Pueblo of Sandia Projects 15-01, 15-02, 15-03, 15-04, 15-05

Pre-treatment Monitoring Report

2015

** 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
PoS	Pueblo of Sandia
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 assessments performed on five non-native phreatophyte removal projects submitted by the Pueblo of Sandia and the Coronado SWCD to the Greater Rio Grande Watershed Alliance in 2015. Following a discussion of the ecological context, and our monitoring methods, we present pertinent background, observations, and assessment results for each 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 2.0, 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. Waypoints were marked with a Garmin GPS unit and named sequentially by site. Photos were taken in the direction that most effectively captured the diverse vegetation community(ies). Where appropriate, one waypoint was used for photos taken in multiple directions.

Prior to entering the field, our GIS specialist created a map with the project boundaries as provided by GRGWA. She 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 specialist.

Estimating Vegetation Cover using LIDAR and eCognition Software

LIDAR, light detecting and ranging, elevation data were used to estimate vegetation height and canopy characteristics a supplement to field monitoring data for some GRGWA pre-treatment project sites, including 15-03. This analysis is especially useful in large or difficult-to-access areas, but because of the effort involved, analysis with LIDAR and eCognition is not typically performed on small, easily accessible sites and for this reason was not performed on the other 2015 Pueblo of Sandia projects.

To perform the analysis, 2012 LIDAR was provided by Bureau of Reclamation (flown in February). One foot 2014 NAIP (National Agriculture Imagery Program) imagery was acquired to get an estimate of vegetation extent. 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/).

In order to classify vegetation, the LIDAR point cloud was filtered to isolate first returns and then LIDAR elevations were calculated to represent height above ground level (AGL). Next, the AGL point cloud was exported by height categories that correlate with the Hink and Ohmart height classes as modified for use in the NMRAM (2.0). These separate point clouds were then converted into separate digital surface models and exported as GeoTiffs.

Understory vegetation was classified first. Understory vegetation were classified using first returns of LiDAR elevations less than 15ft and 1 foot 2014 4- band ortho-imagery within eCognition.

eCognition software is an object based image classification system that allows 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.

Image segmentation within eCognition was based on elevation surface models. NDVI (Normalized Difference Vegetation Index) from the ortho-imagery was calculated and incorporated as a threshold to determine vegetation from dead or non-vegetative areas. The resulting classifications were combined into one image representing total understory vegetation.

The understory vegetation layer was used as an input in the multiple story community classifications (Types 1 and 2). A digital surface model for all heights above ground was used to classify single-story Communities (Types 5, 6S, 6H, and 7). This classification incorporated height classes as well as NDVI to identify active vegetation. Once the vegetation was classified by height, the understory vegetation layer was used to identify whether each class had understory vegetation or not and was then classified accordingly.

Personnel Involved

2015 New Mexico Forest and Watershed Restoration Institute Monitoring Team:

- Kathryn R Mahan, Ecological Monitoring Specialist

2015 New Mexico Forest and Watershed Restoration Institute GIS Team:

- Adrienne Miller, GIS Specialist
- Patti Dappen, GIS Specialist

Other persons contacted:

- Michael Scialdone, Bosque Project Manager, Pueblo of Sandia Environment Department Bosque Program
- Fred Rossbach, Field Coordinator, Greater Rio Grande Watershed Alliance

Pueblo of Sandia Projects

The Pueblo of Sandia is a 39 square mile reservation located north of Albuquerque and south of Bernalillo, New Mexico, at the base of the Sandia Mountains. The Rio Grande is the historical western boundary of the Pueblo, and 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.

2015 is the third 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. This year project numbers 15-01 through 15-05 are distributed the length of the Pueblo.

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). Bottomland typically supports bottomland grassland plant communities, for example, those dominated by burrograss, alkali sacaton, giant sacaton, dropseeds, galleta, vinemesquite, and/or tobosa (USDA NRCS). 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, and/or any of the other grasses listed for Bottomland) (USDA NRCS). As the sites deteriorate, exotics and/or bare ground can become more prominent.

Project 15-01 – Northend Re-Treatment

Low-intensity pre-treatment monitoring was conducted at this site on August 17, 2015 as part of a restoration project targeting non-native phreatophytes scheduled for 2015-2016. The project is located on the Pueblo of Sandia within Sandoval County, NM, north of the city of Albuquerque (Figure 1). It is on the east side of the Rio Grande near the Corrales Ditch and the Riverside Drain. The project was sponsored by the Coronado SWCD and the Pueblo of Sandia Environment Department Bosque Program. Planned treatment includes removal by extraction and mastication of Siberian elms (common in the southern portion of the project), as well as salt cedar and Russian olives (present more in the north). Stated restoration goals are to supplement Bureau of Reclamation restoration projects and failed plantings following a 2001 fire, preserve existing native vegetation, and enhance bosque condition.

Figure 1. 15-01 in geographic context.

The project at this time (October 2015) is planned to be 31 acres. There are some access concerns at this site due to cottonwood mortality. Within the surrounding bosque, there is an approximately one-acre patch of dead and dying cottonwoods with no clear consensus as to the cause; this phenomenon has also been reported at Santa Ana Pueblo, though on a larger scale. Cottonwood trees are culturally important to both Pueblos. Snags in the area have been observed to provide habitat for overwintering bald eagles.

There are also jetty jacks present at this site, which present obstacles for access but are intended to remain in place to protect the levee. The north end of the 15-01 project was burned in 2001 by a fire reportedly started by a firework from Bernalillo. Replanting efforts in this area have been unsuccessful and at the time of the site visit there was an abundance of Russian thistle. Other treatment in the northern and central portion of the project has included mastication, which has left some disturbed soil as well as woody material on the ground. There is some New Mexico olive (*Forestiera neomexicana*) understory in the central portion of the project. Other native species observed in abundance included cottonwood, curlycup gumweed and false indigo-bush (*Amorpha fruticosa*). Lambsquarters were also prevalent, although their status as native or exotic is uncertain. Exotic species observed included tamarisk, Russian olive, Russian thistle, kochia, and a patch of Tree-of-Heaven. Many of the tamarisk were re-sprouts.

Metric (15-01)	**Score**	**15-01 scores compared to 2015 PoS site averages**
Relative Native Plant Community Composition	1	Average
Vegetation Horizontal Patch Structure	3	Above average
Vegetation Vertical Structure	3	Above average
Native Riparian Tree Regeneration	2	Above average
Exotic Invasive Plant Species Cover	1	Average
Project Biotic Score (based on above ratings)	1.9	Above average
Project Biotic Rating	C/ Fair	
Soil Surface Condition	2	Average
Surface Fuels	0.75	Slightly above average

Lowest scores for this project came in the Relative Native Plant Community Composition and the Exotic Invasive Plant Species Cover, due to the high percentage of invasive plants. The amount of surface fuels is due largely to residual mastication material and cottonwood duff. The project scored best in the two structural metrics, indicating the presence of diversity both vertically and horizontally. This is reflected in the vegetation polygon map (Figure 2). This site scored a 1.9 out of 4 overall, which is a “C” or “Fair” biotic rating. Most metrics were above average in comparison to the other 2015 Pueblo of Sandia sites. Note that polygon 5 was not walked in its entirety due to time constraints and its assessment by the Bosque Project Manager as largely homogenous.

