Pueblo of Sandia 15.01-15.05 10 Year Report

10-yr Post Treatment Monitoring Report - 2026

Prepared by

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for the ***Greater Rio Grande Watershed Alliance***

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Acronyms and Abbreviations

Acronym, Abbreviation, or Term	Explanation or Definition as used by NMFWRI
BEMP	Bosque Ecosystem Monitoring Program, small rectangular plot types
CSE	Common Stand Exam
CSWCD	Coronado Soil and Water Conservation District
GIS	Geographic Information Systems
GRGWA	Greater Rio Grande Watershed Alliance
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
QMD	Quadratic Mean Diameter
PC	Plot center
SWCD	Soil and Water Conservation District
TPA	Trees Per Acre
USDA	United States Department of Agriculture

1 Purpose of Report

This report covers 10-year post-treatment low- and high-intensity pre-treatment vegetation monitoring assessments performed on the 15.01, 15.02, 15.03, 15.04, 15.05 non-native vegetation removal project submitted for the Pueblo of Sandia 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 the projects.

2 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% of all land in New Mexico (2012).

Despite this small percentage, it is estimated that an average of 55% of New Mexican vertebrate species (can be higher for certain taxa) depend on wetland and riparian habitat for their survival (New Mexico Department of Game and Fish Conservation Services Division, 2012). For example, the relatively few miles of riparian habitat of the San Juan and Gila river valleys helped support up to 17% of the avian species of the entirety of North America in the past, due to their use as feeding grounds for migrating birds (Hubbard, 1971). 62% of 117 vertebrate species in the Middle Rio Grande sampled in a RMRS study were found to be vulnerable to changes in their habitat (Friggens, M. et al, 2013). These areas also provide flood mitigation, filtration of sediment and pollutants, and water for a variety of purposes including groundwater recharge (Patten, 1998). In addition, native vegetation, such as cottonwood forests, holds 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). 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. 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 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.

3 Monitoring and Field Methods

3.1 Low intensity Field Methods – Adapted NMRAM

Low intensity pre-treatment vegetation monitoring was conducted 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.

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 E. B., 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 E. B., 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 I). First, vegetation communities were mapped out by patch (polygon) according to the Hink and Ohmart system. Next, the presence of invasives, wetland species, and the two dominant species in each vertical stratum ("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, at 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. 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 returning to the office, this polygon map and the photo points were digitized by the monitoring technician and/or specialist. All of the adapted NMRAM methods were collected for both pre- and 5- and 10-years post-treatment.

The NMRAM method has been adapted for the purposes of these projects and is being utilized both inside and outside its intended site ranges. This includes 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 are likely to be variable for several 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, the entire NMRAM assessment is not used and the weighted score roll-ups are considered carefully. Statistical analysis is not appropriate for NMRAM, or other low intensity, rapid field methods.

3.2 Low intensity Field Methods – Photo Points

Photo points 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 photo points 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).

3.3 High-intensity Field Methods – CSE Plots

For post-treatment monitoring, we added additional riparian-adapted Common Stand Exams (CSE). CSE plot locations are synonymous with pre-treatment photo point locations where possible; in some cases, additional plots are established to reach the target sampling density. Once the plot location was determined, a 1/100- and 1/10-acre radius plot was established by placing pin-flags at 11' 9" and 37' 3" from the plot center in each cardinal direction. Photos were taken from plot center in each cardinal direction and from 75' north of plot center toward plot center. Ocular estimates were made of understory aerial and ground cover within the 1/10-acre plot. Overstory canopy cover was estimated using a concave spherical densiometer, with measurements made in four cardinal directions, at the edge of the 1/100-acre plot. This method provides an estimate of canopy cover for a 1/10-acre area centered on the plot. A Hink & Ohmart and modified Hink & Ohmart structure class was determined for the 1/10th acre plot. Soil texture was taken at four cardinal directions of the inner plot facing the outer plot. Three samples taken two feet from the cardinal flag to the sides and towards PC. The samples are combined and then textured. Two Brown's lines are measured at random azimuths. Finally, all plant species observed within the 1/10^{th-}acre area with over 1% cover were recorded, as were other comments regarding conditions at the plot. For more information on sampling density and schema see https://nmfwri.org/wp-content/uploads/2025/10/GRGWA-Monitoring-Plot-Protocols-Update-2025.pdf.

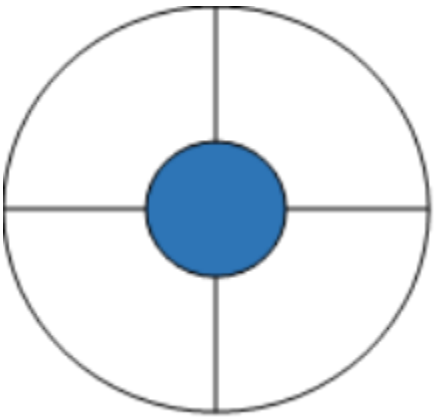


Figure 1: Example of CSE plot layout. The outer circle represents the 1/10-acre plot and the blue circle is the 1/100-acre plot.

3.4 Disclaimer

NMFWRI provides this report and the data collected with the disclaimer that the information contained in these data is dynamic and may change over time. The data are not better than the original sources from which they were derived. It is the responsibility of the data user to use the data appropriately and within the limitations of monitoring data in general, and these data in particular. NMFWRI gives no warranty, expressed or implied, as to the accuracy, reliability, or completeness of these data. These data and related graphics are not legal documents and are not intended to be used as such. This includes but is not limited to using these data as the primary basis for the development of thinning prescriptions or timber sales. NMFWRI shall not be held liable for improper or incorrect use of the data described and/or contained in this report.

Analysis was also done according to our standard protocols. Note that the values reported in the tables are expressed on a per acre basis but represent only areas sampled. We do not scale up these values to calculate volume of wood over the project area and warn readers of this report that they are not intended for that purpose. The accompanying tables show summaries of our data, and some differences are discussed below; however, differences that seem apparent here may not stand up to rigorous statistical tests. For some estimates, the standard deviation exceeds the mean (i.e., the coefficient of variation is greater than 100 percent), and sampling errors for some estimates exceed 100 percent. Therefore, data should be used and results interpreted with appropriate caution.

3.5 Personnel Involved

2025 New Mexico Forest and Watershed Restoration Institute Monitoring Team:

- Vincent Vispo, Assistant Crew Lead
- Patrick Clay Goetsch, Assistant Crew Lead
- Jax Gaglianese-Woody, Monitoring Technician
- Abigail Han, Monitoring & GIS Specialist
- Taryn Schlosser, Crew Logistics Coordinator
- Kathryn Mahan, Monitoring Program Manager

Other persons contacted:

- Aaron Vega, Bosque Project Manager, Pueblo of Sandia Environment Department Bosque Program
- Dee Tarr, Director, Claunch-Pinto Soil & Water Conservation District and Chair of the Greater Rio Grande Watershed Alliance

2021 New Mexico Forest and Watershed Restoration Institute Monitoring Team:

- Carmen Briones, Crew Logistics and Assistant Manager
- Raymundo Melendez, Education and Outreach Program Assistant
- Alex Makowicki, Ecological Monitoring Technician

2021 New Mexico Forest and Watershed Restoration Institute GIS Team:

- Patti Dappen, GIS Program Manager
- Katie Withnall, 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

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

4 Project Context

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, increased flooding and debris/sediment flow from 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 past two decades, 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, when this project was first submitted, was the twelfth year the Pueblo of Sandia had collaborated on non-native 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. In 2021 projects 21.02 and 21.03 were proposed as re-treatments of a 2013 project after a 2018 respray was observed as ineffective.

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 Data, 2025). According to the NRCS Web Soil Survey, there are several soil map units in 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 tansy mustard are common. When the plant community deteriorates, there is an increase in densities of shrubs and short grasses (USDA NRCS n.d.)

5 Projects 15.01-15.05

Projects 15.01-15.05 were established in 2015. Pre-treatment monitoring took place in 2015, and 5-year post-treatment monitoring took place in 2021. Originally scheduled for 2025, 10-year post-treatment monitoring took place August 2026 due to constraints. NMRAM was utilized in 2015, 2021, and 2026 for projects 15.01, 15.02, 15.04, and 15.05, and CSE methods were utilized in 2021 and 2026 on select plots. Projects 15.01, 15.02, and 15.05 are native bosque habitat while 15.03 is on a railroad right-of-way (impacting data collection) and 15.04 is farmland. The treatment areas span the entire length of the Pueblo of Sandia, as shown in Map 1. The 10-year post-treatment monitoring took place during a period of extreme drought for the area. The Rio Grande River was experiencing historic levels of dryness during this time. Impact of the lack of water was evident in the adjacent project areas NMFWRI monitored.

Treatment was completed in 2015 by Boss Reclamation. The treatment method for all five projects was extraction and slash treatment by mastication.

Treatment goals for each project are as follows:

- 15.01: Planned treatment included 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.
- 15.02: 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.
- 15.03: 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 hazards as well as non-native seed source for adjacent areas (bosque and agricultural fields).
- 15.04: Planned treatment includes extraction of Siberian elms which have become established along abandoned irrigation ditches and fence lines, 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.
- 15.05: 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

Projects 15.01-15.05 Location



New Mexico Forest and Watershed Restoration Institute
New Mexico Highlands University

Monitoring Location
Project Boundary

0 1.63 3.25 6.5 Miles

N

Boundary data provided by Greater Rio Grande Watershed Alliance
Created by Abbi Han, September 2026

Map 1. Location of projects 15.01-15.05.



Map 2: Monitoring locations for 15.01.



Map 3: Monitoring locations for 15.02.



Map 4: Monitoring Locations for 15.03.



Map 5: Monitoring Locations for 15.04.

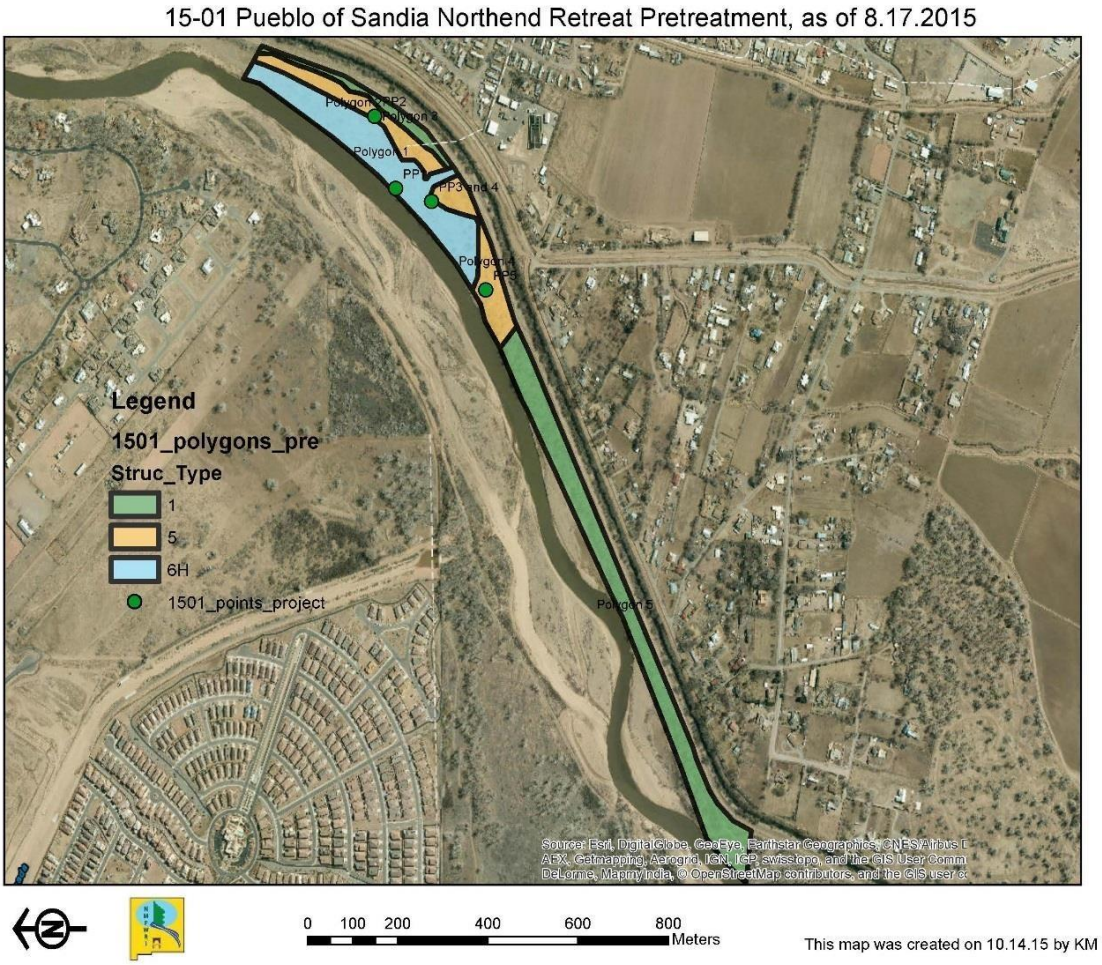


Map 6: Monitoring Locations for 15.05.

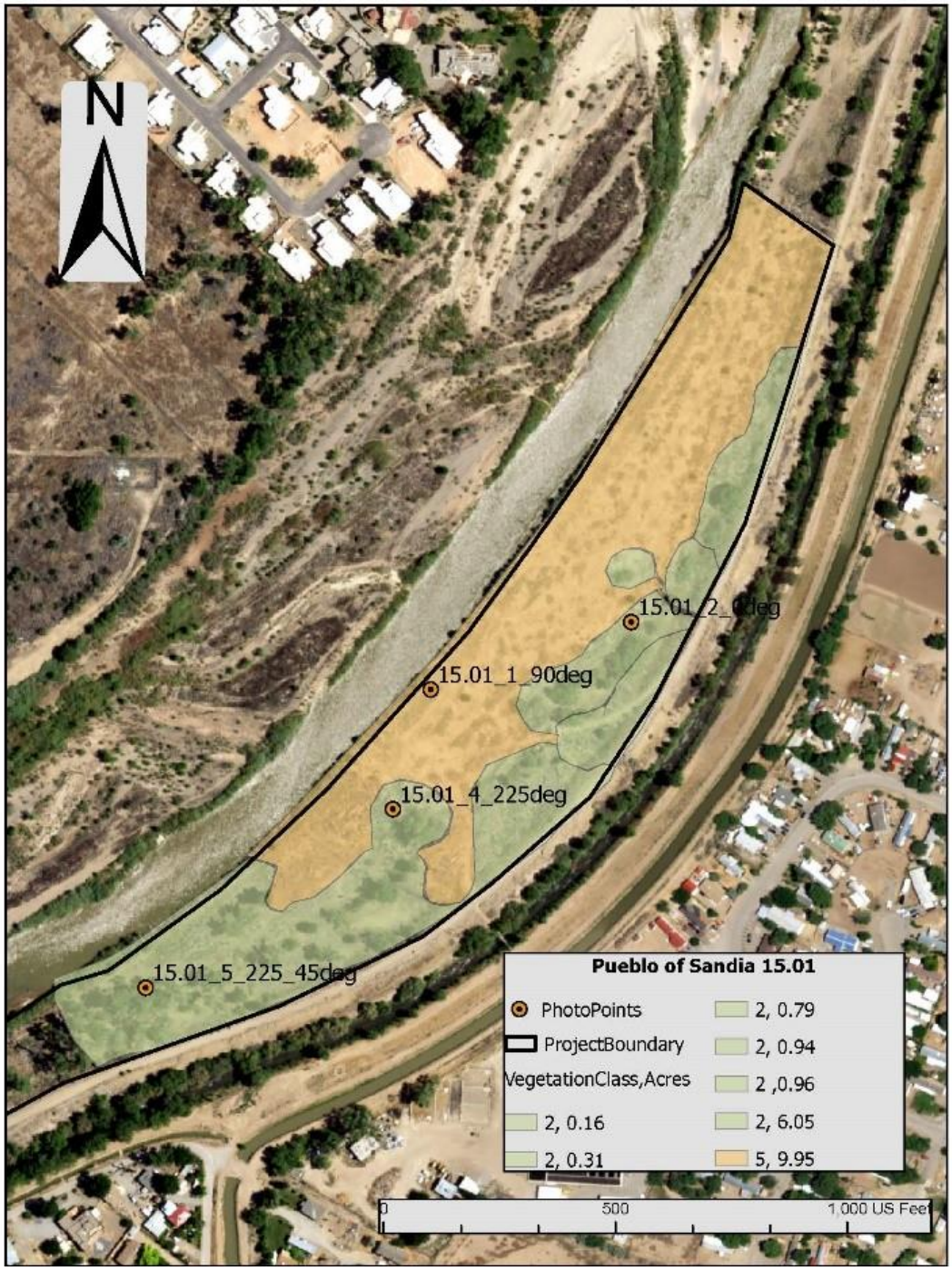
6 Monitoring Results

6.1 Low-intensity Adapted NMRAM

15.01 Low-intensity NMRAM Data



Map 6: 15.01 NMRAM Structure Types in 2015.



