 overall, which is a “C” or “Fair” biotic rating. Most metrics were average in comparison to the other 2017 Pueblo of Sandia sites.

This site also had one plot established (location shown on map below). At this plot, we collected data on vegetation cover and fuel loading using Submethods 1 and 2 outlined in Appendix III, the BEMP plots and the Brown’s transects. The results of this data collection follow the map.

Figure 3. 17-01 Pueblo of Sandia project vegetation polygons.

Figure 4. 17-01 Average surface fuels from 2 transects on plot.

Fuel	Average tons/acre
1-hr	0.47
10-hr	4.88
100-hr	5.81
1000-hr sound	1.3
1000-hr rotten	0
SUM	11.81
Fuel	Avg depth (inches)
Duff	0.06
Litter	1.15
Total	1.21

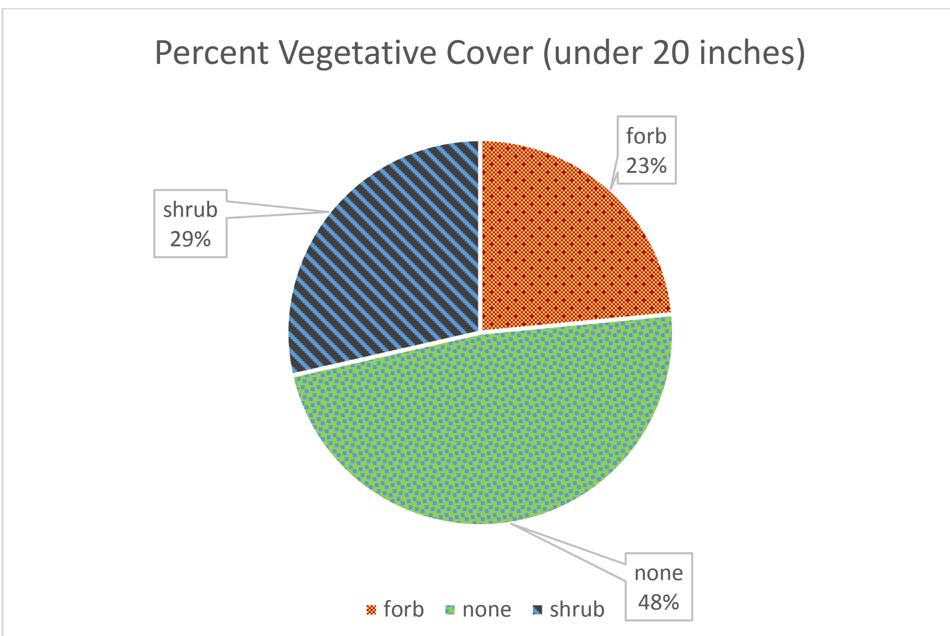


Figure 5. Percent Vegetative Cover for plot on 17-01.

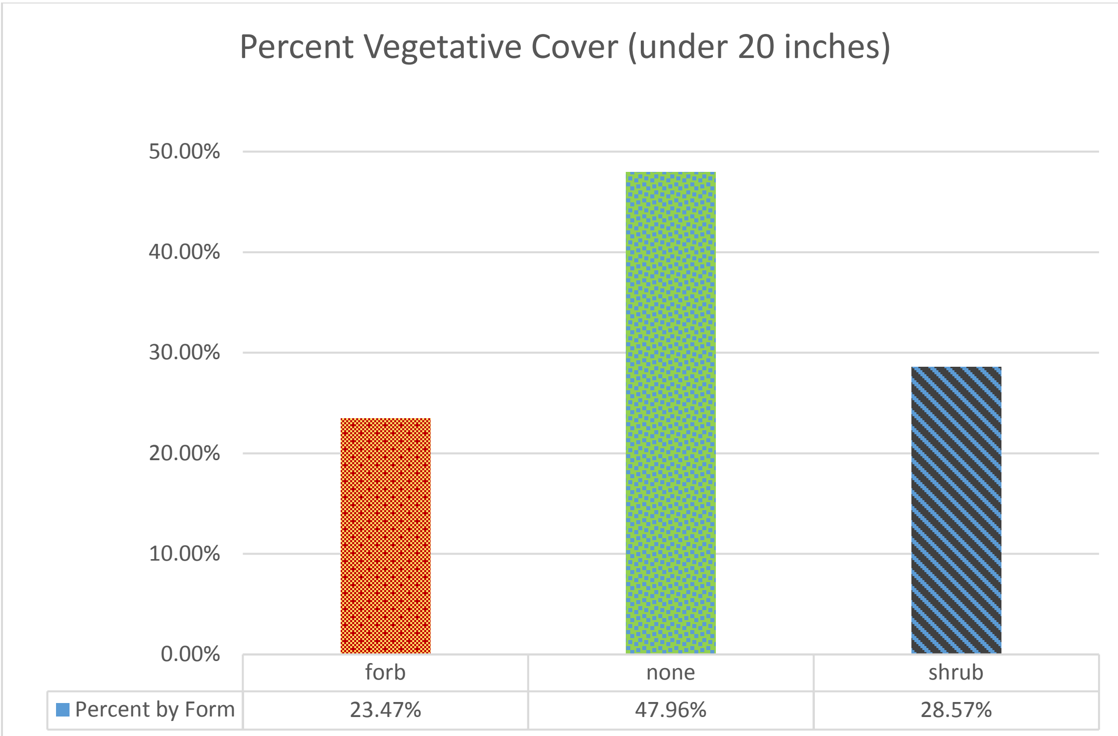


Figure 6. Percent Vegetative Cover for plot on 17-01.

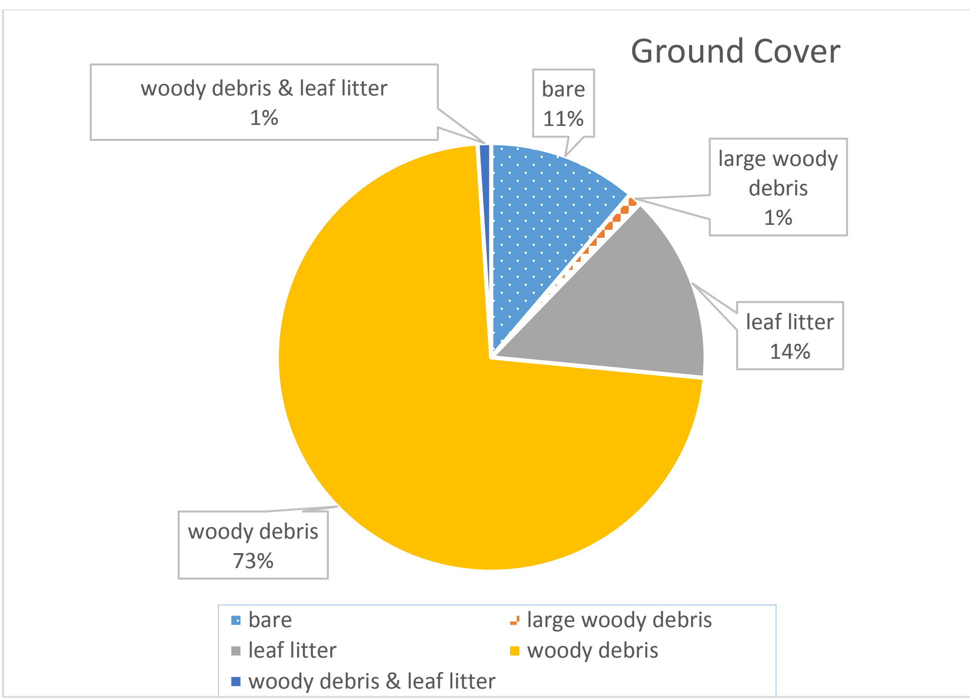


Figure 7. Percent ground cover for plot on 17-01.

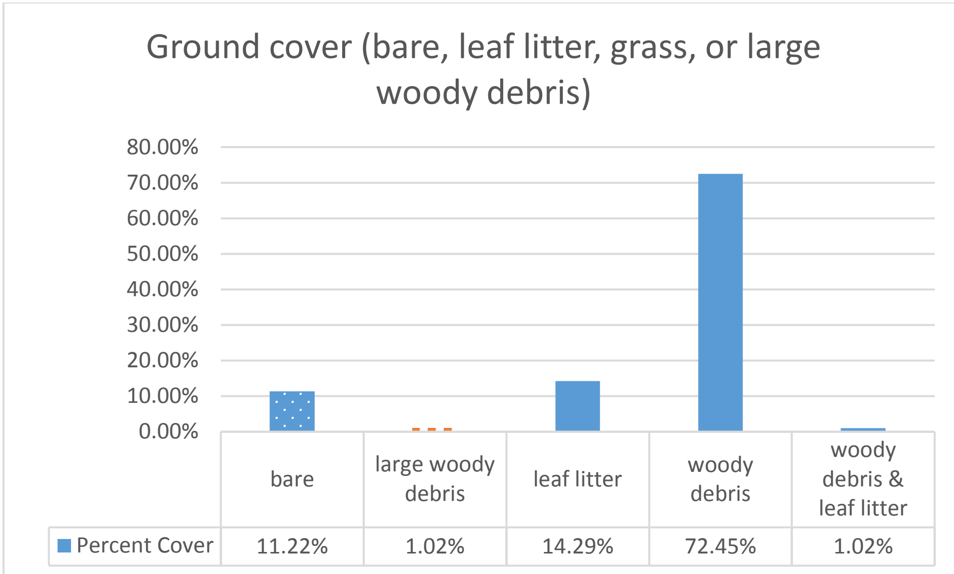
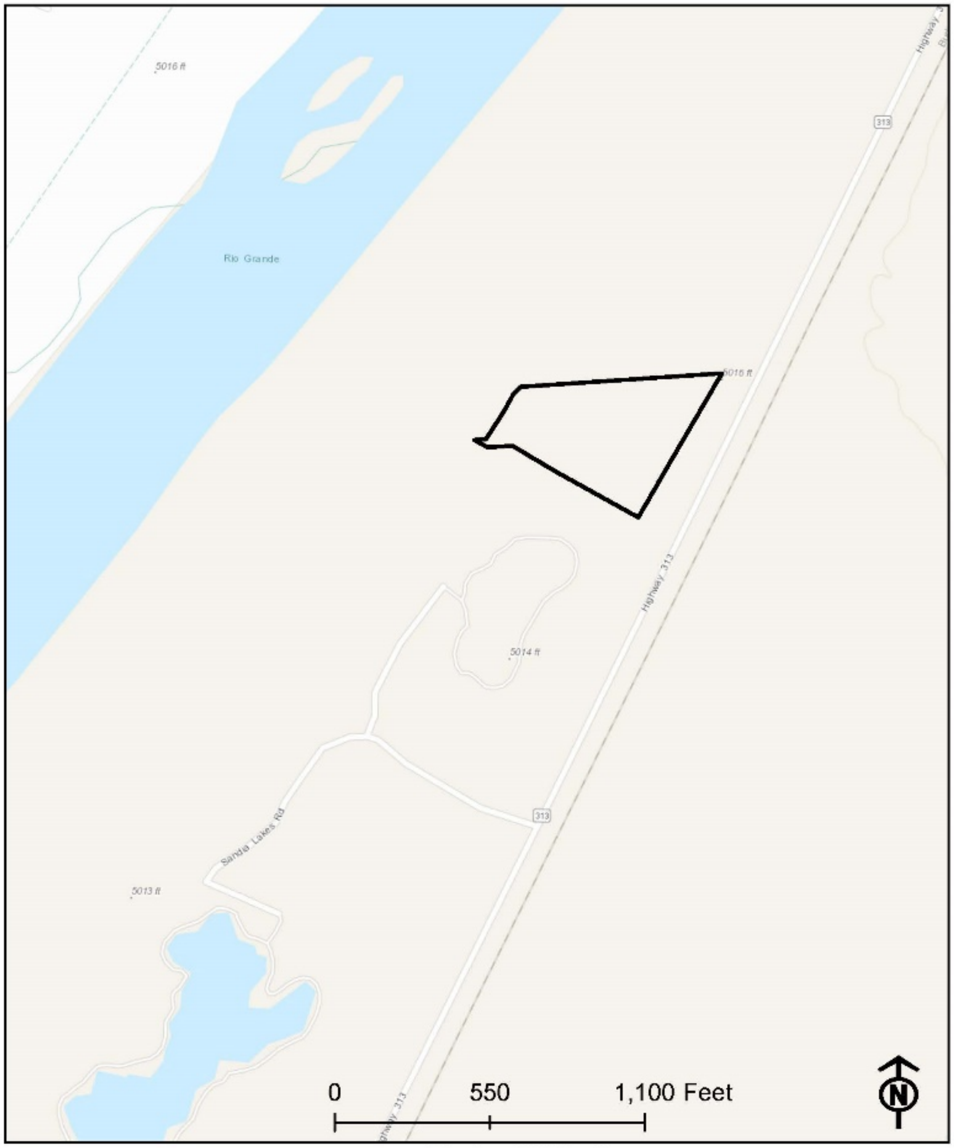


Figure 8. Percent ground cover for plot on 17-01.

Project 17-02 Retreat-Sandia Lakes2

Pre-treatment monitoring was conducted at this 5-acre site on September 14, 2017 as part of a restoration project targeting non-native phreatophytes submitted for 2017. The project is located on the Pueblo of Sandia in Sandoval County and was sponsored by the Coronado Soil and Water Conservation District (CSWCD) and the Pueblo of Sandia Environment Department Bosque Program. The project is a small depression bounded by the Riverside Drain on the west, a canal on the south, and levee roads on the north and east. Planned treatment includes removal of salt cedar, Siberian elm, Russian olive, and Tree-of-Heaven, with cut stump/spray, foliar spray, and/or basal bark spray (for Tree-of-Heaven). Mulberry and cheatgrass are also present on the site but are not considered target species. Restoration goals for the project include the return to native bosque and a reduction in nonnative seed sources (especially Siberian elm and Tree-of-Heaven).