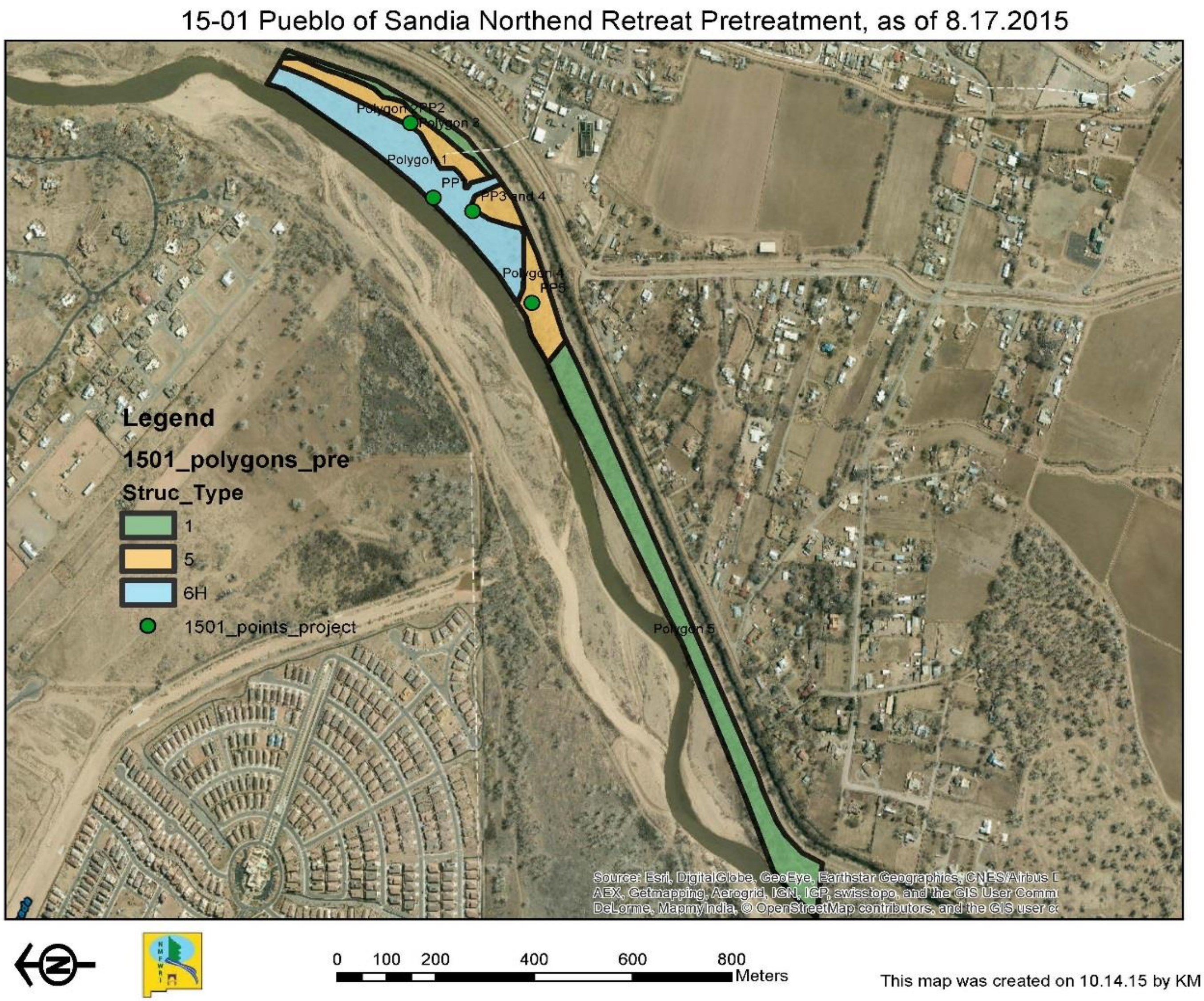


Figure 2. 15-01 Vegetation polygons and photopoints.

Project 15-02, Riverside Drain

Monitoring was conducted at this project site on August 17, 2015. The project is east of the Riverside Drain and west of the Corrales Ditch (Figure 3). The project was sponsored by the Coronado SWCD and the Pueblo of Sandia Environment Department Bosque Program. Planned treatment includes removal of large Russian olive trees as well as Siberian elms and salt cedar. Restoration goals are to preserve native bosque, allow for managed grazing, and continue previous landowner restoration efforts.