Map 7: 15.01 NMRAM Structure Types in 2021.

Project 15.01 NMRAM 2026

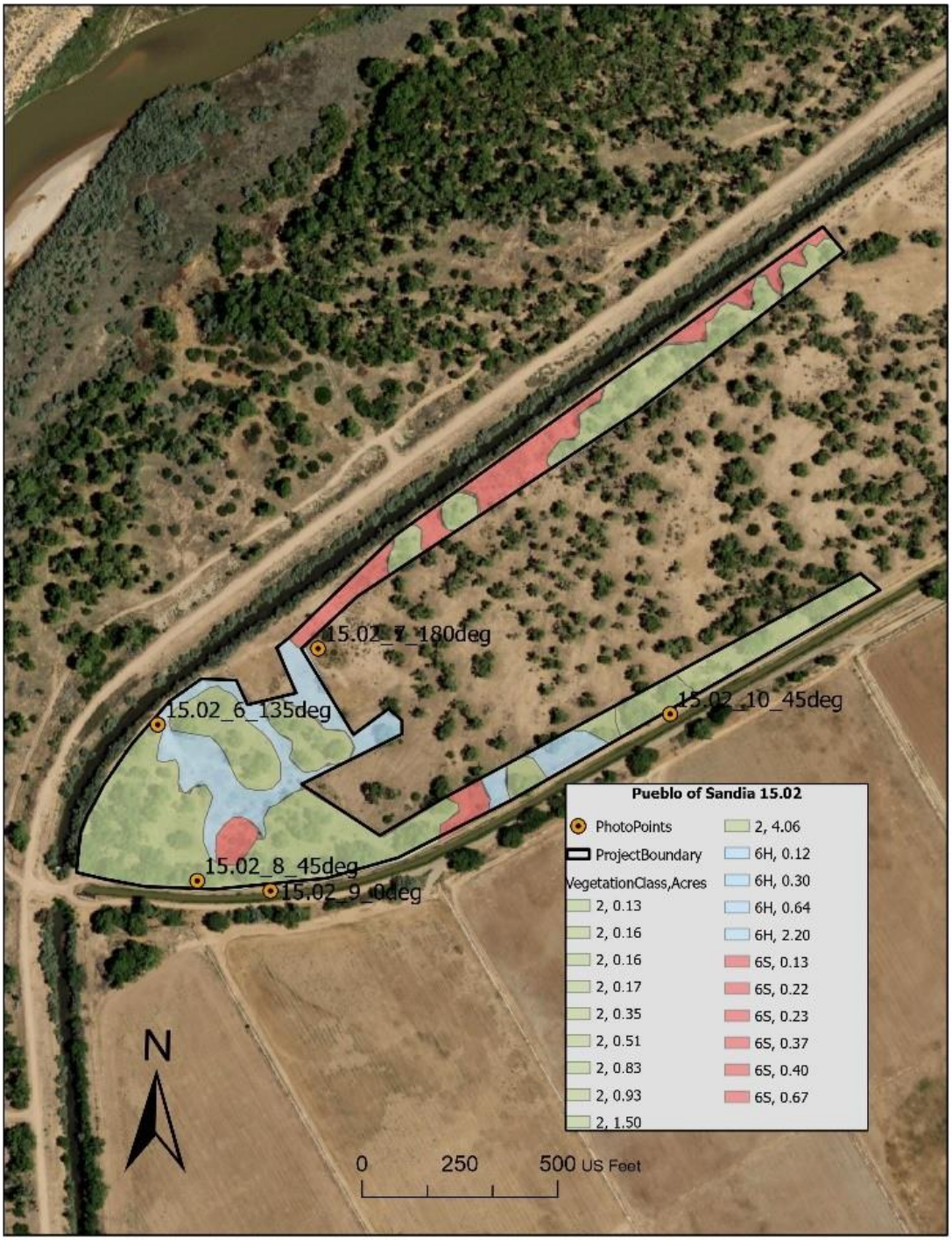


Map 8: 15.01 NMRAM Structure Types in 2026.

Metrics 15.01	Pre-treatment 8-17-2015	5-yr post-treatment 9-24-2021	10-yr-post-treatment 8-20-2026
Relative Native Plant Community Composition	1	2	1
Vegetation Horizontal Patch Structure	3	3	3
Vegetation Vertical Structure	3	1	1
Native Riparian Tree Regeneration	2	3	2
Exotic Invasive Plant Species Cover	1	1	1
Project Biotic Score (based on above ratings)	1.9	1.9	1.5
Project Biotic Rating	C / Fair	C / Fair	D/Poor
Soil Surface Condition	2	2	2
Surface Fuels	0.75	0.75	0.75

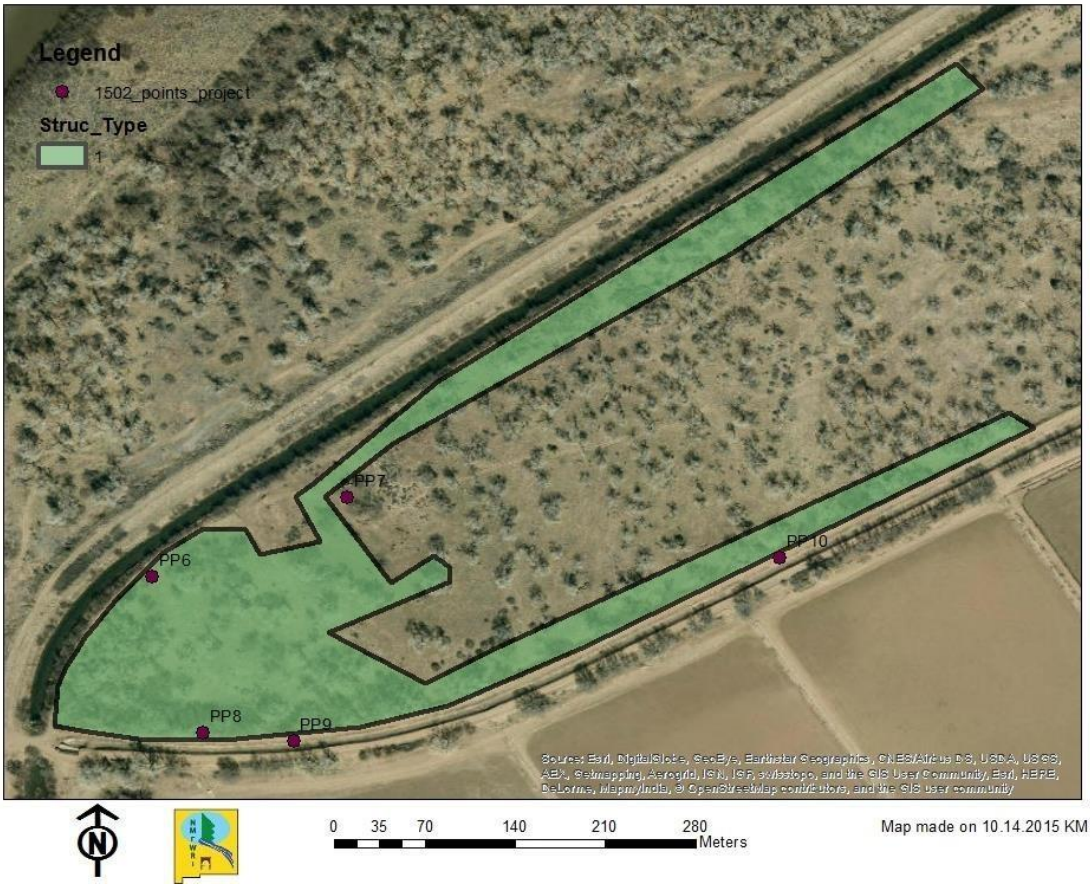
The overall project score for 15.01 dropped from Fair to Poor in 2026. Vegetation horizontal patch structure maintained a score of 3 (good) across all three monitoring visits. Exotic invasive plant species cover was poor (1) for all years as well. Soil surface condition and surface fuels remained unchanged across all three monitoring visits. Native plant composition fluctuated and dropped from 2021 to 2026. Vertical structure was poor.

15.02 Low-intensity NMRAM Data



Map 9: 15.02 NMRAM Structure Types in 2015.

15.02 Riverside Drain



Map 10: 15.02 NMRAM Structure Types in 2021.

Project 15.02 NMRAM 2026



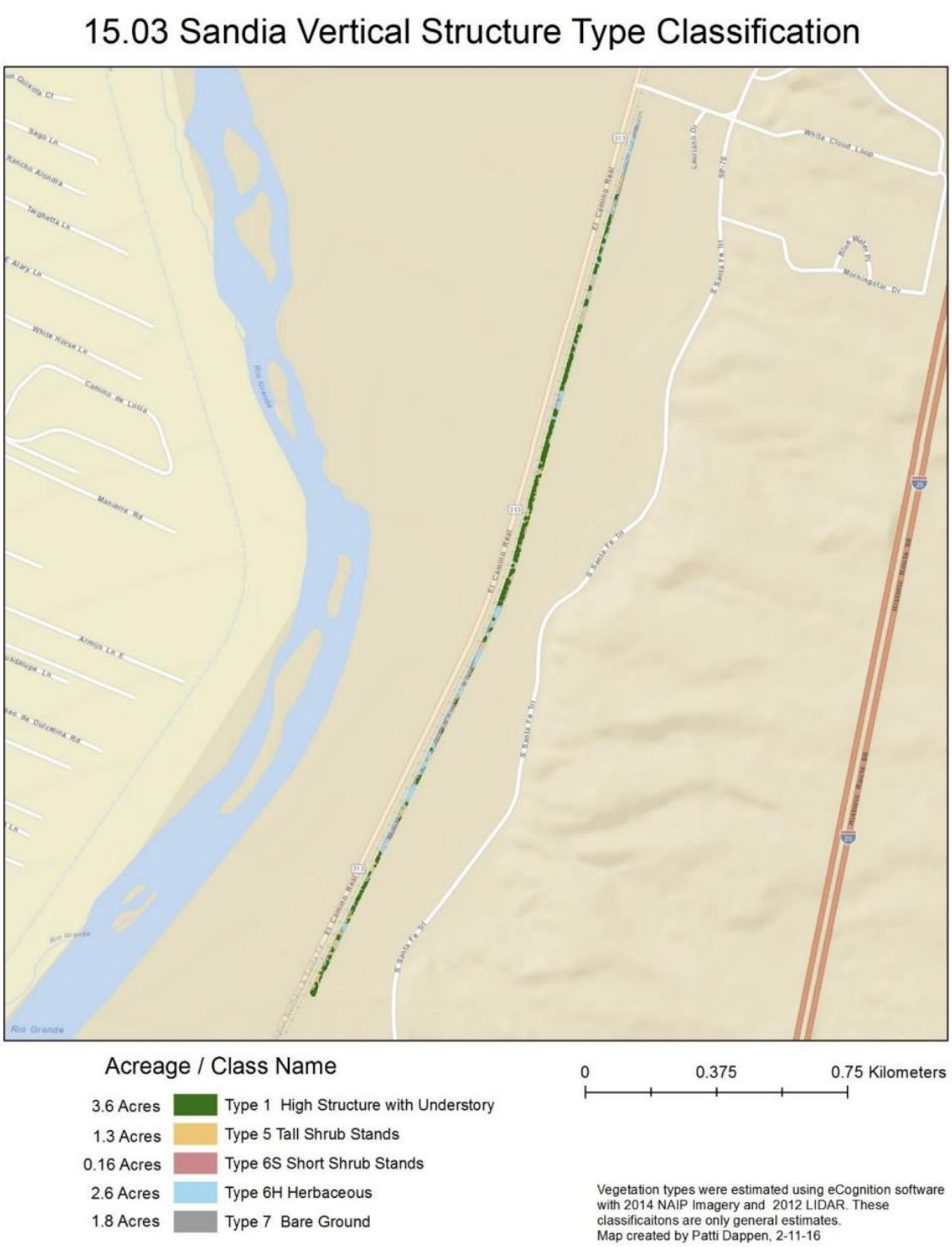
Map 11: 15.02 NMRAM Structure Types in 2026.

