LANDSCAPE PERFORMANCE SERIES
presented by the Landscape Architecture Foundation

Española Healing Foods Oasis
Methods

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This investigation was conducted as part of the Landscape Architecture Foundation's 2025 *Case Study Investigation* (CSI) program. CSI matches faculty-student research teams with design practitioners to document the benefits of exemplary high-performing landscape projects. Teams develop methods to quantify environmental, social, and economic benefits and produce Case Study Briefs for LAF's *Landscape Performance Series*.

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The full case study can be found at: https://landscapeperformance.org/case-study-briefs/espanola-healing-foods

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Acknowledgements

The Española Healing Foods Oasis (EHFO) lies at the heart of the Tewa world – ancestral lands stewarded since time immemorial by the Tewa People. Within this cultural landscape shaped by cycles of care, resistance, and return, the EHFO is not just a garden; it is a site of active rematriation, where Indigenous knowledge, ceremony, and foodways continue to root and regenerate.

This landscape of healing and case study would not have been possible without the enduring commitment and leadership of Tewa Women United (TWU), whose Environmental Justice Program has guided and sustained the EHFO through years of advocacy, cultivation, and community engagement. We offer our deepest gratitude to the entire TWU team for their partnership, generosity, and cultural stewardship throughout this process, including:

- Nathana Bird, Interim Executive Director
- Sherry Aragon, Environmental Justice Program Manager
- Ryan Ramaker, Environmental Justice Program Project Coordinator

We also would like to acknowledge and honor Beata Tsosie-Peña, former Environmental Health and Justice Program Coordinator at TWU and founding visionary of the EHFO. Her leadership and vision have created a living example of environmental justice and cultural healing that continues to grow.

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Student & UNM SA+P Recognition

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- LaShannon Begay, 2026 MLA Candidate - stormwater runoff & heat island analysis
- Holly Hearn, 2026 MLA Candidate - infiltration testing & survey development
- Jasmin Self, 2026 MLA Candidate - vegetation survey & biodiversity calculations

Research Strategy

This case study documents the landscape performance of the Española Healing Foods Oasis (EHFO), a continuously evolving site of ecological restoration, food sovereignty, and cultural healing situated in the ancestral Tewa homelands. The research was carried out in four phases and began as part of the Spring 2025 Measuring Landscape Performance Seminar at the University of New Mexico. This early coursework established a collaborative foundation for the study and aligned the research with the Landscape Architecture Foundation's (LAF) CSI Programs initial phases.

Project Scope and Refinement

Initial site boundaries were defined were defined using the original planting plan from the landscape architect; however, a comparison of this plan with and early drone-based aerial mapping of the site revealed that the extent of the current garden has expanded to just over 1.073 acres. Though consultations with landscape architect Christie Green and Tewa Women United, it was confirmed that additional gardens – the Piñon and Dye Garden, Amaranth Garde, and two spiral gardens – were added beyond the original design scope. This evolving site condition required flexible yet clearly defined research boundary to avoid scope creep while still honoring the full extent of the design's landscape performance impacts.

To account for stormwater influences beyond the EHFO footprint, a slightly larger urban watershed analysis was conducted. This included adjacent impervious surfaces (City Hall and the parking lot to the east), which directly affect site hydrology (see Figure 1.1). Several benefit analyses, including stormwater infiltration, microclimate, and soil health, required data collection and observation in zones both within and beyond the formal garden boundary.

Figure 1.1 *- Aerial view looking west toward the Española Healing Foods Oasis and surrounding context. The adjacent predesigned reference site is an untreated slope used for comparison in environmental monitoring.*

Comparative Framework

In all the Environmental Benefit studies, a consistent reference site was used. This untreated slope, located on adjacent city-owned land, served as a baseline for evaluating relative improvement in soil health, stormwater infiltration, biodiversity, and microclimate regulation. While the slope aspect of the reference site faces south-southeast (in contrast to the east-southeast facing EHFO), it was selected for its proximity, similar soil conditions, and lack of landscape intervention, making it a meaningful comparison for performance trends.

Phased Research Approach

The research for this case study progressed through the following phases:

Phase 1: Aligning Benefits with Project Goals and Values

The research team reviewed the Española Healing Foods Oasis project's goals and core intentions through meetings with Tewa Women United and the landscape architect, radicle. Using this foundation, potential benefits were mapped out according to the LAF's benefit categories. Attention was given to identifying culturally grounded and community-defined outcomes, with thoughtful consideration of how to quantify a project that often transcends conventional performance metrics and categories.

Phase 2: Method Development and Consultation

Drawing on the LAF Landscape Performance Series Guidebook and previous case studies, the team selected and adapted methods that were feasible given student capacity, site conditions, and available data. This phase included outreach to topic-area experts for feedback and validation. Plans were also developed for acquiring or building tools such as a DIY infiltrometer and temperature sensors, supplemented by available tools within the UNM Landscape Architecture Department.

Phase 3: Fieldwork and Data Collection

Data was collected between June and mid-July 2025 by the research team. Field data collection included observations, measurements, and testing related to soil health, infiltration, surface hydrology, and biodiversity. In this same timeframe a social benefits survey and numerous interviews were conducted to learn about the community and economic benefits of the EHFO (see Figure 1.3 on the next page).

Phase 4: Data Analysis and Case Study Compilation

As fieldwork progressed, data was organized, analyzed, and visualized to communicate emerging performance trends. Draft findings were regularly reviewed with the gardens managing non-profit, Tewa Women United, to ensure accuracy and alignment with the original goals and values of the project.

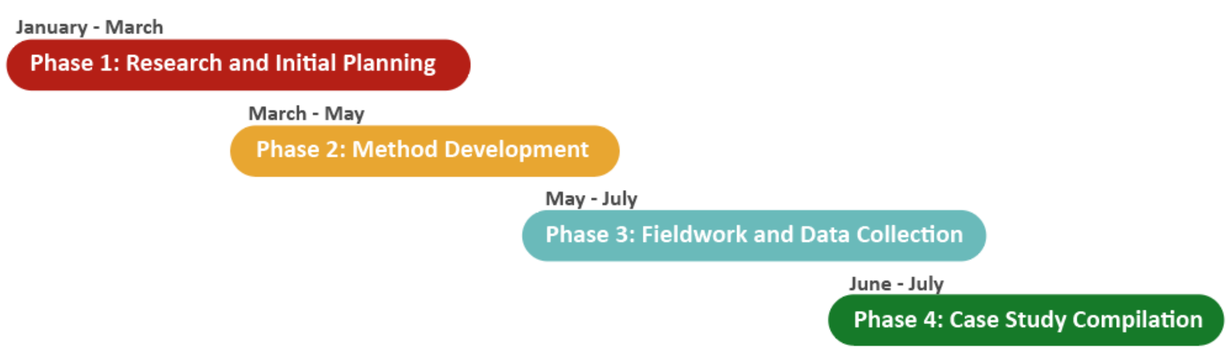

Figure 1.2 *– Research strategy timeline showing development of the case study.*

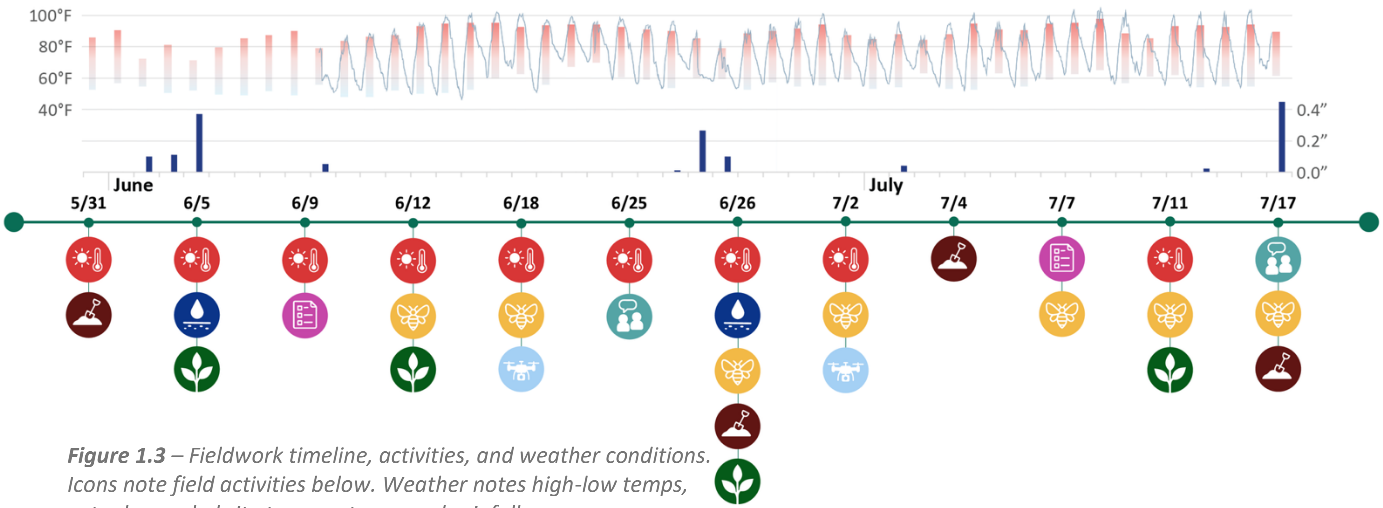

Figure 1.3 – Fieldwork timeline, activities, and weather conditions. Icons note field activities below. Weather notes high-low temps, actual recorded site temperatures, and rainfall.

<u>Microclimate Temperature Readings</u>
Morning, midday, and late afternoon temperature readings were conducted across all zones to compare thermal comfort in the garden, the reference site, and the surrounding urban context.

<u>Soil Health Testing</u>
Soil testing included pH, salinity, compaction, moisture, and microbial activity to evaluate the site’s regenerative benefits. Tests were taken at both the garden and adjacent untreated slope.

<u>Pollinator Observations</u>
Timed pollinator counts and photo documentation were conducted throughout the summer.

<u>Stormwater Infiltration Testing</u>
Double-ring infiltration tests were performed at two garden zones and one location at the reference site to compare infiltration capacity and hydrologic performance.

<u>Survey Outreach</u>
Community surveys were conducted to understand how the site is used and - including both in-person outreach and emailed responses collected through Tewa Women United.

<u>Biodiversity Surveying</u>
Surveys were used to assess herbaceous plant diversity and cover across different zones. Results helped compare species richness between the restored and reference sites.

<u>Meetings with Tewa Women United</u>
Ongoing collaboration and interviews with TWU staff supported our understanding of the garden’s social and cultural benefits.

<u>Drone Mapping</u>
Drone flights were used to capture up-to-date aerial imagery and generate site maps for zone delineation, context analysis, and visuals in this report.

Location and Context

Located along the Rio Grande in Northern New Mexico approximately 25 miles north of Santa Fe, Española, New Mexico is in the heart of the Tewa world (Figure 1.4). The Tewa are a linguistic group of Pueblo Native Americans, who have a deep connection to their ancestral lands. With sacred mountains defining the landscape in four directions, the Tewa have ties to this land since time immemorial and have a rich cultural history and strong traditions that are deeply connected to this place. While Española was not officially incorporated as a city until 1925, it was founded in 1598, 58 years after the Spanish first arrived in this area. Today, Española is a diverse community of just over 10,000 people, predominantly Hispanic and Native American.

Working in a smaller community, the summer heat, and the limited timeframe of the study undoubtedly posed challenges. Interactions with visitors to the EHFO were limited, and survey responses were less than we had anticipated. Nonetheless, the feedback that was received, and the conversations we had were deep and meaningful with those whom we interacted with – proving to me a truly impactful experience in understanding the community's connection to place.

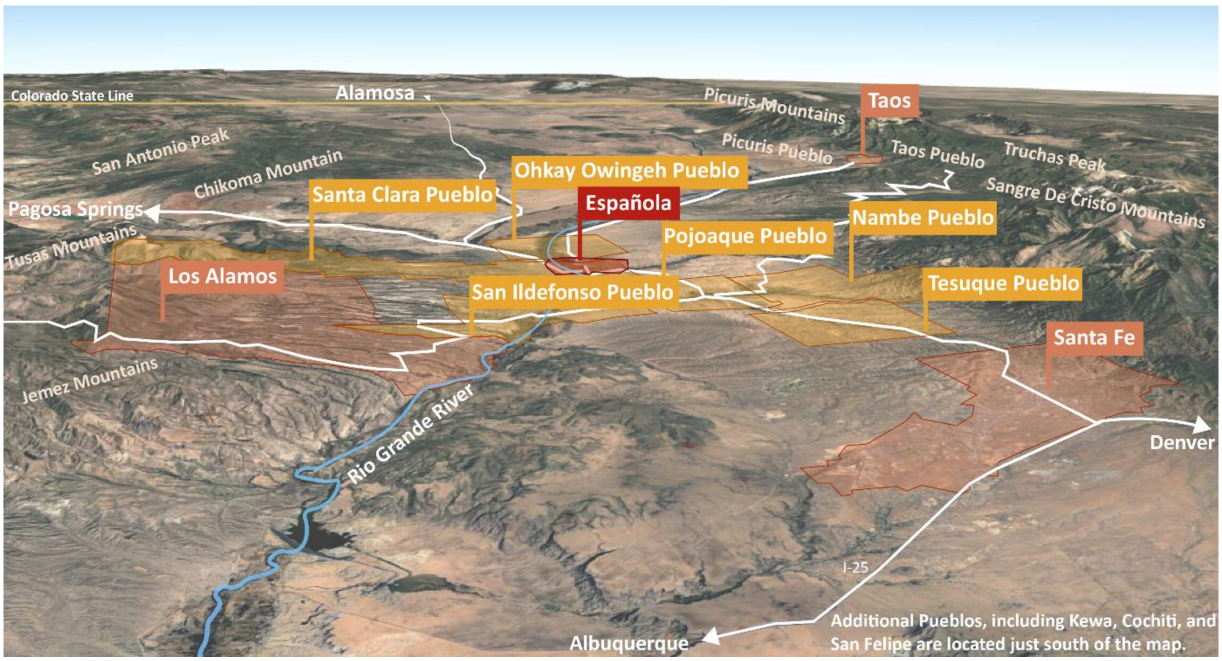

Figure 1.4 *– Map showing the Española Valley in relation to surrounding pueblos, cities and mountains. The Española Healing Foods Oasis sits within the Tewa world, a living cultural landscape shaped by deep relationships between land, water, and community.*

Environmental Benefits

- ***More than doubles soil microbial biomass carbon and supports a more fungal-dominated microbial community in intensively cultivated garden zones, compared to adjacent degraded soils.***

Background

Soil health in arid and semi-arid regions like Española, New Mexico, is shaped by the challenging climate, including limited precipitation (~10 in annually), high evaporation rates (~80 in annually), and low-organic soils. These conditions contribute to alkaline soils (high pH) and elevated salinity (measured via electrical conductivity - EC), both of which have implications for microbial life and plant health.

High soil pH restricts the availability of essential nutrients like phosphorous, iron, and zinc, and influences the composition of microbial communities, often suppressing beneficial fungi. Meanwhile, high EC levels indicate salt accumulation, which can inhibit germination, reduce microbial activity, contribute to surface crusting, and limit infiltration. Together, these two parameters (pH and EC) form a chemical baseline for understanding soil function in arid landscapes.

Additional variables such as compaction, soil moisture, temperature, and microbial biomass are also critical to evaluate ecological recovery, especially in designed or restored landscapes. These factors are tightly interrelated in dryland systems, where microclimates and landform position can produce significant spatial differences in soil function.

At the Española Healing Foods Oasis these dynamics are particularly important. The site includes heavily mulched swales and perennial beds to improve stormwater infiltration and water retention. Additionally, the uppermost swale of the site was ceremonially inoculated with mycorrhizal fungi to support experimental bioremediation of parking lot runoff. This was done using mycelium inoculated pillows placed along the top swale, though only the general location was known by the research team. Evaluating soil health in this context required looking beyond traditional lab metrics to observe and document how physical, chemical, and biological processes interact in situ.

Figure 2.1 *- Site conditions prior to the establishment of the Española Healing Foods Oasis. Photo credit: Tewa Women United.*

Method

To evaluate soil health at the Healing Foods Oasis and compare conditions with the adjacent pre-design reference site, a stratified random sampling approach was used. The study area was divided into four zones based on topographic position, landscape treatment, and availability to runoff or irrigation.

Across these four zones, nine sampling locations were selected to capture representative conditions (Figure 2.2). At each location, soil samples were randomly collected within a 10 ft radius to minimize bias within microsites. The reference site was treated as one sampling zone and included two sampling locations on a south-southeast facing, undeveloped slope exhibiting signs of erosion and limited vegetation cover. This area receives minimal stormwater input from the upper parking lot and represents pre-intervention conditions with a slight change in aspect.

The designed landscape (Española Healing Foods Oasis) was divided into three zones based on slope position and landscape treatment which included:

- Upper Swales (2 locations): Heavily mulched swales on contour that receive initial stormwater runoff from the adjacent parking lot. This area was also inoculated with mycorrhizal fungi as part of a bioremediation strategy.
- Mid-Slope Swales (3 locations): Moderately mulched and planted areas that are more exposed, receiving less direct runoff.
- Lower Orchard Terraces and Spiral Gardens (2 locations): Located at the toe of the slope, these areas contain deeply amended soils and received the most consistent supplemental irrigation and organic input.

Each sample location was georeferenced, and all samples were collected from the top 4-6 inches of the soil profile, following removal of surface mulch and debris. The observations and data collected were used to assess variability in soil chemistry (EC, pH), physical properties (compaction depth, temperature, moisture), and biological (microbial biomass, F:B ratio) indicators based on the landscape treatment.

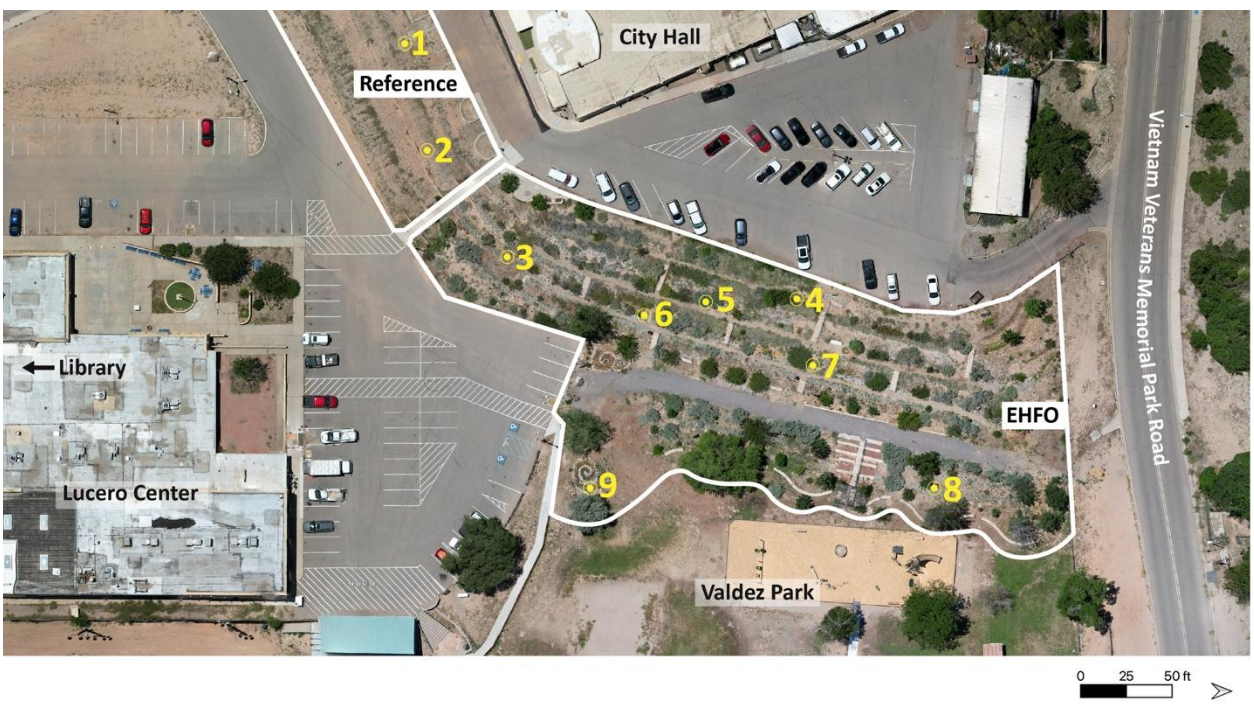

Figure 2.2 *- Initial Map of Soil Sampling Points. Locations 1 and 2 are on the reference site, and the remaining locations are in the Española Healing Foods Oasis.*

Before field testing commenced, the research team consulted NRCS Web Soil Survey to understand the underlying soil types in the area which was confirmed on-site using both hand texture analysis and a jar sedimentation test to roughly estimate sand, silt, and clay percentages. These methods confirmed soils across all test zones to be sandy loam or loamy sand – characteristic of this area in the Rio Grande Valley. This information was used to reference the plant available water (PAW) range and field capacity (FC) for the two soil textures.

Field Measurements and Tools

For this study the following measurements were made using the tools listed below (Table 2.1).

***Table 2.1** – Metrics and Tools used for the soil health study.*

Metric	Purpose/Justification	Tool	Cost Estimate
Soil Texture Class	Confirm soil texture to understand properties	Hand texture analysis and jar sediment test	Free
Soil Moisture (VWC) percentage	Confirm moisture is at or near field capacity (FC)	Vegetronix VG-METER-200 (suitable for alkaline soils)	$120
Soil Temperature at ~4-inch depth	Document soil microclimate conditions	Infrared thermometer used to measure temp in excavated area	$20-50
Depth of Compaction (300psi)	Evaluate compaction & root penetration resistance	Soil compaction meter / Penetrometer	$250
pH & Electrical Conductivity (EC)	Assess chemical environment, salinity	Hanna Instruments HI9811-51 (pH/EC meter) using 1:2 soil-to-distilled water slurry	$275
Microbial Biomass (MBC) & F:B Ratio	Assess and compare biological soil activity	microBIOMETER® test kit & smartphone app	~$10/test, 20-test Starter Kit $200

Initial Sampling Protocol

At the start of each sampling day current weather conditions were noted in addition to precipitation within the past 72 hours. Efforts were made to conduct all soil tests with soil temperatures ranging from 65-86˚F (and not exceeding 104 ˚F) and within 24-48 hours of significant rainfall events to ensure likelihood of elevated microbial activity. Volumetric Water Content (VWC) were measured to confirm that soil moisture was within the plant available water range for loamy sand/sandy loam soils, with field capacity being ~20%. Once verified, the remaining tests were conducted. Soil compaction, noted above, was only tested at all sites during the infiltrometer testing. All results are noted in Appendix A.

Sampling was repeated on four different days for each sampling location during the study, with exception of the microBIOMETER® test which was conducted three times and included aggregated samples for the four zones – one test for the reference site (plots 1 & 2), one test for the upper swales (plots 3-7), one test for the orchard terrace (plot 8), and one test for the spiral garden (plot 9).

pH and EC Testing Protocol

In the field, soil pH and EC were measured using a rapid 1:2 soil-to-water slurry method (Figure 2.3):

1. Calibrate EC probe (per the manufacturers recommended instructions and solution)
2. Gather 5-10 randomly selected sample cores of consistent volume (using the tubular sampler) within a 10 ft radius of the sampling location staying within the landscape zone.
3. Combine and mix thoroughly for a representative sample.
4. Sift 20 mL of the soil sample and mix with 40 mL of distilled water in a clean container.

Field Method (for relative comparison)

5. After mixing thoroughly, allow the slurry was allowed to settle for 10-15 minutes and test the pH and EC (in the solution, not the sediment), allowing the meter to stabilize for ~30 seconds before reading. Remove and rinse the electrode with distilled water when finished.

Laboratory-Standard Method (For most scientifically valid results)

1. Follow steps 1-4 above.
2. After mixing thoroughly, allow the slurry was allowed to settle for 30 minutes and test the pH (into the solution, not the sediment), allowing the meter to stabilize for ~30 seconds before reading. Remove and rinse the electrode with distilled water when finished.
3. Wait four additional hours and reinsert the electrode and test the EC (into the solution, not the sediment), allow the meter to stabilize for ~30 seconds before reading.
4. Remove and rinse the electrode and container with distilled water when finished to prevent cross contamination.

Figure 2.3 *- Field testing on June 26th. Left: Measuring soil moisture at ~4-inch depth using the Vegetronix VG-METER-200 sensor. Right: Preparing a 1:2 soil-to-distilled water slurry to test pH and electrical conductivity using the Hanna Instruments HI9811-51 meter.*

Microbial Biomass Protocol

To evaluate microbial biomass and the fungal to bacterial (F:B) ratio, we used the microBIOMETER®, a field-based test that relies on colorimetric analysis. Using a patented method, the microbes are extracted and suspended in the fluid which is then sampled, placed on a test card, and scanned and analyzed using a smartphone application (Figure 2.4).

To assess soil conditions across the site, an initial approach was taken to collect and test composite samples from each of the 9 sampling locations. However, as the study progressed, due to time, resources, and consistency considerations, we adopted a composite sampling method at the zone scale.

Following the same zone and sampling location and procedure as above:

1. For each testing zone, gather 5-10 randomly selected sample cores of consistent volume (using the tubular sampler) within a 15 ft radius of the sampling location to minimize microsite bias.
2. Combine and mix thoroughly for homogenized composite sample.
3. Sift 5 mL of soil to use for the microBIOMETER test.
4. Following the standard micro microBIOMETER testing procedures
   - Mix soil with the extraction powder and distilled water
   - Allow the solution to settle for 25 minutes
     - *Note: Due to our sandy soils and readings on the first round of testing requiring additional drops (see below), microBIOMETER recommended a shorter settling time. For consistency, 10 min settling time was used for this study.*
   - Apply exactly 3 drops of the sample solution to the test card
     - *Note: Our initial smartphone scans prompted additional drops, requesting an additional 3-6 drops per test card. To ensure consistency, the final three rounds of testing all used 6 drops per test card. See limitations below for more information on testing challenges.*
   - Scan using the smartphone app to determine the microbial biomass carbon (μg C/g), Fungal-to-Bacterial Ratio (F:B), and percent fungal and bacterial composition.
5. Tests were repeated 3 times per zone over the course of the study, ideally after rainfall events or irrigation when microbial activity is expected to be highest.
6. To ensure scientifically valid and comparable microBIOMETER results, all test cards must be handled per manufacturer instructions, and must use the same settling time, and number of drops. Consistent lighting conditions must be used when using the smartphone application.
7. All containers and tools must be cleaned between samples to prevent cross-contamination.