17-02 Pueblo of Sandia



1 inch = 515 feet

Project 17-02 Pueblo of Sandia, is located in the Pueblo's Bosque, east of the Riverside drain and north of Sandia Lakes. N.M.Hwy 313 borders the project area to the east and the Rio Grande on the west.The project is considered a re-treatment with Siberian elm, Russian olive, tamarix and Tree of Heaven as the target species.

Map by Daniel Hernandez

Figure 2. Project 17-02 in geographic context.

According to the NRCS Web Soil Survey, the project area is comprised of 62.0% Gilco loam, 1 to 4 percent slopes, 36.8% Jocity loam, 0 to 2 percent slopes, and 1.2% Peralta loam, moderately saline, sodic, 1 to 3 percent slopes. Ecological sites within this project include R042XA057NM Bottomland, R042XA051NM Sandy, and R042XA055NM Salty Bottomland (USDA NRCS, 2016).

The Bottomland ecological site is dominated by either giant sacaton or alkali sacaton. Vinemesquite grass and sideoats grama may also be present. Reduced cover and hummocking of these grasses characterize initial stages of degradation, typically due to overgrazing and/or changes in hydrology. Transitions to first tobosa- and then to burrograss-dominated states may occur in response to the redistribution of run-in water from overgrazing and subsequent erosion and gullying. Shrub invasion is not usually observed (USDA NRCS n.d.).

The Sandy ecological site is historically dominated by black grama, dropseeds, Indian ricegrass and/or galleta. Heavy grazing leads to reductions of palatable grasses and possibly the persistent loss of black grama, leaving dropseeds, threeawns, and snakeweed. Loamier soils in concave positions that collect surface water runoff may become dominated by burrograss and galleta under continuous grazing. There is evidence that periodic fires may have been characteristic of this state. Grass cover is uniform with some bare patches. Black grama is dominant and stabilizes much of the soil surface, protecting against wind erosion. Sand sage and/or mesquite may be present, but not abundant (USDA NRCS n.d.).

Salty Bottomland can support a range of plant communities which typically include cottonwood, tamarisk, mixed exotics (dominated by Russian olive/ Russian knapweed/ etc), saltgrass and saltgrass-sacaton, and bottomland grassland (possibly dominated by saltgrass, giant sacaton, dropseed, muhly, burrograss, alkali sacaton, galleta, vinemesquite, and/or tobosa). Typically the vegetation consists of a shrub/grass mixture characterized by fourwing saltbrush and greasewood. Tall, mid-grass, and short grasses are present. Blue grama, foxtail, sand dropseed, spike dropseed, giant dropseed, New Mexico feathergrass and tansymustard are common. When the plant community deteriorates, there is an increase in amounts of shrubs and short grasses (USDA NRCS n.d.).

Field crew observations on this site included the presence of salt cedar, kochia, Russian thistle (tumbleweed), mulberry, cheatgrass, Russian olives, and Siberian elms. Native vegetation noted included Rio Grande cottonwood, silverleaf nightshade, globe mallow, sunflowers, sacaton, yerba mansa, rushes, squirreltail and Indian ricegrass, and buffalo gourd.

Table 3. NMRAM Scores for 17-02.

Metric 17-02, 14 Sep 17	**Score**
Relative Native Plant Community Composition	1
Vegetation Horizontal Patch Structure	3
Vegetation Vertical Structure	4
Native Riparian Tree Regeneration	1
Exotic Invasive Plant Species Cover	1
Project Biotic Score (based on above ratings)	2
Project Biotic Rating	C/ Fair
Soil Surface Condition	1
Surface Fuels	0.80

Lowest scores for this project came in the Relative Native Plant Community Composition and Exotic Invasive Plant Species Cover metrics, due to the high percentage of invasive plants (estimated to be around 75% of the site). A low score was also recorded in the Native Riparian Tree Regeneration metrics, due to low diversity of plant communities within the project area and the lack of native riparian regeneration. The high amount of surface fuels is due to masticated material and woody debris, which was especially deep on the eastern side. The Soil Surface Condition metric was low due to roads in the project area.

The project scored best in the Vegetation Vertical Structure metric, because of the dominance of high-structure forest. This site scored a 2 out of 4 overall, which is a “C” or “Fair” biotic rating. Most metrics were average in comparison to the other 2017 Pueblo of Sandia sites.

This site also had one plot established (location shown on map below). At this plot, we collected data on vegetation cover and fuel loading using Submethods 1 and 2 outlined in Appendix III, the BEMP plots and the Brown’s transects. The results of this data collection follow the map.

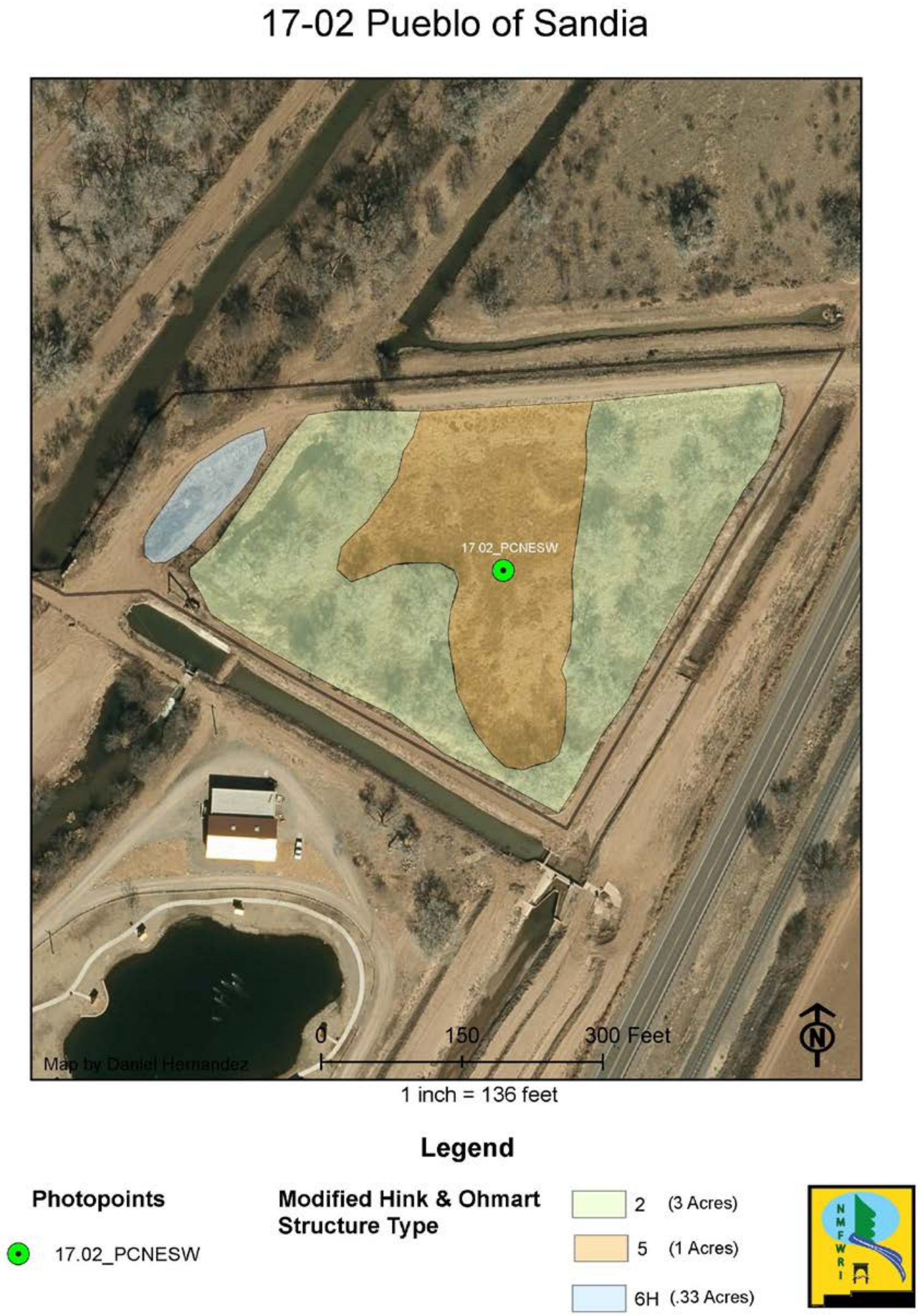


Figure 4. 17-02 Pueblo of Sandia Project Vegetation polygons.

Figure 9. 17-02 Average surface fuels from 2 transects on plot.

Fuel	Average tons/acre
1-hr	0.37
10-hr	1.98
100-hr	1.27
1000-hr sound	0.00
1000-hr rotten	6.77
All woody fuels	10.38
Fuel	Avg depth (inches)
Duff	0
Litter	0.28
Total	0.28

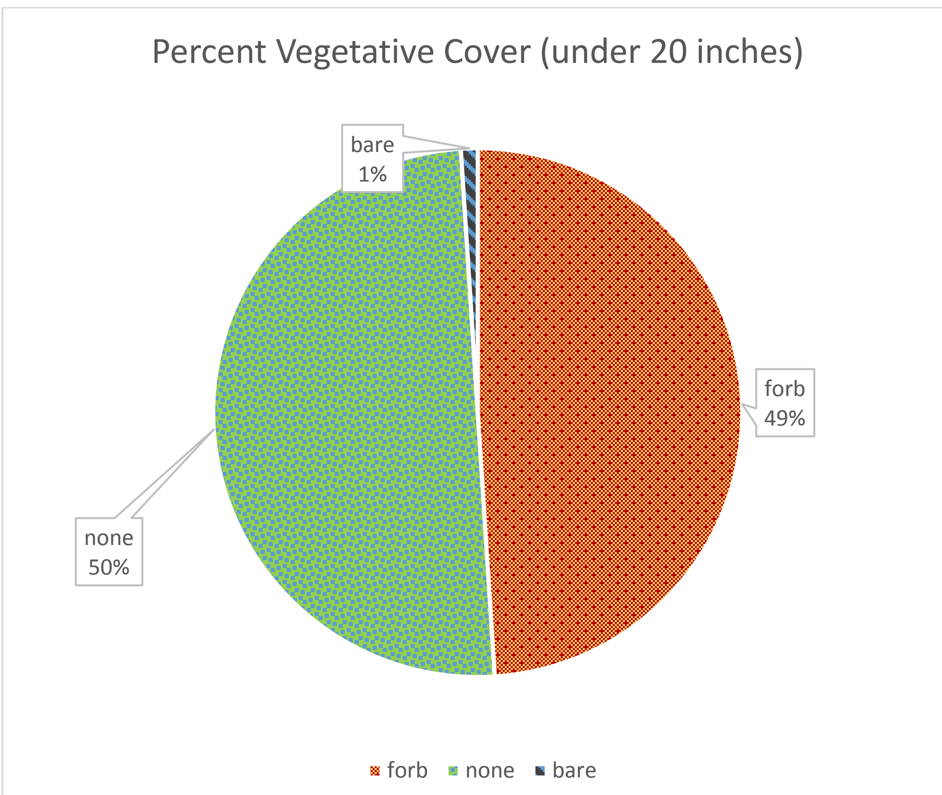


Figure 10. Percent Vegetative Cover for plot on 17-02.

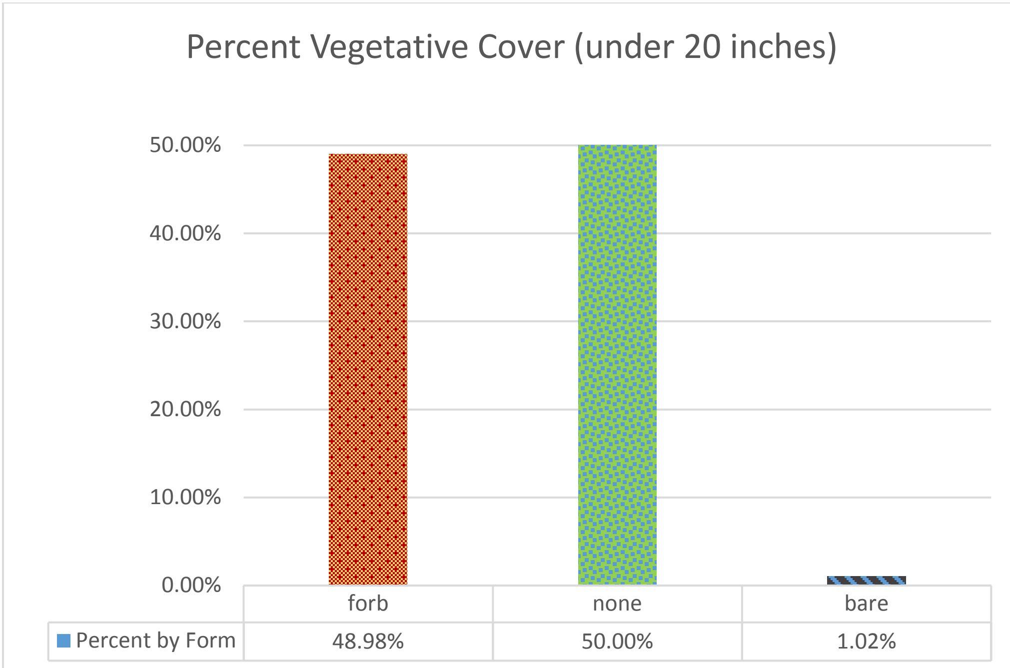


Figure 11. Percent Vegetative Cover for plot on 17-02.