Metrics 15.02	Pre-treatment 8-17-2015	5-year post-treatment 9-24-2021	10-yr post-treatment 8-20-2026
Relative Native Plant Community Composition	1	2	2
Vegetation Horizontal Patch Structure	1	4	3
Vegetation Vertical Structure	2	1	2
Native Riparian Tree Regeneration	1	1	1
Exotic Invasive Plant Species Cover	1	1	1
Project Biotic Score (based on above ratings)	1.1	1.9	1.9
Project Biotic Rating	D / Poor	C / Fair	C/Fair
Soil Surface Condition	2	2	2
Surface Fuels	0.75	0.35	0.4

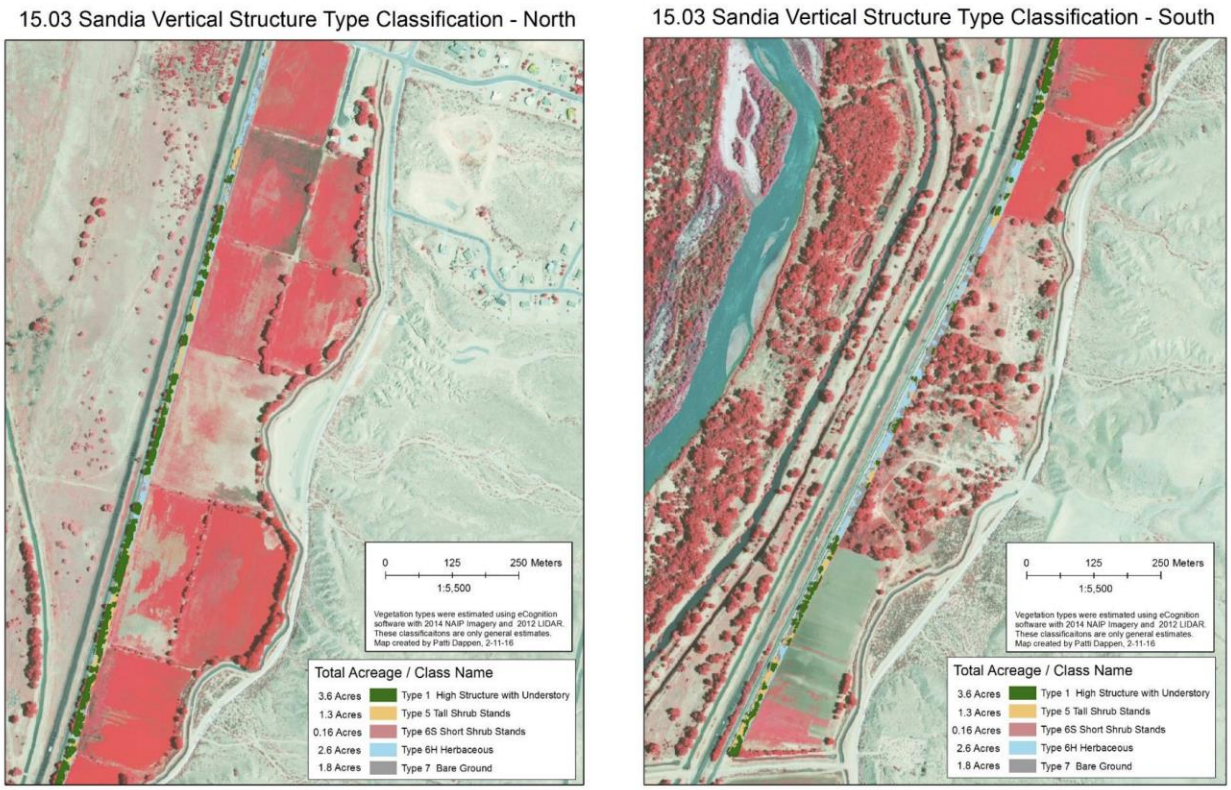
Project 15.02 maintained a 1.9 - C/Fair Project Biotic Score, consistent with data collected in 2021. Native tree regeneration and exotic plant cover both remained poor across all three years. Native plant community composition remained a 2 from 2021. Vegetation horizontal patch structure decreased from 2021 to 3. Soil surface condition stayed consistent across all three visits at a 2. Surface fuels were similar to 2021 levels at 0.4.

15.03 Low-intensity NMRAM Data

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 collection of three photo points, shown in Map 4. In 2015, LiDAR was utilized to collect structure data and in 2021 and 2026 only photos were collected. Structure maps from 2015 are shown below.

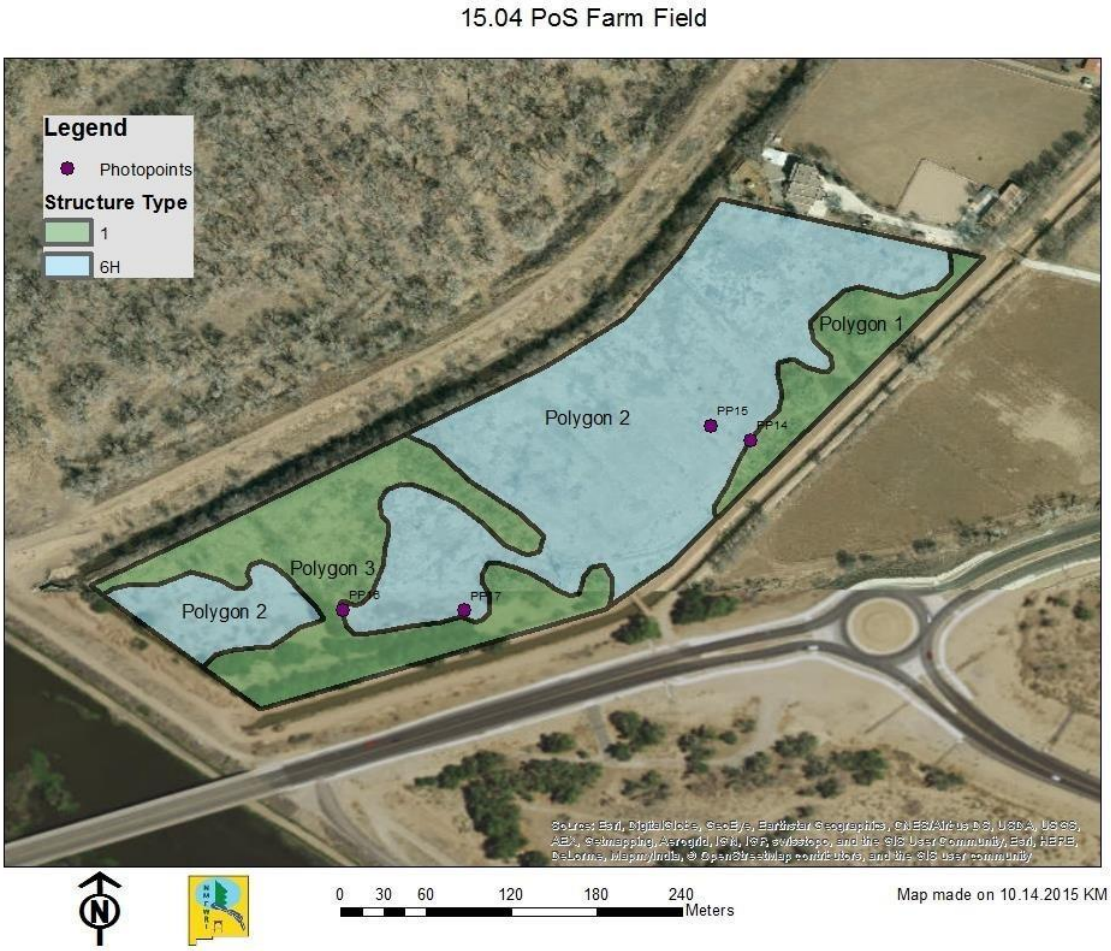


Map 12: 15.03 NMRAM Structure Types in 2015 via remote sensing.



Map 13: 15.03 NMRAM Structure Types in 2015 via remote sensing.

15.04 Low-intensity NMRAM Data



Map 14: 15.04 NMRAM Structure Types in 2015.



Map 15: 15.04 NMRAM Structure Types in 2021.

Project 15.04 NMRAM 2026

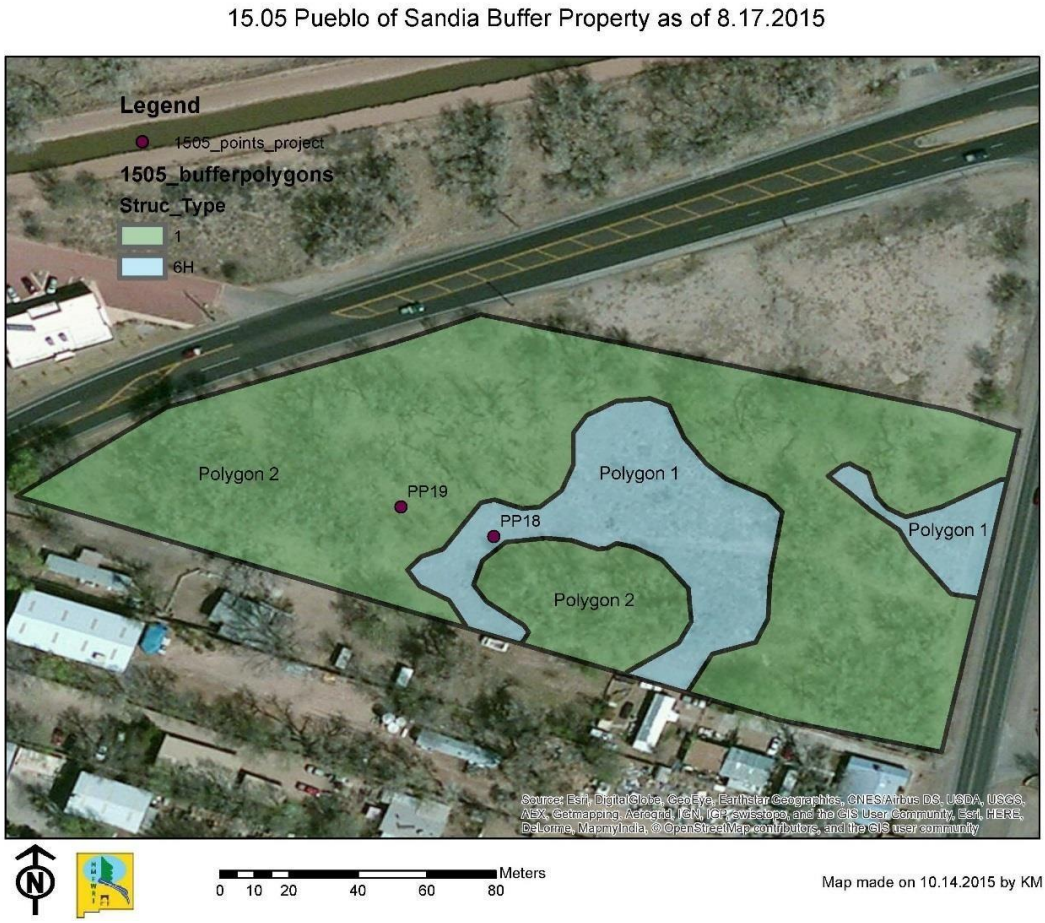


Map 16: 15.04 NMRAM Structure Types in 2026.

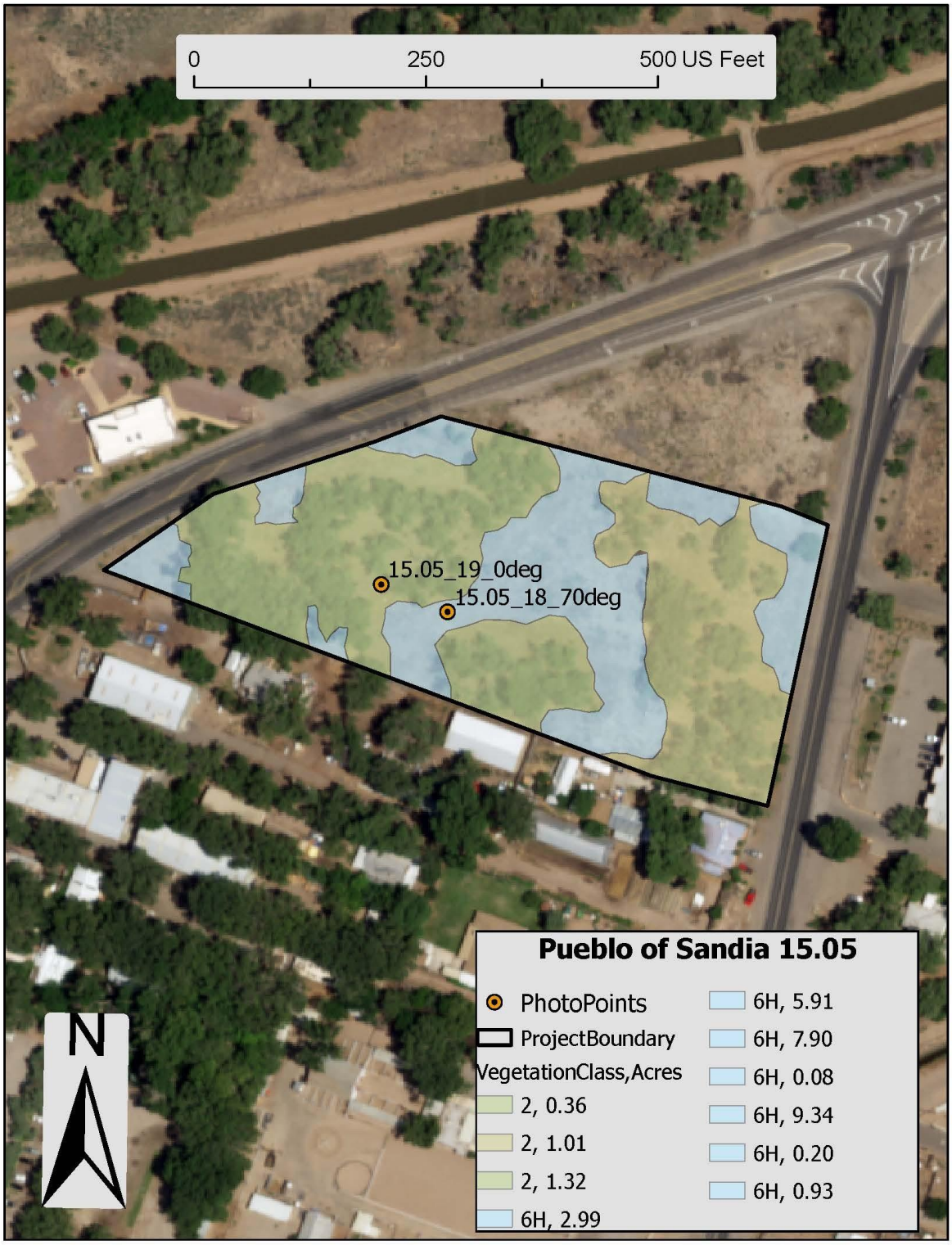
Metrics 15.04	Pre-treatment 08-17-2015	5-year post-treatment 10-14-2021	10-yr-post-treatment 8-24-2026
Relative Native Plant Community Composition	1	2	1
Vegetation Horizontal Patch Structure	2	4	3
Vegetation Vertical Structure	3	1	1
Native Riparian Tree Regeneration	1	3	1
Exotic Invasive Plant Species Cover	1	1	1
Project Biotic Score (based on above ratings)	1.6	2.1	1.3
Project Biotic Rating	D / Poor	C / Fair	D/Poor
Soil Surface Condition	2	2	1
Surface Fuels	0.75	0.20	0.3

The overall rating for 15.04 was 1.3 - D/Poor. Soil surface condition, tree regeneration, vegetation horizontal patch structure, and native plant community composition all decreased from 2021 scores. Exotic plant species cover maintained a poor rating across all three visits. Surface fuels increased slightly from 2021 to 0.3.

15.05 Low-intensity NMRAM Data



Map 17: 15.05 NMRAM Structure Types in 2015.



Map 18: 15.05 NMRAM Structure Types in 2021.

Project 15.05 NMRAM 2026



Map 19: 15.05 NMRAM Structure Types in 2026.