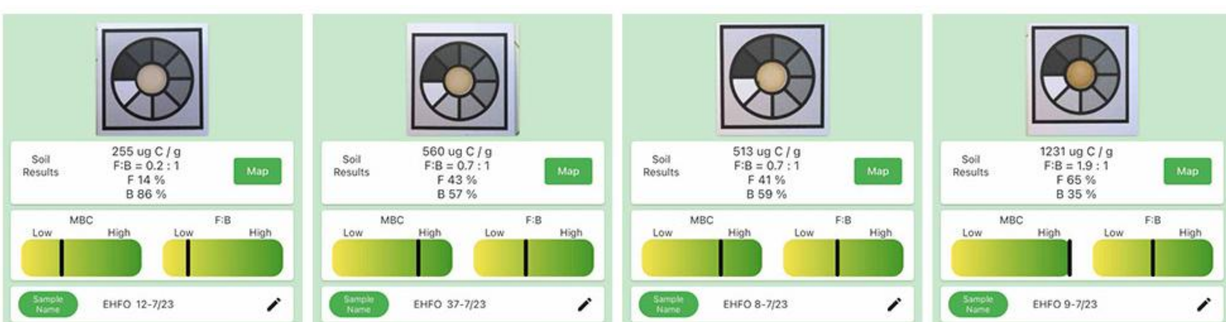

Figure 2.4 *– Screen captures from the microBIOMETER app showing results from composite samples taken within 24-hours of a 0.44" rainfall. Images from the left to right show results from the degraded reference site, heavily amended upper swales, deeply mulched orchard terrace, and deep organic soils of the spiral garden respectively.*

Calculations

<u>Average microbial biomass = X µg C/g</u>
Adjacent Pre-Design Reference Site: (311 + 392 + 255) / 3 = **319 µg C/g**

Upper & Mid-Slope Swales (EHFO): (160 + 430 + 560) / 3 = **383 µg C/g**

Lower Terraces & Spiral Garden (EHFO): (418 + 311 + 513) + (700 + 639 + 1231) / 4 = **635 µg C/g**

<u>Increase in EHFO highly amended areas vs. Reference:</u>
635 / 319 = **2x increase in microbial biomass carbon (MBC)**

<u>Average F:B ratio</u>
Adjacent Pre-Design Reference Site: (0.6 + 0.5 + 0.2) / 3 = **0.43:1 F:B Ratio**

Upper & Mid-Slope Swales (EHFO): (0.2 + 0.5 + 0.7) / 3 = **0.46:1 F:B Ratio**

Lower Terraces & Spiral Garden (EHFO): (0.8 + 0.5 + 0.7) + (1.4 + 1.1 + 1.9) / 6 = **1.1:1 F:B Ratio**

Discussion

This soil health study was approached from an ambitious, practice-informed perspective, grounded in the values and constraints of landscape architecture rather than laboratory science. While the Research Fellow has a limited background in soil science, the methods employed were part of an iterative learning process, refined by trial, error, and critical analysis. Early tests helped to understand the limitation of certain tools and field protocols, leading to more consistent procedures by the end of this study.

Across the study, the use of accessible tools allowed the research team to monitor chemical, physical, and biological soil parameters. Findings revealed that electrical conductivity (EC) was consistently lower in the designed landscape in initial rounds of testing, However, all readings fell below salinity stress thresholds (<4.0 dS/m), suggesting salinity was not a major limiting factor in this landscape. These observations support the use of mulch, organic inputs, and water harvesting in helping to prevent salt accumulation in arid soils.

Soil pH remained alkaline (8.3-9.2) across all tested zones, regardless of landscape treatment. This aligns with regional soil chemistry, where calcareous parent materials and low rainfall reinforce high pH and strong buffering capacity. Despite this, microbial activity showed a clear increase in less exposed areas of the landscape which include increased soil amendments and irrigation. While results were more variable in the early rounds of sampling, later tests yielded more reliable values with increasing monsoonal rainfall, soil moisture, and more refined sampling procedures.

Together, the data collected, and findings illustrate how landscape design can contribute to improved soil health in challenging arid, while also highlighting the value (and limitations) of designer-led monitoring using accessible tools with minimal formal scientific guidance.

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Limitations

- During the six-week field study window, only two minor precipitation events (<0.50 in) occurred, and the region was classified as being under severe to extreme drought. While tests were timed to be aligned with peak microbial activity following rainfall events, soil moisture was variable.
- At the conclusion of the study, it was discovered that the site's irrigation system had been non-operational, and only select plantings were hand watered. This could explain the disparity in microbial testing results between the more intensively managed lower terraces and drier upper swales of the garden.
- Microbial biomass results from the barren reference site initially showed unexpectedly high values, likely due to bacteria-dominated communities in the bare soil. While zone-level differences in biomass and F:B ratios are meaningful, comparisons across zones should be interpreted cautiously, and paired with physical and chemical indicators.
- Microbial testing in arid soils is challenging due to low organic matter, sparse root networks, and dormant microbial communities when soil moisture and temperature is below critical thresholds. This can reduce the sensitivity of tests like the microBIOMETER, and underestimate biological activity.

- Initial rounds of testing produced unusable data due to challenges including rapid settling of soil samples and unreadable test cards. After consulting with Microbiometer, we refined our approach by shortening the settling time from 20 to 10 minutes and consistently adding three additional droplets (six total) to each test. Expanded composite sampling was also used to improve representation and decrease the number of tests needed.
- Most EC readings were conducted using a field-prepared 1:2 soil-to-distilled water slurry, stirred for ~30 seconds and settled for ~15 minutes. While this method is supported by some field protocols for rough estimates, it does not meet lab-grade standards and may slightly under- or overestimate true salt concentration.
- Due to the sample size, results should be interpreted as preliminary indicators of microbial trends rather than definitive site-wide conclusions.
- This study was conducted by a landscape architecture team without formal soil science training, using accessible methods and tools. Findings should be viewed as practice-informed rather than lab-validated.
- A pre-design soil contaminant study indicated pollutant levels were below significant thresholds, but the report could not be obtained during the case study.
- The research team was unable to coordinate with UNM Biology to test the efficacy of bioremediation at the site.

Environmental Benefit

- ***Improves stormwater infiltration rates over 18 times, from 1.62 in per hour in adjacent untreated slopes to over 10 in per hour in the amended contour swales and terraces, demonstrating the site's capacity to absorb intense rainfall events and reduce surface runoff.***

Background

Across northern New Mexico and throughout the arid southwest, short but intense summer monsoon rains can lead to destructive runoff events that quickly erode soils, overwhelm infrastructure, and culminate in flash flooding. At the Española Healing Foods Oasis, stormwater is treated as a vital resource, providing an example of how stormwater can be effectively managed in a small urban watershed. Before 2018 the sloped site experienced considerable sheet and rill erosion that deposited sediment across sidewalks leading to the library/community center parking lot and the park below. To transform this liability into an asset, the site design intercepts runoff and redirects it into the landscape in three heavily amended contour swales and terraces to support plant and soil health.

At the surface, what may seem like contemporary approaches to green infrastructure, Indigenous peoples and their ancestors in this region have practiced these techniques for thousands of years. Techniques like grid gardens, stone terracing, rock mulching, and check dams work in a dynamic relationship with seasonal water cycles. As Dr. Gregory Cajete (Tewa) describes in his book *Native Science*, these practices emerge from generations of observation, experimentation, and cultural adaptation rooted in relationship to place. In Tewa culture, the Avanyu - a water guardian often depicted as a serpentine figure that represents the dynamic flow and life-giving power of water. In traditional teachings - reminds people of the spiritual and ecological importance of respecting and moving in rhythm with water rather than referencing it. The Española Healing Foods Oasis embodies this teaching by blending traditional ecological knowledge with contemporary construction techniques to address erosion, restore infiltration, and honor the ongoing legacy of reciprocity with the land.

To evaluate effectiveness through observation and experimentation, this study explored infiltration rates – how quickly water enters and moves through the soil – using a double-ring infiltrometer. This method reinforces how greater infiltration supports groundwater recharge, reduces surface runoff, and helps to improve soil biology.

<u>Study Objectives</u>

- Quantify infiltration performance of the designed site compared to the untreated or baseline conditions of the adjacent site.
- Evaluate the effectiveness of heavily amended contour swales and terraces in reducing runoff and promoting groundwater recharge.
- Support stormwater-related performance benefits by providing empirical data that can be translated into measurable outcomes.
- Inform landscape maintenance and management by identifying zones of increased infiltration performance across different site features and soil treatments.

Figure 2.5 *- Initial grading of the Española Healing Foods Oasis site. Heavy machinery was used to recontour the eroded slope, creating a stable foundation for future terraces, planting zones, and stormwater interventions. Images courtesy of Tewa Women United (Facebook).*

Figure 2.6 *– Planting and mulching efforts during the early establishment of the Española Healing Foods Oasis. Volunteers and Tewa Women United staff established terraces, added compost and mulch, and planted to stabilize the slope and support long-term ecosystem function. The final image shows the terracing in action, with stone retaining walls, mulch, and young plantings working together to slow runoff and promote infiltration. Images courtesy of Tewa Women United (Facebook).*

Method

Infiltration testing was conducted at three locations to compare the performance of the Española Healing Foods Oasis with the adjacent untreated landscape. Locations were selected to represent a range of conditions and were also used for the soil health assessment:

- Location #1 (Reference/Baseline Condition): an untreated slope outside of the EHFO boundary, with sparse vegetation and signs of erosion.

- Location #2: the upper swale within the EHFO designed to capture and infiltrate runoff from the adjacent City Hall parking lot.
- Location #3: a lower planting terrace within the EHFO with deeper much and more dense vegetation.

These sites reflect variability in slope, vegetation, and soil conditions across the study area. All locations were marked with temporary flags and GPS coordinates to support future monitoring and studies. Figure 2.7 below shows the location and description of each test site.

***Figure 2.7** – Map of the Infiltration testing locations.*

***Figure 2.8** – (Left) Infiltration study test location map. (Middle) Test plot #2 in the upper contour swale of the EHFO. (Right) Test plot #3 in the lower orchard terrace of the EHFO.*

Field Measurements and Tools

At the start of each infiltration test a soil compaction meter (penetrometer) was used to test the depth to compaction (300 psi) in the general location, to observe any potential correlation to the to the infiltration test results.

Infiltration rate (in/hr) was measured using a double-ring infiltrometer. Due to the high cost of commercial models ($220–$700), a custom infiltrometer was constructed from scrap 30-gauge galvanized steel duct piping. While standard designs typically use a 12-inch inner ring and 24-inch outer ring, the DIY model utilized a 4-inch diameter inner ring and 10-inch diameter outer ring. Both rings were cut to a height of 18 inches, allowing for 3 inches to be inserted into the soil and for above-ground reference marks at X and X inches to track the descent of the water column over time.

To fasten the rings in place, each was secured with two 2-1/4 inch bolts, washers, and nuts. Silicone caulk was applied at all seams to prevent water leakage between rings. A 2x2-inch wood board, cut slightly larger than the ring diameter, was used to stabilize the structure during installation. Notches were carved into the underside of the board to hold the rings in place and provide a durable surface for hammering.

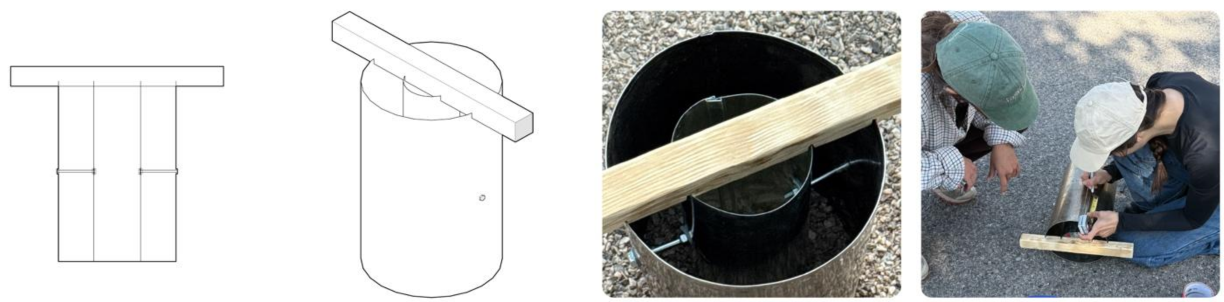

Figure 2.9 *– DIY infiltrometer design and field prep*

Figure 2.10 *– The DIY double-ring infiltrometer showing signs of wear after repeated field use. This low-cost alternative was used to measure stormwater infiltration rates in both the garden and the adjacent untreated slope*

Infiltration Testing Protocol

1. **Pre-soak**: Each testing location was pre-wet with 5 gallons of water 24 hours before testing to simulate field capacity.
2. **Site Preparation**: Surface vegetation and debris were cleared to expose the bare mineral soil below, and infiltrometer rings were hammered into the soil to a depth of 3 inches.
3. **Measurement**:
    - Water was poured to a depth of 7 in.
    - Time was recorded for the water level to drop from 7 to 4 in.
    - The infiltrometer was refilled and the recordings were repeated for multiple pour cycles.
    - Pour cycles were repeated until the difference in infiltration time was less than one minute difference
4. **Rate Calculation**:
    • Infiltration Rate (in/hr) = (Depth ÷ Time in sec) × 3600
    • Steady-state rate was calculated by averaging the 3rd and 4th pours.
    • Rates were compared to Hillel's standard of 0.8 in/hr for sandy soils.

All measurements were used in the Horton Infiltration Model which predicts infiltration over time, expressed in inches per hour, with a simple curve fit.

Raw data was logged in spreadsheets and used to model the infiltration rate over time. A hydrologist from Los Alamos National Laboratory provided a Python code via Google Colab to model the infiltration rate using Horton's Infiltration Equation.

Data Collected

***Table 2.2** – Infiltration Data from June 26th between 9:30am and 2:30pm.*

Site #	Pour #	Time (seconds)	Inches Infiltrated	Infiltration Rate (in/hour)	Soil Compaction Meter Reading (depth to 300 psi)
#1	1	1236	3.000	8.738	6-9 in
#1	2	5100	3.000	2.118	
#1	3	3600	1.625	1.625	
#2	1	81	3.000	133.333	9-15 in
#2	2	61	3.000	177.049	
#2	3	105	3.000	102.857	
#2	4	104	3.000	103.846	
#2	5	171	3.000	63.158	
#2	6	169	3.000	63.905	
#2	7	179	3.000	60.335	
#2	8	183	3.000	59.016	
#3	1	168	3.000	64.286	14-20 in
#3	2	347	3.000	31.124	
#3	3	350	3.000	30.857	
#3	4	431	3.000	25.058	
#3	5	361	3.000	29.917	
#3	6	378	3.000	28.571	

Calculations

The Horton Infiltration Model was used to simulate how infiltration rates decrease over time during a rain event. This model reflects the typical behavior of soil, where infiltration is highest at the beginning of rainfall and gradually decreases to a constant rate as the soil becomes saturated. The Horton Model is widely used in stormwater and landscape design due to its simplicity and effectiveness in estimating infiltration under varying soil moisture conditions.

Using basic field data collected through infiltration testing, the model was applied to simulate realistic infiltration behavior at the site.

Horton Equation: $f(t) = fc + (f_0 - fc) \times e^{(-kt)}$

Where:

- $f(t)$ = infiltration rate at time t
- f_0 = initial infiltration rate
- fc = final (steady state) infiltration rate
- k = decay constant
- t = time since start of infiltration

A Google Colab notebook was created to model the Horton Infiltration Equation using data collected from infiltration testing sites #1, #2, and #3. The notebook includes all equations, data inputs, and visualizations used to simulate infiltration behavior over time. Horton infiltration curves can be found in Figures 2.11 – 2.13 on the next page.

Access the Colab notebook here:
https://colab.research.google.com/drive/1bWoILxcUkJJN15tFFbFYOEF8nVhijzq7?usp=sharing

Horton's Infiltration Equation steady-state infiltration results:

Site 1 (Unimproved):	0.00045 in/sec	1.62 in/hr
Site 2 (EHFO):	0.008263 in/sec	29.75 in/hr
Site 3 (EHFO):	0.014758 in/sec	53.13 in/hr

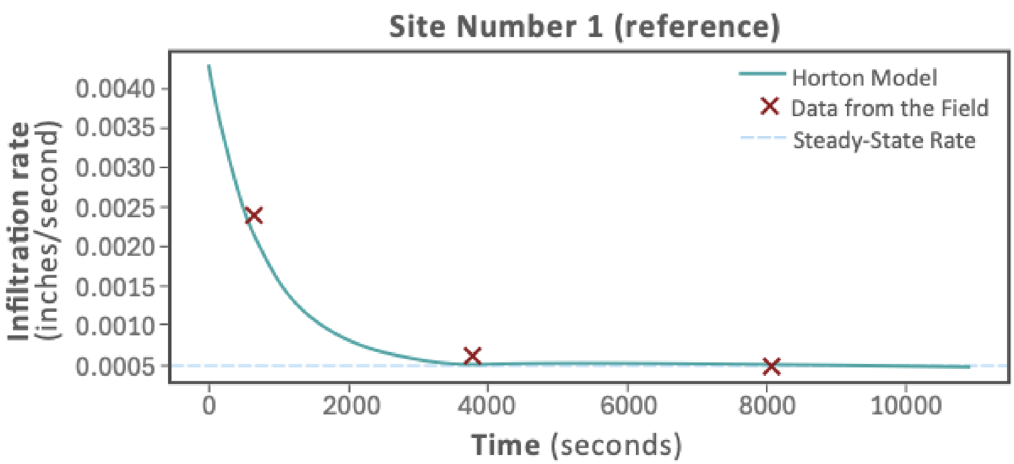

Figure 2.11 *– Horton infiltration curve for location #1*

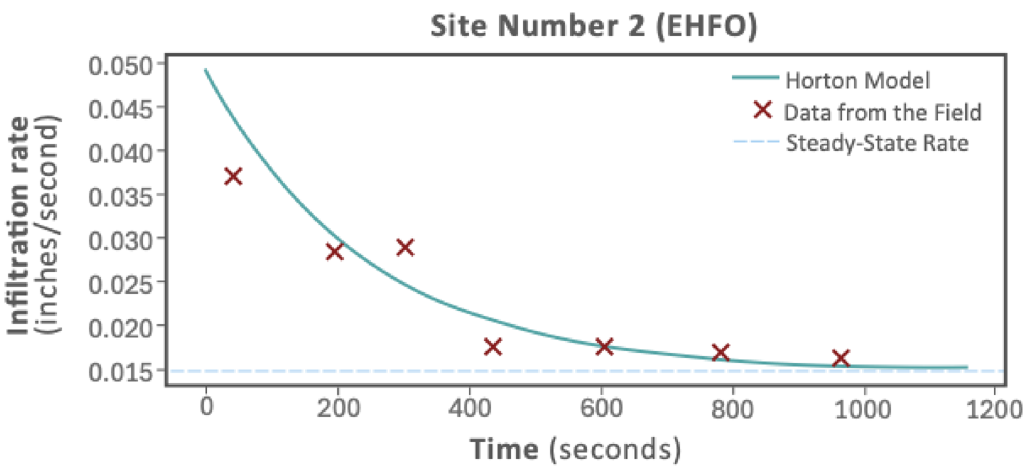

Figure 2.12 *– Horton infiltration curve for location #2*

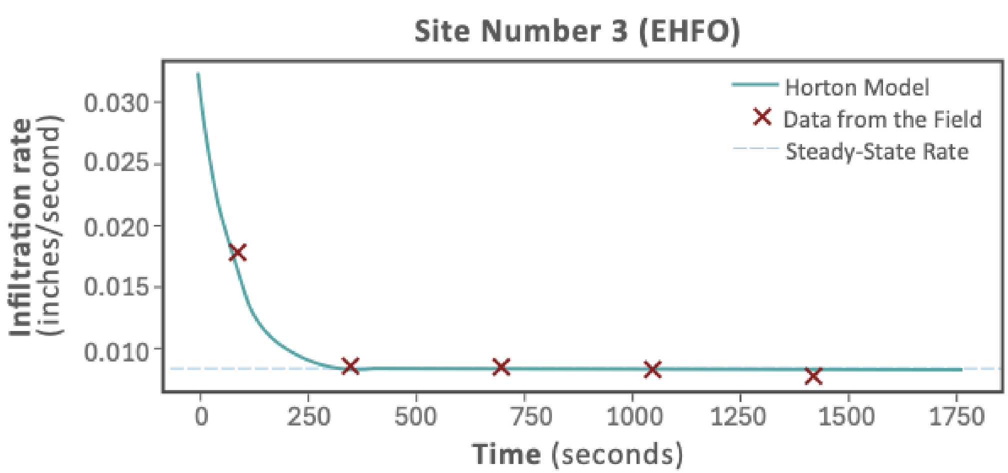

Figure 2.13 *– Horton infiltration curve for location #3*

Discussion

Infiltration rates within the garden's swales and terraces ranged from 29.75 to 53.13 inches per hour, compared to just 1.62 inches per hour on the adjacent untreated slope, representing a more than 30-fold increase. Recognizing that these rates are incredibly high, the Research Fellow conducted quick literature review to confirm if these numbers are valid. Two published studies, one study examining an urban watershed in North Carolina and another in Washington State, noted mean infiltration capacity as high as 42.78 in/hr in an urban forest (Bergeson 2022) and a steady state-infiltration rate 48-50 in/hr in a highway runoff retention basin (Horner 2022). The first study makes the argument that actual infiltration rates in the field may be underestimated by models, but the second study notes there may have been an equipment malfunction in their study. Therefore, out of caution, this study notes in the Benefit that the infiltration rates at the EHFO confidently exceed 10 in/hr – but may in fact be much higher and warrant follow up testing with professional grade equipment.

Nonetheless, the infiltration results from this study demonstrate the effectiveness of the EHFO in enhancing stormwater performance through low-impact soil interventions. These outcomes reflect the cumulative impact of mulching, organic amendments, root penetration, and microtopography in restoring soil porosity and function.

Given Northern New Mexico's monsoonal climate, where short and intense storms are common, this capacity to rapidly absorb water is critical for reducing erosion, recharging soil moisture, and minimizing runoff. The Española Healing Foods Oasis integrates traditional and contemporary stewardship practices and offers a replicable model for improving infiltration on degraded urban sites with minimal infrastructure.

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Limitations

- At the reference site, compacted soils made it difficult to hammer the infiltrometer rings into the ground, which resulted in slight bending of the tool. While this did not significantly affect the test results, it could introduce minor inconsistencies.
- The Horton model is empirical, meaning it doesn't account for soil properties like texture, moisture content, or saturation, so it may oversimplify real-world conditions. It also assumes uniform rainfall and neglects the effects of ponding, layered soils, or water table interactions, limiting its accuracy in complex or long-duration events.
- According to Web Soil Survey, the EHFO is part of the Florita-Rock outcrop complex, and the currently undeveloped area is part of Oelop fine sandy loam. Although these complexes are characteristically similar, they are different underlying soils.
- Although all test locations received rainfall the previous day, the tests were not done simultaneously, and the rapid heating of the intense morning sun may have quickly dried out soils during the study.
- All data was collected on one sampling day, June 26, 2025, and climate conditions such as rainfall and temperature may have affected results. A limited number of replicates were collected per site and may not capture full spatial variability.

Environmental Benefit

- ***Captures up to 90% of runoff volume from the adjacent city hall building and parking lot during a 90th percentile storm event (0.70 in), retaining approximately 3,800 cu ft of rainwater (volume equivalent to 2.8 tanker trucks).***
- ***Reduces runoff up to 84% during a 10-year, 24-hour rainfall event (2.00 in) compared to the highly eroded baseline site condition, demonstrating performance and resilience in extreme rainfall events.***

Background

The Española Healing Foods Oasis is situated downslope from the City Hall building and its eastern parking lot. Before the garden was constructed, the site consisted of a degraded slope where stormwater flowed directly offsite, contributing to erosion and the loss of valuable water resources. The current design features three contour swales and several terraces planted with native, edible, and medicinal vegetation. The swales are supported by earthen and cobble berms to capture and infiltrate runoff, with spillway designed to reduce the velocity of water overflowing the system (Figure 2.14). Together, these interventions transform the site into a passive water-harvesting system, reducing irrigation demand and helping to mitigate downstream flooding.

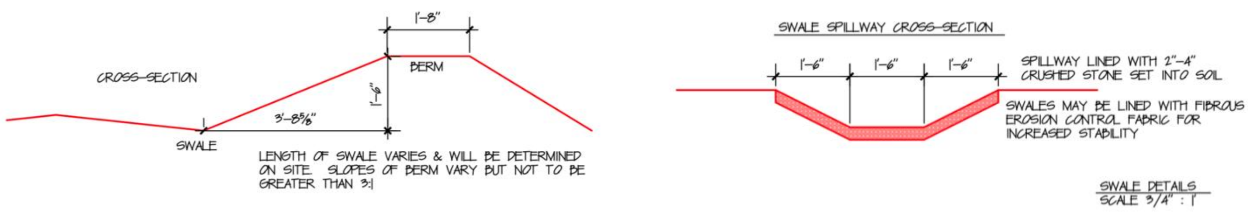

Figure 2.14 *– Swale detail from radicle landscape architecture*

Method

To estimate stormwater runoff and capture, three tools were evaluated before determining the most reliable, user-friendly, and efficient method. While the National Stormwater Calculator (NSC) is frequently used in Landscape Performance Series Case Studies, its limitations became apparent when attempting to use this method for the project. Most notably, NSC oversimplified the site, treating soil, slope, and drainage, leading to results which did not align with field observations and accounts of improvements witnessed in the small urban watershed.

Storm Water Management Module (SWMM), developed by the US EPA, was also considered. While SWMM is the most capable tool for simulating the effectiveness of the site's detailed hydrology, it requires substantial setup time, technical expertise, and calibration to build and run the simulations.

Therefore, it was determined that the most accessible and effective watershed evaluation tool was ModelMyWatershed.org. This web-based tool offered a balance of usability and scientific rigor which incorporates local soil data, land cover, land cover editing, and simple scenario modeling. Part of Stroud Water Research Center's WikiWatershed initiative. This tool allows users to model stormwater runoff and water quality using SLAMM and TR-55 model algorithms and compare different land cover and conservation practice scenarios (Stroud Water Research Center 2025).