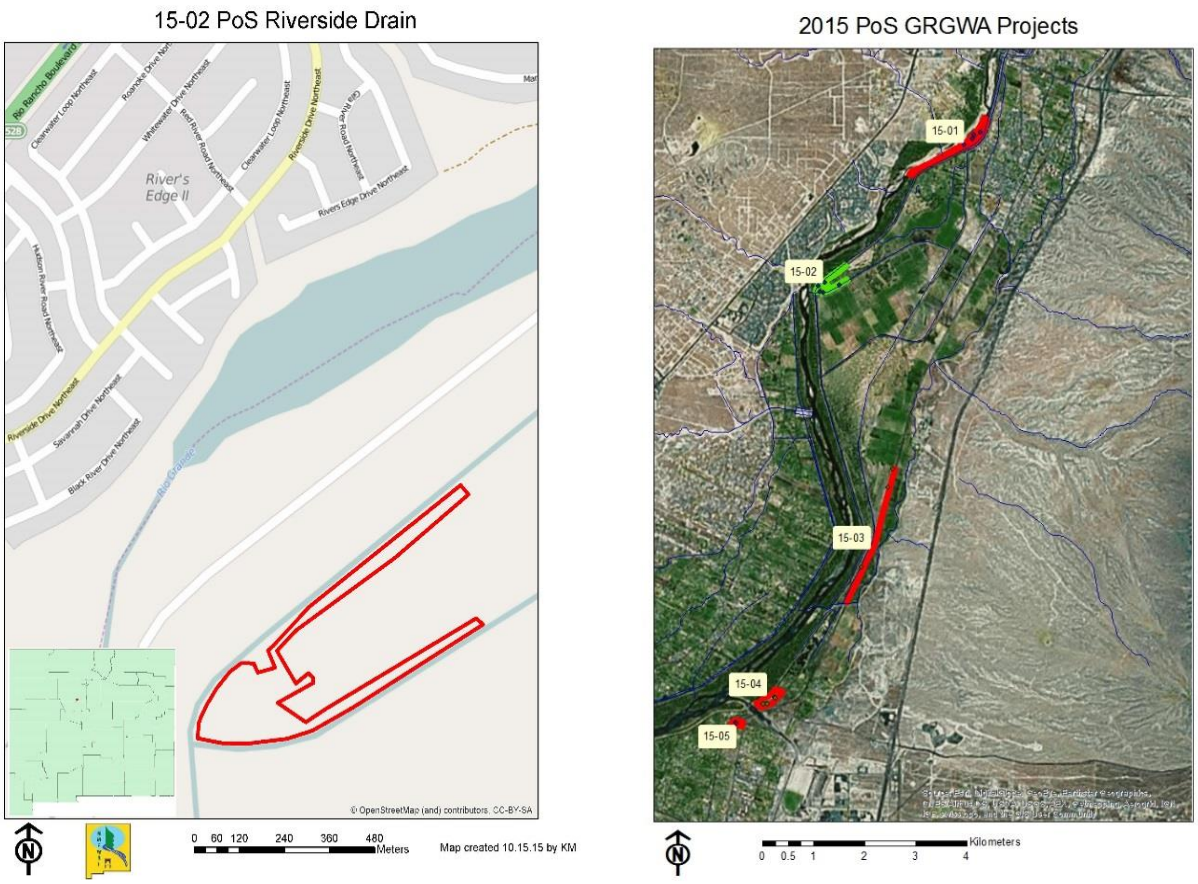


Figure 3. 15-02 in geographic context.

The project at this time is planned to be 13 acres. The delineation of this project was based on the distribution of Siberian elms and Russian olives, which explains its unusual shape. Other exotics observed included tamarisk and Russian thistle. Native species noticed in abundance included cottonwood, juniper, silverleaf nightshade, globemallow and sage. This site supported more xeric plant communities than did project 15-01.

Metric (15-02)	**Score**	**15-02 scores compared to 2015 PoS site averages**
Relative Native Plant Community Composition	1	Average
Vegetation Horizontal Patch Structure	1	Below average
Vegetation Vertical Structure	2	Below average
Native Riparian Tree Regeneration	1	Average
Exotic Invasive Plant Species Cover	1	Average
Project Biotic Score (based on above ratings)	1.1	Below average
Project Biotic Rating	D/Poor	
Soil Surface Condition	2	Average
Surface Fuels	0.75	Slightly above average

Low scores for this project came from the high percentage of invasive plants, the lack of new native tree growth, and because the project boundaries so very closely followed invasive trees, which, combined with the small size, essentially meant the entire project was one vegetation community. This issue with the assessment methods, as well as other concerns, are discussed in the conclusion and recommendations section. The amount of surface fuels is due largely to the presence of weedy species like Russian thistle. The project scored best in the vertical structure metric, because the structure type was a high-structure forest. This is reflected in the vegetation polygon map (Figure 4). This site scored a 1.1 out of 4 overall, which is a “D” or “Poor” biotic rating. Most metrics were average or below average in comparison to the other 2015 Pueblo of Sandia sites.

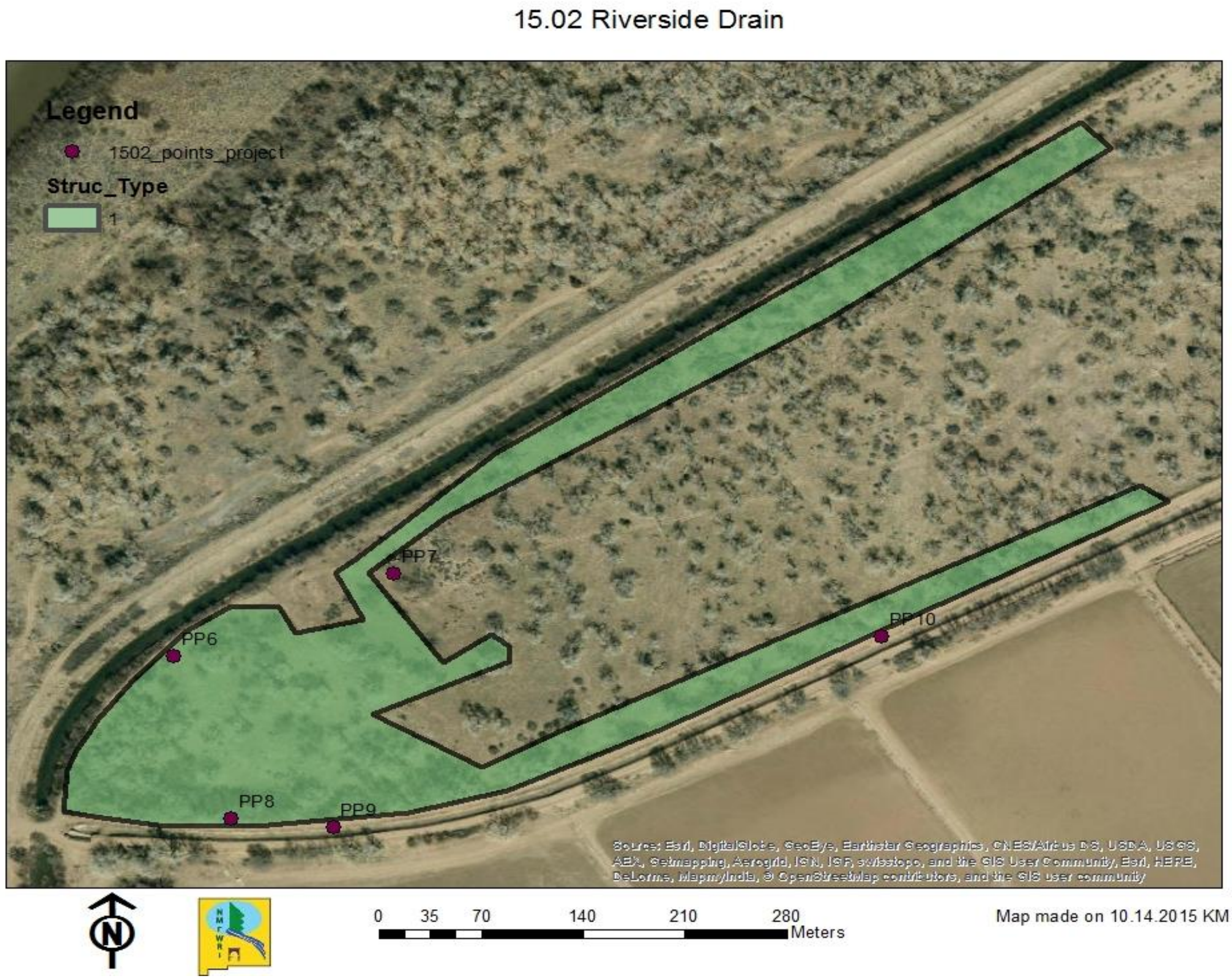


Figure 4. 15-02 Vegetation polygon and photopoints.