Metrics 15.05	Pre-treatment 08-17-2015	5-year post-treatment 9-22-2021	10-yr-post-treatment 8-24-2026
Relative Native Plant Community Composition	2	2	4
Vegetation Horizontal Patch Structure	2	3	3
Vegetation Vertical Structure	3	2	2
Native Riparian Tree Regeneration	1	3	1
Exotic Invasive Plant Species Cover	1	3	4
Project Biotic Score (based on above ratings)	1.9	2.5	3.1
Project Biotic Rating	C / Fair	B / Good	B/Good
Soil Surface Condition	3	3	3
Surface Fuels	0.55	0.70	0.3

Project 15.05 increased its overall score from previous visits to 3.1 - B/Good. The relative native plant community composition saw the largest increase, from a score of 2 in 2021 to a score of 4 in 2026. Exotic plant species cover also improved from 3 to 4. All other characterizations stayed the same or decreased. Native tree regeneration decreased from 3 to 1. Horizontal patch structure maintained a score of 3, and vertical structure stayed the same with a score of 2. Soil surface condition stayed the same across all three visits. Surface fuels decreased to 0.3.

6.3 High-Intensity CSE Plot

Common stand exam data was collected on plots in 2021 and 2026. The CSE protocol was not in place when pre-treatment monitoring took place in 2015. Due to access issues, project 15.03 does not have CSE plots. Project 15.02 CSE plot data was not taken in 2021 due to time constraints and therefore was not collected in 2026 for lack of comparative data.

Project	***Number of Photopoints***	***Number of Plots***	***Plot IDs***
15.01	4	2	15.01_1, 15.05
15.02	5	1	Not sampled in 2021 or 2026 due to time constraints
15.03	3	0	Access constraint
15.04	4	2	15.04_14, 15.04_17
15.05	2	1	15.05_19

Table 1: Explanation of projects and corresponding photopoints and plot information.

6.3.1 Tree Component

Overstory Tree Species Composition

Non-Invasive Species

		Poles			Mature Trees							Total
Diameter Class (in.)		*5-7*	*7-9*	*9-11*	*11-13*	*13-15*	*15-17*	*17-19*	*19-21*	*21-23*	*31+*	
PODEW Rio Grande Cottonwood	COUNT	0	1	0	0	1	0	1	0	1	1	***5.00***
	TPA	0.00	3.33	0.00	0.00	3.33	0.00	3.33	0.00	3.33	3.33	***16.67***
	BA/AC	0.00	1.00	0.00	0.00	3.67	0.00	5.89	0.00	8.88	18.04	***37.47***
	AVE HT.	0.00	22.30	0.00	0.00	49.40	0.00	29.50	0.00	43.90	69.10	
MAPO Osage-orange	COUNT	1	0	0	0	0	0	0	0	0	0	***1.00***
	TPA	3.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	***3.33***
	BA/AC	0.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	***0.51***
	AVE HT.	21.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Summary by Size Class for Native Species	***TPA***	***6.67***			***13.33***							***20.00***
	TPA %	***33.33%***			***66.67%***							***100.00%***
	BA/AC	***1.51***			***36.48***							***37.98***
	BA/AC %	***3.97%***			***96.03%***							***100.00%***
	QMD	***6.44***			***22.40***							***18.66***
	AVE HT.	***22***			***55***							***53***

Table 2: Native tree stand table for Projects 15.01-15.05 combined due to low tree volume.

Individual Plot Summary Table

Macro Plot Name	Total number of sample trees on plot	Growing Stock		
		Number of growing stock sample trees on plot	Trees per Acre	Basal Area per Acre
15.01_5	2	2	20	57.11
15.04_17	1	1	10	1.53
15.05_19	3	3	30	55.31

Table 3: Native tree count, TPA, BA/AC by Plot.

The primary tree species recorded are the Rio Grande Cottonwood (PODEW) and Osage-orange (MAPO). Across all plots, native species account for a total count of 6 trees, yielding 20.00 trees per acre and a total basal area of 37.98 square feet per acre. Rio Grande Cottonwood was the most common with 5 trees (16.67 TPA, 37.47 BA/AC), while only one Osage-orange tree was recorded (3.33 TPA, 0.51 BA/AC).

Poles represent 33.33% of TPA (6.67 TPA) but only 3.97% of the total basal area (1.51 BA/AC). They have a Quadratic Mean Diameter (QMD) of 6.44 inches and an average height of 22 feet. Mature Trees dominate the structure, representing 66.67% of TPA (13.33 TPA) and 96.03% of the total basal area (36.48 BA/AC). They feature a QMD of 22.40 inches and an average height of 55 feet. Overall, native species across all size classes have an average height of 53 feet and a QMD of 18.66 inches.

On the plot level, 15.01_5 contains 2 growing stock sample trees, with 20 Trees per Acre and a Basal Area per Acre of 57.11. Plot 15.04_17 contains 1 growing stock sample tree, with 10 Trees per Acre and a Basal Area per Acre of 1.53. Plot 15.05_19 contains 3 growing stock sample trees, with 30 Trees per Acre and a Basal Area per Acre of 55.31.

Regeneration: Trees & Shrubs

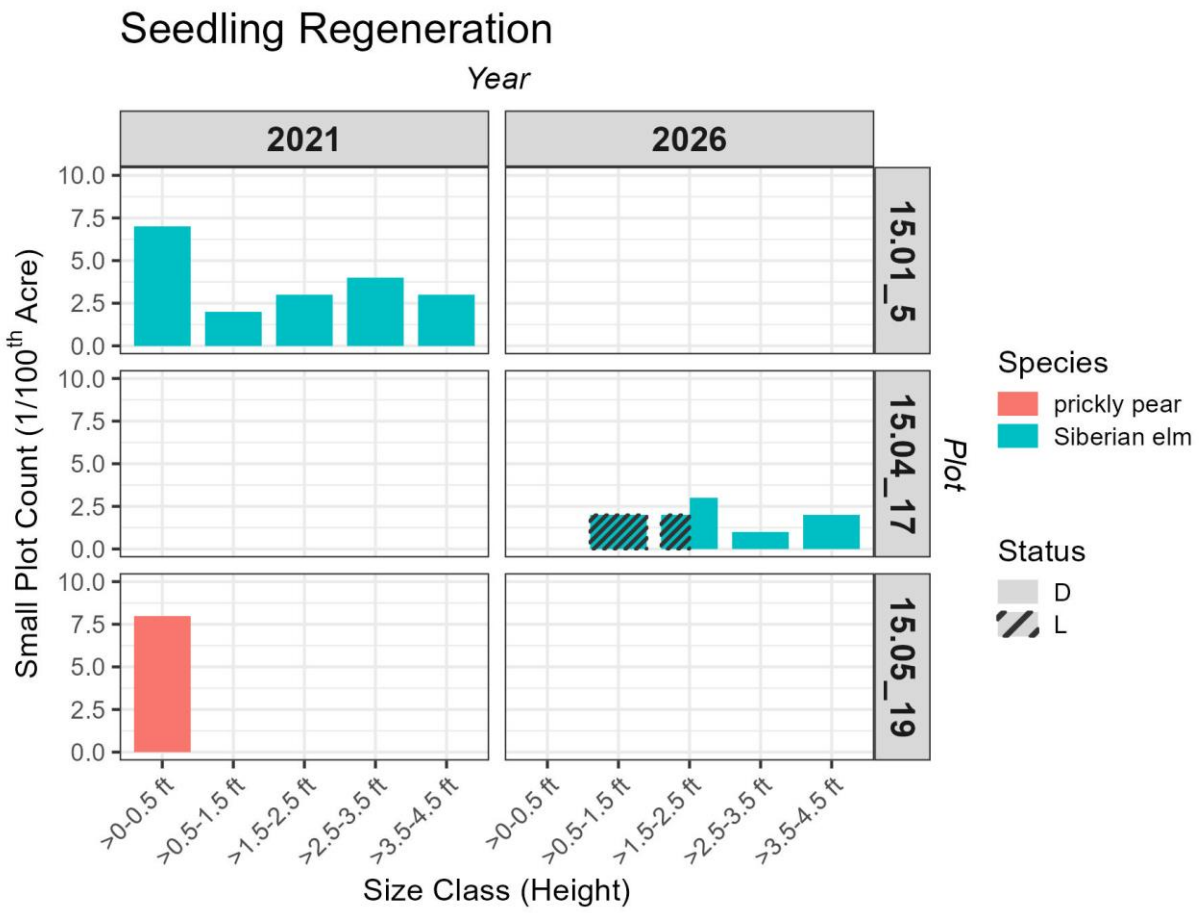


Figure 2: Seedling Regeneration by Plot.

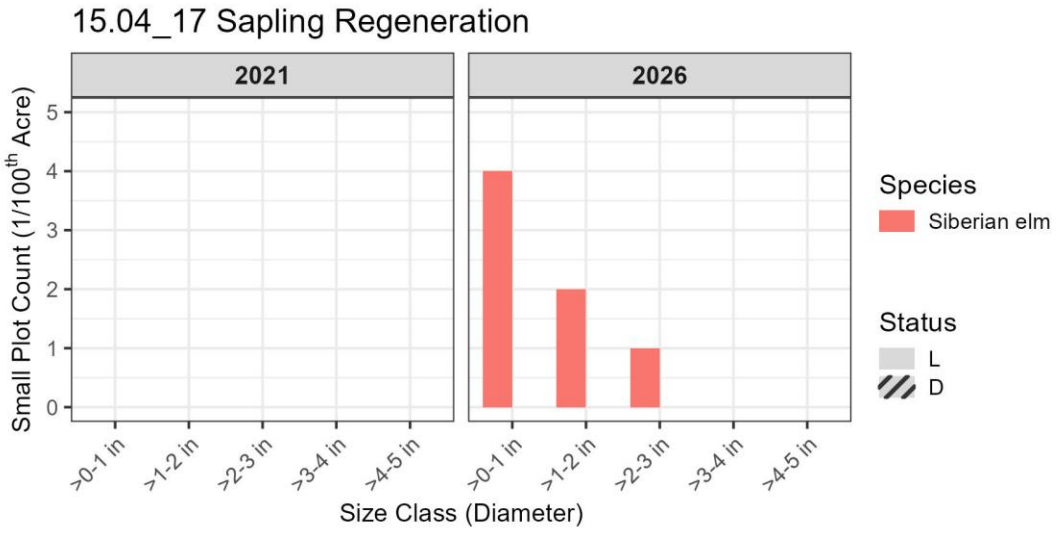


Figure 3: Sapling Regeneration for plot 15.04_17, the only plot with saplings

In Plot 15.01_5, seedling data from 2021 had a total of 19 living Siberian elm (*ULPU*) seedlings across various height classes: 7 in the >0–0.5 ft class, 2 in >0.5–1.5 ft, 3 in >1.5–2.5 ft, 4 in >2.5–3.5 ft, and 3 in >3.5–4.5 ft. No saplings were recorded on this plot. No seedlings or saplings were recorded in 2026.

In Plot 15.04_17, monitoring in 2026 recorded both seedling and sapling regeneration. A total of 10 Siberian elm (*ULPU*) seedlings were documented, comprising 6 living individuals (3 in >1.5–2.5 ft, 1 in >2.5–3.5 ft, and 2 in >3.5–4.5 ft) and 4 dead individuals (2 in >0.5–1.5 ft and 2 in >1.5–2.5 ft). Additionally, 7 living Siberian elm saplings were recorded across diameter classes, consisting of 4 in the >0–1" range, 2 in >1–2", and 1 in >2–3". No seedlings or saplings were recorded on this plot in 2021.

In Plot 15.05_19, seedling data from 2021 recorded a total of 8 living *OPPH* seedlings, all within the smallest height class (>0–0.5 ft). No saplings were observed on this plot and no regeneration was recorded in 2026.

6.3.2 Understory & Forest Floor Component

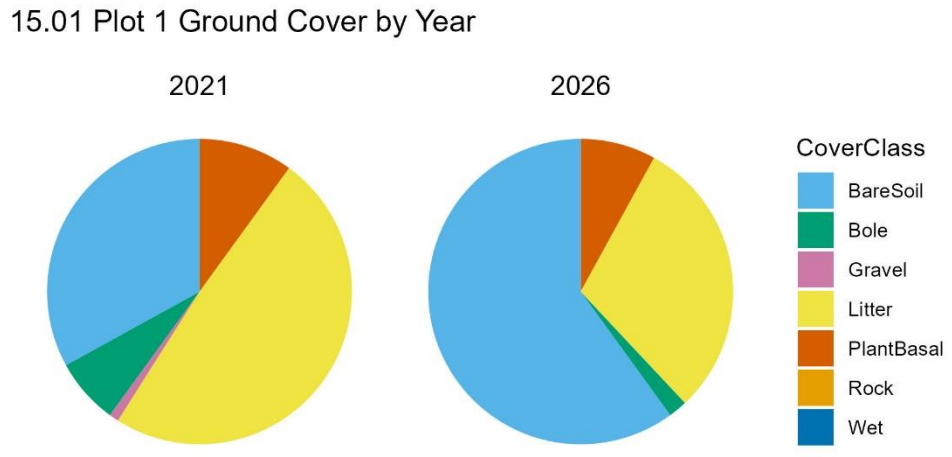
Ground Cover

In 2021, the ground cover on plot 15.01_1 was estimated to be 49% covered by litter, 10% by plant basal (this is the area occupied by the stems of non-woody species), 7% by bole (woody stems), and 33% bare ground. By 2026, the portion of the plot covered by litter had decreased to 30% while bare ground had increased to 60%. Bole coverage shrunk to 2% and plant basal to 8%. Plot 15.01_5 changed even more dramatically. In 2021, litter accounted for 75% of ground cover, but by 2026 it was only 30% and bare ground had increased from 3% to 60%. Plant basal decreased from 15% to 9% and bole from 7% to 1%.

In the 15.04 project area these estimates stayed more stable between monitoring visits. On plot 14, the largest categories of bare soil and plant basal stayed almost exactly the same at 60% and 20% respectively. Bole decreased from 14% to 5% and litter increased from 3% to 10%. On plot 17 litter was also the largest category in both monitoring years: 50% in 2021 increasing to 60% in 2026. Plant basal and bole both decreased, from 25% to 5% and 14% to 8%. Bare soil increased from 8% to 26%.

Finally, on plot 15.05_19 litter increased slightly (55% to 60%) and bare soil jumped from 8% to 36%, while plant basal decreased from 25% to 3% and bole from 10% to 1%.