Land Cover Mapping

Site Mapping and Catchment Delineation:

- A drone-based photogrammetry survey using 10 surveyed ground control points, was used to generate a high-resolution (ground resolution of 2.1 cm/pixel) orthophoto and topographic surface model of the EHFO and contributing areas (Relative horizontal accuracy of 0.167 m and vertical accuracy of 0.290 m).
- Using the orthophoto, land cover types were delineated in CAD and classified into the following categories: impervious (roof + pavement), contour swales/rain gardens, pervious ground, and tree cover for the EHFO site's current condition (Figure 2.15 & Table 2.3)
- To determine the extent of the urban watershed contributing runoff to the EHFO site, a digital surface model (DSM) was produced from the drone-based photogrammetry survey and processed in GIS to derive a 1 ft contour map. This allowed the team to determine the slope and direction of runoff from the city hall rooftop and parking lot, in addition to the EHFO site and surrounding context. From this we visually determined the extent of the watershed used in the area calculations for the hydrological scenario modeling. A GIS shapefile was created and used in both the CAD area takeoffs and imported into ModelMyWatershed.org.
- Pre-development conditions and slope were determined by examining historical imagery and elevation data in Google Earth, referencing the site conditions in November 2015.

***Figure 2.15** – (Left) 2015 Google Earth imagery referenced for the baseline conditions scenario modeling. (Right) CAD area takeoffs and contributing watershed boundary delineation traced over the high-resolution orthophoto.*

Obtaining Rainfall Data

To model the impacts under typical rainfall events to the pre- and post-design conditions, percentile rainfall events for 24-hour distribution were retrieved for the two closest weather stations to the site (EPA and NMED 2015).

- Los Alamos 90th percentile rainfall event: 0.69 in
- Santa Fe 2 90th percentile rainfall event: 0.68 in
- Modeled as: 0.70 in/24-hours

To model the impacts in a design storm event to the pre- and post-design conditions, Point Precipitation Frequency (PF) Estimates were retrieved for a 10-year, 24-hour storm event was selected for peak performance modeling (NOAA 2023).

- Española NM 10-year, 24-hour rainfall event: 1.96 in (90% confidence interval 1.79-2.15)
- Modeled as: 2.00 in/24-hours

Scenario Modeling Using ModelMyWatershed.org

- Uploaded the delineated watershed shapefile (zip containing shp and prj files) into ModelMyWatershed.org
- Under the Analyze tab:
  - Confirmed accuracy of the Land Use/Cover 2019 (NLCD19) – Noted percentages were off from the site mapping numbers due to the coarse resolution of the data
  - Confirmed accuracy of the Soil – Noted to be generally accurate
  - Confirmed accuracy of the Terrain – Noted the slope maximum was much lower (7.0%) than the 30% observed on site
- Under the Model Tab
  - Baseline Scenario
    - Select [+ New Scenario] and renamed as "Baseline Scenario"
    - Using [+ Land Cover] modified the impervious area of City Hall and the parking lot to "Developed-High" and the EHFO site to "Barren Land"
    - Adjusted the Precipitation toggle to 0.70 in to model the 90th percentile rainfall event and recorded the runoff, evapotranspiration, and infiltration numbers
    - Adjusted the Precipitation toggle to 2.00 in to model the 10-year, 24-hour design storm event and recorded the runoff, evapotranspiration, and infiltration numbers
  - Design Scenario
    - Under Baseline Scenario, select duplicate and rename as "Design Scenario"
    - Select and delete the EHFO site polygon for "Barren Land"
    - Using [+ Conservation Practice] added a "Rain Garden" polygon the size of all the contour swales on site (for efficiency) at the top of the EHFO site adjacent to the "Developed-High" polygon
    - Using [+ Land Cover] modified the remainder of the EHFO site to "Shrub/Scrub" which most accurately represents the current site condition (*NLCD Class 52: Areas dominated by woody shrubs or small trees less then 5m tall with shrub canopy typically greater then 20% of total vegetation*)
    - Adjusted the Precipitation toggle to 0.70 in to model the 90th percentile rainfall event and recorded the runoff, evapotranspiration, and infiltration numbers
    - Adjusted the Precipitation toggle to 2.00 in to model the 10-year, 24-hour design storm event and recorded the runoff, evapotranspiration, and infiltration numbers

***Table 2.3** – Area takeoffs for the site land use/cover for the upper EHFO site and contributing urban watershed. Calculated from the high-resolution orthophoto and watershed area determined from the drone-based (DSM).*

Baseline Scenario

EHFO + Watershed Pre-Development Condition

Land/Use Cover	Area (ft²)	Area (ac)
Developed-High	53,429	1.2
Barren Land	24,026	0.6
Total Area	77,455	1.8

Design Scenario

EHFO Site + Watershed Current Condition

Land/Use Cover	Area (ft²)	Area (ac)
Developed-High	53,429	1.2
Shrub/Scrub	20871.03	0.5
Rain Garden	3154.97	0.1
Total Area	77,455	1.8

Calculations

Using the land/use cover data obtained above, runoff, evaporation, and infiltration amounts were calculated for a 90th percentile rainfall event and 10-year, 24-hour design storm event for both the baseline scenario (EHFO + watershed pre-development condition) and the design scenario (EHFO + watershed current condition). All calculations were performed in the Model My Watershed web-based tool (Figure 2.16 & Table 2.4).

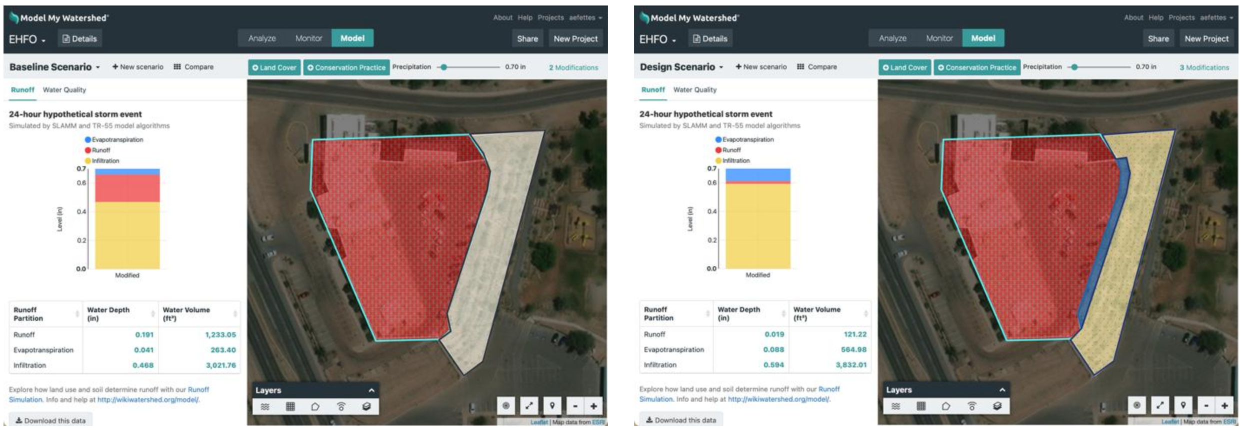

Figure 2.16 *– ModelMyWatershed.org screen capture of the model and results for the 90th percentile rainfall event (0.70 in) for the Baseline Scenario (Left) and Design Scenario (Right).*

Table 2.4 *– Scenario modeling results from Model My Watershed.*

Baseline Scenario

EHFO + Watershed Pre-Development Condition

Model: 90th Percentile Event (0.70 in)

	Depth (in)	Volume (ft³)
Runoff	0.191	1,233.05
Evapotranspiration	0.041	263.40
Infiltration	0.468	3,021.76

Model: 10-year, 24-hour Storm (2.00 in)

	Depth (in)	Volume (ft³)
Runoff	0.88	5,682.50
Evapotranspiration	0.041	263.40
Infiltration	1.079	6,963.28

Design Scenario

EHFO Site + Watershed Current Condition

Model: 90th percentile event (0.70 in)

	Depth (in)	Volume (ft³)
Runoff	0.019	121.22
Evapotranspiration	0.088	564.98
Infiltration	0.594	3,832.01

Model: 10-year, 24-hour Storm (2.00 in)

	Depth (in)	Volume (ft³)
Runoff	0.138	888.74
Evapotranspiration	0.088	564.98
Infiltration	1.775	11,455.46

Discussion

Modeling with Model My Watershed demonstrated the capacity of a design to significantly reduce stormwater runoff volume under both typical and extreme rainfall conditions. During the 90th percentile storm event (0.70 in), the site captured approximately 90% of runoff from the adjacent City Hall parking lot and building – equivalent to over 3,800 ft^3, or roughly 2.8 semi-tanker trucks. This highlights the systems effectiveness in managing frequent, moderate intensity storms that contribute to most urban runoff and pollutant loading. Under a more intense 10-year, 24-hour storm event (2.00 in), the model showed an 84% reduction in total runoff volume compared to the pre-design condition. These results demonstrate not only strong baseline design performance, but also resilience under high-intensity rainfall events. While the model's spatial resolution is coarse and does not account for internal site flow direction, it effectively captured the impact of land cover change and green infrastructure on a small urban watershed.

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Limitations

- The Model My Watershed tool uses coarse 30-meter land cover and soil data that may not reflect fine-grain site conditions. This was compensated by changing the land cover.
- The model assumes a uniform slope condition with no variation within the site and does not model flow direction or routing through the site.
- Green infrastructure features are simplified with the ability on only customize the area.
- Results are generalized estimates and lack full site details and local data.

Environmental Benefit

- ***Increases plant species diversity nearly 4 times compared to the adjacent reference site, as measured by the Simpson's Diversity Index (0.919 vs. 0.237).***
- ***Increases total plant species richness over 17 times compared to the adjacent reference site, from 4 identified species to 71 species in the garden.***
- ***Improves habitat quality for native pollinators by introducing 55 native plant species to the site that provide nectar, pollen, and larval host resources.***

Background

Biodiversity refers to the variety of life at the genetic, species, and ecosystem levels and is a key indicator of ecological health. New Mexico is one of the most biodiverse states in the United States, containing a wide range of ecoregions and ecosystem types that support an abundance of native flora and fauna. Within a 50-mile radius of the Española Healing Foods Oasis, more than 50 Level IV ecoregions are present, reflecting the region's complex ecological mosaic.

In the Rio Grande floodplain and Española Valley where the Healing Foods Oasis is located, centuries of agriculture, urban development, mismanaged grazing and the spread of invasive species have led to significant habitat loss and declines in native plant communities. In some areas, like the EHFO, historic acequia systems which divert river water into the surrounding fields have been lined or covered impacting riparian floodplain ecology and visually disconnecting the people from the water.

The Española Healing Foods Oasis was designed as a response to these ecological challenges. Its planting strategy emphasizes native and regionally adapted edible, medicinal, and dye species that hold both ecological and cultural significance. The garden features layered vegetation, overlapping bloom periods, and drought-tolerant species that collectively enhance habitat structure, support pollinators and wildlife, and increase overall biodiversity across seasons. Plantings, like Indian ricegrass (*Eriocoma hymenoides*) have been ceremonially seeded atop the covered acequia on site, to remember the connection between water, food, and life.

Figure 2.17 *– Regionally adapted crops like amaranth and corn are ecologically resilient and carry deep cultural and spiritual significance. These photos document a seed exchange and agricultural partnership between the Española Healing Foods Oasis and Maya farmers through a collaboration with Qachuu Aloom. The project honors amaranth's ancestral roots in Mesoamerica and supports seed sovereignty, cultural revitalization, and ecological resilience across Indigenous communities in Guatemala and New Mexico. Images courtesy of Tewa Women United (Facebook).*

Methods

Species Inventory

To quantify plant biodiversity, a complete floristic survey was conducted at both the Española Healing Foods Oasis and the adjacent untreated reference slope during the peak of the growing season. Systematic walkthroughs were performed across all garden terraces and planting areas to identify all rooted vascular plant species present. Species identification was conducted using regional field guides and the Seek app by iNaturalist, with results cross-checked against the garden's planting plan for confirmation.

For each species, the survey recorded origin status (native, regionally adapted, or non-native) and whether it is recognized as a host or nectar source for pollinators, based on the USDA Plants Database and Xerces Society resources. See Appendix B for the full plant list and counts.

Two biodiversity metrics were calculated:

- Species Richness: the total number of plant species observed
- Simpson's Diversity Index (1–D): a measure that accounts for both species richness and relative abundance, with greater sensitivity to dominant species

Simpson's Index was selected due to its effectiveness in distinguishing between diverse plantings and simplified vegetative communities, such as the sparsely vegetated reference site. Calculations were completed in Excel and verified using an online index calculator. The same survey protocol was applied at the untreated reference slope to serve as a baseline comparison. This method captured the full extent of biodiversity outcomes associated with the planting design of the Española Healing Foods Oasis.

Calculations

Simpson's Diversity Index (1–D) was selected for this study because it accounts for both species richness and evenness, making it particularly effective for comparing developed and undeveloped landscapes.

Formula

$D = \Sigma[n(n - 1)] \div N(N - 1)$

Simpson's Diversity Index = $1 - D$

Where:

- n = number of individuals per species
- N = total number of individuals

Reference Site

N	2818
N-1	2817
N(N-1)	7938306
Sum n(n-1)	6056392
Simpson's diversity index (D)	**0.237067455**

Española Healing Foods Oasis

N	3322
N-1	3321
N(N-1)	11032362
Sum n(n-1)	554868
Simpson's Diversity Index (D)	**0.949705421**

Figure 2.18 *–Icons indicate each plant's known uses. "Edible" refers to plants with parts used as food, both historically and in modern times. "Medicinal" includes species traditionally and currently used for healing. "Dye" denotes plants that produce natural pigments used for dying textiles or ceramics. "Pollinator Support" identifies plants that attract or sustain bees, butterflies, and other pollinators.*

Discussion

A high level of plant biodiversity supports numerous ecological functions critical to landscape resilience. Diverse plantings provide habitat for insects, birds, and other fauna, support complex trophic interactions, and enhance resistance to pests, diseases, and climate variability. In arid regions like Northern New Mexico, where urban development and land degradation have fragmented native plant communities, even small urban gardens can serve as vital refuges for biodiversity. The Española Healing Foods Oasis introduces a wide range of native and regionally adapted species, selected for ecological function and cultural value. Through layered vegetation and staggered bloom periods, the garden offers continuous floral resources throughout the growing season, sustaining pollinators and other wildlife in an otherwise resource-limited urban environment.

Limitations

- During the study the research team was aware that the irrigation system was being upgraded. However, in the last week of the study, it was learned that the entire irrigation system has been completely offline this year. Therefore, the site was sustaining on limited rainfall, runoff, and hand watering in select area. This likely contributed to the total plant diversity being less than the 200 species noted in the garden’s documentation.
- Plant counts were conducted manually, which introduces potential for human error, especially in densely planted areas. While the planting plan was referenced, species composition has changed over time and may not fully reflect original design intent.
- Observations were conducted during a only a few weeks of a single growing season and does not account for seasonal variation in plant visibility or diversity. A multi-season study would offer a more comprehensive view of plant community dynamics.
- Native status and pollinator host designations were based on current databases and literature, which may evolve over time.
- Simpson’s Diversity Index measures species richness and evenness but does not account for habitat quality, ecological interactions, or site conditions beyond species data.

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Environmental Benefit

- ***Increases pollinator abundance and diversity, with timed counts revealing 15.7 times more individual pollinators compared to the reference site and supporting at least 17 unique genera of pollinators, indicating a rich and varied pollinator community attracted to the garden's native and climate-adapted plantings.***

Background

Pollinators are essential to ecosystem health and agricultural productivity, facilitating the reproduction of flowering plants and supporting broader food webs. In recent decades, many pollinator populations, particularly native bees, have declined due to habitat loss, pesticide exposure, and climate-related pressures. New Mexico supports more than 1,000 species of native bees, many of which are solitary, ground-nesting, and dependent on specific floral resources. Urban development, soil compaction, and simplified vegetation have significantly reduced nesting habitat and floral diversity in many landscapes.

The Española Healing Foods Oasis was intentionally designed to support pollinators through a planting palette of native and regionally adapted flowering species selected for their ecological value, staggered bloom times, and seasonal continuity. The garden received funding through a U.S. Fish and Wildlife Service Partners for Fish and Wildlife grant to establish a pollinator-focused planting, which was installed without irrigation, relying instead on rainfall and stormwater runoff. This study evaluates whether these strategies have contributed to increased pollinator abundance and diversity compared to a nearby unmanaged slope lacking pollinator-supportive interventions.

Study Objectives

- Quantify differences in pollinator abundance, morphogroup and genera richness
- Document dominant flowering species and their associated pollinator visitation
- Collect photographic records to support genus-level identification of pollinators, particularly native bees

Method

Pollinator observations were conducted using a modified version of the Xerces Society's Streamlined Bee Monitoring Protocol. While the standard protocol is designed for consistent bee counts, it was adapted to fit the site's unique conditions and project timeline. Modifications are summarized in Table X below.

Table 2.5 *– Field measurements and tools.*

Tools	Purpose/Justification	Cost Estimate
Tape Measure (100 ft)	Establish transect boundaries for pollinator counts	$15–$25
Paper Data Collection Forms	Used as template to record pollinator abundance and richness	Free
Xerces Society Streamlined Pollinator Monitoring Protocol	Standardized guidance on count timing, weather conditions, and visual identification categories	Free – Available Online

Field Guide: *The Bees in Your Backyard* written by Joseph S. Wilson and Olivia Messinger Carril	Supports in-field visual identification and post-field genus-level verification	$22
Digital Camera with a quality macro lens	Used for photographing pollinators for later genus-level identification	$100-600

Pollinator observations were conducted using a modified version of the Xerces Society's Streamlined Bee Monitoring Protocol. While the standard protocol is designed for consistent bee counts, it was adapted to fit the site's unique conditions and project timeline. Modifications are summarized in Table 2.6 below.

Table 2.6 *– Adjustments to Xerces Protocol*

Protocol Component	Original Xerces Protocol	Modification and Reasoning
Transect Length	Two 100-ft transects per site	Single 100-ft transect per site – Garden size and reference site constraints made multiple transects impractical
Observation Time Frame	12:00–4:00 PM	10:00 AM–2:00 PM – to avoid the monsoonal winds and cloud cover common in summer afternoons. During this late morning window, conditions were typically sunny and calm, and pollinator activity was noticeably higher.
Target Taxa	Only bees	Expanded beyond bees to include butterflies, moths, and wasps to better reflect the diversity of pollinators observed at the site, particularly the frequent foraging activity of wasps.
Inclusion Criteria for Pollinators	Only bees observed making contact with flower reproductive parts for 0.5 seconds.	The same core rule was followed throughout all surveys: only insects observed making contact with the reproductive parts of flowers for 0.5 seconds were recorded as pollinators. Non-pollinating flying insects were noted separately to maintain data integrity while acknowledging broader insect presence. All pollinator benefits and calculations were based solely on confirmed flower-visiting individuals.
Observation Frequency	2 site visits per year, separated by 2-3 weeks during bloom period. Ideally over the course of 3 years.	6 observations over the early to mid-summer. Limited by the academic calendar and case study timeframe.

Surveys were conducted at two locations: the Española Healing Foods and the adjacent unmanaged slope serving as the reference. In each location a 100-foot transect was established and walked at a steady pace (~6.5 feet per minute) over a 15-minute period. On the final observation day, the transect in the Española Healing Foods Oasis was relocated to an area with active flowering (EHFO transect #2), as the original transect had largely completed its bloom cycle.

- <u>EHFO Transects</u>**:** Feature diverse plantings including globemallow, rocky mountain penstemon, prairie coneflower, Texas blueweed, milkweed, rocky mountain bee plant and hairy golden aster.

- <u>Reference Transect</u>**:** Located on the adjacent predesigned reference site, lacking intentional planting or irrigation. Vegetation was sparse with minimal spontaneous wildflower blooms of globemallow, Texas blueweed and hairy golden aster.

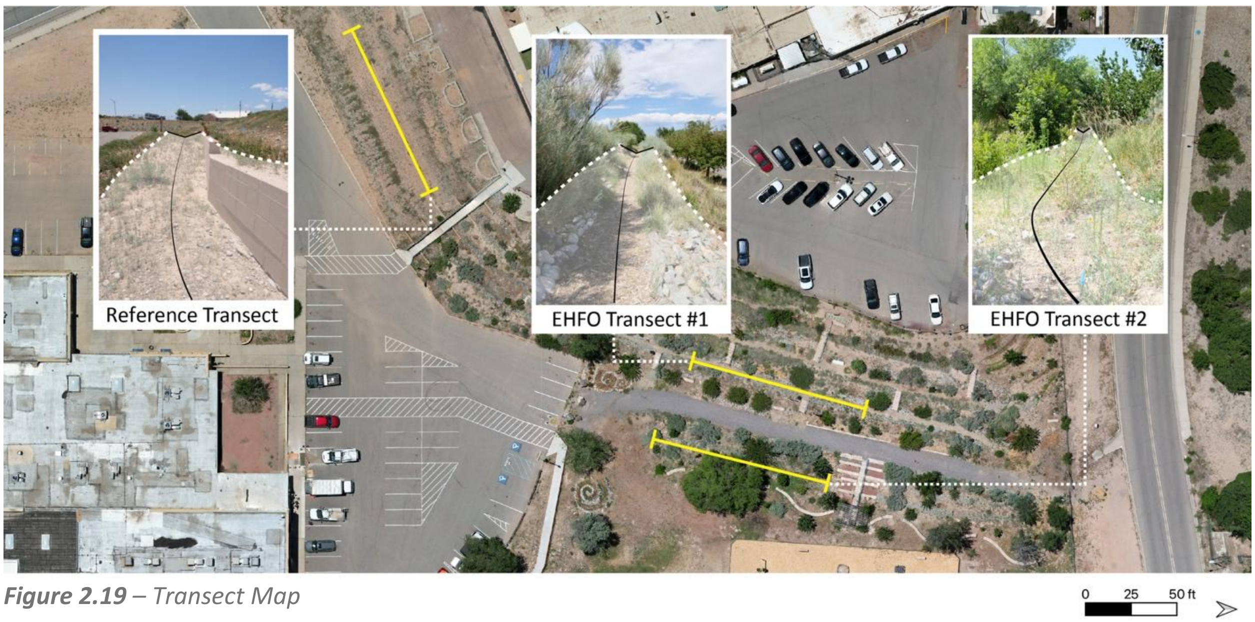
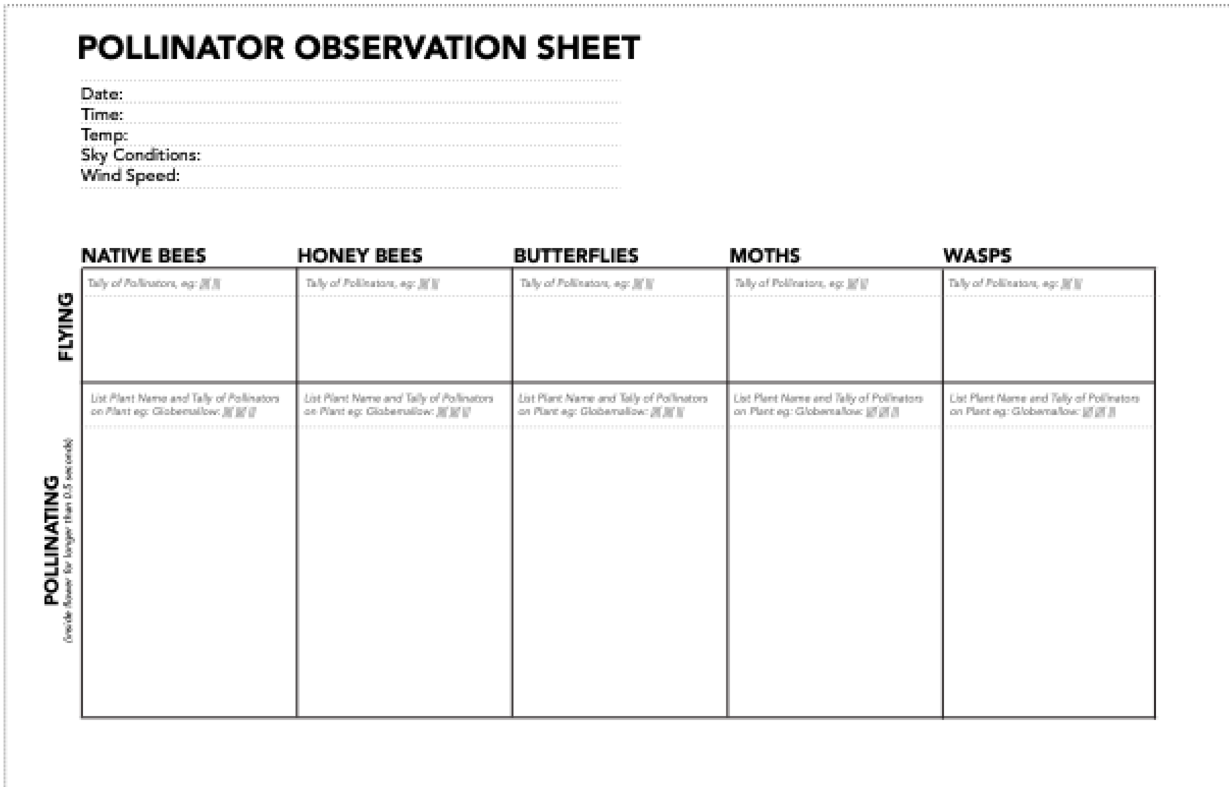


Figure 2.19 *– Transect Map*

All insects actively pollinating flowers within a 3-foot band on either side of the transect were observed. Following Xerces Society guidelines, only insects that contacted the reproductive structures of open flowers were counted as pollinators. Flying insects that did not interact with flowers were noted separately but were excluded from the final pollinator counts.

Pollinators were initially grouped in the field into five broad morphogroups: native bees, honeybees (Apis mellifera), butterflies, moths, and wasps. This morphogrouping approach, adapted from the Xerces Streamlined Bee Monitoring Protocol, facilitated efficient and consistent data collection. Wasps were included as a distinct group due to their frequent floral foraging behavior at the Española Healing Foods Oasis, despite not being a standard category in the Xerces framework.

Field data were initially recorded using custom paper tally sheets based on the Xerces protocol (see Figure 2.20). However, this method proved impractical during fieldwork, particularly when photographs and time tracking were also required. To improve efficiency, observers transitioned to recording data in a phone notes application, which were subsequently transcribed into Excel spreadsheets for analysis.