Project 15-03, Railroad Right-of-way, East Hwy 313

Photos were taken at this 9.6-acre project site on August 17, 2015. It is located on the railroad right-of-way along NM Highway 313 (Figure 5). The project was sponsored by the Coronado SWCD and the Pueblo of Sandia Environment Department Bosque Program. Planned treatment includes removal by extraction and mastication of large Siberian elm trees as well as Russian olives and salt cedar. Restoration goals are to remove trees from the right-of-way, reduce fire hazard as well as non-native seed source for adjacent areas (bosque and agricultural fields).

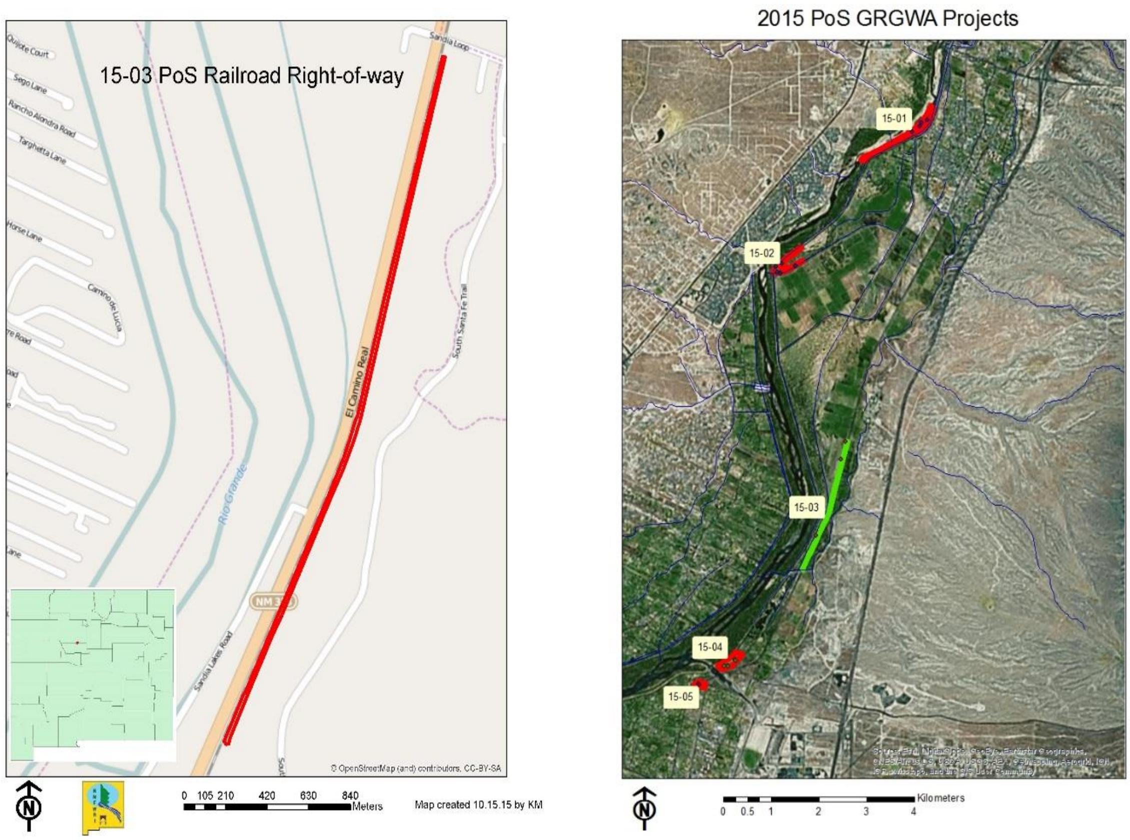


Figure 5. 15-03 in geographic context.

Due to the expense and complication involved in accessing the right-of-way (insurance, safety certifications, railroad personnel, etc), as well as the proximity to the highway, the only monitoring accomplished on this site was the selection of three photopoints, reflected in Figure 6, below. It is notable that the site has several large Siberian elms on the northern portion and on the southern end, with fewer towards the middle.

15-03 Railroad Right of Way

Figure 6. 15-03 Photopoints.

The LIDAR classification of this project allowed us to create a vegetation classification map using the methods explained above. This shows that 3.6 acres of the project within the boundary were Type 1, High Structure Forest, which is likely Siberian elm and Russian olive, as well as some salt cedar. 1.3 acres of the project was Type 5, Tall Shrub stands, which could include some salt cedar. The remainder of the project, 4.56 acres, was classified as 6S Short Shrub, 6H Herbaceous, and 7 Bare Ground in which the presence of target nonnative phreatophytes is unlikely.

Because of the narrow, elongated shape of the project, classification is difficult to see, particulary when the entire project is shown in a single map (Figure 7). Maps showing the northern and southern portions of project separately are found in Figure 8. False color is used on the NAIP imagery to allow the viewer to distinguish the green Type 1 classification from the surrounding vegetation. Note that the acreage totals are for the entire project, not for the separate portions.