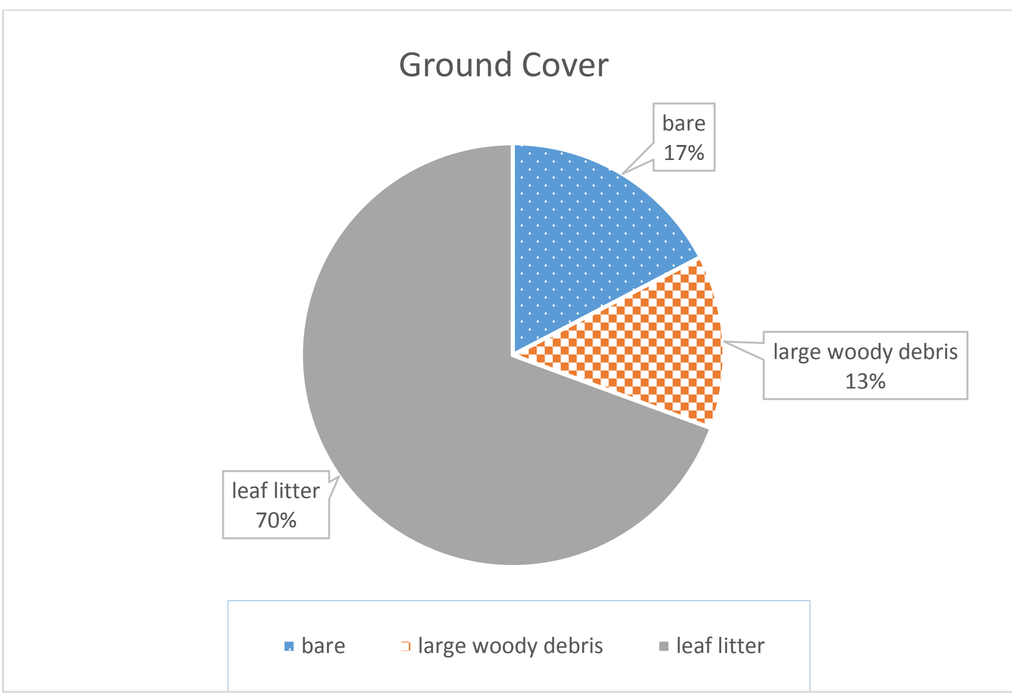


Figure 12. Percent ground cover for plot on 17-02.

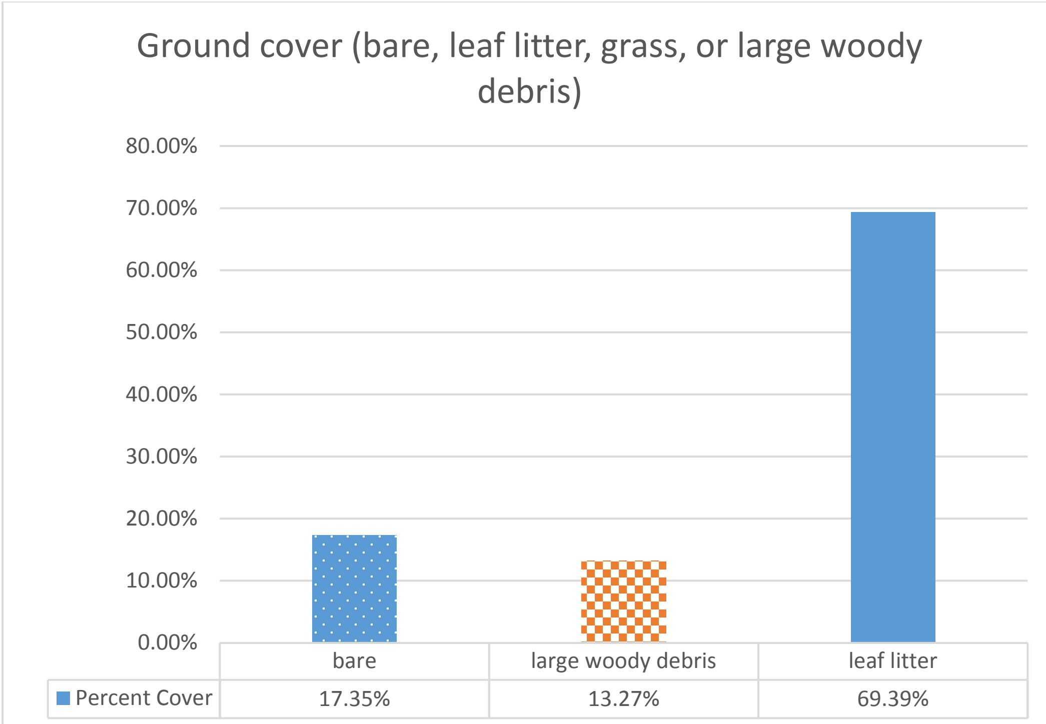


Figure 13. Percent ground cover for plot on 17-02.

Project 17-03 Retreat- Northend

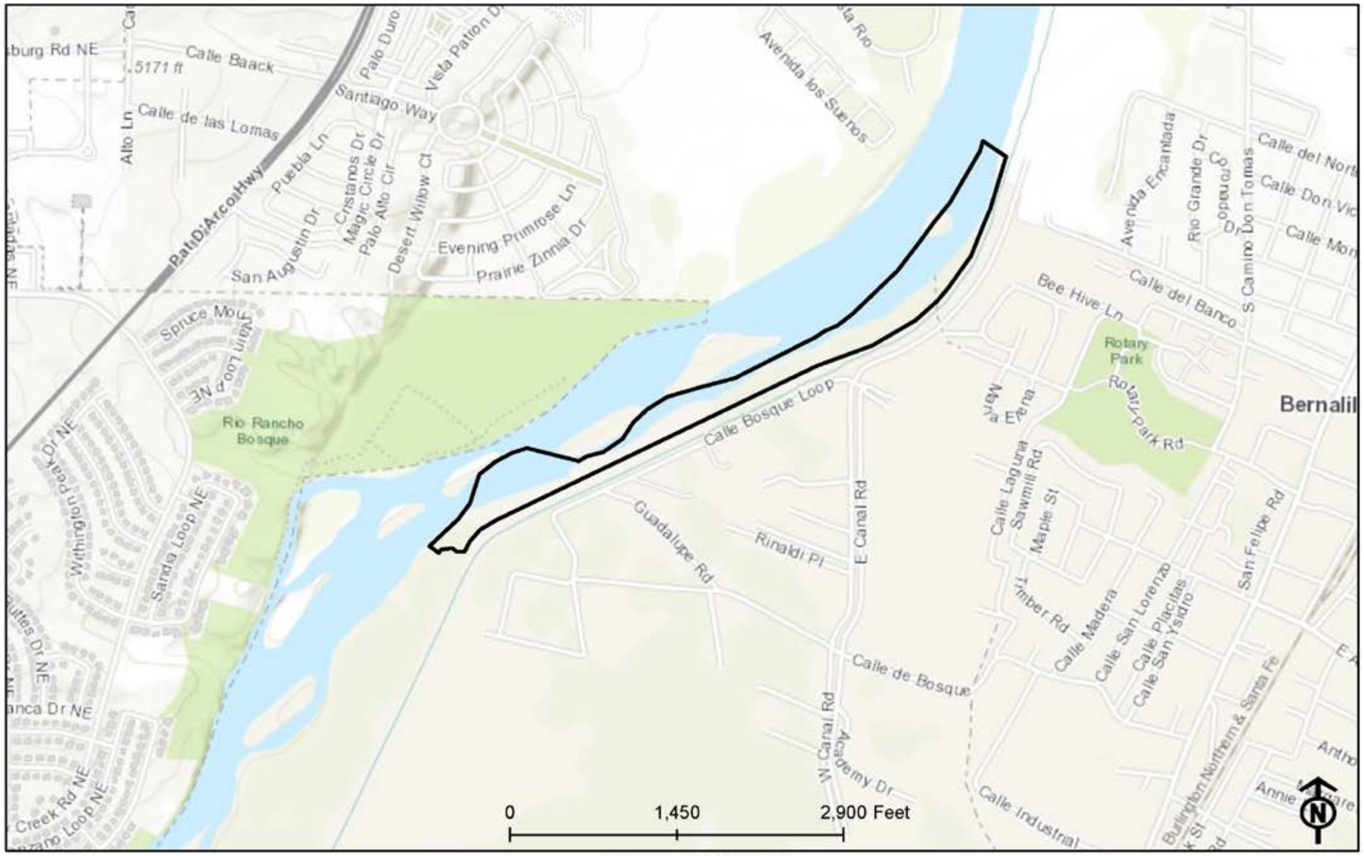
Pre-treatment monitoring was conducted at this 43-acre site on September 9, 2017 as part of a restoration project targeting non-native phreatophytes submitted for 2017. The project is located on the Pueblo of Sandia in Sandoval County. The project boundaries include the Rio Grande on the west and a levee road and the Bernalillo Riverside Drain to the east. The Coronado Soil and Water Conservation District (CSWCD) and the Pueblo of Sandia Environment Department Bosque Program sponsored the project.

According to the Pueblo, the northern portion of the project was planted following a destructive 2001 wildfire but was survival rates were low, possibly due to a drop in the local water table. This same area was also treated in late 2015 as part of the GRGWA project 15-01 where salt cedar was extracted and masticated. Some of that salt cedar has re-sprouted.

The southern portion of the project includes a Bureau of Reclamation project aiming to protect spoil-bank levees. Project-related activities in this area included planting of natives, removal of nonnatives, and creation of silvery minnow habitat; maintenance is ongoing. As part of GRGWA project 15-01, Siberian elm was extracted and masticated in late 2015 but has re-sprouted. Tree-of-heaven and Russian olive are also present in the unit.

Planned treatment in the 2017 proposal includes re-treatment of existing Siberian elm, salt cedar, Russian olive, and Tree-of-heaven with cut stump/spray, and possibly foliar spray. The retreatment will compliment previous and ongoing work in the area. Restoration goals include returning the project to native bosque and allowing existing native vegetation to expand. Seeding and planting has already occurred as part of previous projects, and more work is planned.

17-03 Pueblo of Sandia



1 inch = 1,162 feet

Project 17-03 Pueblo of Sandia, is located between the Rio Grande on the west and a levee road and the Bernalillo Riverside Drain to the east. Access to the site is via N.M. Hwy 313 in the Pueblo of Sandia.The project is considered a re-treatment with siberian elm, Salt cedar and some Tree of Heaven as the target species.

Map by Daniel Hernandez

Figure 14. 17-03 in geographic context.

According to the NRCS Web Soil Survey, the project area is comprised of 71.7% Gilco loam, 1 to 4 percent slopes, unprotected, 24.6% Water, 2.3% Aga loam, 0 to 1 percent slopes, 1.3% Trail silty clay loam, 0 to 1 percent slopes and 0.1% Sparham clay loam, 0 to 1 percent slopes. Ecological sites within this project include water, R042XA057NM Bottomland, R036XB002NM Clayey, and R036XA005NM Riverine Riparian (USDA NRCS, 2016).

The Bottomland ecological site is dominated by either giant sacaton or alkali sacaton. Vinemesquite grass and sideoats grama may also be present. Reduced cover and hummocking of these grasses characterize initial stages of degradation, typically due to overgrazing and/or changes in hydrology. Transitions to first tobosa- and then to burrograss-dominated states may occur in response to the redistribution of run-in water from overgrazing and subsequent erosion and gullying. Shrub invasion is not usually observed (USDA NRCS n.d.).

The Clayey ecological site typically supports a grassland state with a shrub savannah aspect. Pinyon and juniper trees, if any, are scattered. Forbs are conspicuous throughout the site. Plant community in this site are: western wheatgrass, muttongrass, prairie junegrass, spike muhly, fourwing saltbush, alkali sacaton, bottlebrush squirreltail, galleta, blue grama, big sagebrush and rabbitbrush. In case of severe deterioration of plant community is indicated by a heavy infestation of big sagebrush and/or rabbitbrush invading and becoming predominant with very little herbaceous understory. (USDA NRCS, n.d.)

The Riverine Riparian ecological site is made up of sediments adjacent to perennial streams and vegetation is determined largely by local hydrology. Examples of typical species at different strata include Fremont cottonwood, sandbar willow, Western wheatgrass, and Nebraska sedge (USDA NRCS n.d.).

Field crew observations on this site noted the presence of several exotics including salt cedar, Russian olive trees, Tree-of-Heaven, Russian thistle (tumbleweed), pigweed, Siberian elm, cheatgrass, mulberry and kochia. Native vegetation included Rio Grande cottonwood trees and saplings, dropseed grass, juniper, other native grasses, aster spp, Virginia creeper, coyote willows, sumac, locust spp, mushroom spp, narrowleaf cottonwoods, four-wing saltbush, cota (indian tea), purple aster, beebalm, globemallow and New Mexico olive. Old jetty jacks were present in this site, as was masticated material; there were some areas of disturbed/ bare ground as well as patches of vegetation.

Table 5. NMRAM Scores for 17-03.