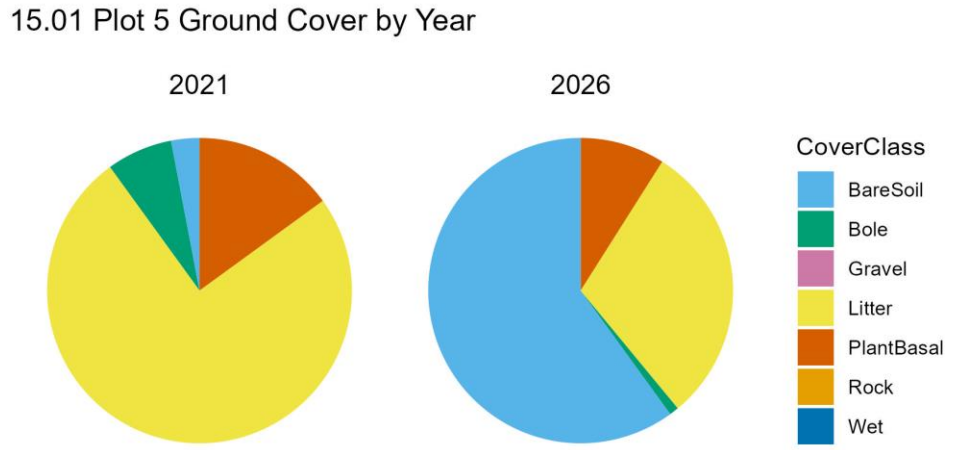
Across project sites there appears to be a trend of increasing bare soil, which is mirrored by decreases in the area occupied by both herbaceous and woody plants.



Cover Class	% Cover
Wet	0
PlantBasal	10
Bole	7
Litter	49
BareSoil	33
Rock	0
Gravel	1

Cover Class	% Cover
Wet	0
PlantBasal	8
Bole	2
Litter	30
BareSoil	60
Rock	0
Gravel	0

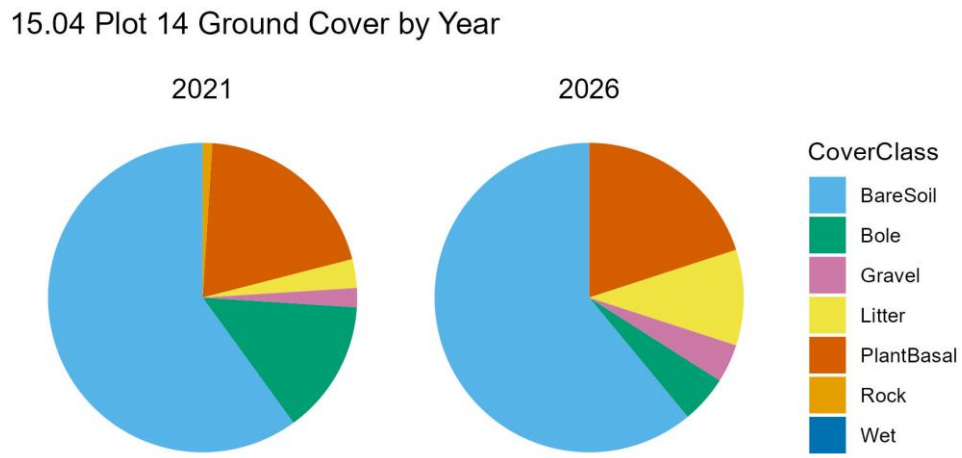
Figure 4: Ground cover in 2021 and 2026 on plot 15.01_1



Cover Class	% Cover
Wet	0
PlantBasal	15
Bole	7
Litter	75
BareSoil	3
Rock	0
Gravel	0

Cover Class	% Cover
Wet	0
PlantBasal	9
Bole	1
Litter	30
BareSoil	60
Rock	0
Gravel	0

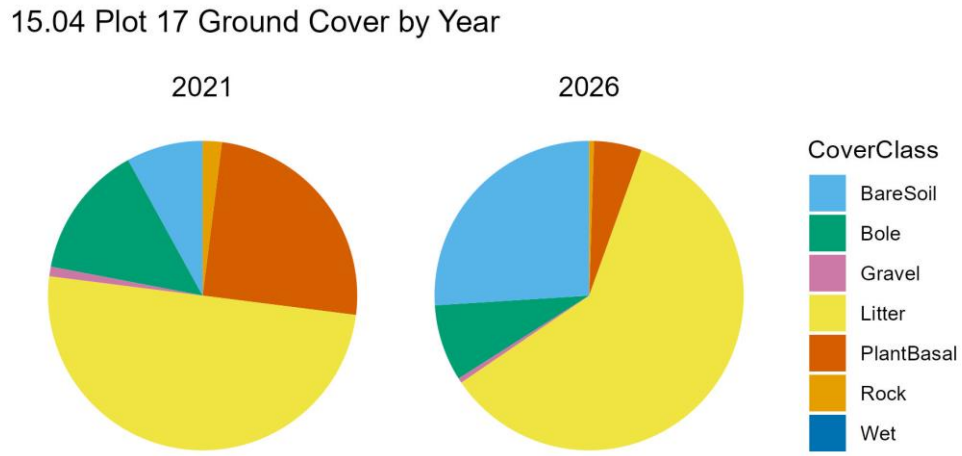
Figure 5: Ground cover in 2021 and 2026 on plot 15.01_5



Cover Class	% Cover
Wet	0
PlantBasal	20
Bole	14
Litter	3
BareSoil	60
Rock	1
Gravel	2

Cover Class	% Cover
Wet	0
PlantBasal	20
Bole	5
Litter	10
BareSoil	61
Rock	0
Gravel	4

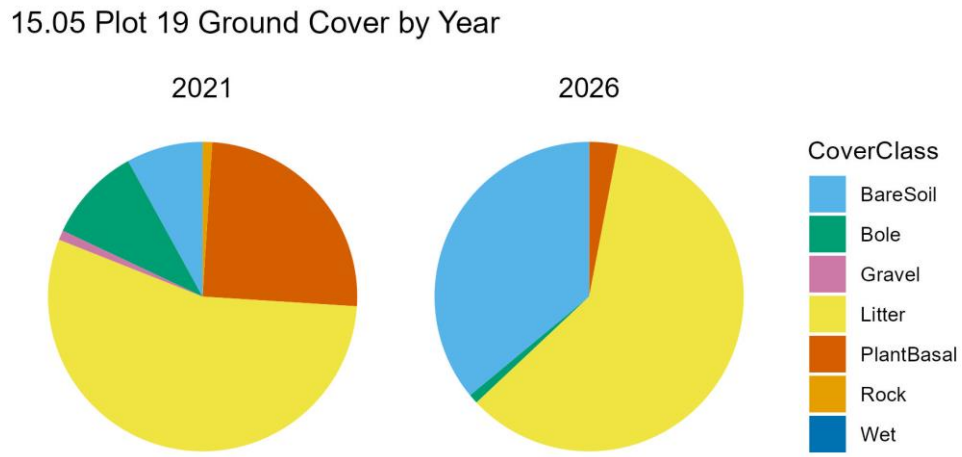
Figure 6: Ground cover in 2021 and 2026 for plot 15.04_14



Cover Class	% Cover
Wet	0
PlantBasal	25
Bole	14
Litter	50
BareSoil	8
Rock	2
Gravel	1

Cover Class	% Cover
Wet	0.0
PlantBasal	5.0
Bole	8.0
Litter	60.0
BareSoil	26.0
Rock	0.5
Gravel	0.5

Figure 7: Ground cover in 2021 and 2026 for plot 15.04_17



Cover Class	% Cover
Wet	0
PlantBasal	25
Bole	10
Litter	55
BareSoil	8
Rock	1
Gravel	1

Cover Class	% Cover
Wet	0
PlantBasal	3
Bole	1
Litter	60
BareSoil	36
Rock	0
Gravel	0

Figure 8: Ground cover in 2021 and 2026 for plot 15.05_19

Aerial Cover

Table 4: Understory species naming conventions for reference.

Common name	**USDA Code**	**Species**
false indigo sp.	AMORP	*Amorpha sp.*
carelessweed	AMPA	*Amaranthus palmeri*
Redroot amaranth	AMRE	*Amaranthus retroflexus*
fourwing saltbush	ATCA2	*Atriplex canescens*
burningbush	BASC5	*Bassia scoparia*
cheatgrass	BRTE	*Bromus tectorum*
spiny aster	CHSP11	*Chloracantha spinosa*
field bindweed	COAR4	*Convolvulus arvensis*
saltgrass	DISP	*Distichlis spicata*
barnyardgrass	ECCR	*Echinochloa crus-galli*
Russian olive	ELAN	*Eleagnus angustifolia*
Canada wildrye	ELCA4	*Elymus canadensis*
squirreltail	ELEL5	*Elymus elymoides*
gummy lovegrass	ERCU	*Eragrostis curtipendicellata*
David's spurge	EUDA5	*Euphorbia davidii*
false goldenaster sp.	HETER8	*Heterotheca sp.*
prickly lettuce	LASE	*Lactuca serriola*
Osage-orange	MAPO	*Maclura pomifera*
white mulberry	MOAL	*Morus alba*
prickly pear sp.	OPUNT	*Opuntia sp.*
James' galleta	PLJA	*Pleuraphis jamesii* (aka *Hilaria jamesii*)
Rio Grande cottonwood	PODEW	*Populus deltoides ssp. wislizeni*
hog plum	PRIN5	*Prunus injuncunda*
upright prairie coneflower	RACO3	*Ratibida columnifera*
green prairie coneflower	RATA	*Ratibida tagetes*
prickly Russian thistle	SATR12	*Salsola tragus*
London rocket	SIIR	*Sisymbrium irio*
silverleaf nightshade	SOEL	*Solanum elaeagnifolium*
alkali sacaton	SPAI	*Sporobolus airoides*
sand dropseed	SPCR	*Sporobolus cryptandrus*
spike dropseed	SPCRS	*Sporobolus cryptandrus* var. *strictus*
globemallow sp.	SPHAE	*Sphaeralcea*
yellow salsify	TRDU	*Tragopogon dubius*
Siberian elm	ULPU	*Ulmus pumila*
unk. shrub sp.	UNK1	NA
unk. forb sp.	UNK2	NA
Unk. Forb sp.	UNK2	NA

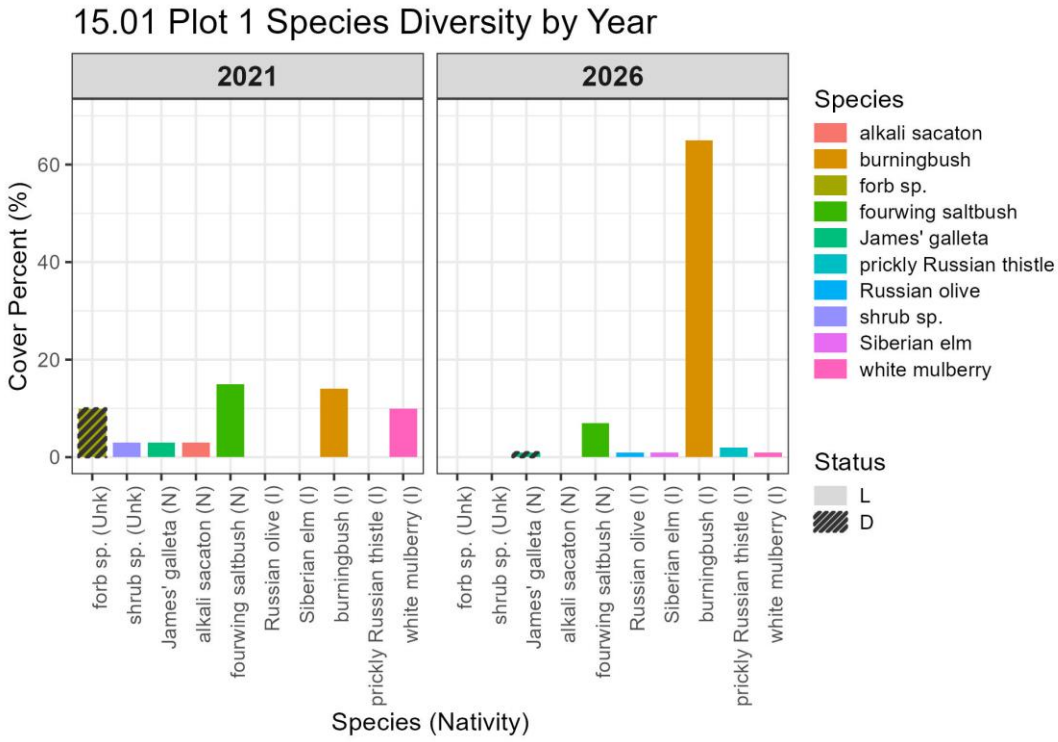


Figure 9: 15.01_1 species diversity by year for 2021 and 2026

On plot 15.01_1, the most noticeable change from 2021 to 2026 was the large increase in the area covered by the introduced burningbush—from 14% to 65%. More introduced species were recorded in 2026 as well, including Russian olive, Siberian elm, and prickly Russian thistle, although their total cover percent was low and the area covered by white mulberry decreased from 10% to 1%. In terms of native species, total cover decreased. Fourwing saltbush was most common in both years, but it fell from 15% to 7%. Alkali sacaton and James' galleta were both observed at 3% in 2021. In 2026, the cover of James' galleta was estimated at only 1% which was dead vegetation and there was no alkali sacaton.

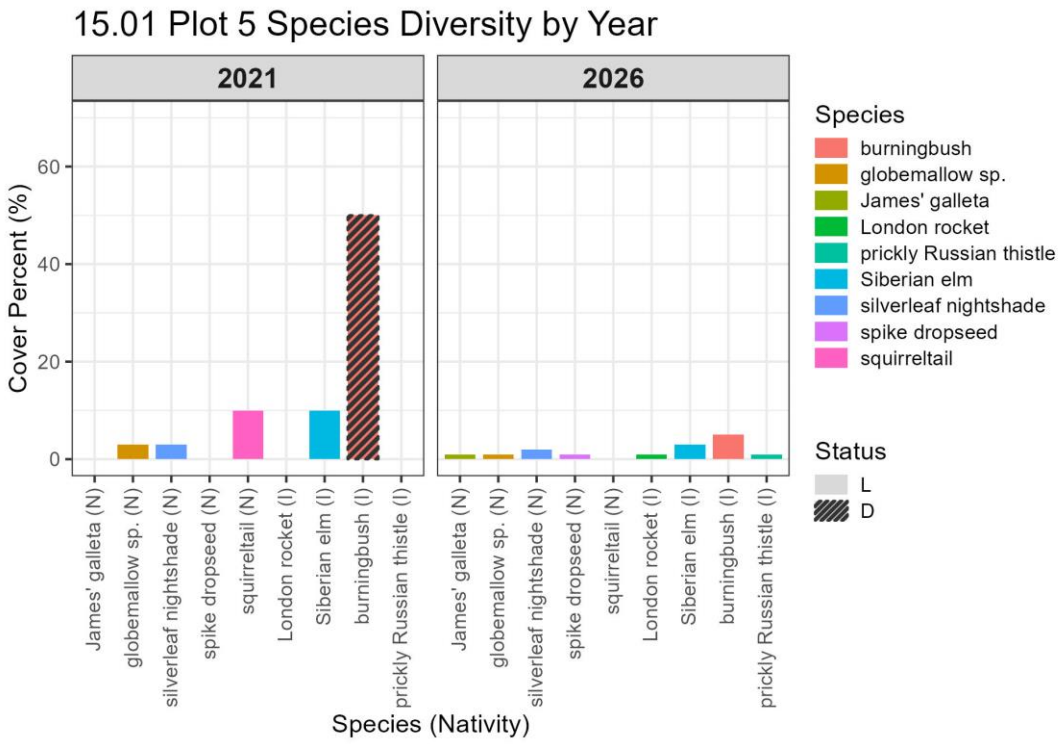


Figure 10: 15.01_5 species diversity by year for 2021 and 2026

On plot 15.01_5 the opposite trend was observed for burningbush cover; it fell from 50% (although this was all dead) in 2021 to only 5% in 2026. In terms of other introduced species, Siberian elm cover also decreased from 10% to 3%, while London rocket and prickly Russian thistle were both recorded in small numbers for the first time in 2026. Globemallows were the only native plants recorded during both the 2021 and 2026 monitoring visits. Silverleaf nightshade (3%) and squirreltail (10%) in 2021 were replaced by James' galleta and spike dropseed (both 1%) in 2026.