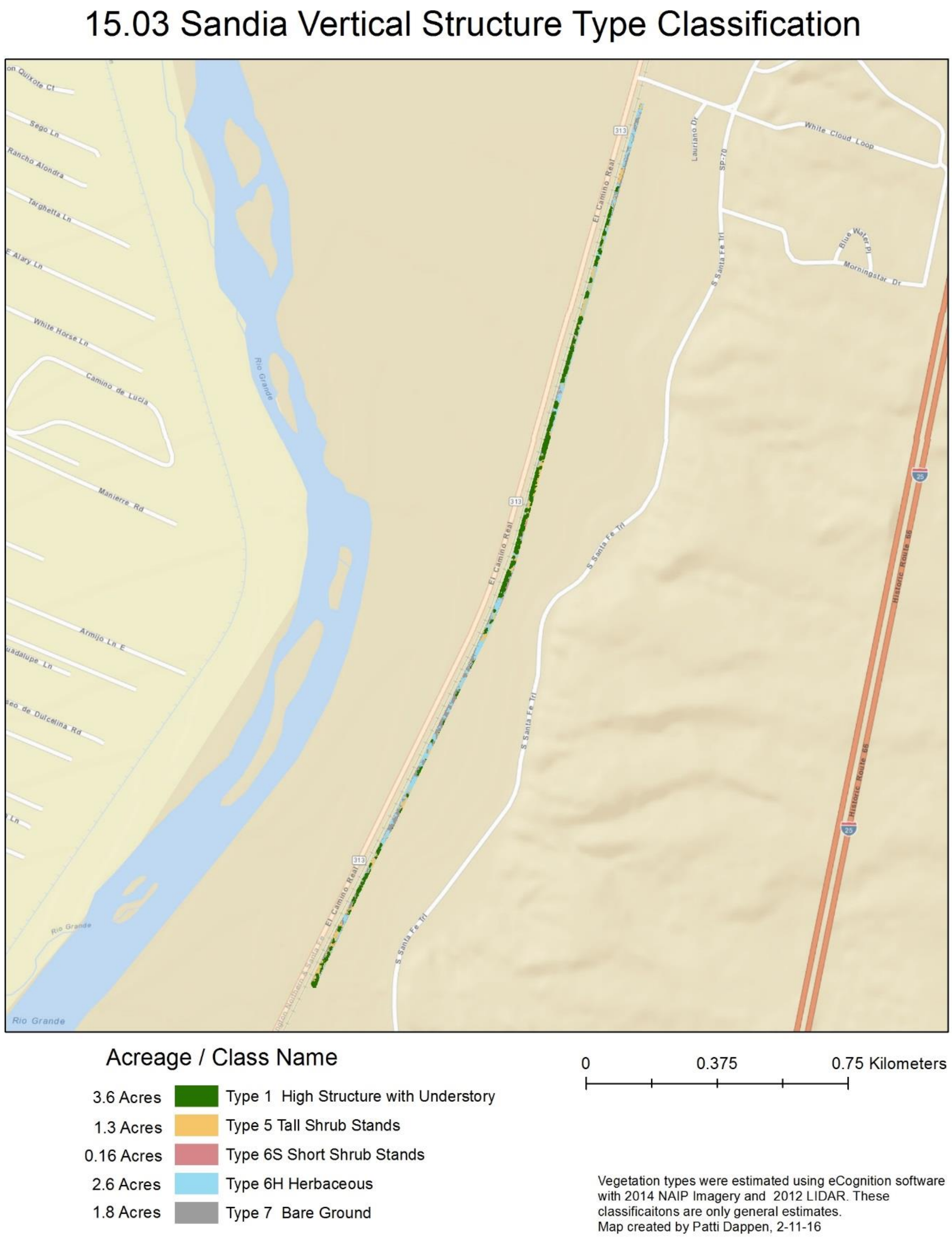
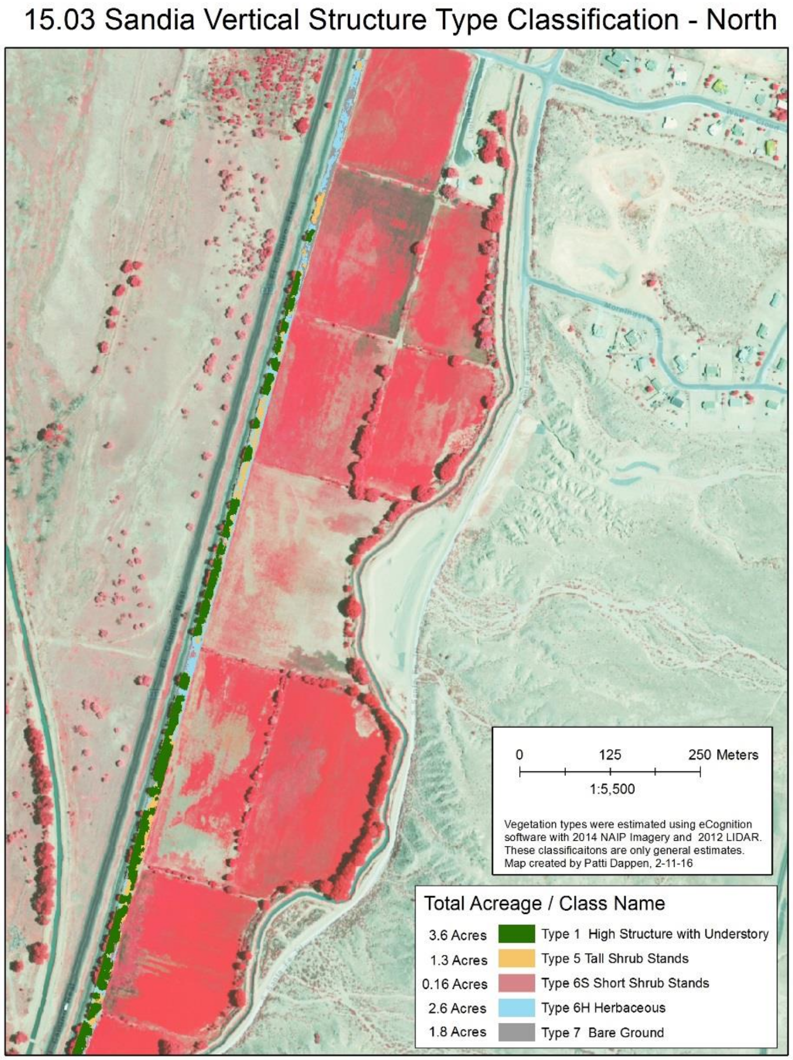


Figure 7. LiDAR and NAIP classification for 15-03.



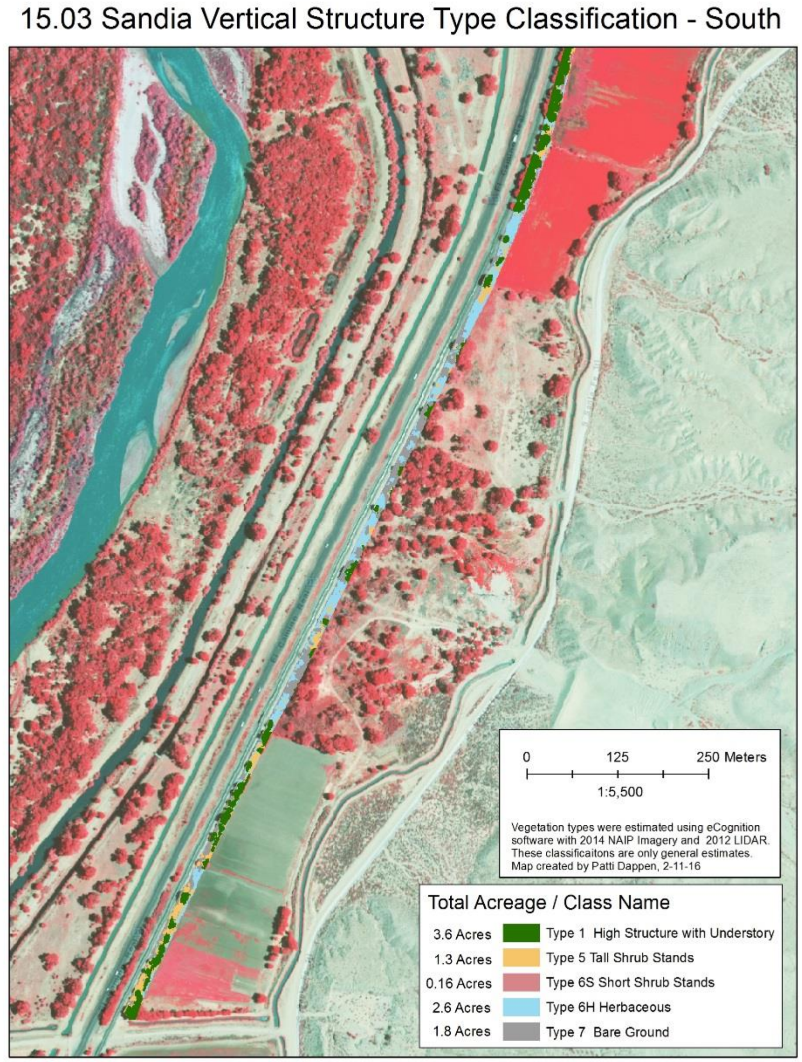


Figure 8. LiDAR and NAIP classification for 15-03, northern and southern.