Metric 17-03, 9 Sep 17	**Score**
Relative Native Plant Community Composition	2
Vegetation Horizontal Patch Structure	4
Vegetation Vertical Structure	2
Native Riparian Tree Regeneration	3
Exotic Invasive Plant Species Cover	1
Project Biotic Score (based on above ratings)	2.3
Project Biotic Rating	C/ Fair
Soil Surface Condition	2
Surface Fuels	0.5

The lowest score for this project came in the Exotic Invasive Plant Species Cover metric, due to the high percentage of invasive plants (estimated 15% of the site). The moderate score in the surface fuels metric is due to masticated material and some patches of bare ground. The project scored best in the Vegetation Horizontal Patch Structure metrics, because there are several different plant communities distributed across the landscape area. This site scored a 2.3 out of 4 overall, which is a “C” or “Fair” biotic rating. Most metrics were at or above average in comparison to the other 2017 Pueblo of Sandia sites.

This site also had one plot established (location shown on map below). At this plot, we collected data on vegetation cover and fuel loading using Submethods 1 and 2 outlined in Appendix III, the BEMP plots and the Brown’s transects.

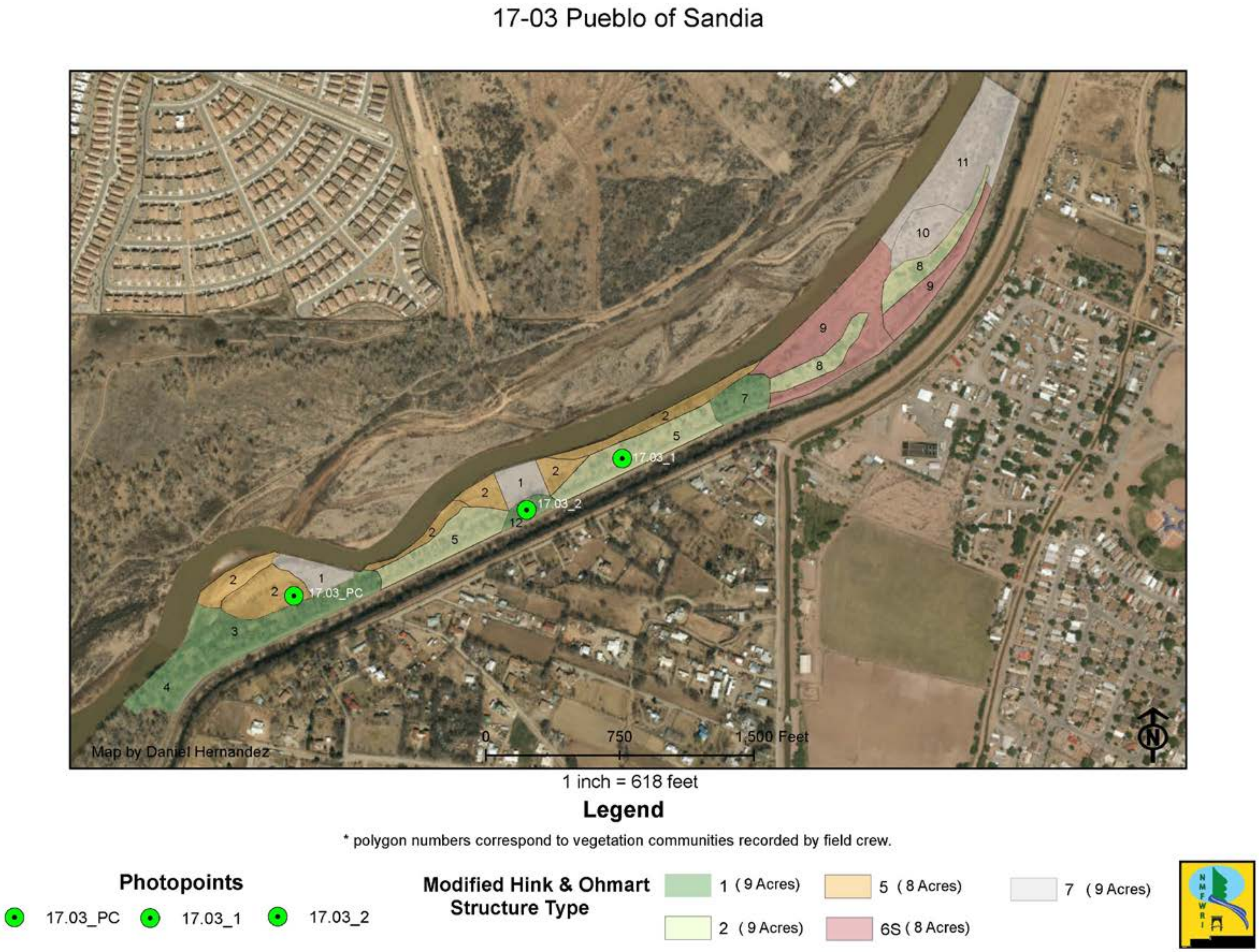


Figure 15. 17-03 Pueblo of Sandia project vegetation polygons.

Table 6. 17-03 Average surface fuels from 2 transects on plot.

Fuel	Average tons/acre
1-hr	0.04
10-hr	0.15
100-hr	0
1000-hr sound	0
1000-hr rotten	0
All woody fuels	0.19
Fuel	Avg depth (inches)
Duff	0.13
Litter	1.28
Total	1.4

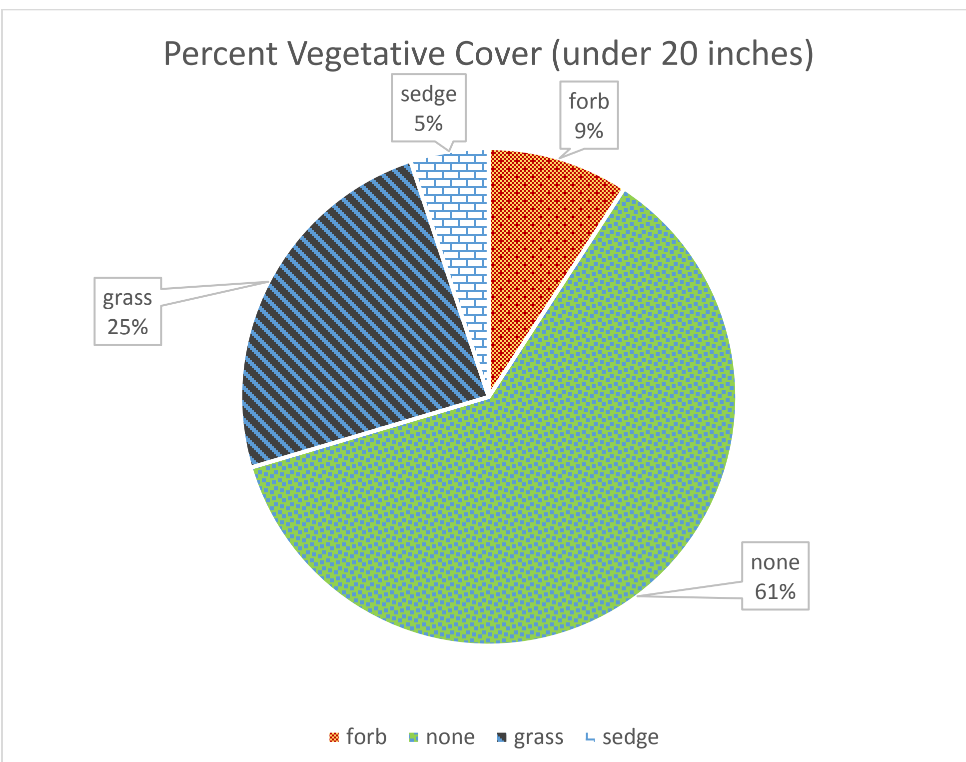


Figure 16. Percent Vegetative Cover for plot on 17-03.

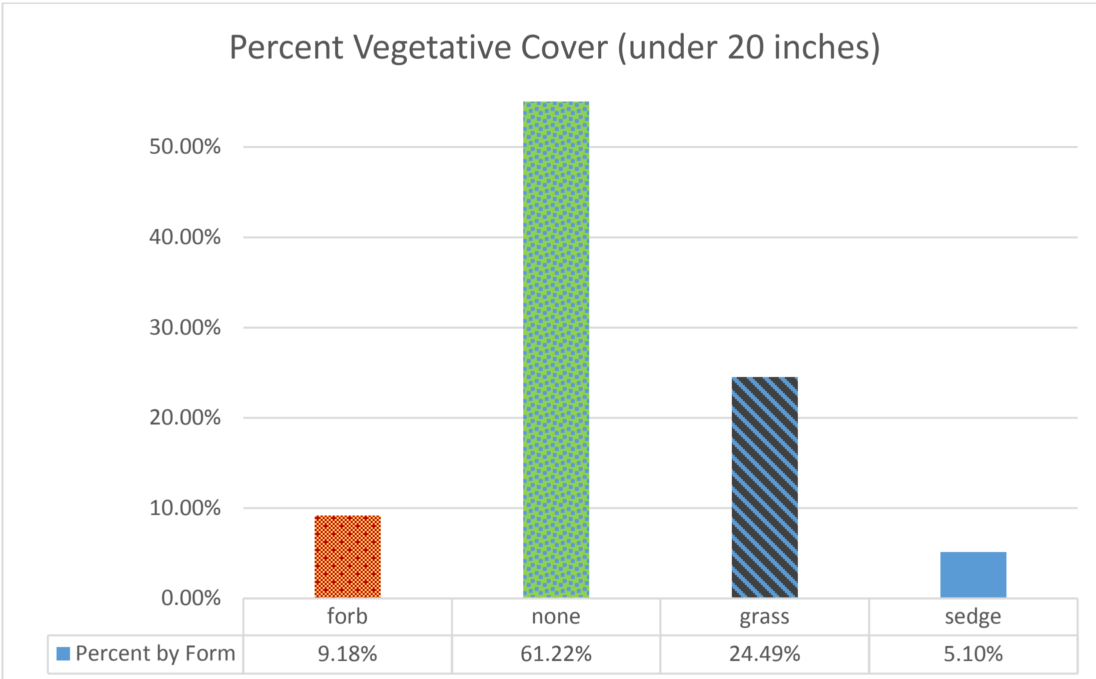


Figure 17. Percent Vegetative Cover for plot on 17-03.

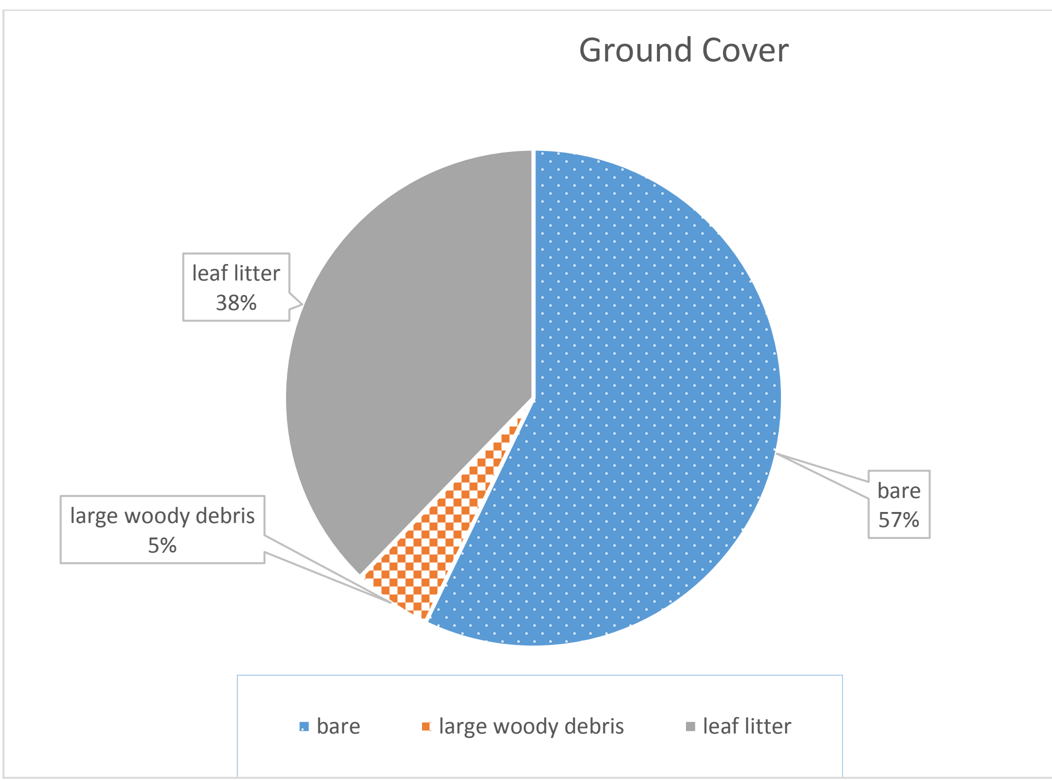


Figure 18. Percent ground cover for plot on 17-03.