POLLINATOR OBSERVATION SHEET

Date:
Time:
Temp:
Sky Conditions:
Wind Speed:

	NATIVE BEES	HONEY BEES	BUTTERFLIES	MOTHS	WASPS
FLYING	*Tally of Pollinators, eg:*	*Tally of Pollinators, eg:*	*Tally of Pollinators, eg:*	*Tally of Pollinators, eg:*	*Tally of Pollinators, eg:*
POLLINATING (inside flower for longer than 0.5 seconds)	*List Plant Name and Tally of Pollinators on Plant eg: Globemallow:*	*List Plant Name and Tally of Pollinators on Plant eg: Globemallow:*	*List Plant Name and Tally of Pollinators on Plant eg: Globemallow:*	*List Plant Name and Tally of Pollinators on Plant eg: Globemallow:*	*List Plant Name and Tally of Pollinators on Plant eg: Globemallow:*

Figure 2.20 *– Pollinator observation sheets*

Pollinator surveys were conducted between 10:00 AM and 2:00 PM, a time window when pollinator activity is typically high and weather conditions in Northern New Mexico are most stable. Prior to fieldwork, the research team reviewed the Xerces Society's Streamlined Bee Monitoring Protocol, including identification guidance for distinguishing bees, wasps, and flies based on morphology and behavior. Observers also familiarized themselves with the flowering plant species present along the transect to support accurate documentation of pollinator–plant interactions. These preparatory steps helped ensure consistency in morphogroup identification and reduced the likelihood of misclassification during data collection.

Data Collected

- Total number of individual pollinators observed.
- Number of distinct morphogroups (Native bees, honeybees, butterflies, moths).

The research team conducted 6 pollinator observations, with full records available in Appendix C.

Table 2.7 *– Sample results from the preliminary pollinator observation conducted on June 7th, 2025. Temp: 80°F, Sky Conditions: Sunny, Wind speed: 3mph, Time: 11:00am.*

EHFO	Native Bees	Honeybees	Butterflies	Moths	Wasps	Total
Flying	17	0	1	0	2	**20**
Pollinating by Flower Type:						
texas blueweed	12					
hairy golden aster	12					
prairie coneflower	12				5	
rocky mountain bee plant	14					
Total Pollinating	**50**				**5**	**55**

Reference	Native Bees	Honeybees	Butterflies	Moths	Wasps	Total
Flying	1				1	**2**
Pollinating by Flower Type:						
Texas blueweed	1					
Total Pollinating	1					**1**

Identification:

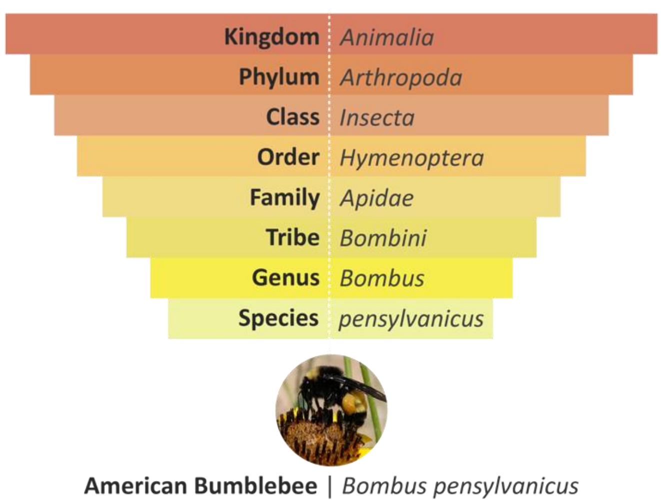


Figure 2.21 *– Linnaean classification hierarchy. This diagram illustrates the nested structure of biological classification, from broad ranks like Kingdom and Phylum to the specific levels of Genus and Species. Developed by Carl Linnaeus in the 18th century, this system established the use of standardized two-part Latin names, with the genus name followed by the species name, for identifying all living organisms.*

Pollinators were photographed and identified to the family and genus levels. Figure 2.21 provides an overview of the Linnaean classification system used to categorize living organisms. Species-level identification was beyond the scope of this study due to the subtle morphological distinctions between species, limitations in the resolution of some field photographs, and the specialized expertise required for definitive identification. Instead, the research team captured field photographs of pollinators and used The Bees in Your Backyard (Joseph S. Wilson & Olivia J. Messinger Carril) to assist with genus-level identification. Observations were further supported by uploading photographs to iNaturalist.com, where feedback from community experts helped confirm or refine identifications.

This combined approach of field guide analysis and community science allowed the team to document at least 7 pollinator families and 14 distinct genera in the Española Healing Foods Oasis. A full collection of pollinator photographs is provided in Appendix C.

Calculations

Pollinator Abundance

Definition: Total individual pollinators observed contacting flowers per site over a 15-minute period.

Table 2.8 *– Sum of pollinator abundance indicating the day of the transect and number of pollinators observed based on the modified protocol.*

EHFO	# of Pollinators
6/12/25	22
6/18/25	23
7/2/25	49
7/7/25	55
7/11/25	48
7/17/25	23
Total Average:	**36.67**

Reference	# of Pollinators
6/12/25	2
6/18/25	7
7/2/25	4
7/7/25	1
7/11/25	0
7/17/25	0
Total Average:	**2.33**

Difference in abundance:
36.67 − 2.33 = ***34.34*** *more average pollinators*

Percent increase:
((36.67 − 2.33) ÷ 2.33) × 100 = ***1473.82%*** *increase*

Times more pollinators:
36.67 ÷ 2.33 = ***15.73****× more individual pollinators*

Morphogroup: Bee
Family: Megachilidae
Genus: Lithurgopsis

Morphogroup: Bee
Family: Apidae
Genus: Bombus

Morphogroup: Bee
Family: Apidae
Genus: Melissodes

Morphogroup: Bee
Family: Halictidae
Genus: Halictus

Morphogroup: Bee
Famiy: Megachilidae
Genus: Megachile

Morphogroup: Bee
Family: Halictidae
Genus: Agapostemon

Morphogroup: Bee
Family: Apidae
Genus: Ceratina

Morphogroup: Bee
Family: Apidae
Genus: Diadasia

Morphogroup: Bee
Family: Andrenidae
Genus: Andrena

Morphogroup: Bee
Family: Andrenidae
Genus: Perdita

Morphogroup: Bee
Family: Apidae
Genus: Neolarra

Morphogroup: Bee
Family: Apidae
Genus: Epimelissodes

Morphogroup: Bee
Family: Halictidae
Genus: Dieunomia

Morphogroup: Butterfly
Family: Hesperiidae
Genus: Burnsius

Morphogroup: Wasp
Family: Scoliidae
Genus: Scolia

Morphogroup: Wasp
Family: Crabronidae
Genus: Philanthus

Morphogroup: Wasp
Family: Crabronidae
Genus: Bicyretes

***Figure 2.22** – Unique pollinator genera identified at the Española Healing Food Oasis. See Appendix C for the full collection of photographs.*

Discussion

During the July 18th pollinator survey, activity at the untreated reference site declined markedly as flowers along the transect senesced. In contrast, pollinators at the Española Healing Foods Oasis shifted to a lower terrace characterized by a shaded microclimate. In this cooler, more humid zone, several of the same species observed along the main transect - *Sphaeralcea* spp. (globemallow), *Helianthus ciliaris* (Texas blueweed), and *Heterotheca villosa* (hairy golden aster) - remained in bloom. This behavioral pattern suggests that fine-scale microclimatic heterogeneity within small urban gardens can provide important temporal refugia for pollinators during periods of floral decline.

Honeybee (*Apis mellifera*) presence within the EHFO was minimal during scheduled observations, although high densities were recorded in a nearby planting of *Perovskia atriplicifolia* (Russian sage) upslope at Española City Hall. As a managed, non-native species, A. mellifera often monopolizes floral resources and may competitively exclude native pollinators in resource-limited environments. Their reduced presence within the Española Healing Foods Oasis compared to the observed abundance and diversity of native bees highlights the importance of designing urban landscapes that prioritize floral resources and habitat features for wild, native pollinator species.

These findings reinforce the role of the Española Healing Foods Oasis as a pollinator-supportive habitat. The site's microclimatic variability, extended bloom periods, and structurally diverse vegetation support resilience against ecological fluctuations and provide critical resources for solitary and specialist bee taxa threatened by habitat loss and climate change.

Sources

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Limitations

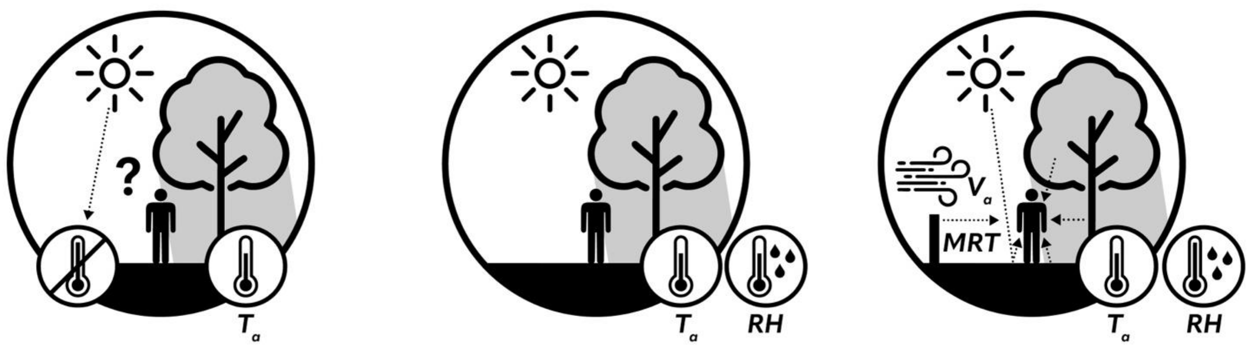
- Observations were limited to early and mid-summer due to the academic research calendar. Consequently, pollinator species active in spring or late fall were not recorded, so pollinator activity on early and late-blooming plants were missed. The total annual diversity supported by the site is likely underrepresented.
- This study provides a single-season snapshot and does not capture interannual variation in climate, phenology, or pollinator population dynamics.
- Beetles, flies, and other incidental floral visitors were excluded from morphogroup counts and genus-level identification. The study focused exclusively on bees (native and honeybees), butterflies, moths, and wasps.
- Genus-level identification was informed by field photography, regional field guides, and online resources; however, the research team does not include trained entomologists, and misidentification is possible.
- Fixed transects may not reflect the full spatial heterogeneity of pollinator activity across the site, particularly in areas with variable microclimates and bloom timing.
- Given photographic constraints and limited taxonomic expertise, the number of identified pollinator genera likely underrepresents the full diversity present at the site.

Environmental Benefit

- ***Reduces perceived heat stress by maintaining Universal Thermal Climate Index (UTCI) values 1.6 to 4.1 °F lower than adjacent untreated areas of the urban landscape, performing within 0.5 to 2.1 °F of the adjacent heavily irrigated city park while offering significantly greater biodiversity and ecological value.***
- ***Cools 2.8 °F more effectively on average overnight than the immediate urban context – indicating passive thermal cooling in an arid climate with minimal irrigation.***

Background

The Española Healing Foods Oasis mitigates urban heat island effects by integrating diverse plantings, shaded gathering spaces, and organic ground materials that reduce surface heat absorption. In contrast, the nearby municipal courthouse parking lot consists of asphalt and concrete, which retain and radiate heat throughout the day. This study compares microclimate conditions across vegetated and non-vegetated zones to evaluate the garden's role in moderating temperature and improving thermal comfort in a semi-arid urban context.



Temperature (T_a) readings only provide the dry bulb reading and must be taken in the shade, not in direct sun. For all temperature readings, care was taken to ensure the sensor was always shaded.

Heat Index (HI) is the "feels like" temperature when relative humidity (RH) is factored in with the actual air temperature (T_a), affecting the ability for the human body to self-cool by sweating.

Universal Thermal Comfort Index (UTCI) provides a more comprehensive understanding of thermal comfort taking into consideration wind and radiant temperatures in addition to the heat index.

***Figure 2.23** – Comparison of three methods to determine comfort, and the advantage of using the Universal Thermal Comfort Index.*

<u>Study Objectives</u>

- Quantify the differences in thermal comfort between the designed garden and the adjacent urban conditions
- Identify microclimate variation within the garden
- Estimate mean radiant temperature (MRT) and heat exposure
- Contribute defensible findings to the landscape performance metrics

Method

Manual measurements at fixed points

Measurements were conducted using a handheld Kestrel 3000 weather meter on four representative hot days at three times: morning (9:00-11:00 AM), midday (12:00-1:00 PM), and late afternoon (3:30-5:00 PM - peak heat). The measurements were taken at a total of ten fixed points (Figure 2.24):

- 6 locations within the garden (points 4 - 9), representing a variety of designed microclimates, including both tree-shaded areas and more exposed areas the site.
- 4 surrounding context locations, including one in the reference site (barren slope similar to the pre-design condition), two in surrounding parking lots, and one in the adjacent park.

Air temperature, relative humidity, average windspeed, and surface temperatures were measured multiple times of day at ten fixed points. Point locations 1, 2, 3, and 10 were in the reference site, surrounding paved areas, and the adjacent park. Point locations 4 through 9 were located throughout the Española Healing Foods Oasis. These point locations represented a variety of microclimates, including both tree-shaded areas and more exposed areas the site.

Figure 2.24 *– Microclimate Testing Locations*

Table 2.9 – Metrics and tools used in the microclimate study.

Metric	Purpose/Justification	Tool	Cost Estimate
Current Local Weather Data & Conditions	Record official readings for reference and comparison	Smartphone weather app or download online data from reliable sources (NOAA and The Weather Channel)	Free
Temperature (T_a), Relative Humidity (RH), & Ave. Windspeed (V_a)	Document site microclimate conditions	Kestrel 3000 handheld weather meter (manual, fixed point data collection)	$180
Composite Surface Temp (CST)	Calculate Mean Radiant Temp. (MRT) for UTCI	Handheld infrared thermometer (or thermal camera - FLIR C5)	$25 ($800)
Hourly Temperature (T_a) & Relative Humidity (RH)	Compare continuous automated readings with manual readings	Kestrel DROP D2 data logger (automatic, fixed-point data collection)	$110/each x 3 = $330
Universal Thermal Comfort Index (UTCI)	Evaluate comfort based on multiple variables	UTCI Calculator https://www.utci.org/utci_calc.php	Free

Using the tools listed in Table 2.9 (above), the following observations at the beginning of each session:

- Date & time
- Local weather conditions from NOAA and The Weather Channel, including air temperature, humidity, wind speed, cloud cover, and recent precipitation.

Then, at each point location, the following observations were recorded with the Kestrel 3000 handheld weather meter and infrared thermometer (or FLIR C5 thermal camera):

- Air temperature
- Relative humidity
- Average windspeed
- Surface temperatures within a 15-foot (5 meter) radius

Initial site readings from the Kestrel 3000 weather meter were taken at least 15 minutes after being on site (to adjust from a hot or air-conditioned vehicle), and point observations were averaged based on readings over one minute. Careful consideration was also taken to keep hands away from the meter's sensors and keep the sensors out of direct sunlight.

This study explores the use of Universal Thermal Comfort Index (UTCI) as a performance metric to more accurately capture a wider range of variables that contributes to comfort in designed landscapes. Heat index, or what is commonly referred to as the "feels like" temperature, is calculated using the air temperature and relative humidity. However, it does not take into consideration sun exposure, wind speed, or radiant surface temperatures. UTCI incorporates all these variables, with radiant surface temperatures factored in as mean radiant temperature (MRT). MRT represents the radiant heat load — basically, how much the environment is “radiating” onto a person**.** The most accurate way to measure MRT is by using a globe thermometer ($50-$300).

MRT can also be estimated using a simple formula (Estimated MRT=0.7×CST+0.3×Ta) which factors surface and air temperature readings, along with a weighted radiant load and air temperature. [provide citations]

For this study, additional surface temperatures readings were collected from representative surfaces in a 15-foot (5 meter) radius using an infrared thermometer (or FLIR C2 thermal camera). Surface temperatures are then averaged into a composite surface temperature (CST), weighted, and calculated with the weighted air temperature to determine the Estimated MRT.

<u>Automated fixed-point monitoring</u>

During peak summer weather conditions (between 9 June - 17 July 2025), three Kestrel D2 data loggers were deployed to record air temperature and relative humidity every hour. Logger placement followed best practices for shaded ambient air monitoring to prevent solar radiation bias, aligning with National Weather Service (NWS) and WMO standards.

While each logger should ideally be mounted at 1.5 meters above ground level and placed in shaded locations, to reduce the risk of theft, the mounting height varies slightly with each point location.

Each of the data loggers were placed in three distinct representative zones within and around the garden (see microclimate fixed-point observation location map):

- D2_01 was placed in a mature shrub centrally located in the garden (height 1m)
- D2_02 was placed near the intersection of the highway and the parking lot entrance (height 1m)
- D2_03 was placed in a mulberry tree near the center of the park (height 3m)

Data retrieved was compared to the manual measurements and analyzed to determine the average high and low temperatures for each zone in the study site and surrounding urban landscape conditions.

Calculations (manual measurement data)

For each fixed-point manual measurement location, all results were entered into an excel spreadsheet (see Appendix D), and the following calculations were performed:

- **Average temp, humidity, and wind speed**
- **Estimated Mean Radiant Temperature (MRT)** - was approximated using composite surface temperature readings using the following formula:

  $$MRT = (0.7 \times CST) + (0.3 \times T_a)$$

  Where:
  - CST = Average surface temperature from IR readings
  - T_a = Ambient air temperature

  MRT values were then entered into the online UTCI calculator to estimate thermal stress levels for each zone.

  Universal Thermal Comfort Index (UTCI) - calculated using the web-based UTCI Calculator (Figure 2.25) https://www.utci.org/utci_calc.php for representative timepoints using:

  - Air Temperature (Converted to °C)
  - Relative Humidity (%)
  - Wind Speed (Converted to m/s)
  - Estimated MRT (converted to Kelvin)

Results from the UTCI Calculator were compared with the average ambient air temperatures and averages between the EHFO and the urban context (see Appendix D). UTCI results were categorized into thermal stress categories to understand impacts on heat stress (Table 2.10).

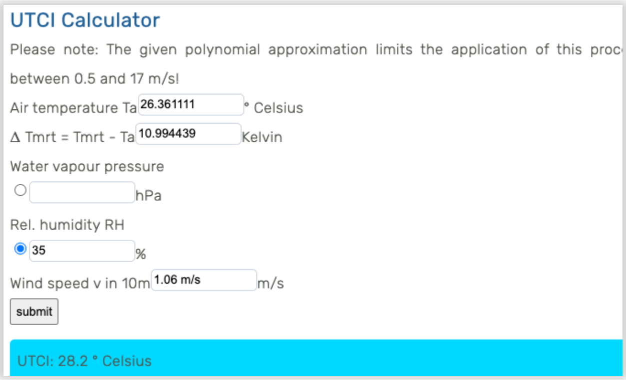


Figure 2.25 – *UTCI Calculator, https://www.utci.org/utci_calc.php*

UTCI (°F)	Stress Category
> 114.8°F	Extreme heat stress
100.4–114.8°F	Very strong heat stress
89.6–100.4°F	Strong heat stress
78.8–89.6°F	Moderate heat stress
48.2–78.8°F	No thermal stress (comfortable)
32–48.2°F	Slight cold stress
8.6–32°F	Moderate cold stress
-16.6–8.6°F	Strong cold stress
-40–-16.6°F	Very strong cold stress
< -40°F	Extreme cold stress

Table 2.10 *- UTCI stress categories adapted from: Yüksel, B. G., and M. M. Sönmez. 2022.*

Calculations (automated data logger data):

Temperature and humidity readings from the Kestrel D2 data loggers for the EHFO, reference site, and the adjacent city park were downloaded and compiled into a single spreadsheet. Simplified spreadsheets were created to analyze the temperature readings based on the date and time for the three locations.

- **Daily maximum (high), minimum (low), and average temperatures** were calculated for each site using grouped daily records. This involved:
  - Using the spreadsheet to query the maximum and minimum temperatures for each location for each day.
  - Average the maximum and minimum temperatures for each location.
- **Diurnal temperature range** was calculated by subtracting the daily low from the daily high.
- **Overnight cooling rates** were determined by subtracting the maximum (high) temperatures from late afternoon (3:00-5:00 PM) and early morning (5:00-7:00 AM) low temperatures, then calculating the difference over that time (Table 2.11)
  - **Extract daily values**:
    Afternoon average = Mean of all readings between 3:00-5:00 PM
    Morning average = Mean of all readings between 5:00-7:00 AM
  - **Calculate daily cooling**:
    Daily Cooling Rate = Afternoon Average – Morning Average
    Mean Cooling Rate = Average of all daily cooling values

Site	Avg. Afternoon Temp	Avg. Morning Temp	Avg. Cooling (PM – AM)
EHFO	86.9 °F	56.9 °F	**30.0°F**
Urban Context	87.9 °F	60.6 °F	**27.3 °F**
Temp Difference			**2.8 °F**

Table 2.11 *– Average afternoon and morning temperatures used to calculate the average overnight cooling rate of the reference site and EHFO.*

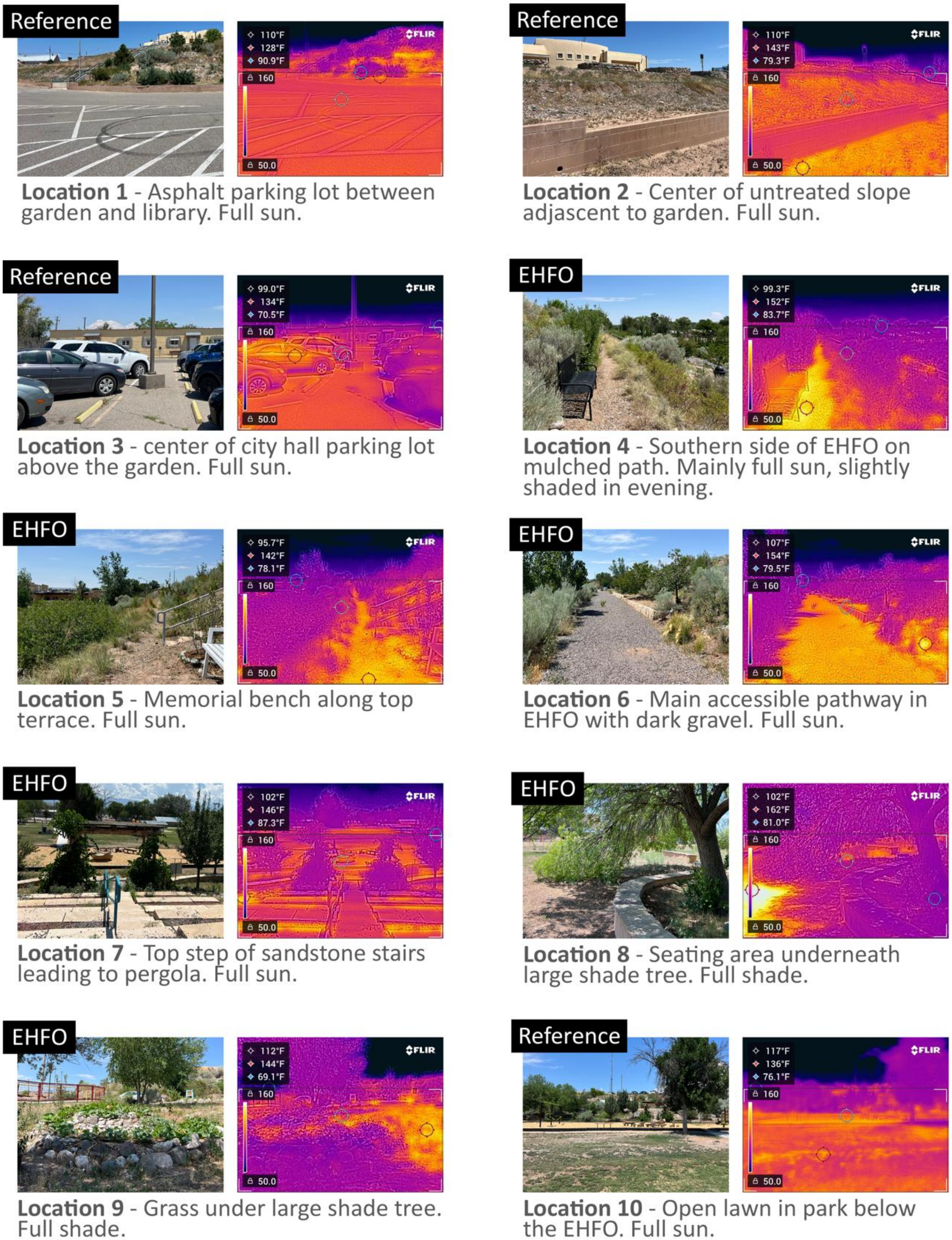


Figure 2.26 *– Site photographs paired with thermal imagery from each of the 10 microclimate monitoring locations.*

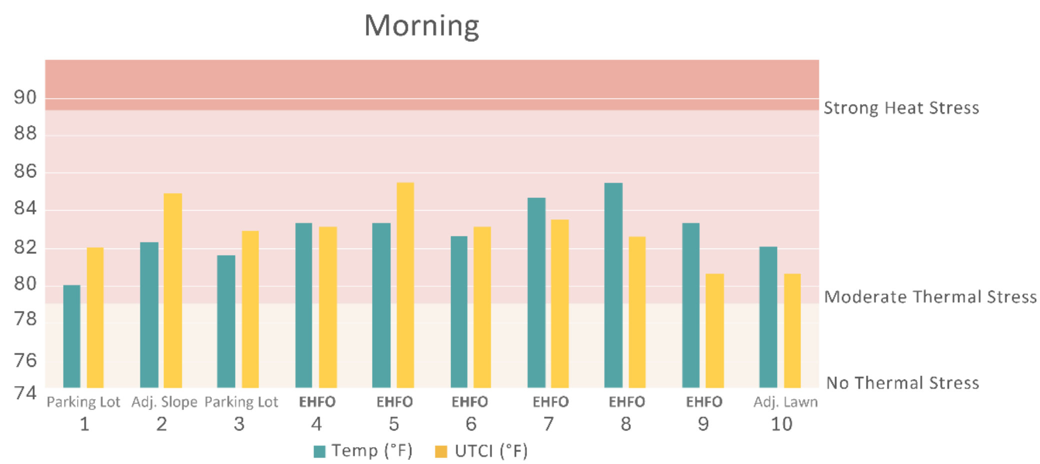


Figure 2.27 *– Morning Ambient Temp and UTCI Graph*

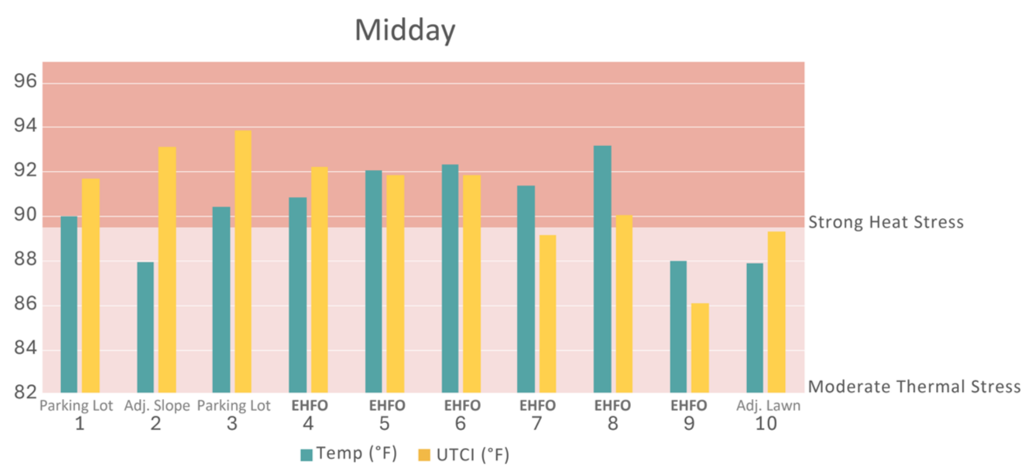


Table 2.28 *– Midday Ambient Temp and UTCI Graph*

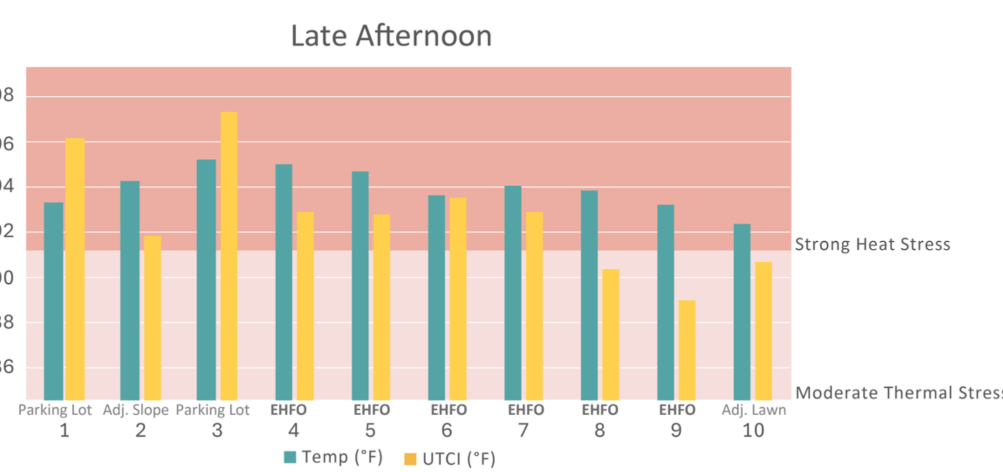


Table 2.29 *– Late Afternoon Ambient Temp and UTCI Graph*

Discussion

Microclimate data from the Española Healing Foods Oasis indicate distinct diurnal heat dynamics compared to surrounding areas. During morning and early afternoon hours, the garden retained more heat than adjacent contexts. This pattern is likely due to the site's east-facing slope, which receives direct solar exposure earlier in the day. Mulch and gravel pathways also contributed to localized warming by absorbing and radiating heat, while flagstone pavers remained noticeably cooler.