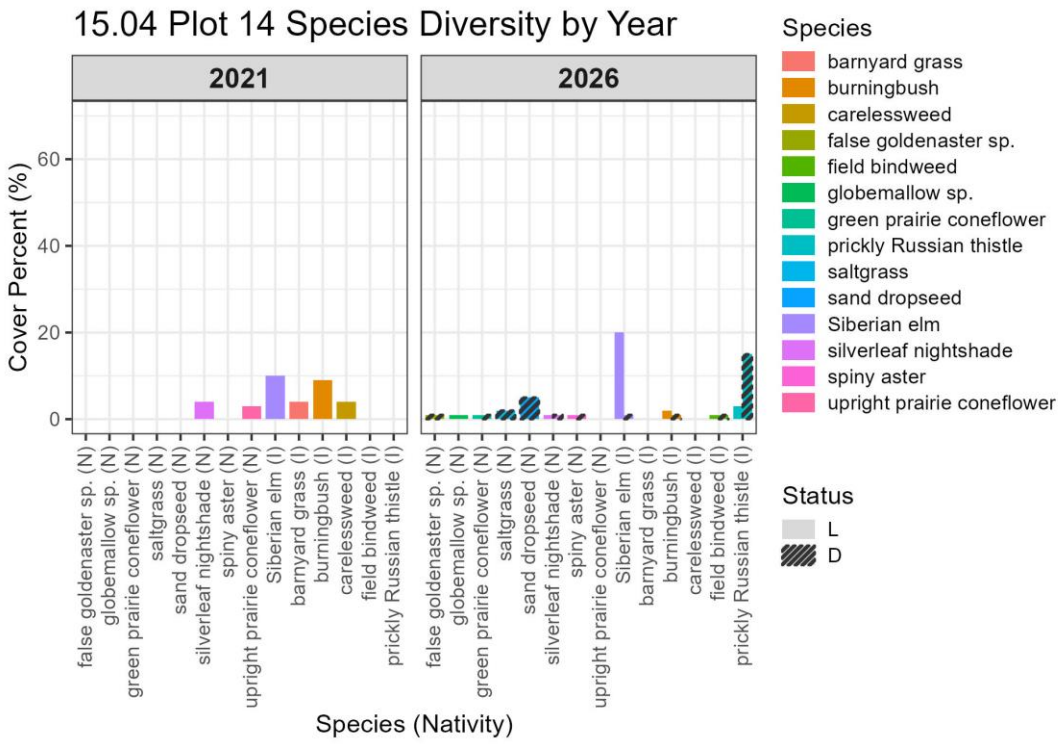


Figure 11: 15.04_14 species diversity by year for 2021 and 2026

The 15.04 project area was generally more diverse although total cover values were lower. Plot 14 saw a slight increase in introduced species. Siberian elm cover grew from 10% to 20%, but burningbrush decreased from 9% to 3%. Barnyard grass and carelessweed were both recorded at 4% in 2021 but were not observed in 2026. In their place was a trace amount of field bindweed and 18% cover from prickly Russian thistle (15 percentage points of which were dead). Only two native species were observed on plot in 2021: silverleaf nightshade at 4% and upright prairie coneflower at 3%. In 2026, upright prairie coneflower was not recorded but silverleaf nightshade remained in small amounts. Several more native species were found, including a false goldenaster species, a globemallow species, green prairie coneflower, saltgrass, sand dropseed, and spiny aster. Most of these were only seen in trace amounts, with only sand dropseed reaching 5% (although this species was dead when observed).

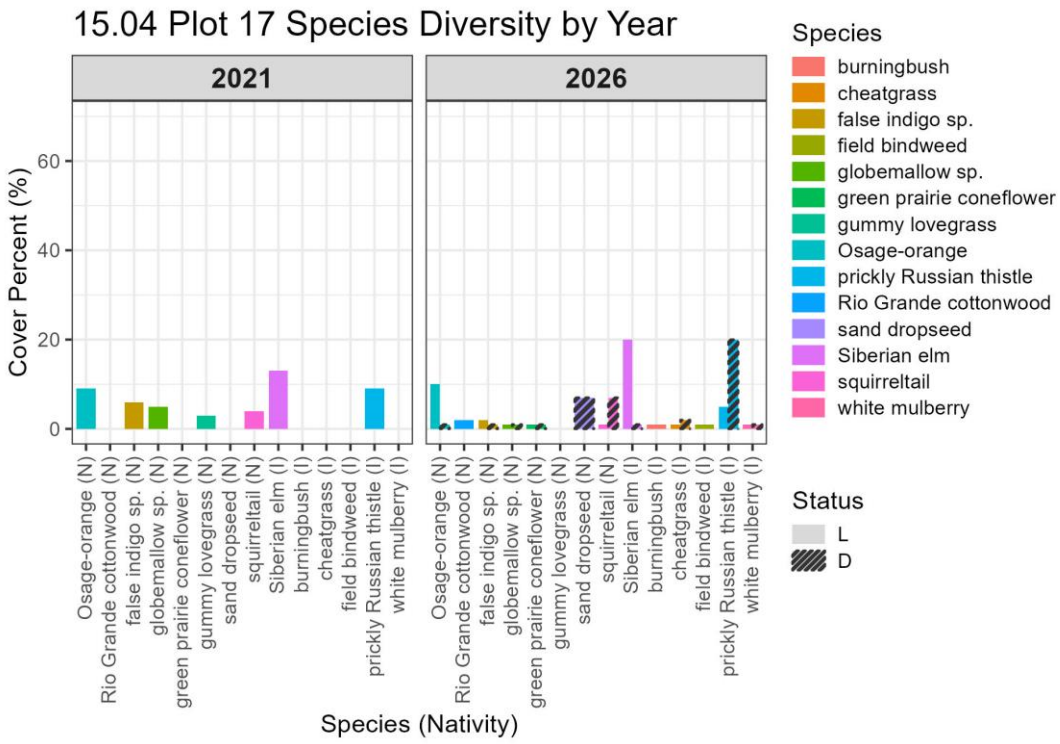


Figure 12: 15.04_17 species diversity by year for 2021 and 2026

Plot 15.04_17 also saw an increase in introduced species. Siberian elm cover grew from 13% to 20% and prickly Russian thistle from 9% to 25%. Other introduced species seen for the first time in 2026 were burningbush, cheatgrass, field bindweed, and white mulberry, all accounting for 1% cover or less respectively. Like plot 14, total cover of native species stayed relatively constant, but diversity increased. In 2021 a species of false indigo, a species of globemallow, gummy lovegrass, and squirreltail were all observed (6%, 5%, 3%, and 4%). In 2026 the false indigo (3%), globmallow (<1%), and squirreltail (8%) remained and were joined by Osage-orange (11%), Rio Grande cottonwood (2%), green prairie coneflower (<1%) and sand dropseed (7%, dead when observed).

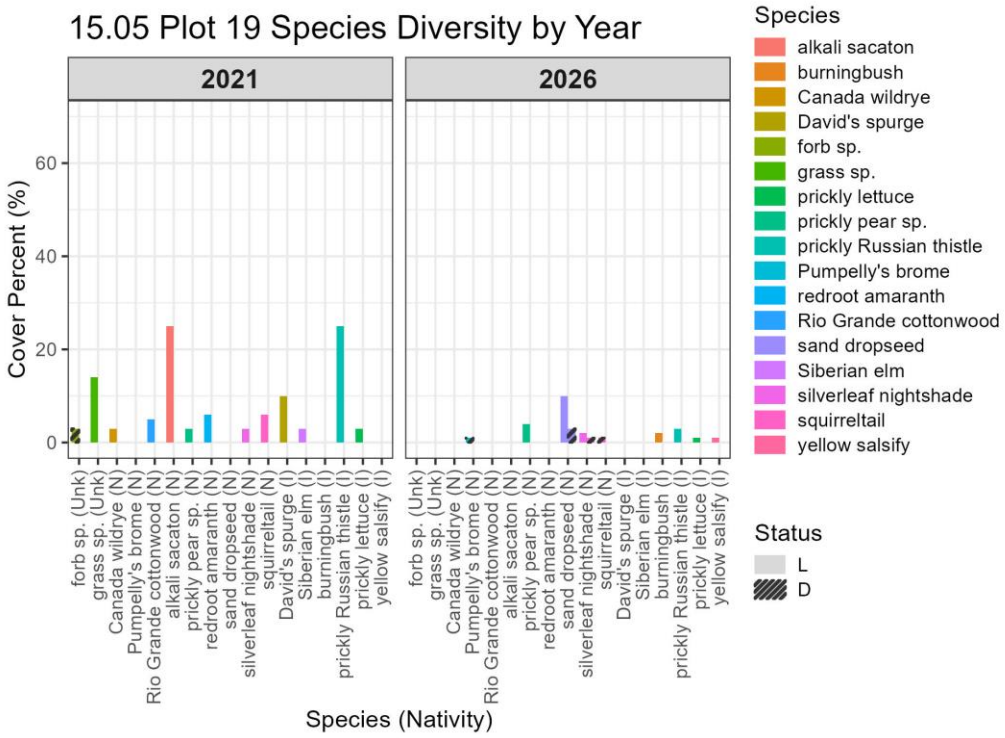
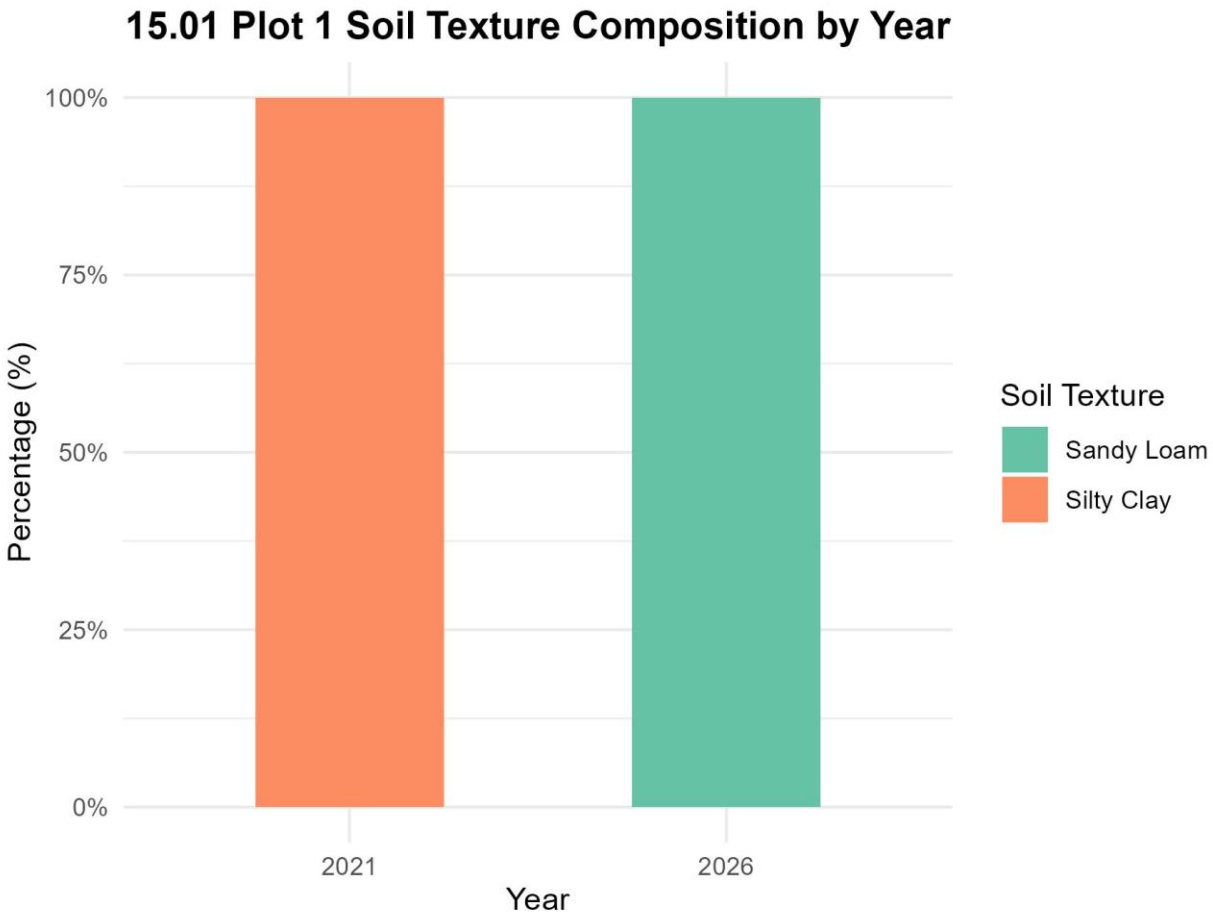


Figure 13: 15.05_19 species diversity by year for 2021 and 2026

Finally, plot 19 – the only plot in the 15.05 project area – saw a decrease in cover of all types. The introduced species observed in this area in 2021 were David's spurge at 10%, Siberian elm at 3%, prickly Russian thistle at 25%, and prickly lettuce at 3%. By 2026 prickly Russian thistle had decreased to 3%, and prickly lettuce to less than 1%. David's spurge and Siberian elm were not observed, but burningbush was recorded at 2% and yellow salsify was seen in trace amounts. In terms of native plants, silverleaf nightshade and squirreltail were observed during both visits, these decreasing from 3% and 6% to less than 1% for both species. A prickly pear species was also recorded in both years, increasing slightly from 3% to 4%. Canada wildrye was recorded only in 2021 at 3% as well as redroot amaranth at 6%, Rio Grande cottonwood at 5%, and alkali sacaton at 25%. The few new native species observed in 2026 were sand dropseed with 13% cover and Pumpelly's brome with trace amounts. An unidentified grass and forb were also recorded in 2021 at 14% and 3%, but the nativity of these is unknown.