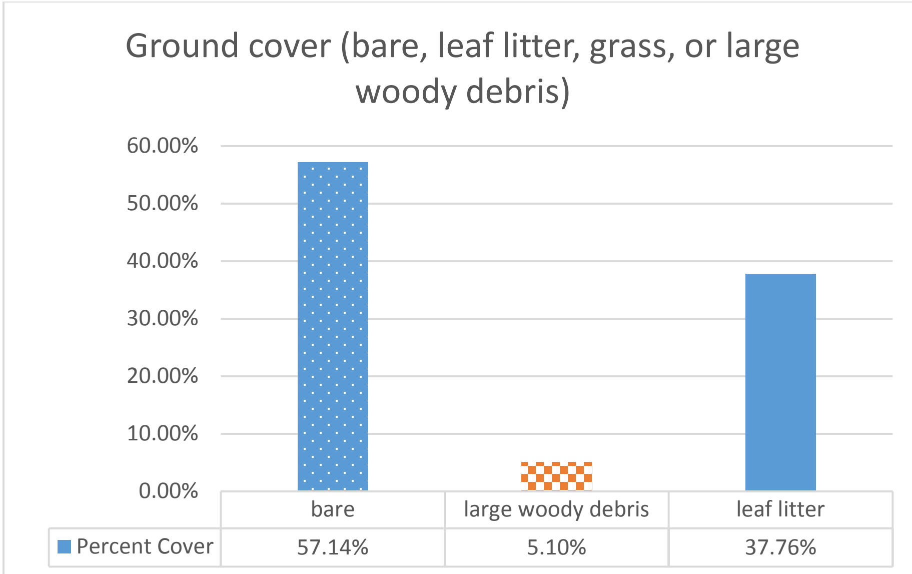
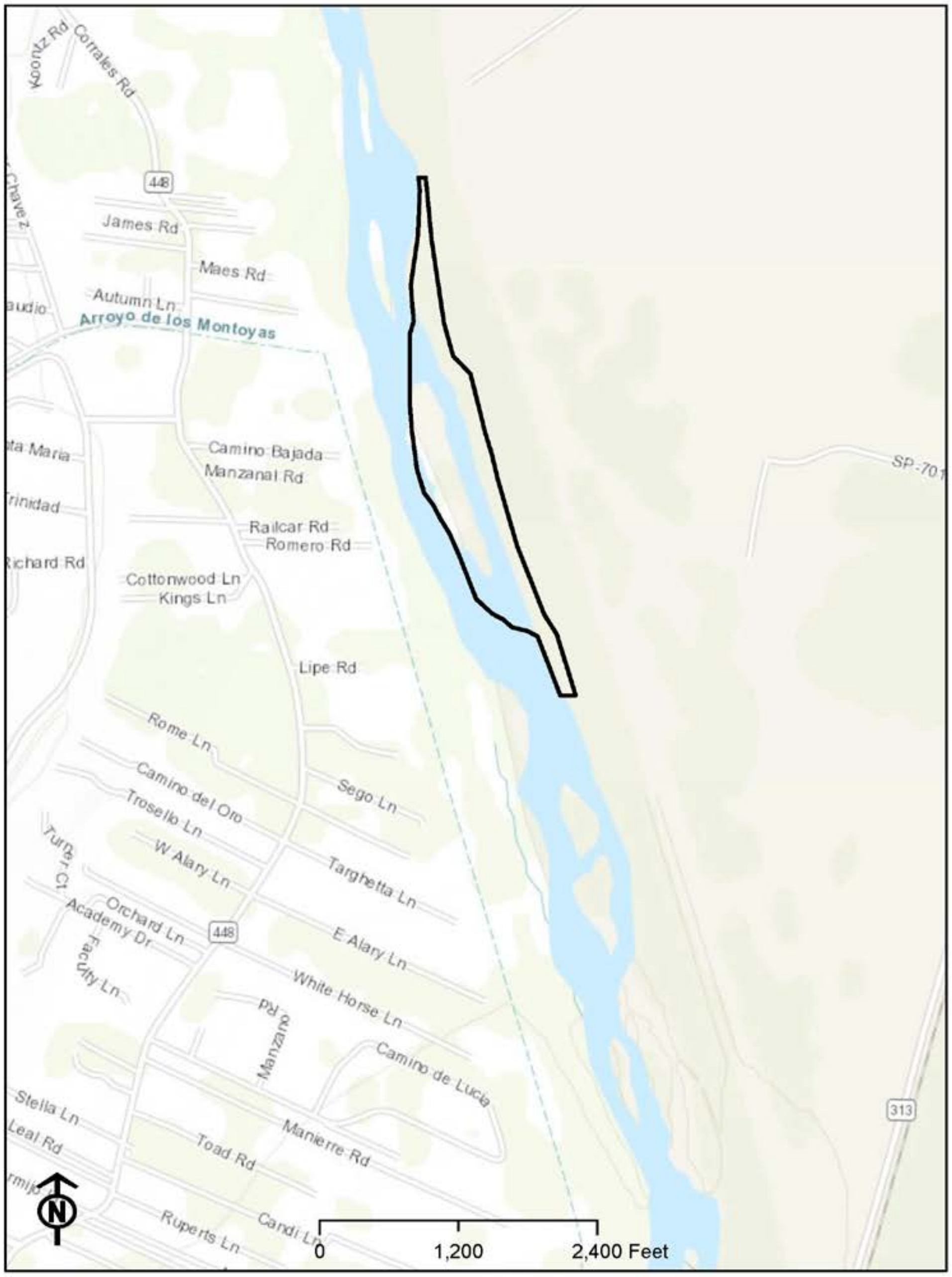


Figure 19. Percent ground cover for plot on 17-03.

Project 17-04 Retreat-WUI-South

Low-intensity pre-treatment monitoring was conducted at this 40-acre site on September 12, 2017 as part of a restoration project targeting non-native phreatophytes submitted for 2017. The project is located on the Pueblo of Sandia in Sandoval County. The project boundaries include the Rio Grande on the west and a fenceline on the east. The Coronado Soil and Water Conservation District (CSWCD) and the Pueblo of Sandia Environment Department Bosque Program sponsored the project. According to the Pueblo, the area was part of a 2007 North American Wetlands Conservation Act project to nonnative species, and was part of a 2011 US Army Corps project including removal of nonnatives, planting, seeding and the construction of floodplain features. The same area burned in the 2012 Romero Fire. However, native vegetation is in the process of re-establishment. The 2017 GRGWA proposal includes removal of Russian olive and Siberian elm by extraction/mastication and herbicide spray, in line with previous project goals.

17-04 Pueblo of Sandia



1 inch = 1,250 feet

Project 17-04 Pueblo of Sandia, is located on the Pueblo of Sandia. The Rio Grande is on the west and a fence line on the east. Access to the project is via N.M. Hwy 313. The project is considered a re-treatment with Russian olive and Siberian elm as the target species.

Figure 20. 17-04 in geographic context.

According to the NRCS Web Soil Survey, the project area is comprised of 63.2% Water and 36.8% Peralta loam, 1 to 3 percent slopes, unprotected. Ecological sites within this project include water, R042XA057NM Bottomland, and R036XA005NM Riverine Riparian (USDA NRCS, 2016).

The Bottomland ecological site is dominated by either giant sacaton or alkali sacaton. Vinemesquite grass and sideoats grama may also be present. Reduced cover and hummocking of these grasses characterize initial stages of degradation, typically due to overgrazing and/or changes in hydrology. Transitions to first tobosa- and then to burrograss-dominated states may occur in response to the redistribution of run-in water from overgrazing and subsequent erosion and gullying. Shrub invasion is not usually observed (USDA NRCS n.d.).

The Riverine Riparian ecological site is made up of sediments adjacent to perennial streams and vegetation is determined largely by local hydrology. Examples of typical species at different strata include Fremont cottonwood, sandbar willow, Western wheatgrass, and Nebraska sedge (USDA NRCS n.d.).

Field crew observations on this site included the presence of exotics including salt cedar, Russian olive, kochia, cocklebur, Siberian elm, and Russian thistle (tumbleweed). Native vegetation observed included Rio Grande cottonwood, purple aster, coyote willow, rocky mountain bee plant, native grass spp, silverleaf nightshade, seep willow, juniper, Rio Grande cottonwood, and narrowleaf cottonwood.

Table 7. NMRAM Scores for 17-04.

Metric 17-04, 12 Sep 17	**Score**
Relative Native Plant Community Composition	2
Vegetation Horizontal Patch Structure	4
Vegetation Vertical Structure	3
Native Riparian Tree Regeneration	3
Exotic Invasive Plant Species Cover	1
Project Biotic Score (based on above ratings)	2.5
Project Biotic Rating	C/ Fair
Soil Surface Condition	4
Surface Fuels	.60

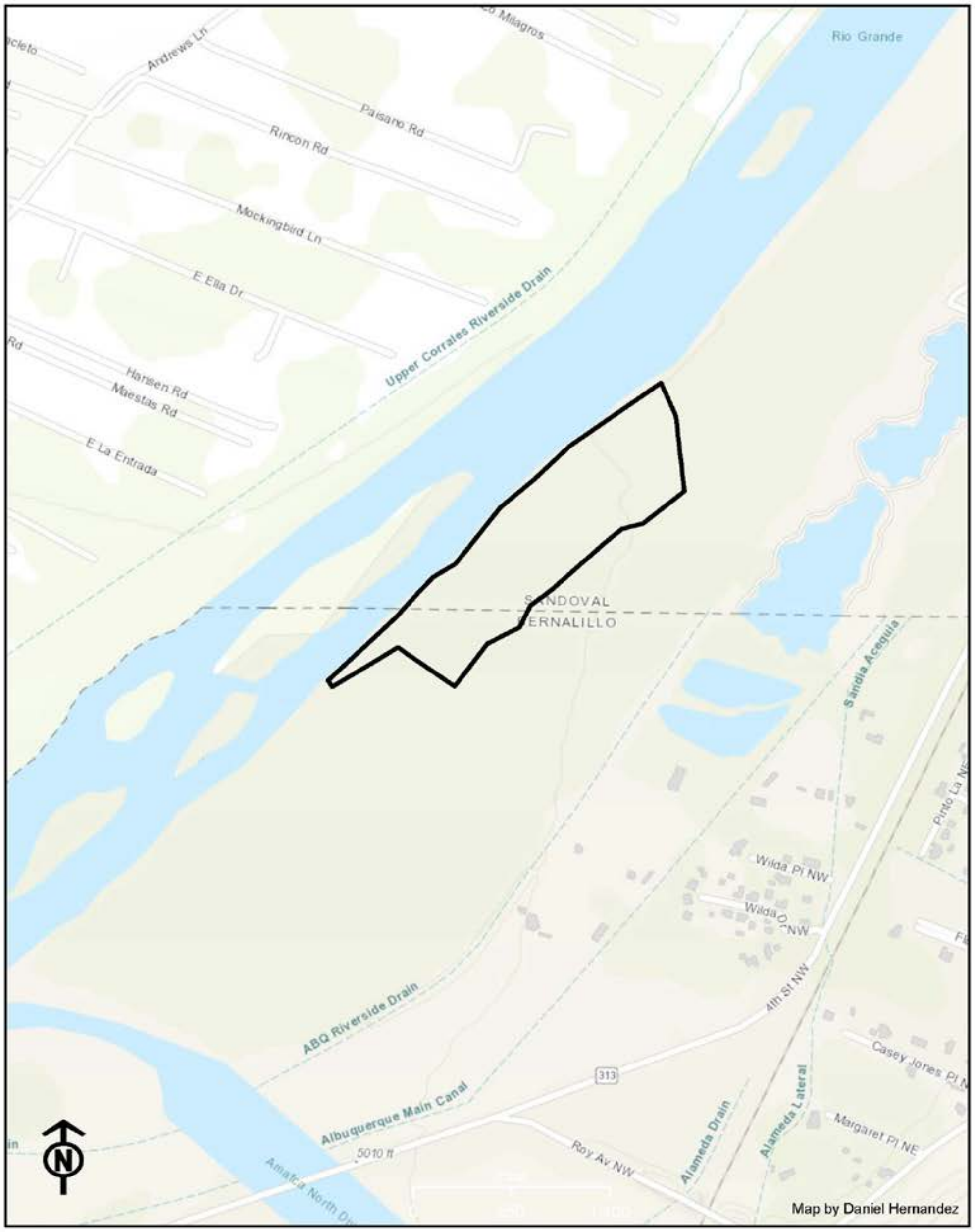
The lowest score for this project came in the Exotic Invasive Plant Species Cover metric, due to the high percentage of invasive plants (estimated at around 40% of the site). In this project, the highest score came in the Vegetation Horizontal Patch Structure metric, because there were several different plant communities distributed across the landscape areas and variable overstory structure. This site scored a 2.5 out of 4 overall, which is a “C” or “Fair” biotic rating. Most metrics were at or above average in comparison to the 2017 Pueblo of Sandia sites.

Figure 21. 17-04 Pueblo of Sandia vegetation polygon map

Project 17-05 Riverside South-Ravenna

Low-intensity pre-treatment monitoring was conducted at this 24-acre site on September 14, 2017 as part of a restoration project targeting non-native phreatophytes submitted for 2017. The project is located on the Pueblo of Sandia in Sandoval and Bernalillo Counties. The Coronado Soil and Water Conservation District (CSWCD) and the Pueblo of Sandia Environment Department Bosque Program sponsored the project. The project is bounded by the Rio Grande on the west. A two-track road runs through the unit. The westernmost portion of this project was also treated in 2014 as GRGWA Project 14-01, which was extraction/mastication of Siberian elms. Re-growth on this project was not re-treated and escaped, according to Fred Rossbach. The northeast corner of the project overlaps with GRGWA proposal 17-01. Planned treatment in this area includes removal of ravennagrass by herbicide spray. A different restoration project occurred in the area in 2017 and included planting and seeding.

17-05 Pueblo of Sandia



1 inch = 833 feet

Project 17-05 is located in the Pueblo of Sandia. The project boundaries include, the Rio Grande to the west and the ABQ Riverside drain to the east, the southern boundary is divided by the Sandoval and Bernalillo county.The project is accessible from N.M. Hwy 313.The project is considered a new treatment with ravennagrass as the target species.