By late afternoon, however, temperatures within the garden began to decline more rapidly than in adjacent hardscaped areas, which continued to retain and emit stored heat. This cooling trend suggests that the garden may help moderate thermal extremes over the course of the day - warming more rapidly in the morning but offering a more comfortable microclimate during peak heat hours and into the evening.

Sources

U.S. Environmental Protection Agency. Reducing Urban Heat Islands: Compendium of Strategies. Washington, D.C.: U.S. Environmental Protection Agency. https://www.epa.gov/heatislands.

Newman, Galen, Dongying Li, and Rui Zhu. Houston Arboretum and Nature Center, Phase 1. Landscape Performance Series. Landscape Architecture Foundation, 2022. https://doi.org/10.31353/cs1830.

Yüksel, B. G., and M. M. Sönmez. Spatiotemporal Analysis of Outdoor Thermal Comfort Using Universal Thermal Climate Index in the Historical Peninsula, Istanbul. Urban Climate 46 (2022): 101343. https://doi.org/10.1016/j.uclim.2022.101343.

Limitations

- Data was collected in the morning (between 9-10am), midday (between 11-1pm) and late afternoon (between 3:30-4:30pm. Because of the orientation of the Española Healing Foods Oasis slope, morning and midday temperature readings were often hotter in the garden than surrounding areas. In the late afternoon, temperature readings were significantly cooler.
- Temperature, wind speed, and humidity readings were collected using handheld instruments designed for rapid field assessment, which may have limited precision compared to professional-grade weather station equipment.
- Measurements were taken as snapshots during specific times of day rather than continuous monitoring, which may not fully capture daily temperature fluctuations or extreme conditions.
- Sampling occurred during a single season, and results may not reflect seasonal variability in microclimate conditions.
- Minor inconsistencies in timing between measurements on different days, as well as localized environmental factors (e.g., transient shading, surface reflectivity, human activity), may have influenced individual readings.
- Surface and air temperature measurements were influenced by short-term weather patterns, such as cloud cover and wind gusts, present at the time of sampling.

Social Benefits

Research Strategy:
To assess the social and cultural benefits of the Española Healing Foods Oasis, the research team conducted a community survey and met with staff from Tewa Women United. These efforts provided insight into how the garden fosters community engagement, stewardship, cultural connection, and emotional well-being. The combination of direct input from community members and institutional knowledge from TWU staff offered a well-rounded understanding of the site's social impacts.

Meeting with Tewa Women United
To supplement survey data, the research team met directly with staff from Tewa Women United to verify details about past events, volunteer engagement, and educational programming. These discussions, along with internal records such as sign-in sheets, flyers, and annual programming summaries provided critical context for assessing how the Española Healing Foods Oasis fosters and sustains a culture of land-based community care.

Survey
The survey was designed to better understand how the Española Healing Foods Oasis supports cultural connection, community engagement, and emotional well-being. It was collaboratively developed to reflect the project's goals and themes and was offered in both digital and paper formats. Distribution channels included garden events, the adjacent public library, community tabling efforts, and social media outreach.

Method
Surveys were conducted between June 5th and July 18th, 2025, to assess the social and cultural impacts of the Española Healing Foods Oasis. The survey aimed to capture personal experiences, cultural connections, and community-level impacts that are often difficult to quantify through observation alone.

Two formats were used:

- Printed paper surveys, distributed on-site at the garden and at the adjacent Española Public Library
- A digital version, hosted on Qualtrics and accessible via a QR code

Figure 3.1 – *Surveys available at the seed library in the Española Public Library*

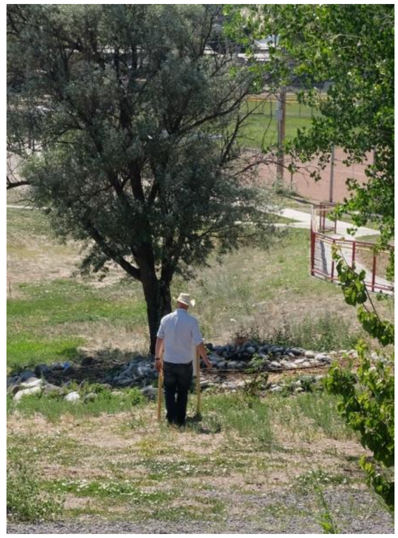


Figure 3.2 – *Anthony installing the survey box in the Española Healing Foods Oasis*

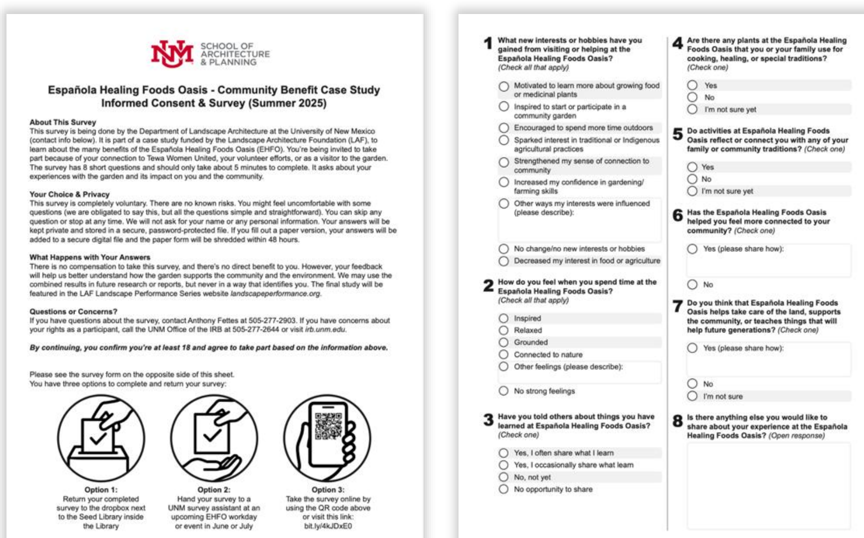
Figure 3.3 - *Kailani with Ryan, Laura and Vicki from Tewa Women United at the Beat the Heat event at the Española farmers market*

Outreach Strategy

We employed the following four outreach strategies:

1. **Survey Boxes and Flyers:**
   Physical survey forms and flyers were posted in the garden and at the adjacent Española Public Library. A drop-box allowed participants to leave completed forms anonymously.
2. **Intercept Surveys in the Garden:**
   On non-event days, team members invited garden visitors to complete the survey.
3. **Social Media Distribution:**
   Tewa Women United shared the survey on Instagram and Facebook on June 9th, June 30th, and July 17th. While Española is a small community, these posts helped reach a broader audience.
4. **In-Person at EHFO Events:**
   Surveys were available at a Tewa Women United "Beat the Heat" event on June 7th at the Española Farmers Market.

Figure 3.4 – *The paper survey that we distributed. A full-sized survey form and flyer can be found in Appendix E.*



SCHOOL OF ARCHITECTURE & PLANNING

Española Healing Foods Oasis - Community Benefit Case Study
Informed Consent & Survey (Summer 2025)

About This Survey
This survey is being done by the Department of Landscape Architecture at the University of New Mexico (contact info below). It is part of a case study funded by the Landscape Architecture Foundation (LAF), to learn about the many benefits of the Española Healing Foods Oasis (EHFO). You're being invited to take part because of your connection to Tewa Women United, your volunteer efforts, or as a visitor to the garden. The survey has 8 short questions and should only take about 5 minutes to complete. It asks about your experiences with the garden and its impact on you and the community.

Your Choice & Privacy
This survey is completely voluntary. There are no known risks. You might feel uncomfortable with some questions (we are obligated to say this, but all the questions simple and straightforward). You can skip any question or stop at any time. We will not ask for your name or any personal information. Your answers will be kept private and stored in a secure, password-protected file. If you fill out a paper version, your answers will be added to a secure digital file and the paper form will be shredded within 48 hours.

What Happens with Your Answers
There is no compensation to take this survey, and there's no direct benefit to you. However, your feedback will help us better understand how the garden supports the community and the environment. We may use the combined results in future research or reports, but never in a way that identifies you. The final study will be featured in the LAF Landscape Performance Series website *landscapeperformance.org*.

Questions or Concerns?
If you have questions about the survey, contact Anthony Fettes at 505-277-2903. If you have concerns about your rights as a participant, call the UNM Office of the IRB at 505-277-2644 or visit *irb.unm.edu*.

By continuing, you confirm you're at least 18 and agree to take part based on the information above.

Please see the survey form on the opposite side of this sheet.
You have three options to complete and return your survey:

Option 1: Return your completed survey to the dropbox next to the Seed Library inside the Library

Option 2: Hand your survey to a UNM survey assistant at an upcoming EHFO workday or event in June or July

Option 3: Take the survey online by using the QR code above or visit this link: bit.ly/4kJDxE0

1 What new interests or hobbies have you gained from visiting or helping at the Española Healing Foods Oasis? *(Check all that apply)*
- Motivated to learn more about growing food or medicinal plants
- Inspired to start or participate in a community garden
- Encouraged to spend more time outdoors
- Sparked interest in traditional or Indigenous agricultural practices
- Strengthened my sense of connection to community
- Increased my confidence in gardening/ farming skills
- Other ways my interests were influenced (please describe):
- No change/no new interests or hobbies
- Decreased my interest in food or agriculture

2 How do you feel when you spend time at the Española Healing Foods Oasis? *(Check all that apply)*
- Inspired
- Relaxed
- Grounded
- Connected to nature
- Other feelings (please describe):
- No strong feelings

3 Have you told others about things you have learned at Española Healing Foods Oasis? *(Check one)*
- Yes, I often share what I learn
- Yes, I occasionally share what learn
- No, not yet
- No opportunity to share

4 Are there any plants at the Española Healing Foods Oasis that you or your family use for cooking, healing, or special traditions? *(Check one)*
- Yes
- No
- I'm not sure yet

5 Do activities at Española Healing Foods Oasis reflect or connect you with any of your family or community traditions? *(Check one)*
- Yes
- No
- I'm not sure yet

6 Has the Española Healing Foods Oasis helped you feel more connected to your community? *(Check one)*
- Yes (please share how):
- No

7 Do you think that Española Healing Foods Oasis helps take care of the land, supports the community, or teaches things that will help future generations? *(Check one)*
- Yes (please share how):
- No
- I'm not sure

8 Is there anything else you would like to share about your experience at the Española Healing Foods Oasis? *(Open response)*

Calculations

Survey data was compiled from both digital (Qualtrics) and paper responses. Responses were manually entered or exported into Excel for analysis. For each quantitative question the percentage of respondents selecting a specific answer was calculated using the following formula:

(Number of responses for that answer ÷ Total number of responses to the question) × 100

For example: If 8 people answered "Yes" to a question and 10 people responded to that question in total, the calculation would be:

$$(8 \div 10) \times 100 = 80\%$$

- ***Increases interest in growing food and Indigenous agriculture practices, with 77% of 22 of surveyed volunteers and visitors expressing motivation to learn more about growing food or medicinal plants and 73% expressing interest in traditional or Indigenous agricultural methods after visiting the garden.***

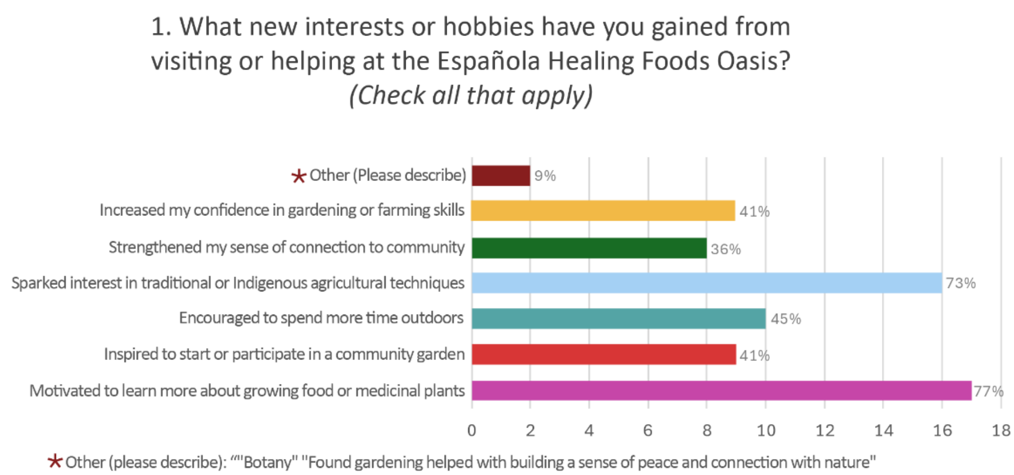


***Figure 3.5** – Survey Question 1 Results*

This survey question was designed to assess how the Española Healing Foods Oasis fosters cultural and social learning through gardening. As both an educational space and a place of rest and harvest, the garden encourages deeper engagement with land-based knowledge. Many respondents reported increased confidence in growing food or medicinal plants, along with a growing interest in traditional and Indigenous agricultural techniques. These responses suggest that the garden contributes to the revitalization of cultural practices, supports food sovereignty, and strengthens community connection through hands-on experiences with cultivating, gathering, and caring for culturally significant plants.

- ***Enhances emotional well-being, with 67% of 22 surveyed volunteers and visitors reporting a sense of connection to nature, 67% feeling inspired, 67% feeling grounded, and 62% feeling relaxed after visiting.***

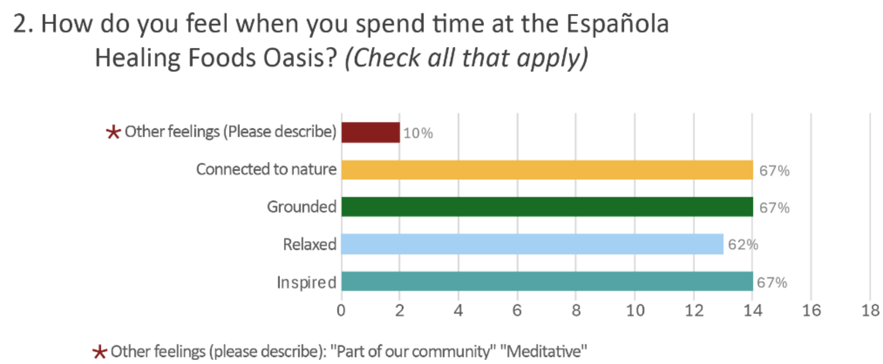


Figure 3.6 *– Survey Question 2 Results*

This survey question was designed to explore how time spent in the Española Healing Foods Oasis may support emotional well-being. Unlike manicured parks, the garden's naturalistic and immersive setting fosters a deeper sensory connection with the landscape. Respondents reported feeling inspired, grounded, and relaxed, with many expressing a strong sense of connection to nature. These responses suggest that the garden offers a restorative experience that supports mental health and nurtures emotional connections to both land and community.

- ***Supports peer, family, and community learning, with 92% of 22 surveyed volunteers and visitors reporting that they frequently or occasionally share what they have learned at the Española Healing Foods Oasis with others.***

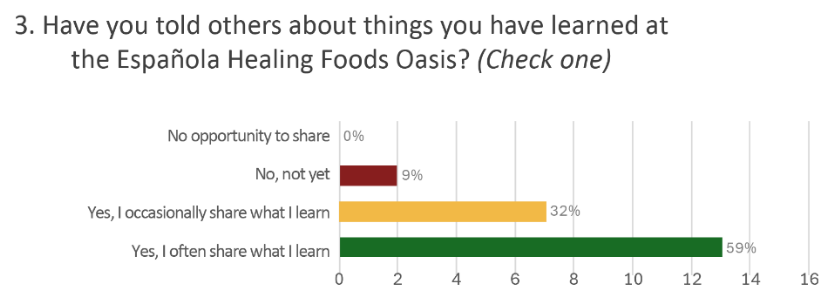


Figure 3.7 *– Survey Question 3 Results*

This question was designed to understand how knowledge gained in the garden extends beyond the site and circulates within the broader community. As a space rooted in the sharing of traditional ecological knowledge, the Española Healing Foods Oasis supports ongoing peer, family, and community learning. Survey responses suggest that the garden contributes not only to individual education but also to the collective transmission of land-based practices, helping to sustain and revitalize cultural knowledge.

- ***Strengthens social connection and sense of belonging, with 67% of 21 surveyed volunteers and visitors reporting that the Española Healing Foods Oasis helps them feel more connected to their community.***

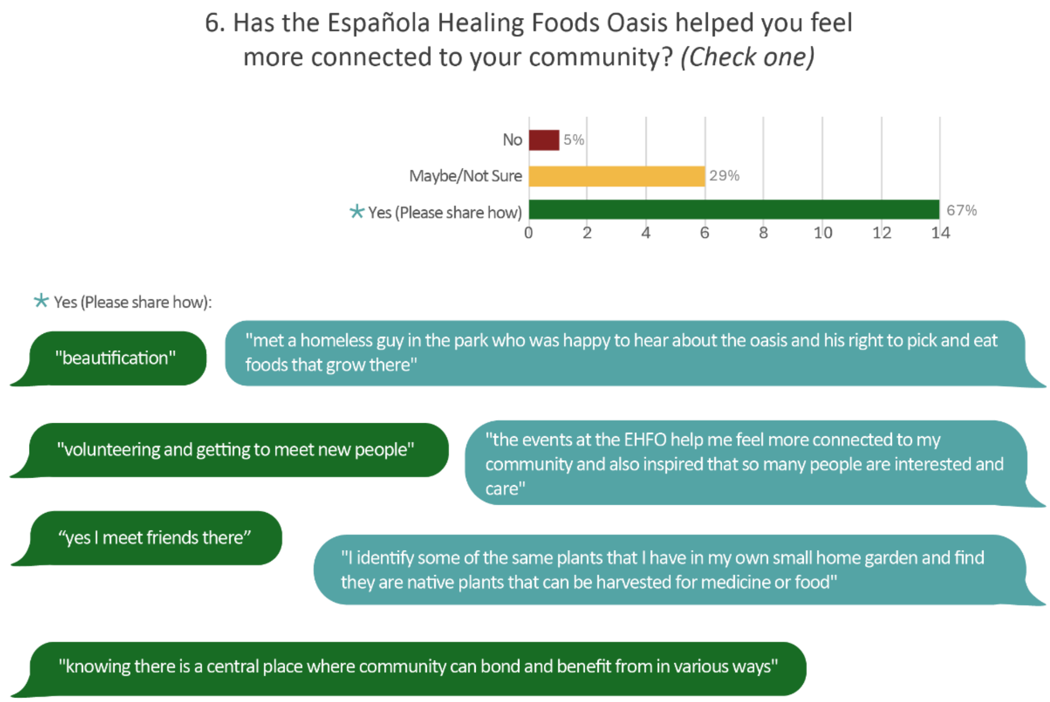


Figure 3.8 *– Survey Question 6 Results*

This question was developed to understand how the garden fosters social connection and a sense of belonging. The Española Healing Foods Oasis was envisioned as a place to grow food, share knowledge, and serve as a gathering space for community building. Written responses highlight the garden's role in strengthening relationships, providing a welcoming and accessible space to meet others, exchange knowledge, and honor cultural continuity through plants and traditions.

- ***Uplifts future generations, with 90% of 20 surveyed volunteers and visitors agreeing that the Española Healing Foods Oasis helps care for the land, support the community, or teaches things that will benefit future generations.***

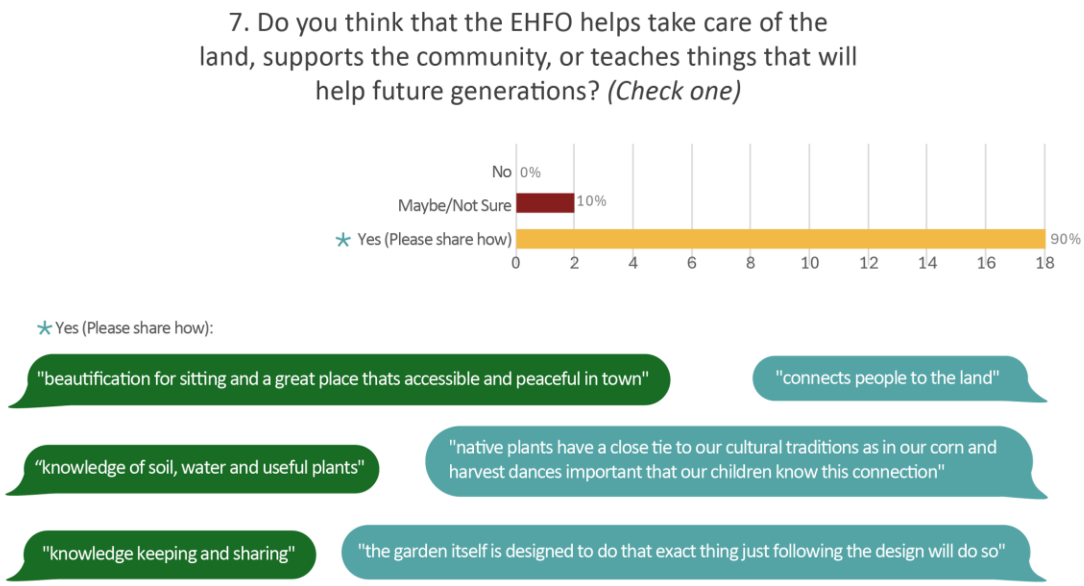


Figure 3.9 *– Survey Question 7 Results*

This question was developed to explore how the garden contributes to intergenerational resilience through care for land, culture, and community. The Española Healing Foods Oasis was conceived as a living archive that supports ecological restoration, food sovereignty, and the continuity of cultural knowledge. Survey findings indicate that 90% of respondents believe the garden supports future generations by offering a space for learning, gathering, and stewardship. Written responses emphasize the significance of accessible beauty, knowledge exchange, traditional ecological practices, and the transmission of values through intentional design.

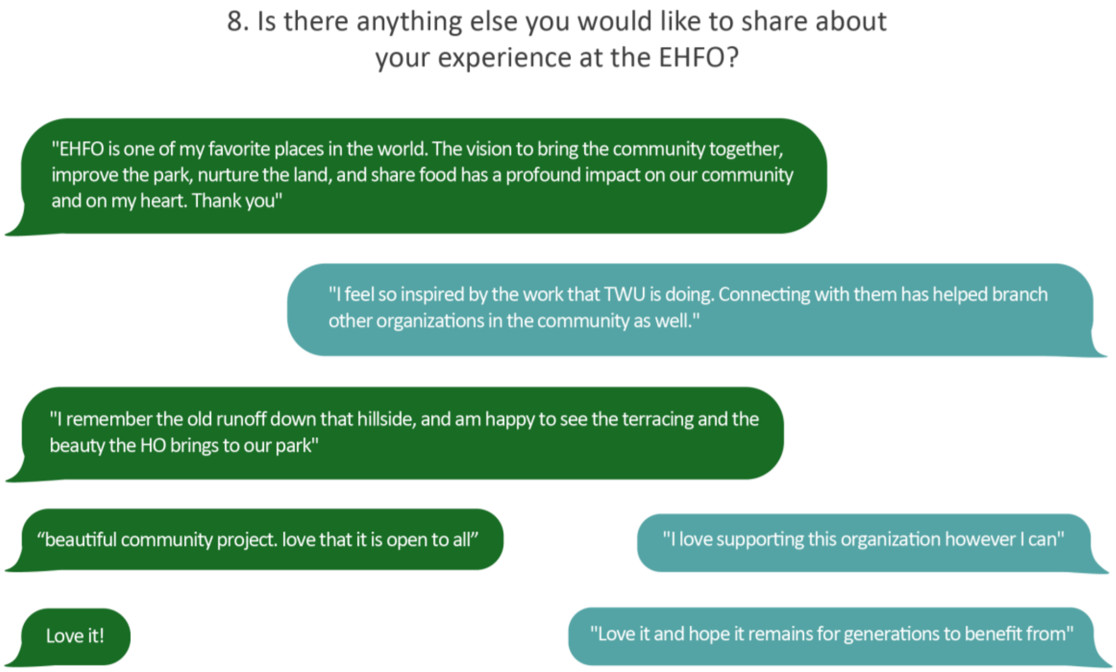


***Figure 3.10** – Survey Question 8 Results*

This concluding question invited respondents to share any final thoughts about their experience at the Española Healing Foods Oasis. While not directly linked to a specific benefit category, these reflections speak to the emotional resonance of the garden and its broader role in the community. Many participants expressed deep appreciation for the beauty, openness, and intergenerational vision of the space. Comments highlight the garden’s ability to inspire, restore, and connect both personally and collectively.