Soils

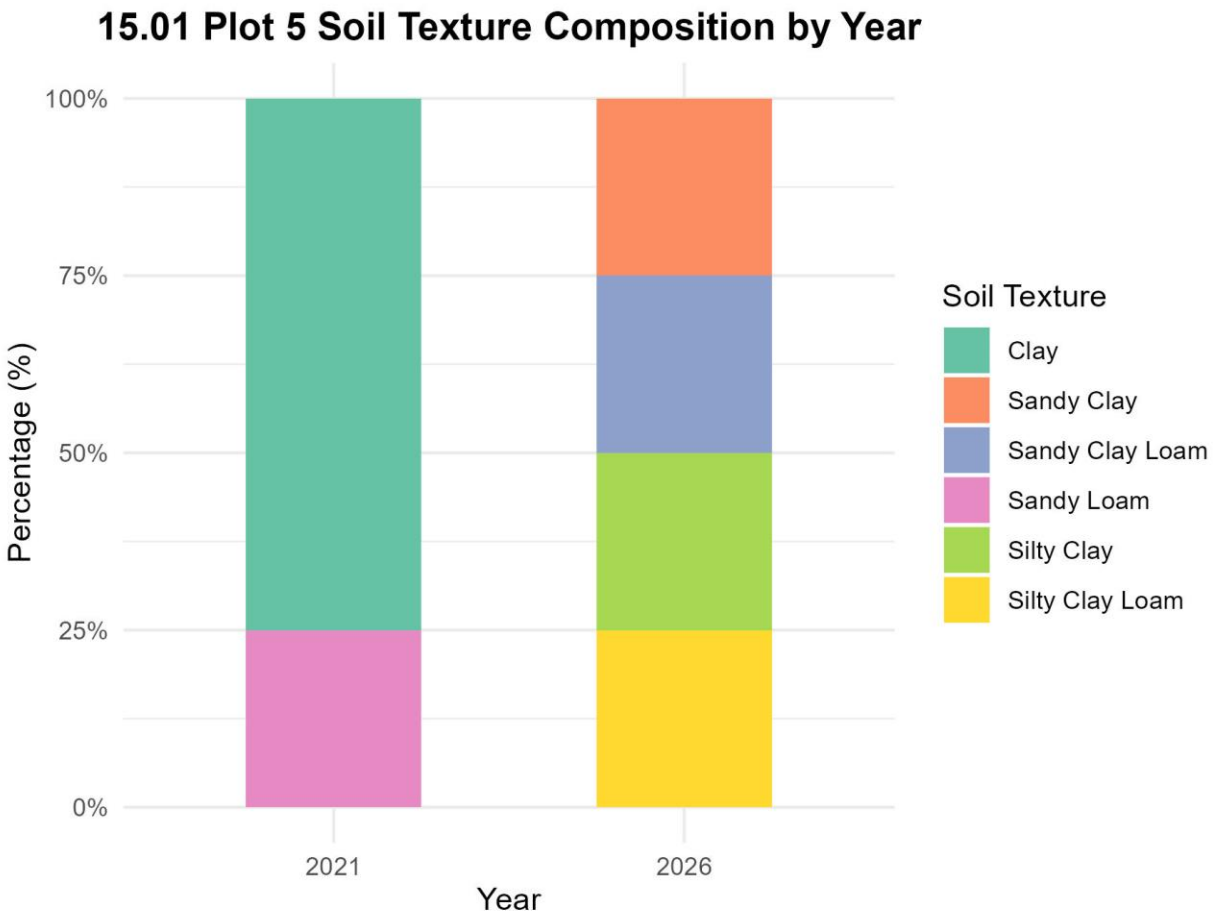


Soil Texture Frequency:

Project	Plot	Year	Soil Texture	Frequency
15.01	1	2021	Silty Clay	4
		2026	Sandy Loam	4

Figure 14: 15.01_1 Soil Texture Composition by Year.

Plot 15.01_1 soil composition was entirely homogenous, consisting of 100% of silty clay (frequency of 4) in 2021. By 2026, the soil texture shifted entirely to 100% sandy loam (frequency of 4).

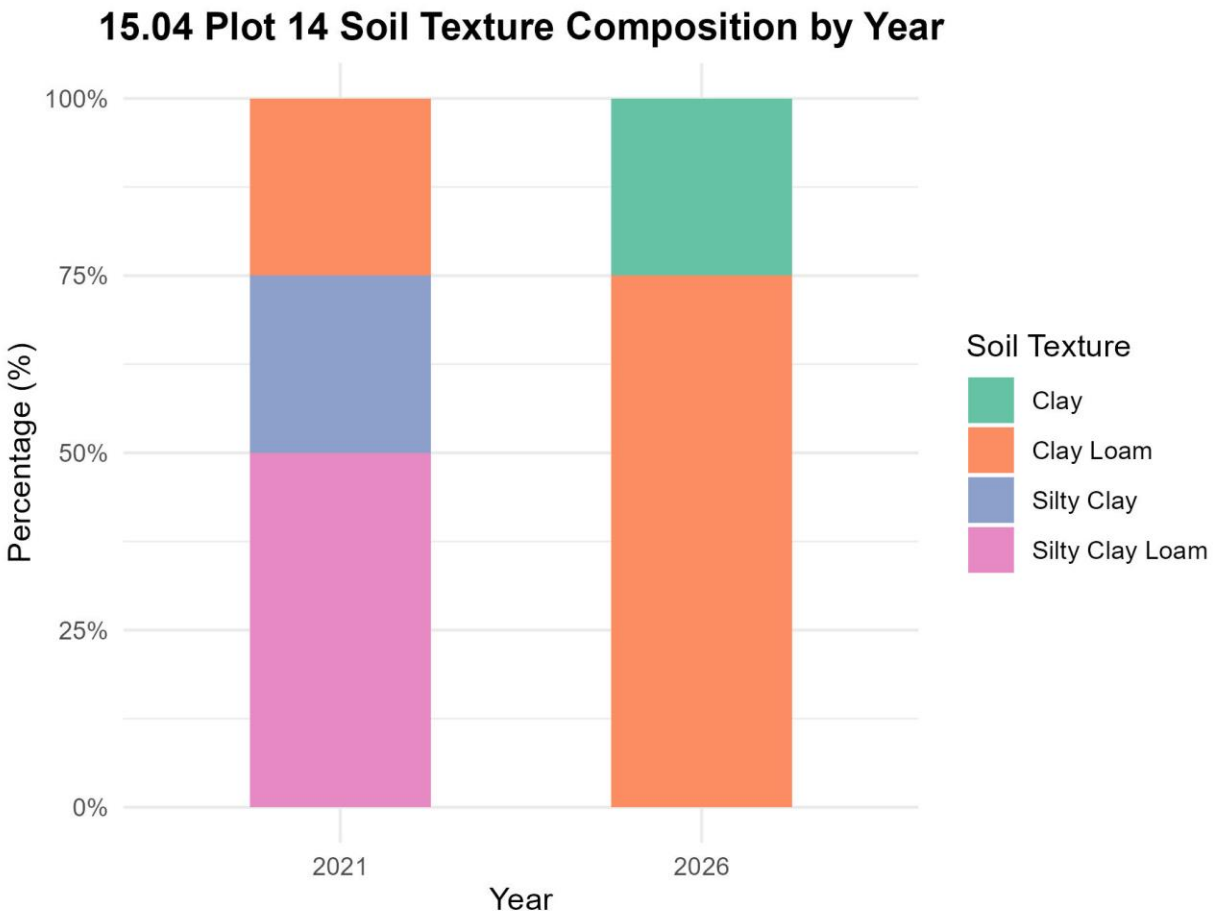


Soil Texture Frequency:

Project	Plot	Year	Soil Texture	Frequency
15.01	5	2021	Clay	3
			Sandy Loam	1
		2026	Sandy Clay	1
			Sandy Clay Loam	1
			Silty Clay	1
			Silty Clay Loam	1

Figure 15: 15.01_5 Soil Texture Composition by Year.

In 2021, Plot 15.01_5 was dominated by clay at 75% and sandy loam at 25% . In 2026, the soil texture became completely diversified, split equally into four distinct types: sandy clay, sandy clay loam, silty clay, and silty clay loam.

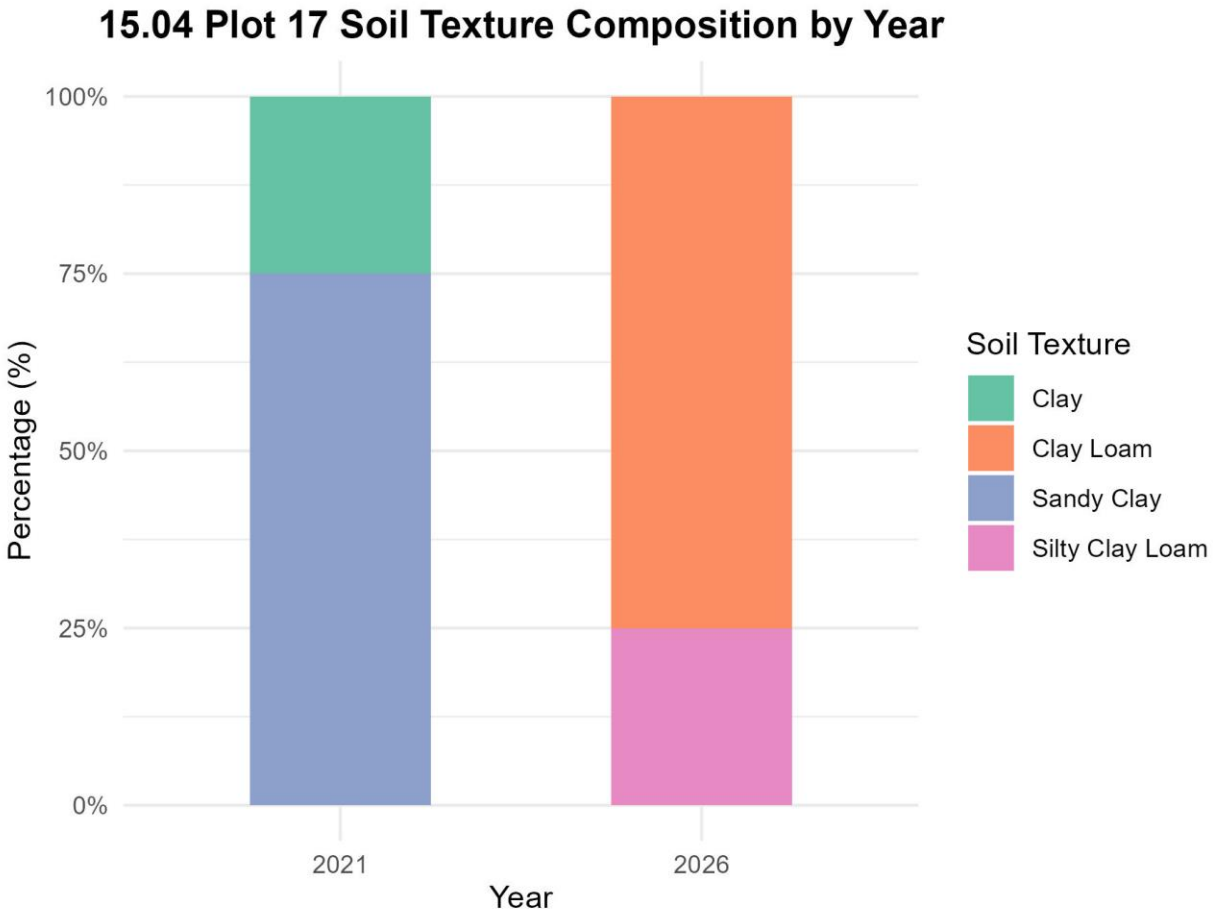


Soil Texture Frequency:

Project	Plot	Year	Soil Texture	Frequency
15.04	14	2021	Clay Loam	1
			Silty Clay	1
			Silty Clay Loam	2
		2026	Clay	1
			Clay Loam	3

Figure 16: 15.04_14 Soil Texture Composition by Year.

In 2021 for plot 15.04_14, silty clay loam made up 50% of the sample, while silty clay and clay loam each accounted for 25%. By 2026, the soil texture shifted predominantly to clay loam at 75% and clay at 25%.

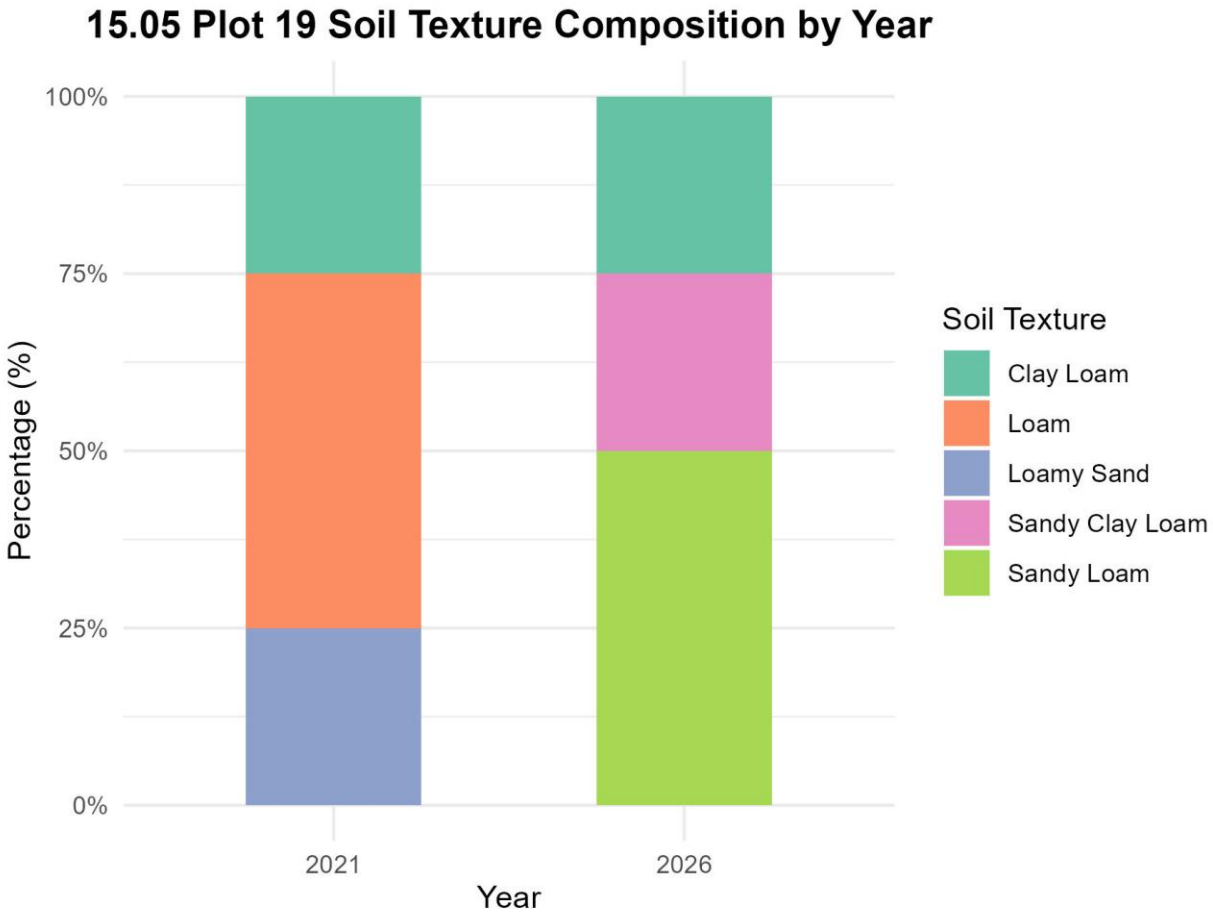


Soil Texture Frequency:

Project	Plot	Year	Soil Texture	Frequency
15.04	17	2021	Clay	1
			Sandy Clay	3
		2026	Clay Loam	3
			Silty Clay Loam	1

Figure 17: 15.04_17 Soil Texture Composition by Year.