Figure 22. 17-05 in geographic context.

According to the NRCS Web Soil Survey, the project area is comprised of 75.1% Trail loamy sand, 1 to 3 percent slopes, unprotected, 23.4% Vinton and Brazito soils, occasionally flooded and 1.5% Torrifluvents, frequently flooded. Ecological sites within this project include R042XA051NM Sandy, R042XA054NM Deep Sand, and R042XA057NM Bottomland (USDA NRCS, 2016).

The Sandy ecological site is historically dominated by black grama, dropseeds, Indian ricegrass and/or galleta. Heavy grazing leads to reductions of palatable grasses and possibly the persistent loss of black grama, leaving dropseeds, threeawns, and snakeweed. Loamier soils in concave positions that collect surface water runoff may become dominated by burrograss and galleta under continuous grazing. There is evidence that periodic fires may have been characteristic of this state. Grass cover is uniform with some bare patches. Black grama is dominant and stabilizes much of the soil surface, protecting against wind erosion. Sand sage and/or mesquite may be present, but not abundant (USDA NRCS n.d.).

The Deep Sand ecological site type is mainly grassland and quite an amount of shrubs. The grasslands consists of a mixture of short-, mid-, and tall grasses. Annual grasses and forbs occur in relatively large amounts. Plant community include: six-weeks grama, sand muhly, blue grama, foxtail barley, bottlebrush squirreltail, tumblegrass and threeawn spp. Other forbs include: tansymustard, stickleaf, globemallow, silverleaf nightshade, locoweed, woolly grounsel, and indian paintbrush. When the plant community deteriorates, there is an increase of woody and succulent plants. Mesquite and juniper may overtake in the site. In severe conditions of worsening of plant community, there will be active soil erosion resulting in bared sand dunes. (USDA NRCS, n. d.)

The Bottomland ecological site is dominated by either giant sacaton or alkali sacaton. Vinemesquite grass and sideoats grama may also be present. Reduced cover and hummocking of these grasses characterize initial stages of degradation, typically due to overgrazing and/or changes in hydrology. Transitions to first tobosa- and then to burrograss-dominated states may occur in response to the redistribution of run-in water from overgrazing and subsequent erosion and gullying. Shrub invasion is not usually observed (USDA NRCS n.d.).

Field crew observations on this site included the presence of exotics including salt cedar, Russian olive trees, kochia, ravennagrass, siberian elm, giant reed, and Russian thistle (tumbleweed). Native vegetation included Rio Grande cottonwood, coyote willow, New Mexico olive, sunflower spp, native grass spp, Canadian wildrye, narrowleaf cottonwood, Virgin’s bower, and yerba mansa. The crew also noted the presence of graffiti on cottonwood snags.

Table 8. NMRAM Scores for 17-05.

Metric 17-05, 14 Sep 17	**Score**
Relative Native Plant Community Composition	2
Vegetation Horizontal Patch Structure	3
Vegetation Vertical Structure	3
Native Riparian Tree Regeneration	1
Exotic Invasive Plant Species Cover	1
Project Biotic Score (based on above ratings)	2.1
Project Biotic Rating	C/ Fair
Soil Surface Condition	4
Surface Fuels	0.80

The lowest scores for this project came in Native Riparian Tree Regeneration and Exotic Invasive Plant Species cover metrics, due to the high percentage of invasive plants (estimated at around 25% of the site). The high score surface fuel metric comes from the abundance of Ravenna grass. This project scored best in the Soil Surface Condition metric. This site scored a 2.1 out of 4 overall, which is a “C” or “Fair” biotic rating. In this table of metrics we have a mix of below average and above average in comparison to the 2017 Pueblo of Sandia sites.

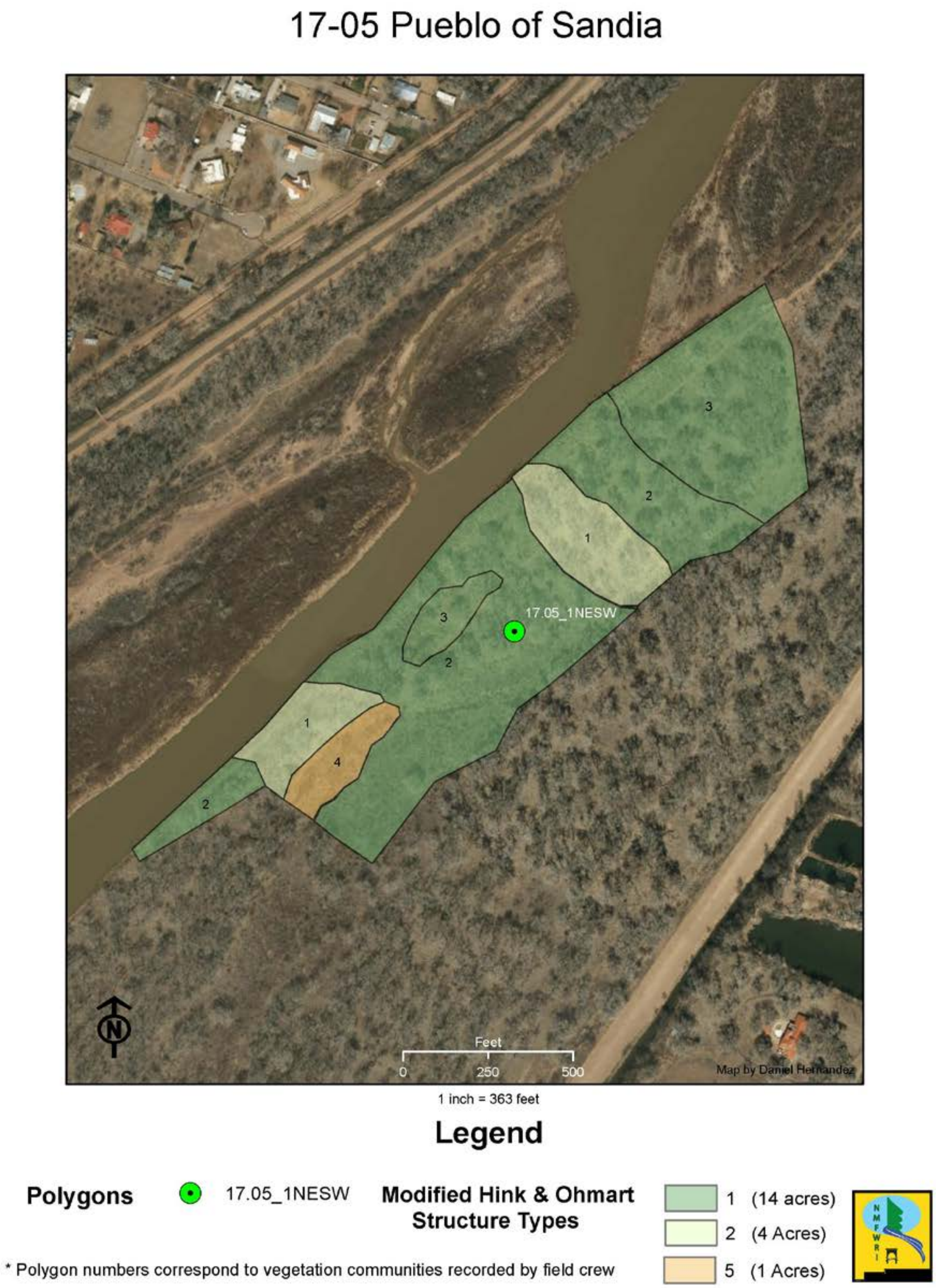
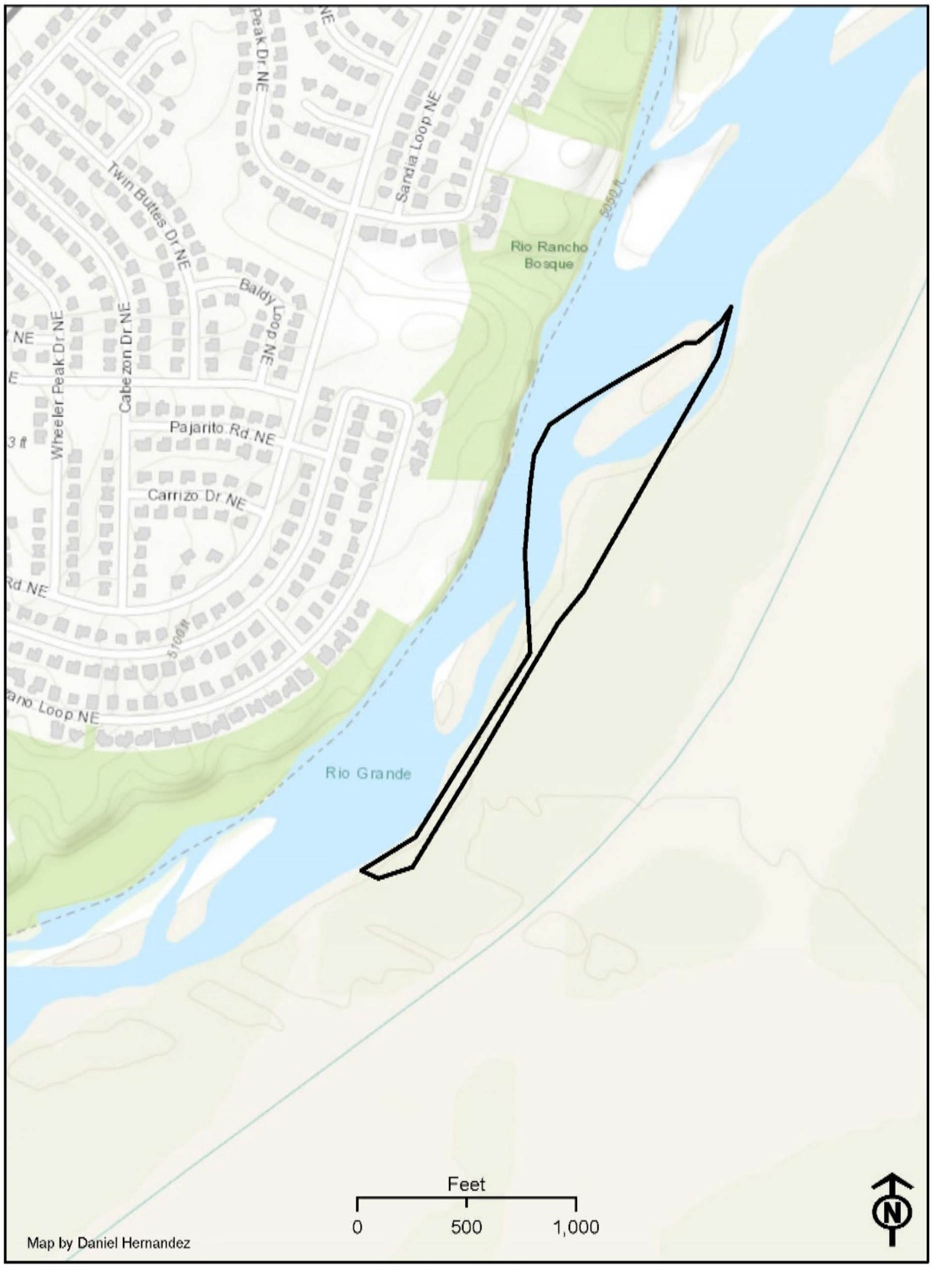


Figure 23. 17-05 Pueblo of Sandia vegetation polygon map

Project 17-06a Retreat-WUI-Pt Bar

Low-intensity pre-treatment monitoring was conducted at this 14-acre site on September 19, 2017 as part of a restoration project targeting non-native phreatophytes submitted for 2017. The project is located on the Pueblo of Sandia in Sandoval County. The project boundaries include the Rio Grande on the west and Project 17-06b on the east. The Coronado Soil and Water Conservation District (CSWCD) and the Pueblo of Sandia Environment Department Bosque Program sponsored the project. The project is a bank-attached point bar with several Russian olives as well as native vegetation. The 2017 proposal includes treatment of Russian olive, Siberian elm, and salt cedar through extraction and mastication and/or herbicide spray. Cheatgrass was also noted on-site but is not one of the target species in the proposal.

17-06a Pueblo of Sandia



1 inch = 667 feet

Project 17-06a is located in the Pueblo of Sandia. The project is only accessible via a levee road which runs north to south parallel to the Rio Grande. The project is considered to be a re-treatment with Russian olive, Siberian elm, and salt cedar as the target species.

Figure 24. 17-06a in geographic context.

According to the NRCS Web Soil Survey, the project area is comprised of 58.5% Water, 37.8% Gilco loam, 1 to 4 percent slopes, unprotected, and 3.7% Aga loam, 1 to 3 percent slopes, unprotected. Ecological sites within this project include water, R042XA057NM Bottomland, and R036XA005NM Riverine Riparian (USDA NRCS, 2016).

The Bottomland ecological site is dominated by either giant sacaton or alkali sacaton. Vinemesquite grass and sideoats grama may also be present. Reduced cover and hummocking of these grasses characterize initial stages of degradation, typically due to overgrazing and/or changes in hydrology. Transitions to first tobosa- and then to burrograss-dominated states may occur in response to the redistribution of run-in water from overgrazing and subsequent erosion and gullying. Shrub invasion is not usually observed (USDA NRCS n.d.).

The Riverine Riparian ecological site is made up of sediments adjacent to perennial streams and vegetation is determined largely by local hydrology. Examples of typical species at different strata include Fremont cottonwood, sandbar willow, Western wheatgrass, and Nebraska sedge (USDA NRCS n.d.).