Discussion

Two survey questions were included to assess the cultural relevance of the Española Healing Foods Oasis: 1) “Are there any plants at the Española Healing Foods Oasis that you or your family use for cooking, healing, or special traditions?” and 2) “Do activities at the Española Healing Foods Oasis reflect or connect you with any of your family or community traditions?” These questions aimed to evaluate visitors’ recognition of culturally significant plants and connections to traditional practices.

Thirteen respondents selected “I’m not sure yet,” six selected “Yes,” and three selected “No” for both questions. While a portion of respondents did report cultural connections, the high number of “I’m not sure yet” responses limited the ability to draw conclusive findings from this data. As a result, these questions were not used to support a formal social or cultural benefit in the case study.

Despite multi-faceted outreach efforts, including in-person tabling, distribution at the public library, social media promotion, and the availability of both paper and digital formats, survey participation remained limited. Several factors likely influenced the response rate. High summer temperatures significantly reduced garden visitation during peak daylight hours, constraining opportunities for in-person engagement. In addition, the small population size of Española and the specialized nature of the garden may have contributed to a narrower respondent pool. These challenges illustrate the difficulty of collecting comprehensive social data in rural communities during summer field seasons and suggest that future research may benefit from extended engagement timelines and additional outreach partnerships.

Limitations:

- Interception survey participation was likely limited by seasonal conditions. During the peak summer months in Española extreme midday heat discourages outdoor activity, leading to low foot traffic in the garden and fewer opportunities for intercept surveys.
- As a small, close-knit community, Española has a relatively small population which may have contributed to the low total number of responses.
- Event-based responses may skew toward more engaged or informed participants and may not fully represent the experiences of more casual users.
- The Qualtrics platform did not allow punctuation in open-ended responses and gave error messages if participants used commas or periods while writing responses, which likely discouraged some participants from finishing online surveys.

Social Benefit

- ***Provides hands-on education for approximately 40 to 70 community members each year through 4 to 6 workshops focused on bioremediation, water harvesting, seed sovereignty, and traditional plant medicine, deepening shared knowledge of culturally grounded ecological practices.***

Background

The Española Healing Foods Oasis functions as a space for sharing traditional ecological knowledge. Tewa Women United and community partners occasionally host workshops on topics such as soil regeneration, seed saving, medicinal plants, and cultural history.

Figure 3.11 *– Photographs from a seed saving workshop with seeds from the Española Healing Foods Oasis. Images courtesy of Tewa Women United (Facebook).*

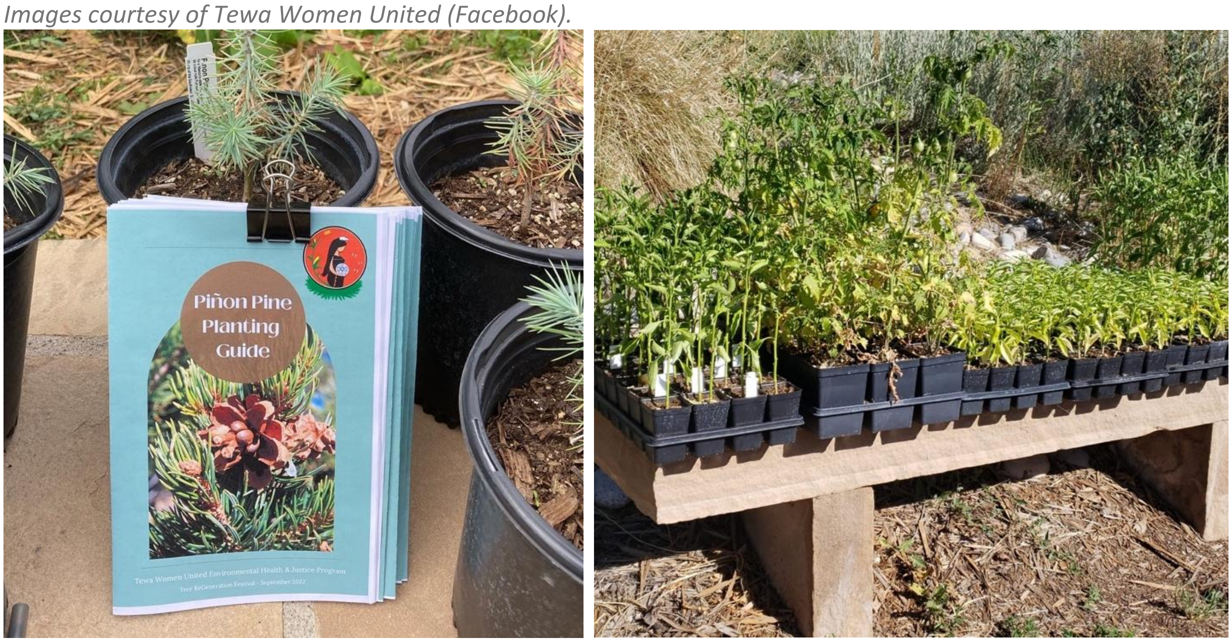


Figure 3.12 *– Plants are often gifted to workshop participants. Images courtesy of Tewa Women United (Facebook).*

Method:

Tools and Data Sources:

- Internal calendars, flyers, and event announcements
- Attendance sheets
- Tewa Women United staff interviews to confirm undocumented or recurring programming
- Public flyers and email announcements
- Meeting with TWU to review full programming history

Records were obtained from Tewa Women United on June 25th, 2025.

Workshop Topics Include:

- Bioremediation
- Pollinator spaces
- Small-space gardening
- Seed sovereignty / food sovereignty
- Water harvesting and low-water-use practices
- Traditional plant medicine
- Composting
- Advocacy

Sources

- Tewa Women United Records

Limitations

- Some events may not have been formally documented or advertised.
- Participant counts are estimated for certain events when exact numbers were unavailable.
- This benefit does not evaluate the long-term retention or personal impact of workshop content on participants.

Social Benefit

- ***Builds a culture of stewardship by engaging community members in an average of 10 volunteer events per year, each with approximately 6 participants contributing to planting, maintenance, and culturally rooted land care, equating to an estimated 300 hours of community stewardship annually with an estimated value of $3,600 in labor.***

Background:

To evaluate the Española Healing Foods Oasis' role in cultivating a culture of stewardship we analyzed volunteer participation across four years of community workdays and maintenance events, coordinated by Tewa Women United. These workdays support site maintenance and planting and moments of cultural reconnection, skill-sharing, and relationship-building centered on land care.

Volunteer activities included planting native and culturally significant species, applying mulch and amendments, hand-weeding, shaping basins and berms, repairing infrastructure, and preparing for ceremonies or educational events. Participants included youth, elders, families, local organizational partners, and Tewa Women United staff.

Figure 3.13 *– Volunteer events. Images courtesy of Tewa Women United (Facebook).*

Method

<u>Data Sources:</u>

- Sign-in sheets and registration lists from volunteer workdays and events
- Annual event summaries and programming reports
- Email correspondence and interviews with TWU staff

Records were obtained from Tewa Women United on June 25th, 2025.

Data Collected:

- Number of community volunteer events per year
- Number of individual volunteers per year
- Total volunteer hours per year (if available)
- General categories of activities (e.g., planting, maintenance, educational workshops)

Calculations

- Average number of volunteers per year
- Average number of events per year
- Comparison to pre-EHFO conditions (0 engagement)
- Monetary value of volunteer hours at $12/hour is the Española minimum wage (NM Dept. of Workforce Solutions 2025)

Average number of events per year = 10

Standard event time = 5 hours

Standard number of volunteers at each event = 6

- *Total length of standard volunteer event at the EHFO* = 5 hours
- *Total hours per year for event* = 50 hours
  - Avg # of Volunteers is 6
  - Total number of volunteer hours = 300 hours

[TWU confirmed during construction phase there were at least 10,000 volunteer hours]

Total Monetary Value Across Multiple Years
(Volunteer Hours 2021 + 2022 + 2023 + 2024) × $12.00

Sources

New Mexico Department of Workforce Solutions. Minimum Wage Information. Accessed July 20, 2025. https://www.dws.state.nm.us/Minimum-Wage-Information.

Tewa Women United. Interview with the organization by Kailani Gorman, June 25, 2025.

Limitations

- Some informal or drop-in participation may not be captured by sign-in sheets.
- Event records from early years (2018–2020) are less complete or aggregated.
- Volunteer hour estimates rely on standard event lengths and attendance patterns and may not reflect exact contributions.
- Cultural and relational value of these gatherings goes beyond what can be captured in hourly wage equivalents.

Economic Benefit

- ***Supports 2 to 8 ongoing jobs annually related to landscape care, educational programming, and site coordination.***

Background

New Mexico has some of the highest poverty rates in the country at around 18%. Although it is the fifth largest state, it ranks 45th in terms of population density. The Española Healing Foods Oasis supported the creation of 2 to 8 new jobs through its design, construction, and maintenance. These included paid opportunities for local residents in landscaping, irrigation, planting, and natural infrastructure installation. While modest in scale, these jobs represent meaningful investment in community-based green infrastructure and land stewardship in a rural and economically disadvantaged region.

Method

Tewa Women United. Interview with the organization by Kailani Gorman, June 25, 2025.

<u>Job Count Criteria:</u>

- Count includes all paid positions directly tied to the EHFO's construction and maintenance.
- Includes full-time, part-time, and seasonal roles.
- Roles may include site preparation, stonework, planting, irrigation setup, mycoremediation efforts, maintenance, and site documentation.
- Does not include unpaid volunteer hours or community workshops.

Calculations:

- Job Creation Total = Number of paid individuals hired for construction and maintenance

Sources:

Tewa Women United. Interview with the organization by Kailani Gorman, June 25, 2025.

Limitations

- Some employment records may not distinguish between paid and volunteer labor.
- Informal or temporary jobs may be underreported or not fully documented.
- Calculations do not account for induced economic benefits (e.g., spending by workers in local economy).

Economic Benefit

- ***Mobilized over $20,000 of in-kind donations of plants, mulch, stone, gravel, and other materials from local partners and suppliers. These contributions reduced overall project costs and reflects strong community support for the project.***

Background

New Mexico faces persistent economic challenges, with a poverty rate of approximately 18%. Though it is the fifth largest state geographically, it ranks 45th in population density. Supporting local businesses through community-based projects like the Española Healing Foods Oasis plays an important role in strengthening regional economic resilience.

Figure 4.1 – Flagstone, plants and soil that were donated during the initial phases of the Española Healing Foods Oasis. Images courtesy of Tewa Women United (Facebook).

Method

Data Sources:

- Project records from Tewa Women United
- On site estimation of materials
- Area calculations from the high-resolution drone orthophoto
- Price lists from local suppliers

Table 4.1 *– Donated materials, estimated quantity, and cost*

Calculations:

Material	**Quantity**	**Unit Cost**	**Total Estimated Cost**
Rocks (4”-8” cobble)	110 yd^3	\$75/yd^3	\$8,250
Gravel	60 yd^3	\$44/yd^3	\$2,640
Mulch	150 yd^3	\$50/yd^3	\$7,500
Planting materials	General estimate	\$8,500 x 0.30 (discount)	\$2,250
Total			**\$20,640**

Discussion

The in-kind contributions received during the design and implementation phases of the Española Healing Foods Oasis illustrate a strong alignment between community values and ecological investment. These material donations significantly reduced project costs and enabled a higher standard of construction and ecological design than would have been feasible with the budget alone.

Sources

Christie Green, radicle. Interview with the landscape architect by Anthony Fettes and Kailani Gorman, March 24, & July 22, 2025.

Tewa Women United. Interview with the organization by Kailani Gorman, June 25, 2025.

Limitations:

- Inventory of landscape and other construction materials is not comprehensive and is only a rough estimate based on interviews.
- Quantities were estimated visually on site and through area takeoffs using the high resolution orthophoto of the EHFO.
- Prices of rocks, gravel, and mulch are based off of online listings from local suppliers.

Appendix A – Soil Testing

Soil Health Testing **6/25/25**

Weather Conditions: Mostly sunny . Hight 79F/Low 59F. Measurable rain: 0.38 in (past 72 hours), 0.00 in (past 7 days)

Sample Location/Plot #	*Reference: Plant available water range and field capacity (%)*	% Moisture (VWC)	Soil Temp (°F)	Compaction depth (300psi)	pH	EC (μs/cm)	Microbial Biomass (μg C/g)	F:B Ratio
01_Reference Site	7-16%	40%	76.2	6"	9.2	890		
02_Reference Site	7-16%	12%	72.0	9"	8.6	430	131	0.1:1
03_EHFO (piñon/dye garden)	9-21%	35%	70.0	15"	8.3	190		
04_EHFO (upper swale)	9-21%	24%	69.2	9"	8.5	210		
05_EHFO (mid swale)	9-21%	14%	78.8	8"	8.9	150		
06_EHFO (lower swale)	9-21%	24%	70.0	9"	8.8	230		
07_EHFO (lower swale)	9-21%	60%	75.5	15"	8.7	200	125	0.1:1
08_EHFO (orchard terrace)	9-21%	44%	63.3	20"	8.4	180	310	0.5:1
09_EHFO (spiral garden)	9-21%	66%	58.0	14"	8.5	210	132	0.1:1

Notes: To improve efficiency the second round of microbiometer tests combined the samples within each zone. Tests in this round were also prompted to add three additional drops (except 08). The test for the reference site required six additional drops. Due to the inconsistency of drops added to the test cards, this data should not be included in the final calculations.

Soil Health Testing **7/4/25**

Weather Conditions: Mostly sunny w/scattered monsoonal rains. Hight 88F/Low 53F. Measurable rain: 0.04 in (past 72 hours), 0.00 in (past 7 days)

Sample Location/Plot #	*Reference: Plant available water range and field capacity (%)*	% Moisture (VWC)	Soil Temp (°F)	Compaction depth (300psi)	pH	EC (μs/cm)	Microbial Biomass (μg C/g)	F:B Ratio
01_Reference Site	7-16%	13%	103.2	Not tested in this round of sampling	Not tested in this round of sampling	Not tested in this round of sampling		
02_Reference Site	7-16%	12%	101.3				311	0.6:1
03_EHFO (piñon/dye garden)	9-21%	13%	80.2					
04_EHFO (upper swale)	9-21%	15%	64.6					
05_EHFO (mid swale)	9-21%	16%	92.1					
06_EHFO (lower swale)	9-21%	11%	77.5					
07_EHFO (lower swale)	9-21%						180	0.2:1
08_EHFO (orchard terrace)	9-21%	14%	63.5				418	0.8:1
09_EHFO (spiral garden)	9-21%	23%	60.3				780	1.4:1

Soil Health Testing **7/17/25**

Weather Conditions: Partly cloudy w/scattered monsoonal rains. Hight 89F/Low 62F. Measurable rain: 0.00 in (past 72 hours), 0.00 in (past 7 days) - 0.46 in fell after the site visit

Sample Location/Plot #	*Reference: Plant available water range and field capacity (%)*	% Moisture (VWC)	Soil Temp (°F)	Compaction depth (300psi)	pH	EC (μs/cm)	Microbial Biomass (μg C/g)	F:B Ratio
01_Reference Site	7-16%	10%	Not tested in this round of sampling	Not tested in this round of sampling				
02_Reference Site	7-16%	12%			9.1	620	392	0.5:1
03_EHFO (piñon/dye garden)	9-21%	14%						
04_EHFO (upper swale)	9-21%	29%						
05_EHFO (mid swale)	9-21%	24%						
06_EHFO (lower swale)	9-21%	13%						
07_EHFO (lower swale)	9-21%	34%			8.9	180	430	0.5:1
08_EHFO (orchard terrace)	9-21%	9%			8.9	240	311	0.5:1
09_EHFO (spiral garden)	9-21%	28%			8.6	330	639	1.1:1

Soil Health Testing **7/22/25**

Weather Conditions: Mostly sunny w/scattered monsoonal rains. Hight 94F/Low 57F. Measurable rain: 0.44 in (past 72 hours), 0.90 in (past 7 days)

Sample Location/Plot #	*Reference: Plant available water range and field capacity (%)*	% Moisture (VWC)	Soil Temp (°F)	Compaction depth (300psi)	pH	EC (μs/cm)	Microbial Biomass (μg C/g)	F:B Ratio
01_Reference Site	7-16%	24%	Not tested in this round of sampling	Not tested in this round of sampling				
02_Reference Site	7-16%				9.1	410	255	0.2:1
03_EHFO (piñon/dye garden)	9-21%	25%						
04_EHFO (upper swale)	9-21%	VWC taken from composite sample						
05_EHFO (mid swale)	9-21%							
06_EHFO (lower swale)	9-21%							
07_EHFO (lower swale)	9-21%				8.9	730	560	0.7:1
08_EHFO (orchard terrace)	9-21%	26%			8.9	1490	513	0.7:1
09_EHFO (spiral garden)	9-21%	31%			8.6	480	1231	1.9:1

Notes: This round of testing was condicted the morning after a 0.44" rainfall event and 0.90" total for the past week. Testing also followed strict lab-grade protocols for sample processing.

Appendix B - Biodiversity

Control Slope

Control Slope	n	n-1	n(n-1)	Native	Pollinator Host
Texas blueweed (*Helianthus ciliaris)*	126	125	15750	Y	Y
Bindweed (*Convolvulus arvensis)*	45	44	1980	N	N
Summer Cypress (*Bassia scoporia*)	2450	2449	6000050	N	N
Tumbleweed (*Salsola trugus L.*)	197	196	38612	N	N

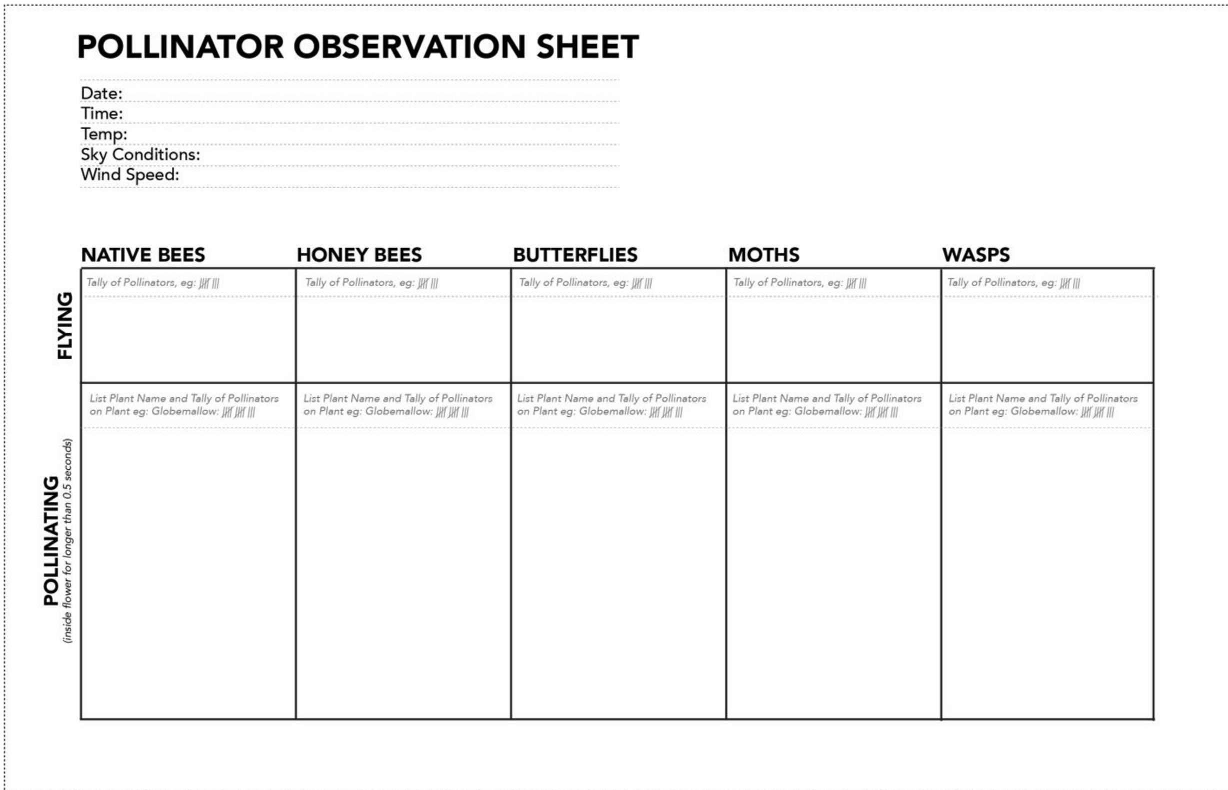
EHFO

Garden	n	n-1	n(n-1)	Yes/No	Pollinator Host
Trees					
Apple (*Malus spp.)*	10	9	90	Y	N
Apricot (*Prunus ameiaca)*	4	3	12	N	Y
Ash-velvet (*Fraxinus velutina)*	5	4	20	Y	Y
Black Locust (Robinia pseudoacacia)	8	7	56	N	Y
Blue arrow juniper (*Juniperus chinensis)*	2	1	2	Y	Y
Burr Oak (*Quercus macrocarpa)*	8	7	56	Y	Y
Chokecherry (*Prunus virgiana)*	6	5	30	Y	Y
Crabapple (*Malus spp.)*	5	4	20	N	N
Desert Olive (*Forestiera neomexicana)*	10	9	90	Y	Unknown
Fremont cottonwood (*Populus fremontii)*	2	1	2	Y	Y
Gambel Oak (*Quercus neomexicana)*	1	0	0	Y	Y
Mulberry (*Morus spp.)*	1	0	0	N	N
Narrowleaf cottonwood (P*opulus augustifolia)*	1	0	0	Y	y
New Mexico Locust (*Robinia neomexicana)*	4	3	12	Y	Y
Oneseed Juniper (*Juniperus monosperma)*	1	0	0	Y	Y
Peach (*Prunus persica)*	3	2	6	N	N
Pear (*Pyrus spp.)*	4	3	12	N	N
Pinon pine (*Pinus edulis)*	3	2	6	Y	Y
Plum (*Prunus americana)*	4	3	12	N	Y
Russian Olive	2	1	2	N	N
Siberian Elm (*Ulmus pumila)*	2	1	0	N	N
Shrubs					
Apache Plume (*Fallugia paradoxa)*	2	1	2	Y	Y
Big sage (*Artemisia tridentata)*	2	1	2	Y	Y
Chamisa (*Ericameria nauseosa)*	129	128	16512	Y	Y
Curl leaf mahogany (*Cercocarpus ledifolius)*	1	0	0	Y	Y
Desert Willow (*Chilopsis linearis)*	2	1	2	Y	Y
False Indigo (*Amorpha fruticosa)*	3	2	6	Y	Y

Fourwing saltbush *(Atriplex canascens)*	7	6	42	Y	Y
Gambel Oak (Quercus neomexicana)	1	0		Y	Y
Grape (*Vitis spp.)*	4	3	12	N	N
Mexican Sage (*Salvia darcyi)*	5	4	20	N	Y
Mountain mahogany (*Cercocarpus montanus)*	5	4	20	Y	Y
Narrow leaf yucca (*Yucca glauca)*	2	1	2	Y	Y
NM Bird of paradise (*Caesalpinia mexicana)*	2	1	2	N	N
Oak (*Quercus spp.)*	3	2	6	Y	Y
Rosemary (*Salvia rosmarinus)*	2	1	2	Y	N
Sand sagebrush (*Artemesia filifolia)*	11	10	110	Y	Y
Three Lead Sumac (*Rhus trilobata)*	6	5	30	Y	Y
Utah serviceberry (*Amelanchier utahensis)*	3	2	6	Y	Y
Wax Currant (*Ribes cereum)*	9	8	72	Y	Y
Wild rose (*Rosa fendleri)*	64	63	4032	Y	Y
Woldberry (*Lycium paradoxa)*	64	63	4032	Y	Y
Yellow flowering yucca (*Yucca baccata)*	3	2	6	N	N
Grasses & Forbs					
Alfalfa		-1	0	N	N
Amaranth (*Amaranthus spp.)*	68	67	4556	Y	Y
Aster (*Heterotheca spp.)*	356	355	126380	Y	Y
Bear grass *(Xerophyllum tenax)*	1	0	0	Y	Y
Beardtongue *(Penstemon neomexicanus)*	2	1	2	Y	Y
Beeplant *(Cleome serrulata)*	3	2	6	Y	Y
Bindweed (*Convolvulus arvensis*)	60	59	3540	N	N
Blackberry (*Rhubus spp.)*	2	1	2	N	N
Blue flax (*Linum lewisii)*	9	8	72	Y	Y
Blue Grama (*Bouteloua gracilis*)	142	141	20022	Y	Y
Bottlebrush squirelltail (*Elamus elmoidies)*	25	24	600	Y	Y
Bristleweed (*Xanthisma junceum*)	3	2	6	Y	Unknown
Cheatgrass (*Bromus tectorum)*	50	49	2450	N	N
David's splurge (*Euphorbia davidii)*	290	289	83810	Y	Unknown
Daylily (*Hemerocallis fulva*)	2	1	2	N	N
Deergrass (*Muhlenbergia rigens)*	153	152	23256	Y	Y
Desert four o'clock (*Mirabilis multiflora)*	10	9	90	Y	Y
Desert globemallow (*Sphaeralcea ambigua)*	9	8	72	Y	Y
False golden star (*Heterotheca villosa)*	54	53	2862	Y	Y
Flower of an hour (*Hibiscus trionum)*	2	1	2	N	N
Galleta grass (*Pleuraphis jamesii)*	1	0		Y	Y
Giant Sacaton (*Sporobolus wrightii)*	4	3	12	Y	Y