Project 15-04 Farm Field, Hwy 313 Round-about area

Low-intensity pre-treatment monitoring was conducted at this site on August 17th, 2015 as part of a restoration project targeting non-native phreatophytes scheduled for 2015-2016. The project is located within the Pueblo of Sandia, on Highway 313 near the north side of Albuquerque in Sandoval County, NM (Figure 9). The project is on the east side of the Rio Grande with the Riverside Drain as the western boundary. The project was sponsored by the Coronado SWCD and the Pueblo of Sandia Environment Department Bosque Program. Planned treatment includes extraction of Siberian elms which have become established along abandoned irrigation ditches and fencelines, as well as sparse salt cedar, Russian olive, and a patch of tree-of-heaven. Restoration goals are to remove invasive phreatophytes as well as their seed source to allow the farm field to return to production.

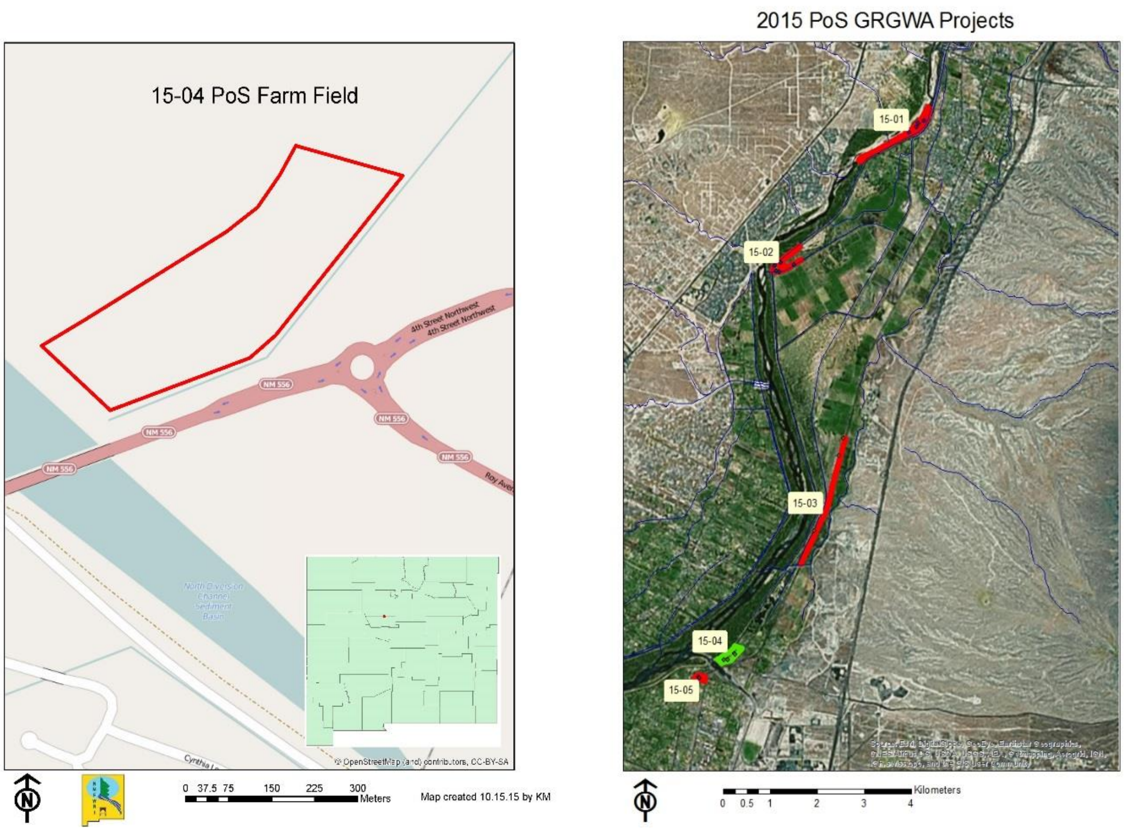


Figure 9. 15-04 in geographic context.

This site is an abandoned farm field where many Siberian elms have grown up along old irrigation ditches. Some salt cedar is present as well as one patch of tree-of-heaven. Alternative methods were discussed for treating tree-of-heaven, including extraction, but at this time they have not been explored. Other exotic species observed include Russian thistle, kochia, and Siberian elm. Native species observed in abundance include cottonwood, cota, sunflower, silverleaf nightshade, amaranth, and winterfat.

Metric (15-04)	Score	Average for 2015 PoS sites
Relative Native Plant Community Composition	1	Average
Vegetation Horizontal Patch Structure	2	Average
Vegetation Vertical Structure	3	Average
Exotic Invasive Plant Species Cover	1	Average
Native Riparian Tree Regeneration	1	Average
Project Biotic Score (based on above ratings)	1.6	Average
Project Biotic Rating	D/Poor	D/Poor
Soil Surface Condition	2	Average
Surface Fuels	0.75	Slightly above average

Low scores for this project came from the high percentage of invasive plants and the lack of new native tree growth. The amount of surface fuels is due largely to the presence of weedy species like Russian thistle. The project scored best in the vertical structure metric, because there were multiple structure types present including a high-structure forest. This is reflected in the vegetation polygon map, Figure 10. This site scored a 1.6 out of 4 overall, which is a “D” or “Poor” biotic rating. Most metrics were average in comparison to the other 2015 Pueblo of Sandia sites.