Field crew observations on this site included exotic species like salt cedar, Siberian elm, Russian olive, and Tree-of-Heaven and cheatgrass. Native vegetation included Rio Grande cottonwood, coyote willow, narrowleaf cottonwood, honey locust, dropseed grass, sacaton, ricegrass, silverleaf nightshade, silverleaf buffalo berry, ironweed, Rocky Mountain juniper, and rubber rabbitbrush. Throughout the project there are many Russian olives. Also noted was an unknown forb with yellow flowers, about two feet tall.

Table 9. NMRAM Scores for 17-06a.

Metric 17-06a, 19 Sep 17	**Score**
Relative Native Plant Community Composition	1
Vegetation Horizontal Patch Structure	1
Vegetation Vertical Structure	3
Native Riparian Tree Regeneration	2
Exotic Invasive Plant Species Cover	1
Project Biotic Score (based on above ratings)	1.5
Project Biotic Rating	D/Poor
Soil Surface Condition	4
Surface Fuels	.70

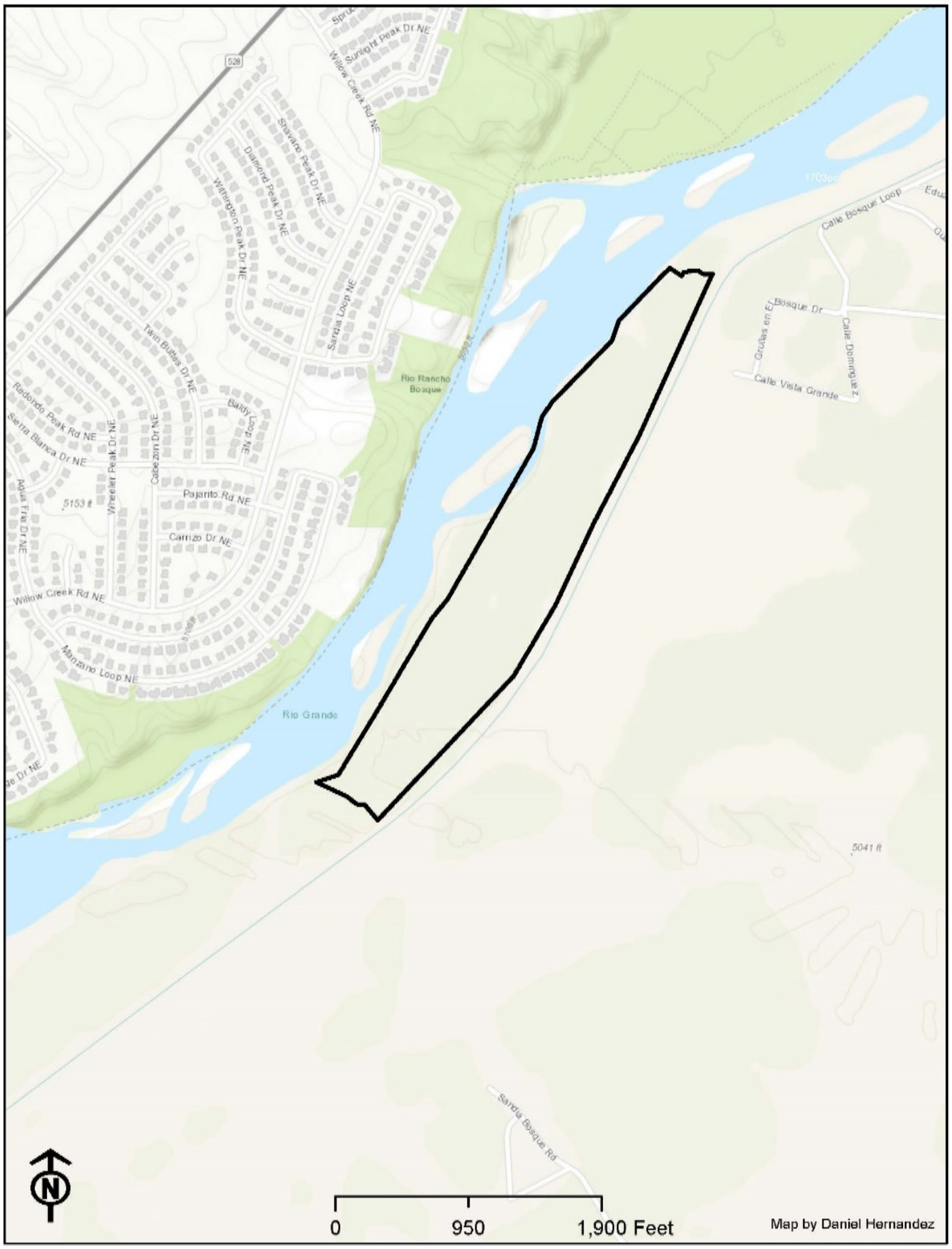
Low scores for this project came in the Relative Native Plant Community Composition, Vegetation Horizontal Patch Structure and Exotic Invasive Plant Species Cover metrics, due to high percentage of invasive plants, lack of new regeneration of native riparian trees, and a low diversity of plant communities within the project area. The project scored highest in Soil Surface Condition. This site scored a 1.5 out of 4 overall, which is a “D” or “Poor” biotic rating. Most metrics were below average, in comparison to the other 2017 Pueblo of Sandia sites.

Figure 25. 17-06a Pueblo of Sandia vegetation polygon map

Project 17-06b Retreat-WUI-North

Low-intensity pre-treatment monitoring was conducted at this 60-acre site on September 19, 2017 as part of a restoration project targeting non-native phreatophytes submitted in 2017. The project is located on the Pueblo of Sandia in Sandoval County. The project boundaries include GRGWA project 17-06a to the west and by a levee road and the Bernalillo Riverside Drain on the east. The Coronado Soil and Water Conservation District (CSWCD) and the Pueblo of Sandia Environment Department Bosque Program sponsored the project. In 2005-2006, the area was treated with mastication and spraying in a US Army Corps project. Proposed additional treatment includes removal of Russian olive, Siberian elm, and salt cedar. The goal of the project is to return the area to native bosque.

17-06b Pueblo of Sandia



1 inch = 1,044 feet

Project 17-06b is located in the Pueblo of Sandia. The project is situated between the Rio Grande to the west and a levee road to the east. The project is a re-treatment with Russian olive, Siberian elm and salt cedar as the target species.

Figure 26. 17-06b in geographic context

According to the NRCS Web Soil Survey, the project area is comprised of 82.2% Gilco loam, 1 to 4 percent slopes, unprotected, 14.3% Aga loam, 1 to 3 percent slopes, unprotected and 2.5% Aga loam, 0 to 1 percent slopes. Ecological sites within this project include R042XA057NM Bottomland (USDA NRCS, 2016).

The Bottomland ecological site is dominated by either giant sacaton or alkali sacaton. Vinemesquite grass and sideoats grama may also be present. Reduced cover and hummocking of these grasses characterize initial stages of degradation, typically due to overgrazing and/or changes in hydrology. Transitions to first tobosa- and then to burrograss-dominated states may occur in response to the redistribution of run-in water from overgrazing and subsequent erosion and gullying. Shrub invasion is not usually observed (USDA NRCS n.d.).

Field crew observations on this site included exotic species like salt cedar, Russian olive trees, Siberian elms, cheatgrass, and Tree-of-Heaven. Native vegetation included Rio Grande cottonwood, dropseed grass, New Mexico olive, cholla cactus, pricklypear cactus, cota (indian tea), four-wing saltbush, silverleaf buffaloberry, horsetail, sunflowers, and rubber rabbitbrush. In this site, there are areas where small amounts of cottonwood regeneration was observed. In one of the vegetation polygons, there are about three cottonwoods trees that are medium height. A dense population of New Mexico olive is present at this site.

Table 10. NMRAM Scores for 17-06b.

Metric 17-06b, 19 Sep 17	**Score**
Relative Native Plant Community Composition	2
Vegetation Horizontal Patch Structure	4
Vegetation Vertical Structure	2
Native Riparian Tree Regeneration	2
Exotic Invasive Plant Species Cover	1
Project Biotic Score (based on above ratings)	2.2
Project Biotic Rating	C/ Fair
Soil Surface Condition	4
Surface Fuels	.70

Low score for this project came in the Exotic Invasive Plant Species Cover metrics, because of high percentage of invasive plants and lack of new native tree growth. The project scored highest in Vegetation Horizontal Patch Structure metric, due to the abundance of Russian olive and its high structure forest. This site scored a 2.2 out of 4 overall, which is a “C” or “Fair” biotic rating. Most metrics in this table are average in comparison to the other 2017 Pueblo of Sandia sites.

This site also had one plot established (location shown on map below). At this plot, we collected data on vegetation cover and fuel loading using Submethods 1 and 2 outlined in Appendix III, the BEMP plots and the Brown's transects.

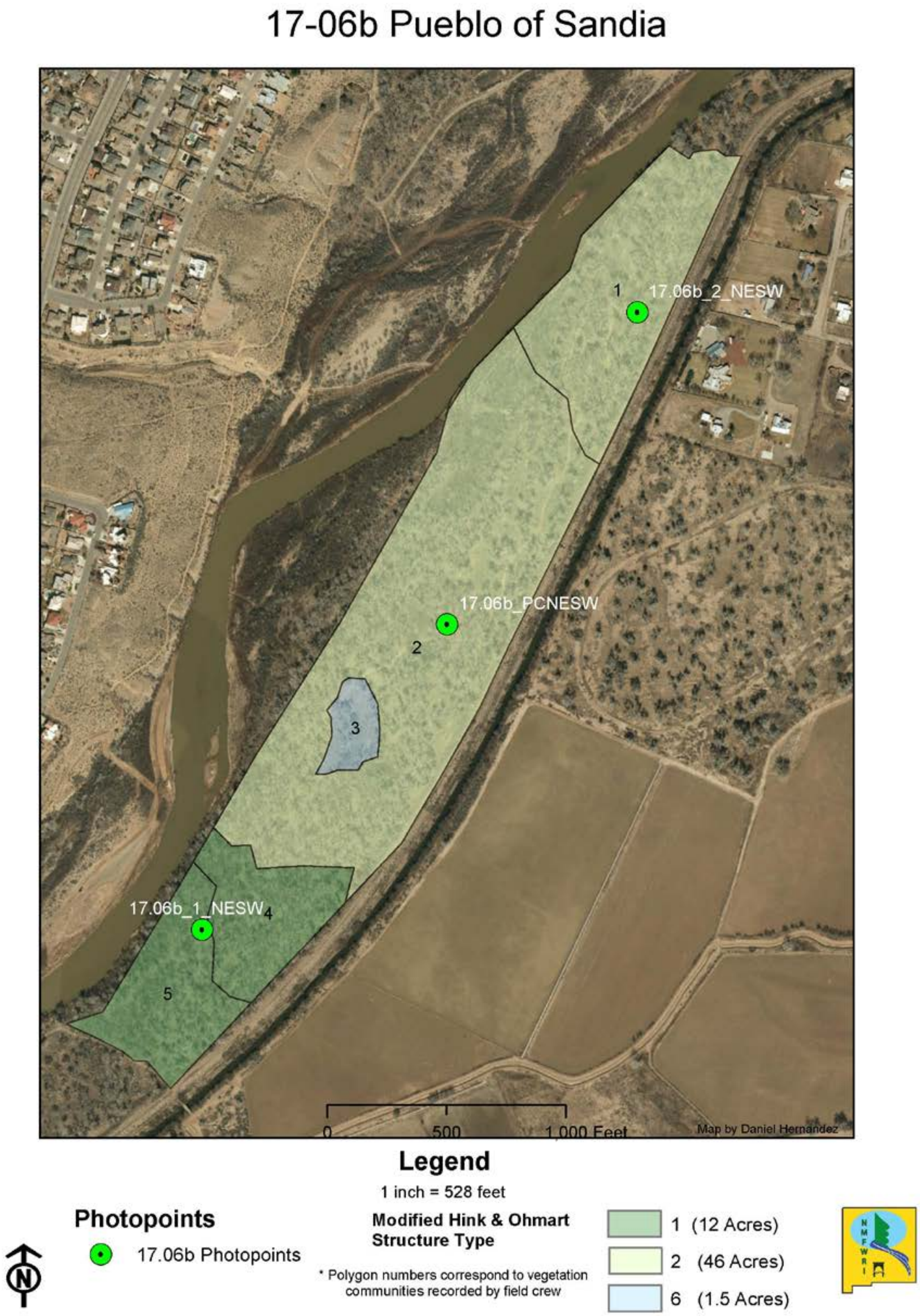


Figure 27. 17-06b Pueblo of Sandia vegetation polygon map.

Table 11. 17-06b Average surface fuels from 2 transects on plot.