Globemallow (*Spaeralcea ambigua)*	102	101	10302	Y	Y
Gunnison's milkvetch (*Calochortus gunnisonii)*	20	19	380	N	Y
Horseweed (*Erigeron canadensis)*	50	49	2450	Y	Y
Lamb's Quarter (*Chenopodium alba)*	150	149	22350	N	Y
Lavander cotton (*Santolina chamaecyparissus)*	26	25	650	N	N
Little bluestem (*Andropogon scoparius)*	76	75	5700	Y	Y
Navoja Tea (*Thelasperma megapotamicum)*	70	69	4830	Y	Y
Nightshade (*Solanum elaeagnifolium)*	40	39	1560	Y	Y
Prairie Coneflower (*Ratibida tagetes)*	11	10	110	Y	Y
Prickly lettuce (*Latuca serriola)*	50	49	2450	N	N
Puncture vine (*Tribulus terrestris*)	22	21	462	N	N
Purple prairie clover (*Dalea purpurea)*	1	0	0	Y	Y
Ribwort Plaintain (*Plantago lanceolata)*	11	10	110	N	N
Ricegrass (*Orzyopsis hymenoides)*	397	395	132528	Y	Y
Rocky mountain beeplant (*Cleome serrulata)*	2	1	2	Y	Y
Showy milkweed (*Asclepias asperula)*	6	5	30	Y	Y
Sulfur Buckwheat (*eriogonum umbellatum)*	5	4	20	Y	Y
Summer Cypress (*Bassia scoporia*)	15	14	210	N	N
Summer Cypress (*Bassia scoporia*)	250	249	62250	N	N
Sunflower (*Helianthus annus)*	65	64	4160	Y	Y
Texas blueweed (*Helianthus ciliaris)*	53	52	2756	Y	Y
Velvetweed (*Oenothera curtiflora)*	14	13	182	Y	Y
Western wheatgrass (*Pascopyrum smithii)*	17	16	272	Y	Y
Yellow day lilly (*Hemorocallis fulva)*	2	1	2	N	N
Yerba Mansa (*Anemopsis californica)*	90	89	8010	Y	Y
Agricultural					
Chile peppers (*Capsicum spp.)*	6	5	30	Y	N
Corn (*Zhea mays)*	30	29	870	N	N
Mint (*Mentha spp.)*	50	49	2450	N	N
Squash (*Cucurbita spp.)*	18	17	306	Y	Y
Tomato (*Solanum lycopersicum)*	9	8	72	N	N

Appendix C – Pollinator Counts


POLLINATOR OBSERVATION SHEET

Date:
Time:
Temp:
Sky Conditions:
Wind Speed:

	NATIVE BEES	HONEY BEES	BUTTERFLIES	MOTHS	WASPS
FLYING	Tally of Pollinators, eg: ||||/ |||	Tally of Pollinators, eg: ||||/ |||	Tally of Pollinators, eg: ||||/ |||	Tally of Pollinators, eg: ||||/ |||	Tally of Pollinators, eg: ||||/ |||
POLLINATING (inside flower for longer than 0.5 seconds)	List Plant Name and Tally of Pollinators on Plant eg: Globemallow: ||||/ ||||/ |||	List Plant Name and Tally of Pollinators on Plant eg: Globemallow: ||||/ ||||/ |||	List Plant Name and Tally of Pollinators on Plant eg: Globemallow: ||||/ ||||/ |||	List Plant Name and Tally of Pollinators on Plant eg: Globemallow: ||||/ ||||/ |||	List Plant Name and Tally of Pollinators on Plant eg: Globemallow: ||||/ ||||/ |||

June 12th

starting time	12:55pm
Temp	88f
Sky	Sunny
Wind	6mph

EHFO	Native Bees	Honeybees	Butterflies	Moths	Wasps	Total
Flying	25	1	0	1	0	**27**
Pollinating by Flower Type:						0
blue flax	2					2
rocky mountain penstemon	6					6
milkweed	2					2
cota	1					1
texas blueweed	1				1	2
hairy golden aster	7					7
purple prairie clover	2					2
Total Pollinating	**21**	**0**	**0**	**0**	**1**	**22**

Control	Native Bees	Honeybees	Butterflies	Moths	Wasps	Total
Flying	1					**1**
Pollinating by Flower Type:						0
globemallow	1					1
texas blueweed	1					1
Total Pollinating	**2**	0	0	0	0	**2**

June 18th

starting time	1:10pm
Temp	88f
Sky	Sunny
Wind	4mph

EHFO	Native Bees	Honeybees	Butterflies	Moths	Wasps	Total
Flying	12	0	0	0	2	**14**
Pollinating by Flower Type:						
rocky mountain penstemon	3					
globemallow	6					
hairy golden aster	6					
purple prairie clover	1					
cota	1					
mexican hat	4					
texas blueweed	1					
blackberry	1					
Total Pollinating	**23**					**23**

Control	Native Bees	Honeybees	Butterflies	Moths	Wasps	Total
Flying	2	0	1	0	0	**3**
Pollinating by Flower Type:						
globemallow	3					
texas blueweed	3				1	
Total Pollinating	**6**				1	**7**

July 2nd

starting time	11am
Temp	73f
Sky	Sunny
Wind	4mph

EHFO	Native Bees	Honeybees	Butterflies	Moths	Wasps	Total
Flying	31		1		3	**35**
Pollinating by Flower Type:						
hairy golden aster	14					
prairie coneflower	22				7	
texas blueweed	3					
rocky mountain bee plant	3					
Total Pollinating	**42**				**7**	**49**

Control	Native Bees	Honeybees	Butterflies	Moths	Wasps	Total
Flying	5				1	**6**
Pollinating by Flower Type:						
texas blueweed	4					
Total Pollinating	**4**					**4**

July 7th

starting time	11am
Temp	80f
Sky	Sunny
Wind	3mph

EHFO	Native Bees	Honeybees	Butterflies	Moths	Wasps	Total
Flying	17	0	1	0	2	**20**
Pollinating by Flower Type:						
texas blueweed	12					
hairy golden aster	12					
prairie coneflower	12				5	
rocky mountain bee plant	14					
Total Pollinating	**50**				**5**	**55**

Control	Native Bees	Honeybees	Butterflies	Moths	Wasps	Total
Flying	1				1	**2**
Pollinating by Flower Type:						
texas blueweed	1					
Total Pollinating	1					**1**

July 11th	
starting time	2:00pm
Temp	93
Sky	Sunny
Wind	5mph

EHFO	Native Bees	Honeybees	Butterflies	Moths	Wasps	Total
Flying	14					**14**
Pollinating by Flower Type:						
texas blueweed	9				1	
cota	2				1	
hairy golden aster	4					
rocky mountain bee plant	12				1	
mexican hat	4				1	
globemallow	12					
rocky mountain penstemon	1					
Total Pollinating	**44**				**4**	**48**

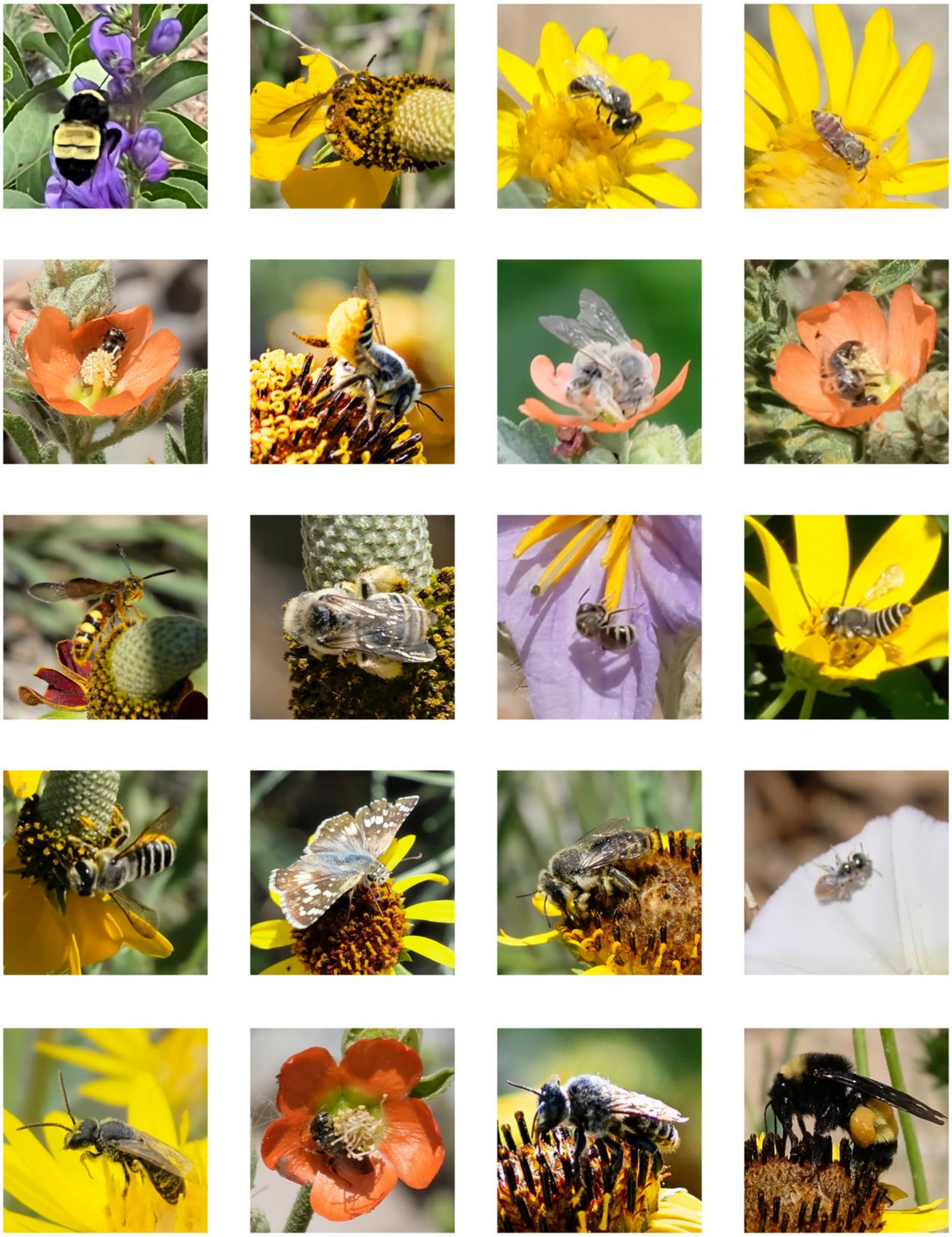
Control	Native Bees	Honeybees	Butterflies	Moths	Wasps	Total
Flying	0					**0**
Pollinating by Flower Type:						
Total Pollinating	0					**0**

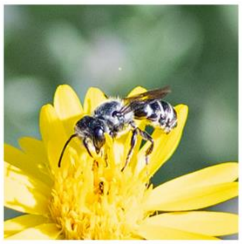
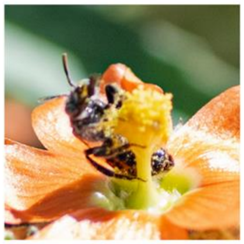
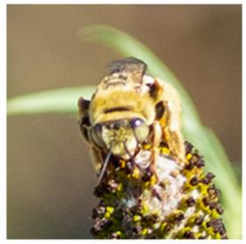
July 17th	
starting time	10:45am
Temp	80f
Sky	Sunny
Wind	6mph

EHFO	Native Bees	Honeybees	Butterflies	Moths	Wasps	Total
Flying	19		3		6	**28**
Pollinating by Flower Type:						
helianthus	18	1	1		1	
globemallow	2					
Total Pollinating	**20**	**1**	**1**		**1**	**23**

Control	Native Bees	Honeybees	Butterflies	Moths	Wasps	Total
Flying	0					**0**
Pollinating by Flower Type:	0					**0**

Española Healing Foods Oasis







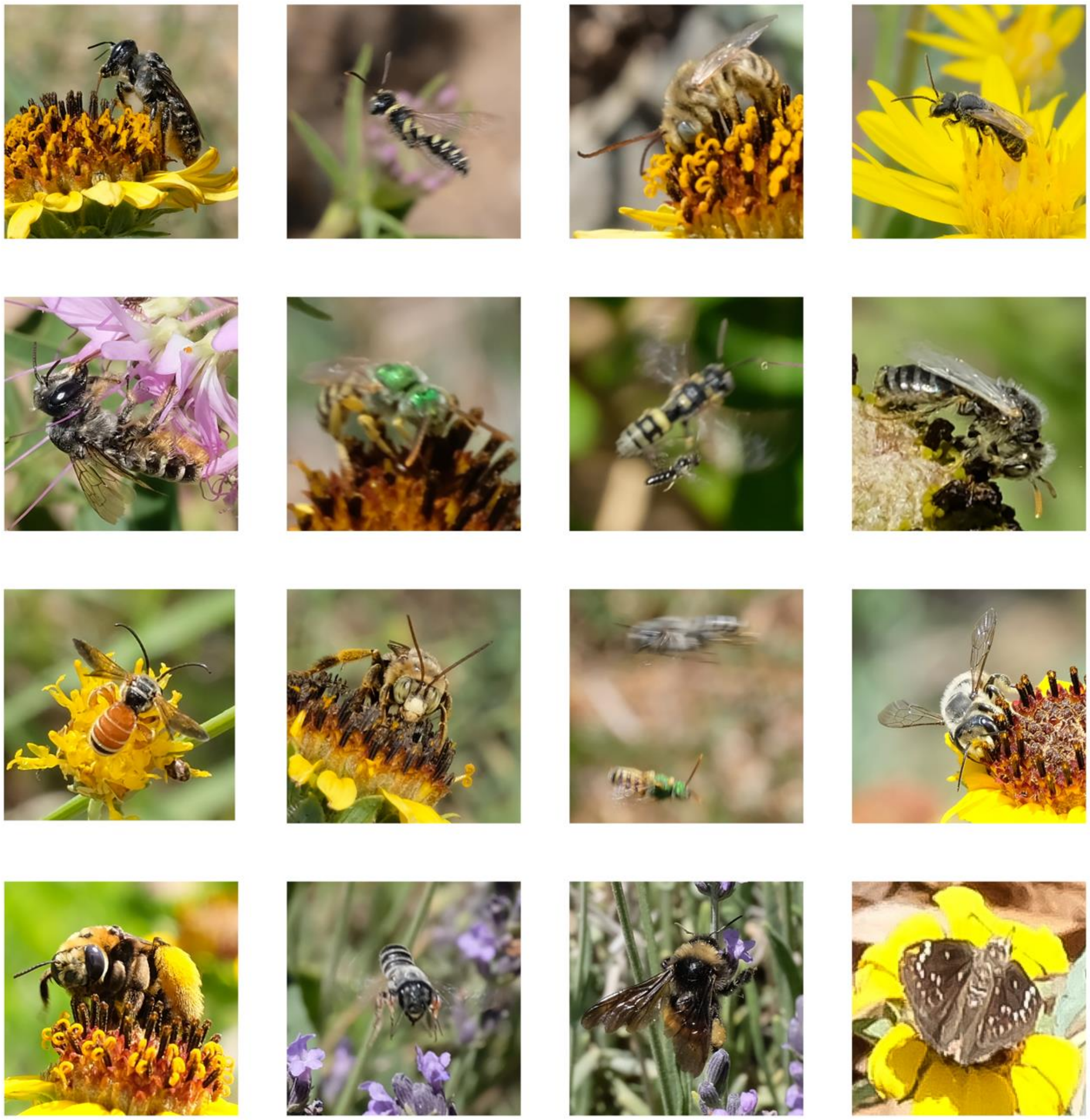




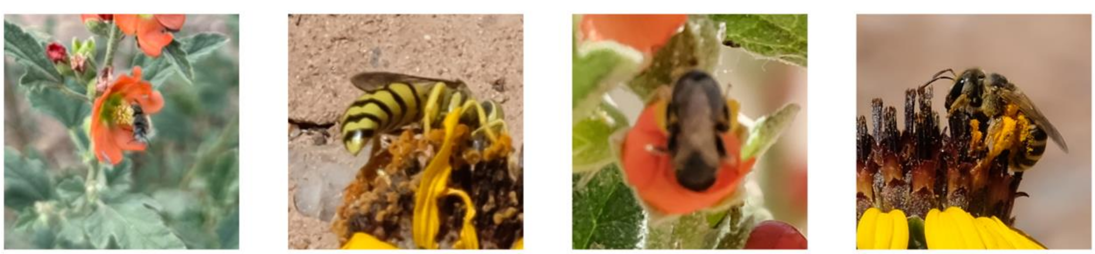






Reference Site



Appendix D – Microclimate

Location 1 - Asphalt parking lot between garden and library. (Full sun)

Time of Day	Date	Time	Temp (°F)	Temp (°C)	Relative Humidity (%)	Average Wind	Grnd Surface (°F)	Surfaces - 15' (°F)	CST Average (°F)	CST Average (°C)	MRT Calculation (°C)	MRT-Air Temp (°C)	Wind Speed (M/S)	UTCI (°C)	UTCI (°F)
Morning	6/18/25	10:38am	80.5	26.94	27.90	3.00	103.00	98.90	100.58						
Morning	6/10/25	9:33am	81.6	27.67	33.60	2.00	99.30	98.30	98.75						
Morning	6/26/25	10:38am	81	27.22	42.30	0.60	98.30	95.10	96.65						
Morning	7/3/25	10:08am	74.5	23.61	39.30	1.70	103.50	98.60	101.05						
Averages			84.08	26.36	35.68	1.83	100.98	97.50	99.24	32.50	44.94	18.14	0.8200	27.5	82.9
Midday	6/12/25	11:20pm	89.4	32.08	26.60	2.70	121.60	89.00	106.20						
Midday	6/19/25	11:15pm	92.5	33.61	19.50	3.50	122.50	118.60	120.55						
Midday	7/2/25	11:00pm	87.7	30.94	33.60	3.30	126.30	130.50	123.40						
Midday	7/11/25	12:15pm	83.8	28.78	29.10	1.30	126.00	123.20	124.60						
Averages			88.4	31.33	27.45	2.70	124.55	112.83	118.69	48.16	43.71	16.83	1.207000	33.1	91.58
Late Afternoon	6/12/25	4:00pm	94.5	34.72	14.80	1.70	126.10	120.90	123.50						
Late Afternoon	6/20/25	3:35pm	95.5	35.28	12.10	7.00	113.70	108.60	111.20						
Late Afternoon	6/22/25	4:30pm	95.2	35.11	16.90	3.50	124.00	123.00	123.50						
Late Afternoon	7/2/25	3:40pm	84.5	29.17	27.60	1.80	127.60	133.50	130.50						
Late Afternoon	7/11/25	3:30pm	100.7	38.17	13.80	1.40	127.00	123.00	125.00						
Averages			94.08	34.48	16.94	3.24	123.64	119.80	121.74	49.86	45.25	15.77	1.4484000	32.2	89.96

Location 2 - Center of unterraced slope adjacent to garden (Full sun)

Time of Day	Date	Time	Temp (°F)	Temp (°C)	Relative Humidity (%)	Average Wind	Grnd Surface (°F)	Surfaces - 15' (°F)	CST Average (°F)	CST Average (°C)	MRT Calculation (°C)	MRT-Air Temp (°C)	Wind Speed (M/S)	UTCI (°C)	UTCI (°F)
Morning	6/18/25	10:48am	85	29.44	23.60	1.90	121.60	102.80	112.20						
Morning	6/10/25	9:33am	85	29.44	29.40	2.70	111.50	105.20	108.35						
Morning	6/26/25	10:38am	78.9	26.06	48.90	0.60	98.30 93.4, 90.4		91.10						
Morning	7/3/25	10:08am	77.9	25.50	38.40	0.70	120.50	96.20	107.85						
			81.7	27.61	35.58	1.48	113.06	100.77	104.91	40.51	38.64	12.90	0.660384	29.1	84.38
Midday	6/12/25	11:25pm	91	32.78	26.30	1.90	131.50	111.00	121.25						
Midday	6/19/25	11:15pm	92.2	33.44	19.30	2.70	133.20	122.40	127.80						
Midday	7/2/25	11:00pm	80.7	27.06	30.90	1.50	142.30	123.40	132.85						
Midday	7/11/25	12:15pm	87.5	30.83	27.30	1.70	135.80	126.90	131.35						
			87.85	31.03	26.18	1.95	135.70	120.93	128.31	53.51	46.76	22.48	0.871728	33.9	93.02
Late Afternoon	6/12/25	4:00pm	95.9	35.50	12.10	2.90	136.80	122.80	129.65						
Late Afternoon	6/20/25	3:45pm	95.8	35.44	12.90	8.00	109.70	98.50	104.10						
Late Afternoon	6/22/25	4:30pm	94	34.44	18.30	2.30	118.00	102.00	110.00						
Late Afternoon	7/2/25	3:40pm	89.6	32.00	24.10	3.00	132.30	136.20	134.25						
Late Afternoon	7/11/25	3:40pm	97.5	36.39	11.30	2.30	134.20	121.60	127.90						
			94.56	34.76	15.80	3.70	126.29	112.50	119.18	48.43	44.33	13.60	1.654048	35.5	95.90

location 3 - center of city hall parking lot above the garden (Full sun)

Time of Day	Date	Time	Temp (°F)	Temp (°C)	Relative Humidity (%)	Average Wind	Grnd Surface (°F)	Surfaces - 15' (°F)	CST Average (°F)	CST Average (°C)	MRT Calculation (°C)	MRT-Air Temp (°C)	Wind Speed (M/S)	UTCI (°C)	UTCI (°F)
Morning	6/18/25	10:48am	85	29.44	24.90	2.10	101.80	90.40	96.10	35.61					
Morning	6/10/25	9:33am	86.4	30.22	27.90	2.30	92.80	94.00	93.40	34.11					
Morning	6/26/25	10:38am	75.2	24.00	49.00	0.70	99.00	99.30	99.15	37.31					
Morning	7/3/25	10:08am	77.6	25.33	36.60	1.50	102.00	100.50	101.25	38.47					
			81.05	27.25	34.60	1.65	98.90	96.05	97.48	36.38	33.61	9.13	0.73664	28	82.40
Midday	6/12/25	11:25pm	92.4	33.56	15.30	1.80	131.00	114.90	122.95	50.53					
Midday	6/19/25	11:15pm	94.1	34.50	19.40	2.80	124.00	116.20	120.10	48.94					
Midday	7/2/25	11:00pm	84.2	29.00	31.90	1.70	124.80	120.40	122.60	50.33					
Midday	7/11/25	11:10pm	90.6	32.56	25.60	1.90	124.60	111.90	118.25	47.92					
			90.325	32.40	25.38	2.05	126.10	115.85	120.98	49.43	44.32	17.03	0.916432	34.3	93.74
Late Afternoon	6/12/25	4:00pm	96.6	35.89	13.80	1.30	126.30	121.70	123.95	51.08					
Late Afternoon	6/20/25	3:45pm	95.2	35.11	10.90	2.00	110.20	99.20	104.70	40.39					
Late Afternoon	6/22/25	4:30pm	97.2	36.22	18.40	2.30	120.50	116.80	118.25	47.92					
Late Afternoon	7/2/25	3:50pm	93.7	33.17	22.50	2.10	136.50	123.60	130.05	52.75					
Late Afternoon	7/11/25	3:40pm	99.5	37.50	11.30	2.50	125.00	112.30	118.65	48.14					
			96.04	35.58	15.18	2.02	123.44	114.50	118.58	48.06	44.21	12.48	0.9038208	36.2	97.16

Location 4 - Southern side of DHFO on mulched path (mostly Full sun, slightly shaded in evening)

Time of Day	Date	Time	Temp (°F)	Temp (°C)	Relative Humidity (%)	Average Wind	Grnd Surface (°F)	Surfaces - 15' (°F)	15' Average (°F)	CST Average (°F)	CST Average (°C)	MRT Calculation (°C)	MRT-Air Temp (°C)	Wind Speed (M/S)	UTCI (°C)	UTCI (°F)
Morning	6/18/25	10:48am	84	28.89	23.20	2.10	113.30	98.80	98.00	105.60	40.89					
Morning	6/10/25	9:33am	85	29.44	27.30	2.10	104.00 80.7, 85, 83.1		82.93	93.47	34.15					
Morning	6/26/25	10:38am	82.9	28.28	47.30	0.70	101.60 82.7, 78.9		80.8	92.10	33.39					
Morning	7/3/25	10:08am	79	26.11	36.10	1.00	118.50 72.4, 77.3, 73.4		74.08	96.25	35.69					
			82.725	28.18	33.43	1.48	109.10 ->		83.93	96.85	36.03	35.25	2.68	0.600384	28.1	82.58
Midday	6/12/25	11:20pm	94.6	34.78	15.90	1.70	140.00	98.00	98.00	118.00	47.78					
Midday	6/19/25	11:15pm	95.2	35.11	19.60	2.70	143.70 92.4, 91.4, 95.7		93.17	118.44	48.02					
Midday	7/2/25	11:30pm	82.5	28.06	28.00	4.10	145.80 87.2, 80.2, 88.4		81.6	113.70	45.39					
Midday	7/11/25	11:10pm	90.9	32.72	23.30	3.00	149.00 91, 94, 91.7		92.23	118.62	48.12					
			90.8	32.67	24.08	3.48	141.63 ->		90.76	117.19	47.33	48.35	23.18	1.17168	33.4	92.12
Late Afternoon	6/12/25	4:00pm	96.9	36.06	15.60	1.60	102.40 97.1, 93.2, 91.5		93.93	98.17	36.76					
Late Afternoon	6/20/25	3:45pm	95	35.00	11.30	3.50	106.70 91.3, 92.2, 92.9		92.13	99.42	37.45					
Late Afternoon	6/22/25	4:40pm	96.9	36.06	18.60	2.00	98.90	97.80	97.80	98.35	36.86					
Late Afternoon	7/2/25	3:50pm	90.7	32.61	23.10	3.10	96.30 87.1, 89.2, 89.4		88.57	92.44	33.58					
Late Afternoon	7/11/25	3:30pm	101.7	38.72	15.10	0.80	115.60 97.4, 89.4, 97.3		98.03	106.82	41.56					
			96.24	35.69	16.72	2.20	103.98 ->		94.09	99.04	37.24	31.69	20.52	0.983488	33.2	91.76

Location 5 - Memorial bench along top terrace (Full sun, slightly shaded in evening)