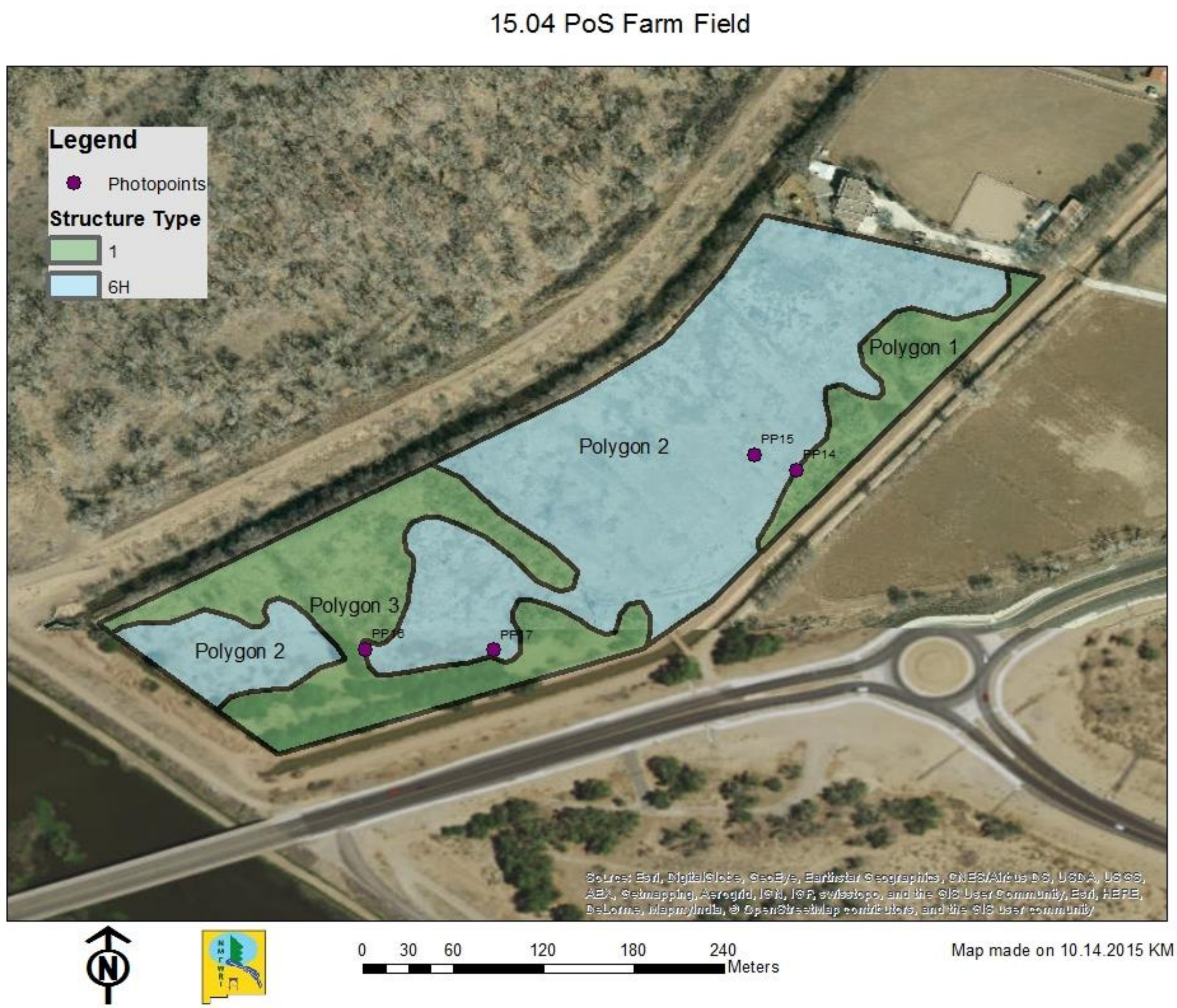


Figure 10. 15-04 Vegetation polygons and photopoints.

Project 15-05, Buffer Property, Hwy 313, 2nd & 4th street

Low-intensity pre-treatment monitoring was conducted at this 4.2 -acre project site on August 17, 2015 as part of a restoration project targeting non-native phreatophytes scheduled for 2015-2016. The project is located on the Pueblo of Sandia within Sandoval County, NM, between 2nd and 4th streets of the city of Albuquerque (Figure 11). The project was sponsored by the Coronado SWCD and the Pueblo of Sandia Environment Department Bosque Program. Planned treatment includes removal by extraction and mastication of Siberian elm trees as well as Russian olives and salt cedar of various sizes. Restoration goals are to return the area to natural bosque and upland vegetation and preserve existing native vegetation.

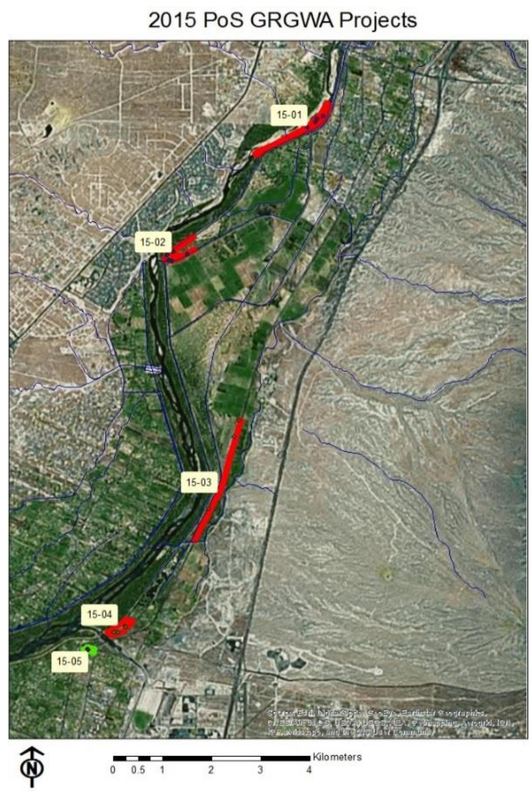


Figure 11. 15-05 in geographic context.

This site was recently purchased by the Pueblo. The property is bordered by a fence, though it is incomplete on the northeast side. There is no known development on the property, although there is a two-track road and concrete debris present. There are small to medium Siberian elms present, as well as some Russian thistle. This project has good ground cover, due largely to cottonwood leaves. It also has good canopy cover and shade. Native species observed in abundance included Canada lettuce, Canada wild rye, bursage, cota, and dropseed grass.

Metric (15-05)	**Score**	**Average for 2015 PoS sites**
Relative Native Plant Community Composition	2	Above average
Vegetation Horizontal Patch Structure	2	Average
Vegetation Vertical Structure	3	Average
Native Riparian Tree Regeneration	1	Average
Exotic Invasive Plant Species Cover	1	Average
Project Biotic Score (based on above ratings)	1.9	Above average
Project Biotic Rating	C/Fair	
Soil Surface Condition	3	Above average
Surface Fuels	0.55	Below average

Low scores for this project came from the high percentage of invasive plants and the lack of new native tree growth; the above-average score in the Relative Native Plant Community Composition metric came in large part from the native cottonwood and native grass presence. The amount of surface fuels is due largely to the presence of cottonwood leaves as ground cover. The project scored best in the vertical structure metric, because there were multiple structure types present including a high-structure forest. This is reflected in the vegetation polygon map, Figure 12. This site scored a 1.9 out of 4 overall, which is a “C” or “Fair” biotic rating. Most metrics were average or above average in comparison to the other 2015 Pueblo of Sandia sites.