Fuel	Average tons/acre
1-hr	0.19
10-hr	1.52
100-hr	2.70
1000-hr sound	24.19
1000-hr rotten	3.65
All woody fuels	32.24
Fuel	**Avg depth (inches)**
Duff	1.19
Litter	1.88
Total	3.06

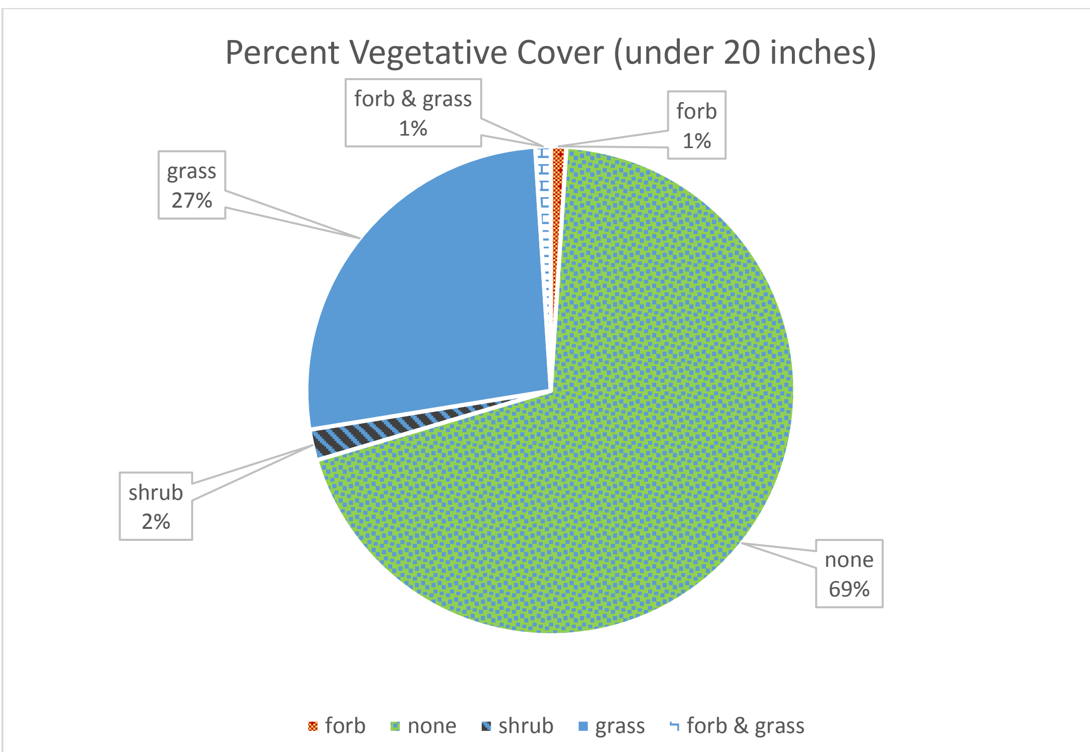


Figure 28. Percent Vegetative Cover for plot on 17-06b.

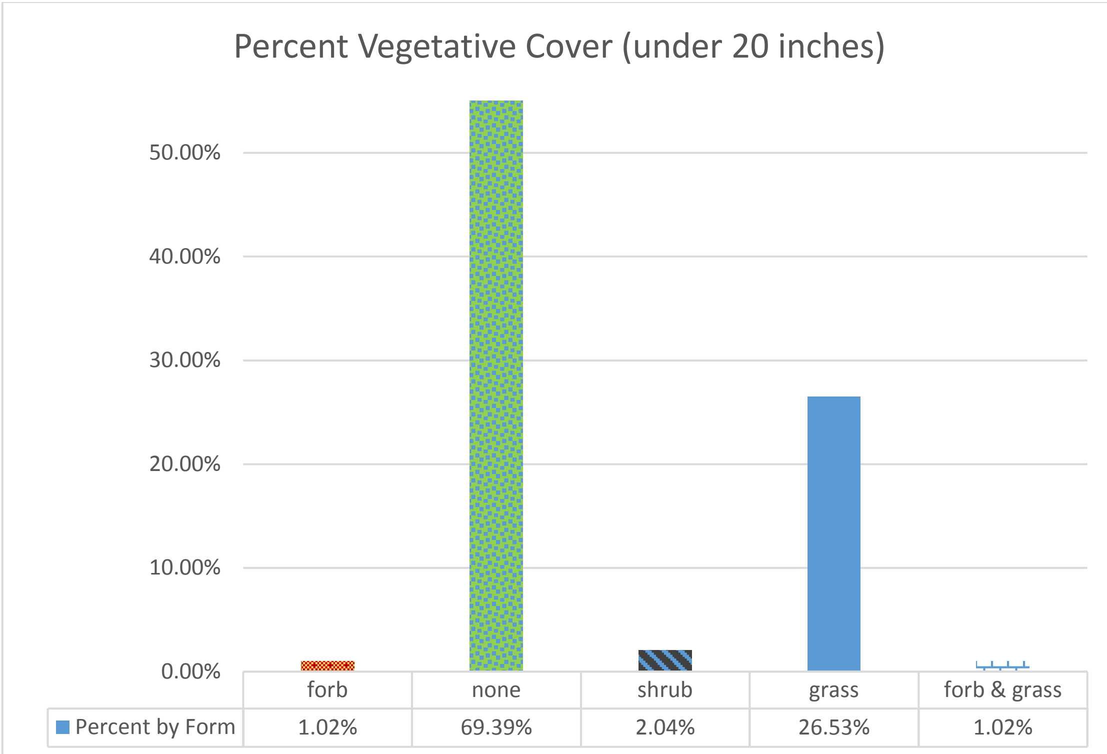


Figure 29. Percent Vegetative Cover for plot on 17-06b.

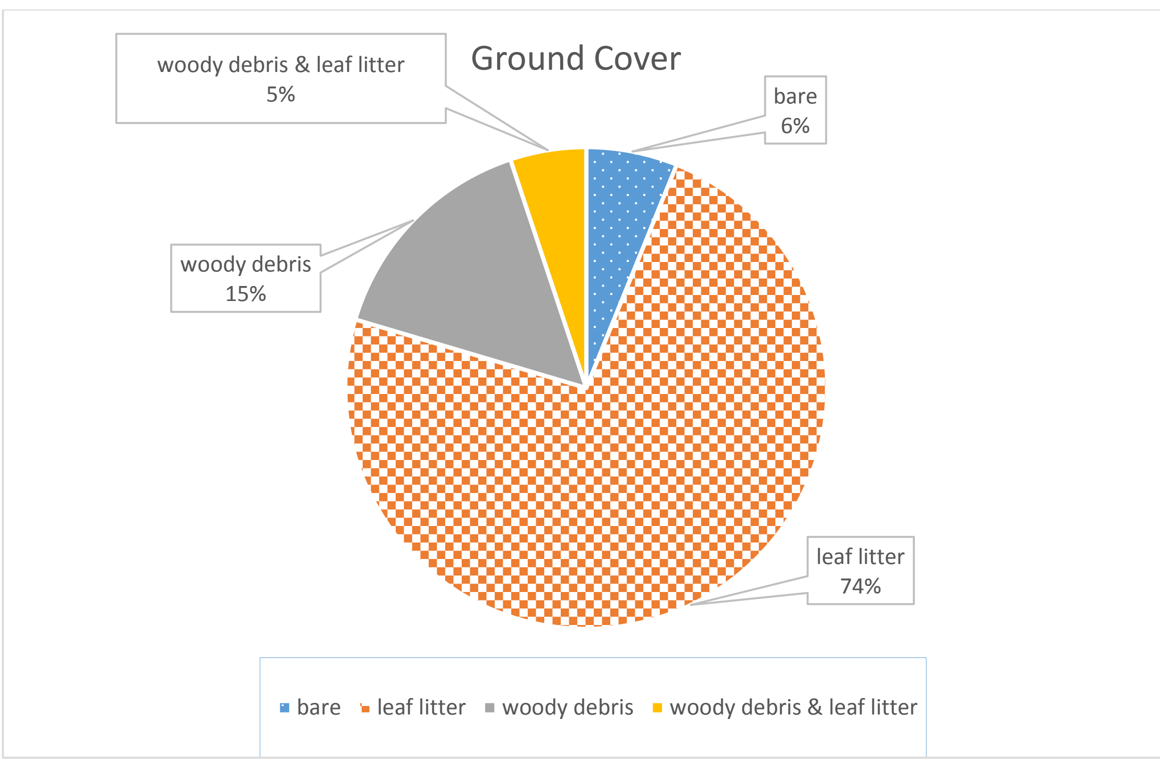


Figure 30. Percent ground cover for plot on 17-06b.

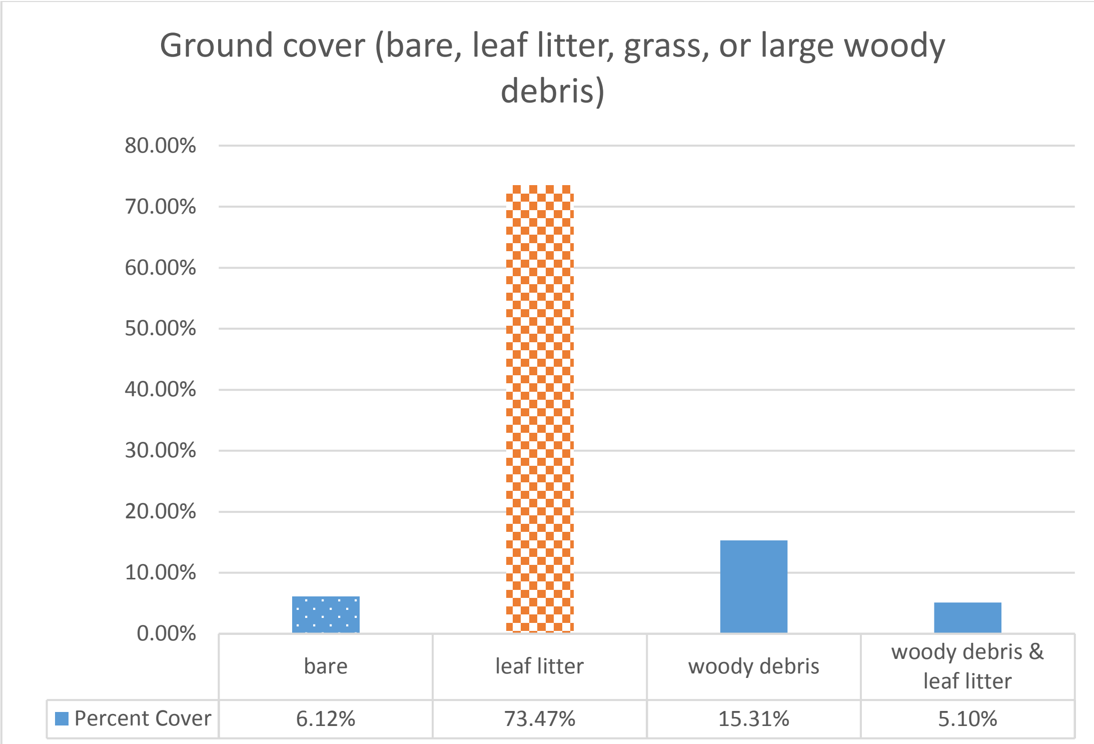


Figure 31. Percent ground cover for plot on 17-06b.

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.

References

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Appendix I - Photopoint Table

Name	Latitude	Longitude
17.01_1_NESW	35.22508	-106.59376
17.01_PCNESW	35.22297	-106.59628
17.02_PCNESW	35.22705	-106.58953
17.03_1_NESW	35.30306	-106.56596
17.03_2_NESW	35.30426	-106.56777
17.03_PCNESW	35.30287	-106.57208
17.04_1_NESW	35.26275	-106.59472
17.04_2_NESW	35.25562	-106.59230
17.05_1_NESW	35.21855	-106.60214
17.06a_1_NESW	35.29483	-106.58079
17.06b_1_NESW	35.29205	-106.58164
17.06b_PCNESW	35.29561	-106.57828

Appendix II – Photos

** NOTE: PHOTOS ARE NOT AVAILABLE IN THIS PUBLIC-RELEASE VERSION OF OUR REPORT. PLEASE CONTACT THE PUEBLO OF SANDIA ENVIRONMENT DEPARTMENT TO REQUEST ACCESS TO MONITORING PHOTOS IF NEEDED.**

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)

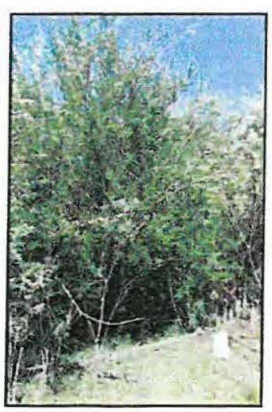
Type 1 - High Structure Forest with a well-developed understory.

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.

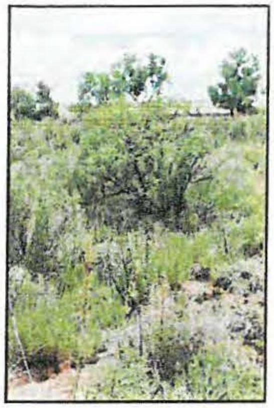
Tall mature to intermediate-aged trees (>5 m [>15 feet]) with canopy covering >25% of the area of the community (polygon) and understory layer (1-5 m [3-15 feet]) covering <25% of the area of the community (polygon). Majority of foliage is over 5 m (15 feet) above the ground. (This type incorporates 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 (1.5-5 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.

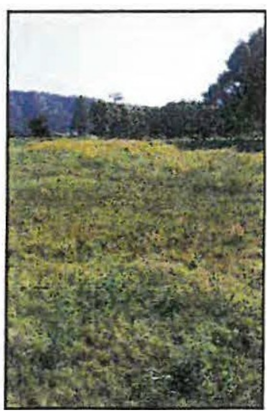


Type 6S-Short Shrub Stands.

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.

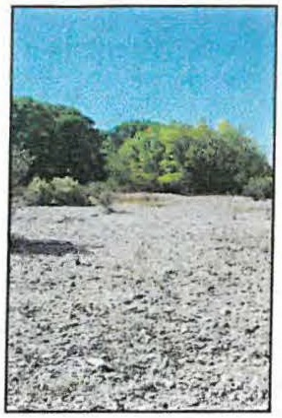
Type 6W-Herbaceous Wetland.

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.