Time of Day	Date	Time	Temp (°F)	Temp (°C)	Relative Humidity (%)	Average Wind	Grnd Surface (°F)	Surfaces - 15' (°F)	15' Average (°F)	CST Average (°F)	CST Average (°C)	MRT Calculation (°C)	MRT-Air Temp (°C)	Wind Speed (M/S)	UTCI (°C)	UTCI (°F)
Morning	6/18/25	10:48am	83.5	28.61	23.50	2.30	124.00	98.70	98.70	111.35	44.08					
Morning	6/10/25	9:33am	87	30.56	25.50	1.80	105.00 81.4, 83.6, 88.6		81.87	94.35	34.64					
Morning	6/26/25	10:38am	84.9	29.39	44.50	0.70	92.10 81.4, 101.2, 77.1		86.57	88.34	31.85					
Morning	7/3/25	10:08am	75.5	24.17	40.30	2.10	115.30 84.5, 78.3, 70.6		77.80	96.55	35.85					
			82.73	28.18	33.43	1.73	109.10 ->		86.74	97.90	36.61	28.71	8.43	0.771144	29.4	84.92
Midday	6/12/25	11:20pm	92	33.33	16.00	1.60	140.00	89.80	89.80	114.90	45.83					
Midday	6/19/25	11:15pm	98.3	36.83	17.60	2.50	139.10 93.7, 88.2, 105.6		95.83	117.47	47.48					
Midday	7/2/25	11:00pm	88.9	31.61	26.10	1.60	141.10 88.4, 78.3, 93.5		86.73	113.91	45.51					
Midday	7/11/25	11:10pm	88.6	31.44	24.70	2.20	145.60 93.1, 85.9, 97		92	118.70	48.17					
			91.95	33.31	23.00	1.98	141.40	89.80	90.09	116.14	46.75	37.34	13.44	0.882384	33.2	91.76
Late Afternoon	6/12/25	4:00pm	93.6	34.11	13.70	1.50	93.50 84.3, 83.5, 83.6		83.47	88.46	31.37					
Late Afternoon	6/20/25	3:45pm	94.6	34.78	13.60	2.80	108.10 91.1, 94.8, 94.6		93.50	100.80	38.22					
Late Afternoon	6/22/25	4:30pm	96	35.56	18.00	1.90	134.00	87.20	87.20	108.60	38.11					
Late Afternoon	7/2/25	3:40pm	93.5	34.17	22.50	2.20	96.00 79.9, 86.9, 82.2		83.00	89.50	31.94					
Late Afternoon	7/11/25	3:30pm	103.5	39.61	15.50	0.80	119.70 92.8, 99.6, 101.1		97.83	108.77	42.65					
			96.16	35.64	16.66	1.76	106.26 ->		89.00	97.63	36.46	28.89	0.01	0.7067904	34.3	93.74

Location 6 - main accessible pathway with dark grey gravel (Full sun)

Time of Day	Date	Time	Temp (°F)	Temp (°C)	Relative Humidity (%)	Average Wind	Gnd Surface (°F)	Surfaces - 15' (°F)	15' Average (°F)	CST Average (°F)	CST Average (°C)	MRT Calculation (°C)	MRT-Air Temp (°C)	Wind Speed (M/S)	UTCI (°C)	UTCI (°F)
Morning	6/18/25	10:30am	86	30.00	22.60	2.20	121.80	94.60	94.60	107.80	42.11					
Morning	6/20/25	9:30am	85.1	29.50	26.30	1.80	87.30	81.5, 85.4, 85.8	84.10	85.79	29.83					
Morning	6/26/25	10:30am	84.5	29.17	44.30	0.70	112.40	95.1, 71.9, 108.3, 93.7	92.25	102.33	38.07					
Morning	7/2/25	10:00am	77.9	25.50	37.90	1.30	121.60	79.6, 81, 78.5	71.70	96.65	35.92					
			83.375	28.54	32.78	1.48	110.88 ->		86.66	98.12	36.73	31.00	-2.46	0.618208	28.1	82.58
Midday	6/12/25	12:15pm	97.9	33.83	26.90	1.50	134.80	93.20	93.20	113.60	45.33					
Midday	6/20/25	12:15pm	95.4	35.22	19.30	2.50	131.30	92.6, 91.2, 94.5	92.77	112.99	44.99					
Midday	7/2/25	12:30pm	86.5	30.28	26.50	0.90	139.30	87.3, 85, 85.3	85.87	112.54	44.74					
Midday	7/11/25	12:15pm	94.1	34.50	23.50	1.30	144.10	90.5, 88.5, 88.1	89.03	116.57						
			92.225	33.46	24.00	1.55	137.63 ->		90.22	113.93	45.52	36.93	-3.47	0.692912	33.2	91.76
Late Afternoon	6/12/25	4:00pm	95.2	35.11	13.70	1.30	134.30	96, 77, 89.8	85.69	109.05	43.31					
Late Afternoon	6/20/25	3:35pm	94.4	34.67	12.30	5.30	112.30	89.9, 87.8, 88.2	88.63	100.42	38.01					
Late Afternoon	6/22/25	4:30pm	97	36.11	18.60	1.90	85.10	91.70	91.70	88.40	31.33					
Late Afternoon	7/2/25	3:30pm	85	29.44	25.30	1.40	138.80	94, 90.6, 89.2	91.27	115.04	46.13					
Late Afternoon	7/11/25	3:30pm	99.5	37.50	16.20	0.60	143.50	95.8, 93.3, 94.4	94.5	143.58	61.94					
			92.9	34.57	17.38	2.10	132.78 ->		90.04	121.48	44.14	37.44	-2.67	0.838784	33.6	92.64

Location 7 - top step of sandstone stairway that connects main path to shaded pergola (Full sun)

Time of Day	Date	Time	Temp (°F)	Temp (°C)	Relative Humidity (%)	Average Wind	Gnd Surface (°F)	Surfaces - 15' (°F)	15' Average (°F)	CST Average (°F)	CST Average (°C)	MRT Calculation (°C)	MRT-Air Temp (°C)	Wind Speed (M/S)	UTCI (°C)	UTCI (°F)
Morning	6/18/25	10:30am	84	28.89	25.40	2.70	113.20	90.00	90.00	101.60	38.67					
Morning	6/20/25	9:30am	87.4	30.78	27.30	1.80	109.30	82.9, 83.9, 77	81.27	95.29	35.16					
Morning	6/26/25	10:30am	83.5	28.61	43.80	0.70	118.50	76.6, 82.4, 71, 125.3	88.28	103.39	39.11					
Morning	7/2/25	10:00am	81.5	27.50	31.40	1.30	91.30	72.5, 69.6, 73.2	71.77	81.54	27.74					
			84.1	28.94	31.48	1.50	108.28	90.00	82.83	95.58	35.17	39.61	-1.07	0.704858	28.5	82.94
Midday	6/12/25	12:15pm	88.5	31.39	25.30	1.80	102.80	91.20	96.29	98.60	35.89					
Midday	6/20/25	12:15pm	93.9	34.39	17.60	2.10	105.80	98.5, 92.5, 93.9	94.90	99.95	37.75					
Midday	7/2/25	12:30pm	91.5	33.06	22.40	1.30	102.40	77.5, 81.6, 85.1	81.58	91.69	33.27					
Midday	7/11/25	12:15pm	93.3	34.06	21.90	1.30	109.50	83.1, 86.8, 84.9	84.93	94.22	34.56					
			91.8	33.22	21.80	1.63	105.23	91.20	88.10	95.48	35.27	33.87	-0.60	0.618208	31.7	89.06
Late Afternoon	6/12/25	4:00pm	95.5	35.28	25.40	2.00	97.30	86.3, 87.5, 86.2	86.67	91.94	33.30					
Late Afternoon	6/20/25	3:35pm	93.6	34.22	12.80	7.00	100.00	87.3, 81.8, 82.5	83.87	91.94	33.30					
Late Afternoon	6/22/25	4:30pm	96.7	35.94	19.20	1.80	112.00	96.90	96.90	104.45	40.25					
Late Afternoon	7/2/25	3:30pm	88.6	31.44	23.60	3.50	108.50	89.6, 83.4, 86.4	86.47	97.48	36.35					
Late Afternoon	7/11/25	3:30pm	99.1	37.28	13.80	1.30	109.40	97.5, 88.6, 94.1	93.3	101.35	38.53					
			94.7	34.83	18.86	3.08	105.42	96.90	89.44	97.43	36.35	35.29	0.46	1.3768832	33.7	92.66

Location 8 - seating underneath large shade tree (Full shade)

Time of Day	Date	Time	Temp (°F)	Temp (°C)	Relative Humidity (%)	Average Wind	Gnd Surface (°F)	Surfaces - 15' (°F)	15' Average (°F)	CST Average (°F)	CST Average (°C)	MRT Calculation (°C)	MRT-Air Temp (°C)	Wind Speed (M/S)	UTCI (°C)	UTCI (°F)
Morning	6/18/25	10:30am	85	29.44	25.00	1.20	81.30	83.2, 78.8	81.00	81.05	27.25					
Morning	6/20/25	9:30am	90	32.22	24.70	1.80	91.80	77.7, 83.4, 79.5, 80	80.15	85.58	29.76					
Morning	6/26/25	10:30am	83.2	28.44	44.70	0.70	69.90	76.4, 68.5, 68.4, 73	71.57	70.74	21.52					
Morning	7/2/25	10:00am	81.1	27.28	32.90	1.80	63.50	64.7, 61, 68.5	63.73	63.62	17.55					
			84.825	29.35	31.83	1.38	76.38		74.11	75.24	24.02	27.75	-1.60	0.525272	27.6	82.04
Midday	6/12/25	12:15pm	94	34.44	27.60	1.50	76.20	79, 78	77.50	76.85	24.92					
Midday	6/20/25	12:15pm	96.6	35.89	18.50	2.20	89.40	90.7, 87.3, 85, 85	87.00	88.20	31.22					
Midday	7/2/25	12:30pm	93	33.89	21.80	1.30	65.70	69.8, 72, 88.6	74.13	69.92	21.06					
Midday	7/11/25	12:15pm	88.7	31.50	26.80	4.30	75.70	78.8, 82.5, 81.8	81.03	78.37	25.76					
			93.075	33.93	23.80	2.20	76.75		79.92	78.33	25.74	31.47	-2.46	0.983488	32.2	89.96
Late Afternoon	6/12/25	4:00pm	94.1	34.50	13.00	1.30	80.50	84, 83.1, 82.7, 68.4	79.56	80.03	26.68					
Late Afternoon	6/20/25	3:35pm	93.1	33.94	12.10	2.50	80.50	83.6, 83.9, 83.5, 78.8	82.45	83.48	28.60					
Late Afternoon	6/22/25	4:30pm	96	35.56	17.60	1.80	86.00	85, 90	87.50	86.75	30.42					
Late Afternoon	7/2/25	3:30pm	89.5	31.94	29.60	1.20	69.50	82.7, 87.8, 84.1	84.69	77.38	25.19					
Late Afternoon	7/11/25	3:30pm	96.1	35.61	10.90	2.00	95.00	87.2, 74.2, 86.7	82.7	88.85	31.58					
			93.76	34.31	16.64	1.72	83.18		83.40	83.29	28.49	32.57	-1.75	0.7868868	32.2	89.96

Location 9 - Grass under large russian olive tree (Full shade)

Time of Day	Date	Time	Temp (°F)	Temp (°C)	Relative Humidity (%)	Average Wind	Gnd Surface (°F)	Surfaces - 15' (°F)	15' Average (°F)	CST Average (°F)	CST Average (°C)	MRT Calculation (°C)	MRT-Air Temp (°C)	Wind Speed (M/S)	UTCI (°C)	UTCI (°F)
Morning	6/18/25	10:30am	82.5	28.06	22.70	2.20	78.30	83.70	83.70	81.00	27.22					
Morning	6/20/25	9:30am	87.5	30.83	25.70	1.80	83.30	78.1, 77.7, 93	82.93	83.12	28.40					
Morning	6/26/25	10:30am	88	26.67	44.10	0.70	68.90	65, 64.5, 68.7	70.07	69.48	20.83					
Morning	7/2/25	10:00am	81.1	27.28	32.70	1.80	71.70	68.5, 69.6, 87.3	75.07	73.38	22.99					
			81.78	28.21	31.30	1.43	75.55		77.94	76.75	24.86	27.20	-1.00	0.657832	26.7	80.06
Midday	6/12/25	12:15pm	89.7	32.06	27.90	1.40	70.10	79.10	79.10	74.60	23.67					
Midday	6/20/25	12:15pm	94.8	34.89	21.80	2.80	81.80	83.1, 86.6, 100.6	90.10	86.45	30.25					
Midday	7/2/25	12:30pm	79.3	26.28	31.20	2.50	75.80	71.2, 76.7, 78.2	75.37	75.08	23.94					
Midday	7/11/25	12:15pm	89.2	31.78	25.00	2.10	82.10	77.7, 83.7, 90.3	83.9	83.00	28.33					
			87.93	31.25	26.28	2.00	77.45		82.12	79.78	26.55	29.64	-1.41	0.69408	30	86.00
Late Afternoon	6/12/25	4:00pm	93.8	34.33	12.80	1.30	73.00	80.2, 84.7, 90	84.97	78.98	26.10					
Late Afternoon	6/20/25	3:35pm	91	32.78	13.30	9.20	73.00	90.2, 77.8, 83.7	83.90	78.45	25.81					
Late Afternoon	6/22/25	4:30pm	95.1	35.06	17.00	1.80	90.30	97.7, 82	89.85	90.08	32.26					
Late Afternoon	7/2/25	3:30pm	89.4	31.89	24.30	3.70	69.90	81.1, 86, 72	83.03	76.47	24.70					
Late Afternoon	7/11/25	3:30pm	95.3	35.17	9.70	1.90	90.20	79.6, 82.2, 87.7	82.2	86.20	30.11					
			92.92	33.84	15.38	3.54	79.28		84.79	82.04	27.80	32.03	-1.81	1.5835216	31.7	89.06

Location 10 - Open lawn between two shaded seating areas in adjacent park (Full sun)

Time of Day	Date	Time	Temp (°F)	Temp (°C)	Relative Humidity (%)	Average Wind	Gnd Surface (°F)	Surfaces - 15' (°F)	CST Average (°F)	CST Average (°C)	MRT Calculation (°C)	MRT-Air Temp (°C)	Wind Speed (M/S)	UTCI (°C)	UTCI (°F)
Morning	6/18/25	10:30am	81	27.22	23.00	6.00	97.50	89.58	93.50						
Morning	6/20/25	9:30am	84.8	29.33	25.70	1.80	92.80	92.48	92.29						
Morning	6/26/25	10:30am	80.6	27.00	44.10	0.70	88.10	87.53	87.82						
Morning	7/2/25	10:00am	79.6	26.44	34.30	3.40	84.80	80.78	82.35						
			81.5	27.50	31.78	2.98	90.40	87.53	88.97	31.65	30.40	2.90	1.329844	26.7	80.06
Midday	6/12/25	12:15pm	91.8	33.22	31.50	1.40	93.80	98.08	96.93						
Midday	6/20/25	12:15pm	91.2	33.44	30.80	3.10	124.80	105.90	114.95						
Midday	7/2/25	12:30pm	79.5	26.39	37.30	2.50	96.20	96.60	96.40						
Midday	7/11/25	12:15pm	90.1	32.28	27.40	2.90	109.90	105.18	107.50						
			87.83	31.33	29.00	2.23	105.78	100.98	103.34	39.63	37.14	5.81	0.994864	31.8	89.24
Late Afternoon	6/12/25	4:00pm	92	33.33	14.40	2.00	111.50	101.88	106.65						
Late Afternoon	6/20/25	3:35pm	92.2	33.44	12.80	7.40	88.80	86.68	87.73						
Late Afternoon	6/22/25	4:30pm	94.2	34.56	17.20	1.80	95.00	89.00	92.00						
Late Afternoon	7/2/25	3:30pm	86	30.00	28.50	6.00	79.40	81.70	80.55						
Late Afternoon	7/11/25	3:30pm	96.5	35.83	11.50	1.80	91.90	101.20	96.55						
			92.18	33.43	16.78	3.40	93.32	92.06	92.69	33.72	33.63	0.20	1.510936	31.8	89.24

Drop Sensor Data

Row Labels	Max of EHFO	Min of EHFO	Max of Urban Context	Min of Urban Context	Max of Park	Min of Park
6/9/25	78.7	56.5	79.7	58.2		
6/10/25	87.0	50.5	85.3	51.9		
6/11/25	88.0	52.1	88.2	54.0		
6/12/25	91.3	51.6	90.0	52.9		
6/13/25	94.9	49.6	93.9	53.3		
6/14/25	99.5	48.9	97.0	51.7		
6/15/25	100.8	46.0	99.2	48.9		
6/16/25	101.7	60.0	100.3	62.2		
6/17/25	100.6	64.9	97.1	69.8		
6/18/25	96.6	50.3	93.6	53.2	92.2	79.8
6/19/25	98.8	70.0	96.8	71.3	95.9	71.3
6/20/25	95.8	70.0	97.0	71.6	94.9	71.5
6/21/25	98.3	58.6	95.5	62.2	94.2	60.5
6/22/25	93.4	56.1	92.3	59.2	92.9	57.2
6/23/25	95.9	53.1	93.2	55.2	91.7	54.1
6/24/25	90.0	59.9	87.2	60.8	86.5	59.7
6/25/25	83.6	57.7	78.7	59.4	78.2	58.5
6/26/25	91.1	53.2	88.5	54.0	87.9	53.9
6/27/25	94.0	55.6	90.8	57.0	90.7	56.8
6/28/25	97.5	56.5	97.0	57.9	94.6	57.9
6/29/25	100.7	55.4	98.2	58.9	96.4	56.9
6/30/25	91.1	57.4	87.1	61.6	87.6	58.8
7/1/25	87.5	54.2	83.6	55.5	82.5	55.0
7/2/25	95.4	55.9	89.9	57.9	86.5	56.4
7/3/25	86.9	65.0	86.8	66.7	84.5	67.4
7/4/25	94.6	54.1	92.9	55.7	90.8	55.5
7/5/25	101.1	51.5	98.0	54.6	94.9	53.2
7/6/25	95.4	61.6	93.6	64.4	93.5	63.0
7/7/25	94.5	54.0	90.1	55.7	89.2	55.5
7/8/25	99.2	58.0	100.6	59.7	96.4	59.6
7/9/25	103.0	61.8	98.2	63.9	97.4	62.9
7/10/25	104.4	63.7	102.3	66.7	102.0	65.3
7/11/25	102.6	55.9	97.9	58.5	96.5	57.3
7/12/25	87.5	61.4	84.9	64.2	84.2	63.2
7/13/25	99.8	55.1	98.7	56.6	95.4	56.3
7/14/25	102.0	54.1	95.8	55.4	94.9	55.1
7/15/25	101.8	55.5	99.5	57.7	94.5	57.2
7/16/25	102.9	53.5	99.2	55.5	97.5	55.1
7/17/25	88.7	65.1	85.6	67.3	84.2	66.4
Grand Total	**104.4**	**46.0**	**102.3**	**48.9**	**102.0**	**53.2**

Average Max/Min	**95.3**	**56.8**	**92.9**	**59.0**	**91.6**	**60.0**

EHFO Cooling Advantage

Day	EHFO Evening	Urban Context Evening	EHFO Morning	Urban Context Morning	EHFO Cooling	Urban Context Cooling	Cooling Advantage EHFO vs Urban
6/9/25	64.7	69.5					
6/10/25	83.4	83.5	54.7	56.1	28.7	27.4	-1.3
6/11/25	85.1	85.9	55.4	56.2	29.7	29.8	0.1
6/12/25	84.6	85.7	56.4	57.8	28.2	27.9	-0.3
6/13/25	92.7	93.3	54.5	56.6	38.2	36.7	-1.5
6/14/25	96.9	96.2	53.8	57.0	43.1	39.1	-3.9
6/15/25	94.2	96.3	51.5	55.4	42.7	40.9	-1.8
6/16/25	100.1	98.4	63.5	65.0	36.7	33.4	-3.2
6/17/25	97.8	95.4	68.2	71.4	29.7	24.1	-5.6
6/18/25	95.1	92.1	55.2	58.2	39.9	33.9	-6.0
6/19/25	96.6	95.3	71.7	72.5	24.9	22.8	-2.1
6/20/25	91.2	92.8	70.6	72.1	20.5	20.8	0.2
6/21/25	95.2	93.8	61.9	65.1	33.3	28.7	-4.6
6/22/25	92.3	90.5	58.8	62.4	33.4	28.1	-5.3
6/23/25	94.3	91.6	56.4	59.2	37.9	32.5	-5.4
6/24/25	65.6	65.8	65.8	67.2	-0.2	-1.5	-1.2
6/25/25	69.1	71.0	59.2	61.1	9.9	10.0	0.1
6/26/25	88.7	87.5	55.9	57.5	32.8	30.0	-2.8
6/27/25	89.5	88.8	58.7	61.0	30.8	27.8	-3.0
6/28/25	94.0	93.4	60.0	62.4	34.0	31.0	-3.0
6/29/25	97.3	96.2	59.4	63.0	37.8	33.2	-4.6
6/30/25	80.3	80.8	61.0	64.2	19.3	16.6	-2.7
7/1/25	83.3	81.5	57.4	60.1	25.9	21.5	-4.4
7/2/25	90.4	88.0	58.5	61.4	31.9	26.7	-5.2
7/3/25	79.6	79.5	66.3	67.2	13.3	12.3	-1.1
7/4/25	92.9	91.8	58.0	60.5	34.9	31.3	-3.6
7/5/25	94.6	94.1	56.6	59.1	38.0	35.0	-3.0
7/6/25	86.7	87.3	71.9	73.3	14.8	14.0	-0.8
7/7/25	89.4	87.8	58.7	61.1	30.7	26.7	-4.0
7/8/25	95.3	97.9	63.9	64.9	31.4	33.0	1.6
7/9/25	95.5	94.6	64.8	66.5	30.7	28.1	-2.6
7/10/25	100.7	100.3	66.6	69.9	34.1	30.5	-3.6
7/11/25	97.1	96.5	58.2	61.1	38.9	35.3	-3.6
7/12/25	79.9	81.5	64.0	66.4	15.9	15.1	-0.8
7/13/25	84.9	85.5	58.6	61.0	26.3	24.4	-1.9
7/14/25	94.4	92.6	56.5	59.2	37.9	33.4	-4.5
7/15/25	93.7	94.3	59.4	61.3	34.3	33.0	-1.3
7/16/25	99.2	96.3	57.6	60.2	41.6	36.1	-5.5
Totals	89.6	89.3	60.3	62.5	30.0	27.3	**-2.8**

Appendix E – Survey

SCHOOL OF ARCHITECTURE & PLANNING

Española Healing Foods Oasis - Community Benefit Case Study Informed Consent & Survey (Summer 2025)

About This Survey

This survey is being done by the Department of Landscape Architecture at the University of New Mexico (contact info below). It is part of a case study funded by the Landscape Architecture Foundation (LAF), to learn about the many benefits of the Española Healing Foods Oasis (EHFO). You're being invited to take part because of your connection to Tewa Women United, your volunteer efforts, or as a visitor to the garden. The survey has 8 short questions and should only take about 5 minutes to complete. It asks about your experiences with the garden and its impact on you and the community.

Your Choice & Privacy

This survey is completely voluntary. There are no known risks. You might feel uncomfortable with some questions (we are obligated to say this, but all the questions simple and straightforward). You can skip any question or stop at any time. We will not ask for your name or any personal information. Your answers will be kept private and stored in a secure, password-protected file. If you fill out a paper version, your answers will be added to a secure digital file and the paper form will be shredded within 48 hours.

What Happens with Your Answers

There is no compensation to take this survey, and there's no direct benefit to you. However, your feedback will help us better understand how the garden supports the community and the environment. We may use the combined results in future research or reports, but never in a way that identifies you. The final study will be featured in the LAF Landscape Performance Series website *landscapeperformance.org*.

Questions or Concerns?

If you have questions about the survey, contact Anthony Fettes at 505-277-2903. If you have concerns about your rights as a participant, call the UNM Office of the IRB at 505-277-2644 or visit *irb.unm.edu*.

By continuing, you confirm you're at least 18 and agree to take part based on the information above.

Please see the survey form on the opposite side of this sheet.
You have three options to complete and return your survey:

Option 1:
Return your completed survey to the dropbox next to the Seed Library inside the Library

Option 2:
Hand your survey to a UNM survey assistant at an upcoming EHFO workday or event in June or July

Option 3:
Take the survey online by using the QR code above or visit this link: bit.ly/4kJDxE0

1 What new interests or hobbies have you gained from visiting or helping at the Española Healing Foods Oasis? *(Check all that apply)*

- ◯ Motivated to learn more about growing food or medicinal plants
- ◯ Inspired to start or participate in a community garden
- ◯ Encouraged to spend more time outdoors
- ◯ Sparked interest in traditional or Indigenous agricultural practices
- ◯ Strengthened my sense of connection to community
- ◯ Increased my confidence in gardening/ farming skills
- ◯ Other ways my interests were influenced (please describe):
- ◯ No change/no new interests or hobbies
- ◯ Decreased my interest in food or agriculture

2 How do you feel when you spend time at the Española Healing Foods Oasis? *(Check all that apply)*

- ◯ Inspired
- ◯ Relaxed
- ◯ Grounded
- ◯ Connected to nature
- ◯ Other feelings (please describe):
- ◯ No strong feelings

3 Have you told others about things you have learned at Española Healing Foods Oasis? *(Check one)*

- ◯ Yes, I often share what I learn
- ◯ Yes, I occasionally share what learn
- ◯ No, not yet
- ◯ No opportunity to share

4 Are there any plants at the Española Healing Foods Oasis that you or your family use for cooking, healing, or special traditions? *(Check one)*

- ◯ Yes
- ◯ No
- ◯ I'm not sure yet

5 Do activities at Española Healing Foods Oasis reflect or connect you with any of your family or community traditions? *(Check one)*

- ◯ Yes
- ◯ No
- ◯ I'm not sure yet

6 Has the Española Healing Foods Oasis helped you feel more connected to your community? *(Check one)*

- ◯ Yes (please share how):
- ◯ No

7 Do you think that Española Healing Foods Oasis helps take care of the land, supports the community, or teaches things that will help future generations? *(Check one)*

- ◯ Yes (please share how):
- ◯ No
- ◯ I'm not sure

8 Is there anything else you would like to share about your experience at the Española Healing Foods Oasis? *(Open response)*

SCHOOL OF ARCHITECTURE & PLANNING

Understanding the Community Benefits of the **Española Healing Foods Oasis**

We are seeking survey participants!

We are looking for adults (18 and over) who have:

- Volunteered at the Española Healing Foods Oasis (EHFO)
- Attended events at EHFO
- Contributed to the project in a professional capacity
- Simply enjoyed visiting the EHFO

What's this study about?

This study aims to understand the environmental, social, and community benefits of the Española Healing Foods Oasis. Your insights will help inform future community-based projects.

What does participation involve?

Participation involves a brief 5–10 minute survey, available online or on paper. Printed surveys will be available during EHFO volunteer days through July 11th.

There is no compensation for participating, but your input will support recognition of the Española Healing Foods Oasis as an exemplary landscape project on the Landscape Architecture Foundation's – Landscape Performance Series website: www.landscapeperformance.org

Scan the QR code to take the survey:

or visit this link:
bit.ly/4kJDxE0

Paper surveys are also available next to the Seed Library inside the Library

This research is led by Anthony Fettes, Assistant Professor of Landscape Architecture at the University of New Mexico.

Please email aefettes@unm.edu for more information