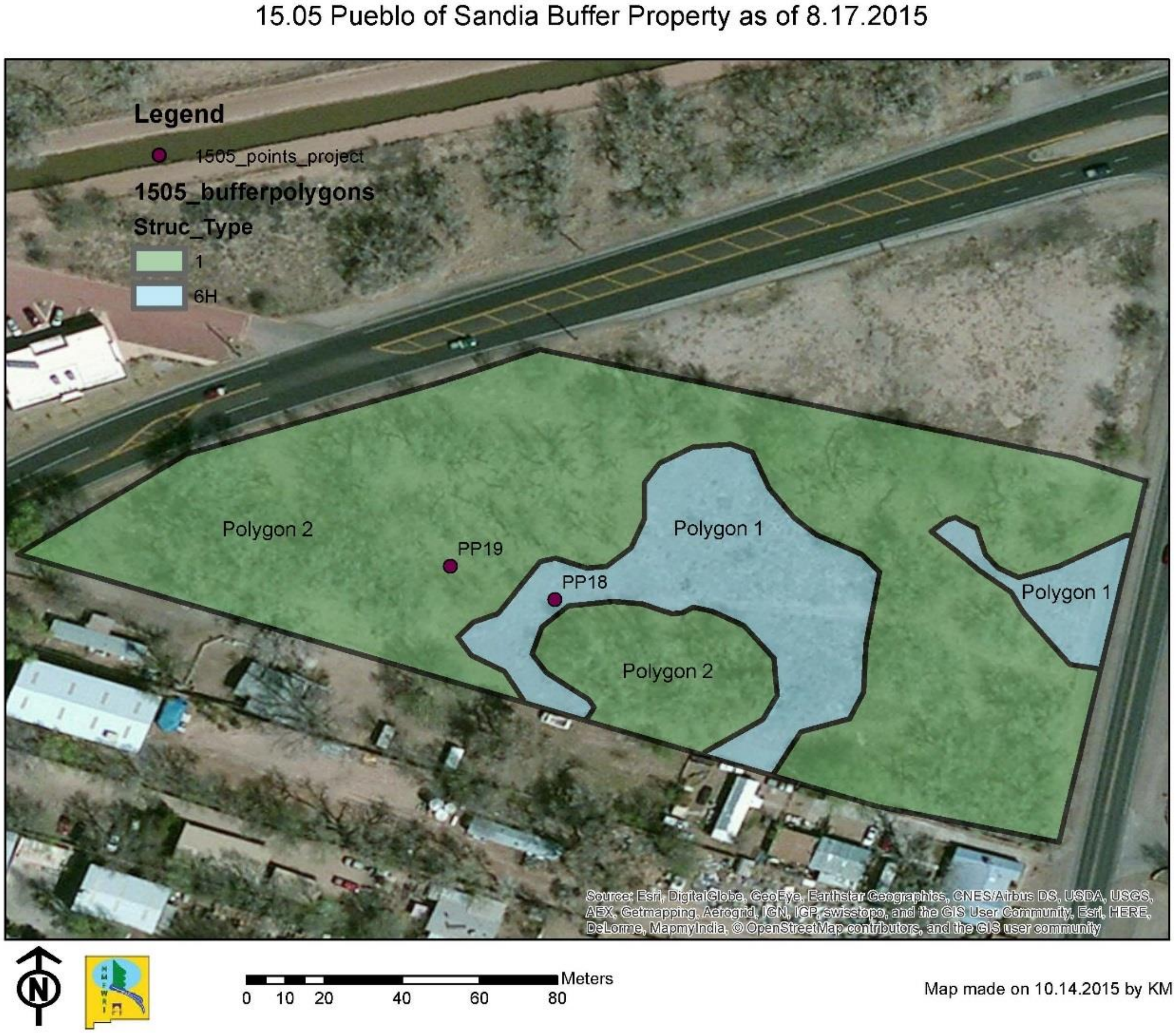


Figure 12. 15-05 Vegetation polygons and photopoints.

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 2.0. 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 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 I: Photopoint Table

Project Name	Point number in NMFWRI GPX files	Photo name on maps	Direction facing	Description	Coordinates
15.01	PP1	PoSNER1	E	polygon 1 - 2001 firework burn	35°18'28.96"N, 106°33'41.35"W
15.01	PP2	PoSNER2	N	polygon 2	35°18'30.47"N, 106°33'36.16"W
15.01	PP3	PoSNER3	SE	polygon 3 - along levee	35°18'26.40"N, 106°33'42.29"W
15.01	PP4	PoSNER4	SW	masticated area (standing on birm)	35°18'26.40"N, 106°33'42.29"W
15.01	PP5	PoSNER5	SW & NE (2 photos)		35°18'22.50"N, 106°33'48.65"W
15.02	PP6	PoSRD6	SE	Russian olive and cottonwood	35°16'54.83"N, 106°35'39.80"W
15.02	PP7	PoSRD7	S	grazed area/ trees	35°16'56.82"N, 106°35'34.90"W
15.02	PP8	PoSRD8	NE	arm of trees	35°16'50.91"N, 106°35'38.51"W
15.02	PP9	PoSRD9	N	arm of trees	35°16'50.68"N, 106°35'36.25"W
15.02	PP10	PoSRD10	NE	arm of trees	35°16'55.31"N, 106°35'24.03"W
15.03	PP11	PoSRR11	S	N end of project	35°15'3.14"N, 106°34'40.10"W
15.03	PP12	PoSRR12	SSW	line of elms	35°14'51.65"N, 106°34'43.81"W
15.03	PP13	PoSRR13	S	cottonwood and elms	35°14'2.34"N, 106°35'3.63"W
15.04	PP14	PoSFF14	ENE	polygon 1	35°12'41.19"N, 106°36'8.32"W
15.04	PP15	PoSFF15	SSW	polygon 2	35°12'41.53"N, 106°36'9.22"W
15.04	PP16	PosFF16	NW	polygon 3	35°12'37.33"N, 106°36'17.60"W
15.04	PP17	PosFF17	ESE	tree of heaven patch	35°12'37.32"N, 106°36'14.83"W
15.05	PP18	PoSBP18	ENE	polygon 1 - lots of dropseed	35°12'25.28"N, 106°36'38.24"W
15.05	PP 19	PoSBP19	N	polygon 2 - cottonwood & elm	35°12'25.56"N, 106°36'39.11"W
15.06	NONE - DID NOT USE GRGWA TO RETREAT				

Appendix II: Photo pages, by site

** 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: All current monitoring options

Low-intensity methods

- Where: happens on all sites with GRGWA projects
- Method name: NMRAM (New Mexico Rapid Assessment Method v 2.0)
- 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.

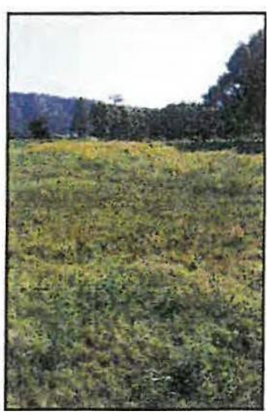
Young tree and shrub layer only (15-5 m [4.5-15 feet]) covering >25% of the area of the community (polygon). Stands dominated by tall shrubs and young trees, may include herbaceous vegetation underneath the woody vegetation. Photograph on San Francisco River by Y. Chauvin, 2012.

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.