Plot 15.04_17 comprised 75% sandy clay and 25% clay in 2021. In 2026, the plot transitioned to 75% clay loam and 25% silty clay loam.



Soil Texture Frequency:

Project	Plot	Year	Soil Texture	Frequency
15.05	19	2021	Clay Loam	1
			Loam	2
			Loamy Sand	1
		2026	Clay Loam	1
			Sandy Clay Loam	1
			Sandy Loam	2

Figure 18: 15.05_19 Soil Texture Composition by Year.

In 2021, loam accounted for 50% of the soil for plot 15.05_19, with clay loam and loamy sand each making up 25%. In 2026, sandy loam became the largest component at 50%, accompanied by clay loam and sandy clay loam at 25% each.

Surface Fuels

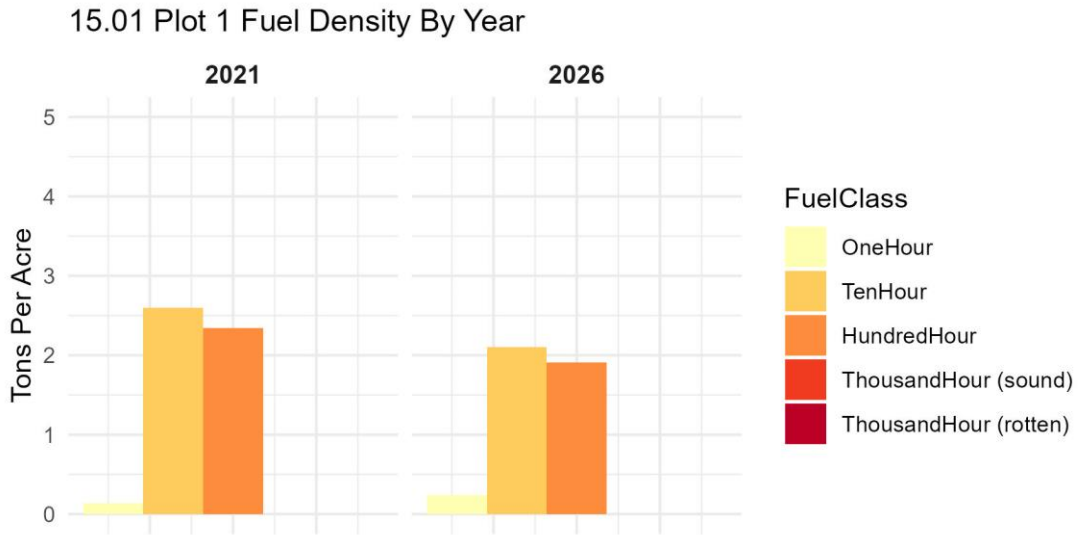


Figure 19: 15.01_1 Fuel Density in 2021 and 2026

In 2021, total fuel density consisted mainly of ten-hour fuels (2.6 tons/acre) and hundred-hour fuels (2.3 tons/acre), with a minor presence of hundred-hour fuels (0.13 tons/acre).

In 2026, fuel levels decreased slightly across the main categories, with ten-hour fuels dropping to 2 tons/acre and hundred-hour fuels down to 1.9 tons/acre, while hundred-hour fuels saw a slight increase to 0.24 tons/acre. No thousand-hour (sound or rotten) fuels were recorded in either year.

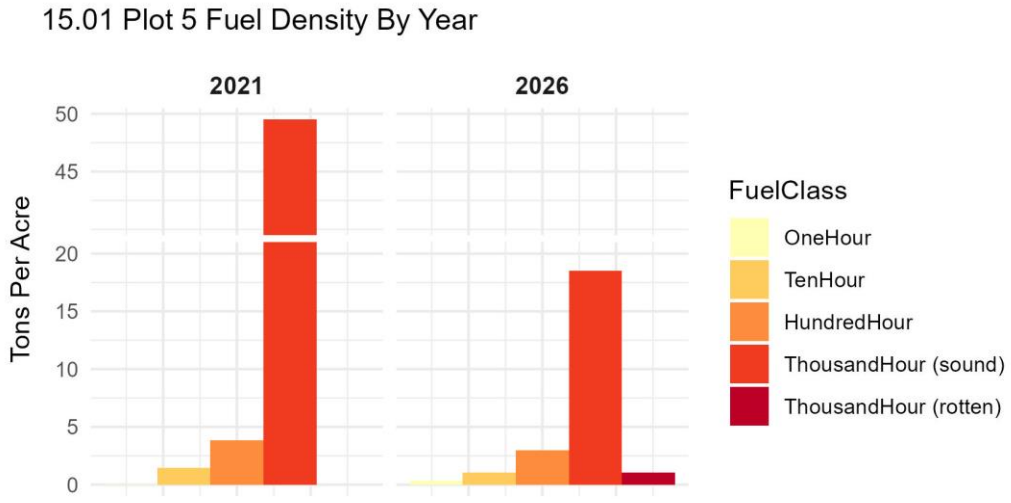


Figure 20: 15.01_5 Fuel Density in 2021 and 2026

For plot 15.01_5, fuel density was exceptionally high in 2021, dominated by thousand-hour (sound) fuels at 49 tons/acre. Lower levels were recorded for hundred-hour (3.8 tons/acre) and ten-hour (1.4 tons/acre) fuels.

In 2026, fuel load decreased significantly, though thousand-hour (sound) fuels remained the main contributor at 18.5 tons/acre. hundred-hour fuels fell slightly to 2.9 tons/acre and ten-hour fuels to 1 ton/acre. Trace amounts of hundred-hour fuels (0.3 tons/acre) and thousand-hour (rotten) fuels (1 tons/acre) appeared in 2026.

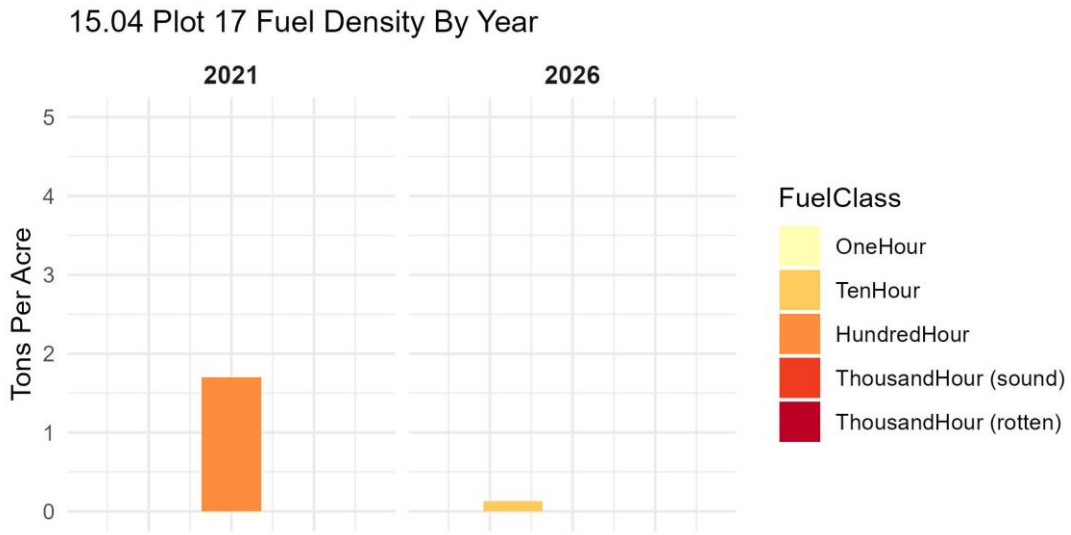


Figure 21: 15.04_17 Fuel Density in 2021 and 2026

For plot 15.04_17, fuel density consisted exclusively of hundred-hour fuels at 1.7 tons/acre in 2021. In 2026, fuel density dropped to near zero, with only a trace presence of ten-hour fuels (0.12 tons/acre) remaining. No other fuel classes were detected.

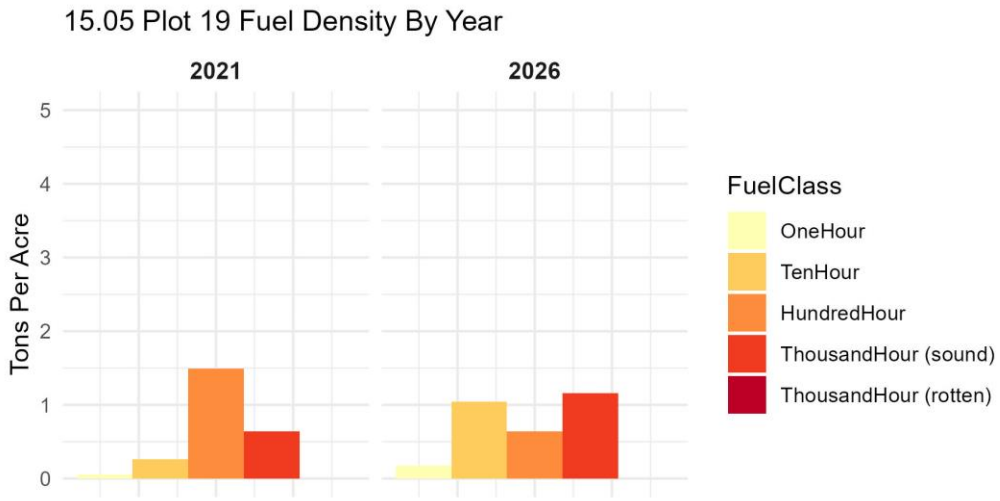


Figure 22: 15.05_19 Fuel Density in 2021 and 2026

In 2021, total fuel density was relatively low, driven primarily by hundred-hour fuels (1.5 tons/acre), thousand-hour (sound) fuels (0.64 tons/acre), ten-hour fuels (0.25 tons/acre), and hundred-hour fuels (0.05 tons/acre).

Overall fuel density increased in 2026, led by thousand-hour (sound) fuels (1.16 tons/acre) and ten-hour fuels (1 tons/acre). Hundred-hour fuels dropped to 0.64 tons/acre, while hundred-hour fuels rose slightly to 0.17 tons/acre. No thousand-hour (rotten) fuels were recorded in either year.

Plot 15.04_14, located in an old farm field, was in a bare area that did not record any fuels data on each of the Brown's transects.

6.4 Data Summary

The monitoring data across project sites (15.01, 15.02, 15.04, and 15.05) utilized low-intensity NMRAM methods in 2015, 2021, and 2026. Overall NMRAM biotic performance varied by location, with Project 15.05 improving to a B/Good (score 3.1), Project 15.02 stayed the same at C/Fair (score 1.9), and Projects 15.01 and 15.04 declining to D/Poor (scores of 1.5 and 1.3, respectively). Across all evaluated sites, exotic invasive plant species cover generally remained a persistent management challenge, while soil surface condition scores held mostly constant with the exception of a decrease in Project 15.04 where the farmland site may be more susceptible to wind erosion or human activities.

Across projects, there was a decline or persistence of poor vertical structural diversity, indicating that project sites did not have adequate canopy recovery for 10-year post-treatment. Native tree regeneration was poor across sites, and on the plot-level, Siberian elm seedlings and saplings were the only woody species recorded. Few mature trees were recorded across plots, five cottonwoods and one Osage-orange.

Across understory environments, a consistent landscape-wide trend emerged toward increased bare ground alongside reductions in plant basal and bole coverage. Ground cover shifts were accompanied by soil texture changes, such as Plot 15.01_1 transitioning entirely from silty clay to sandy loam, and Plot 15.01_5 diversifying into equal proportions of sandy clay, sandy clay loam, silty clay, and silty clay loam potentially indicating erosion activity.

Understory vegetation composition saw shifts in both native diversity and invasive species. Plot 15.01_1 saw a major surge of burningbush (*Bassia scoparia*) cover from 14% to 65% alongside declines in native fourwing saltbush (*Atriplex canescens*), whereas Plot 15.01_5 experienced a decrease in burningbush cover from 50% down to 5%. In Project 15.04, Siberian elm (*Ulmus pumila*) and prickly Russian thistle (*Salsola tragus*) increased from 2021. Finally, surface fuel densities did not change significantly between 2021 and 2026; large thousand-hour sound fuels dominated Plot 15.01_5 but saw substantial reductions from nearly 50 tons per acre in 2021 to 18.5 tons per acre in 2026, while fuel loads on other plots remained lower and shifted primarily between ten-hour and hundred-hour classes.

7 Management Implications

The treatment goals of projects 15.01-15.05 were focused on non-native phreatophyte removal. Ten years post-treatment, the majority of project areas have experienced re-invasion of target species. While CSE plot data recorded invasive tree regeneration on two plots (15.01_5 and 15.04_17), NMRAM data showed Siberian elm and Russian olive as being present in projects 15.01, 15.02, 15.05. Tree-of-heaven was also present in 15.01. Continuous maintenance of these sites would be necessary to manage these species, as well as continuous monitoring to track new invasions that can occur easily from other untreated sites.

Overall, the trend of the monitored sites at the landscape and plot-scale indicates a degrading ecosystem. Even though the original project goal was primarily removal of non-native phreatophytes, most projects also saw increasing bare soil, herbaceous exotic species invasion, and decreasing structure complexity. These trends align within the greater climatic realities of the Middle Rio Grande, as drought and channelization of the Rio Grande River continue to affect adjacent bosque ecosystems. This ecological response requires additional management considerations, including native grass revegetation to reduce bare soil expansion or pole planting to support native willow growth and stabilization. However, more creative strategies may be necessary as water availability is further limited by persistent drought events in the future.

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Appendix I - Modified Hink and Ohmart categories

The following are examples of the modified Hink & Ohmart Vegetation Vertical Structure Type Definitions categories with text from (Muldavin E., 2021). All photos credit NMFWRI.

Multiple-Story Communities (Woodlands/Forests)



Type 1- High Structure Forest with a well-developed understory. Trees (>6 m) with a canopy covering >25% of the area of the community polygon and woody understory layer of tall shrubs or short trees (1.5-6 m) covering >25% of the area of the community (polygon). Substantial foliage is in all height layers.



Type 2 -Low Structure Forest with little or no understory. Trees (>6 m) with canopy covering >25% of the area of the community polygon and minimal woody understory layer (1.5-6 m) covering <25% of the area of the community (polygon). Majority of foliage is over 7 m above the ground.

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



Type 5 -Tall Shrubland. Young tree and shrub layer (1.5-6 m) 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.



Type 6S- Short Shrubland. Short stature shrubs or very young trees (>1.5 m) covering >25% of the area of the community (polygon). Stands dominated by short woody vegetation, may include herbaceous vegetation among the woody vegetation.



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 <25% cover.



Type 6H- Herbaceous vegetation. 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 <25% cover.



Type 7-Sparse Vegetation, Bare Ground. Bare ground, may include sparse woody or herbaceous vegetation, but total vegetation cover <10%. May be natural disturbance in origin (e.g., cobble bars) or anthropogenic (e.g., roads).