GROUP A: PROJECT MANAGEMENT

A.1 Title and Approval Sheet

Quality Assurance Project Plan

Restoring Springs and Wetlands on State Trust Lands in the Lower Embudo Valley

Submitted by:

New Mexico Environment Department
Surface Water Quality Bureau

APPROVAL SIGNATURES

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A.2 Table of Contents

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BLM	Bureau of Land Management
DQO	Data Quality Objectives
EPA	United States Environmental Protection Agency
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
NM BGMR	New Mexico Bureau of Geology & Mineral Resources
NM RAM	New Mexico Rapid Assessment Method (for Montane Riverine Wetlands)
NM SLO	New Mexico State Land Office
QA	Quality Assurance
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
SIP	San Isidro Permaculture, Inc
SOP	Standard Operating Procedures
STEPL	Spreadsheet Tool for Estimating Pollutant Loads
SWQB	Surface Water Quality Bureau
SWPPP	Stormwater Pollution Protection Plan
TMDL	Total Maximum Daily Load
US ACE	U.S. Army Corps of Engineers
USLE	Universal Soil Loss Equation
WAP	Wetland Action Plan
WBP	Watershed Based Plan

ACRONYMS

A.3 Distribution List

Table 1. below contains the distribution list, project roles and responsibilities for this project. The QA Officer will ensure that copies of this QAPP and any subsequent revisions are distributed to members who have signature authority to approve this QAPP. The SWQB Project Officer will ensure that copies of the approved QAPP and any subsequent revisions are distributed to the Project Manager. The Project Manager will distribute to all other project personnel listed in Table 1 who do not have signature authority to approve the QAPP. All members of the distribution list who do not have signature authority to approve this QAPP will review the QAPP and sign the Acknowledgment Statement prior to initiating any work for this project. The signed Acknowledgement Statements will be collected by the SWQB Project Officer and will be given to the QA Officer for filing with the original approved QAPP.

Table 1. Distribution List, Project Roles, and Responsibilities

Name	Organization	Title/Role	Responsibility	Contact Information
Abraham Franklin	SWQB	Program Manager	Reviewing and approving QAPP, managing project personnel and resources	505-946-8952 abraham.franklin@state.nm.us
Miguel Montoya	SWQB	QA Officer	Reviewing and approving QAPP	505-819-9882 miguel.montoya@state.nm.us
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Jan-Willem Jansens	Ecotone Landscape Planning, LLC	Project Manager	Project oversight, data management, stakeholder outreach and education, data collection, surveys and assessments, regulatory requirements, post-restoration inspections	505-470-2531 jwjansens@ecotonelandscapeplanning.com

			and monitoring, adaptive management and follow-up, record keeping, and progress and final reporting	
Mark K. Meyers	NM State Land Office	Project Coordinator	Contract management, coordinating field data collection	505-946-7082 MKMeyers@slo.state.nm.us
Jeremiah Kidd	San Isidro Permaculture, Inc.	Field Contractor	Implementation planning, design, and oversight	505-501-4769 jeremiah@sipermaculture.com
Stacey Timmons	NM Bureau of Geology & Mineral Resources	Field Contractor	Conducting hydrogeologic assessment of springs	575-835-6951 stacy.timmons@nmt.edu
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Erin McElroy	Ecotone Landscape Planning, LLC	Data Management Coordinator	Coordinating monitoring and assessments, WAP preparation	509-554-2784 Erin.Mcelroy@ecotonelandscapeplanning.com
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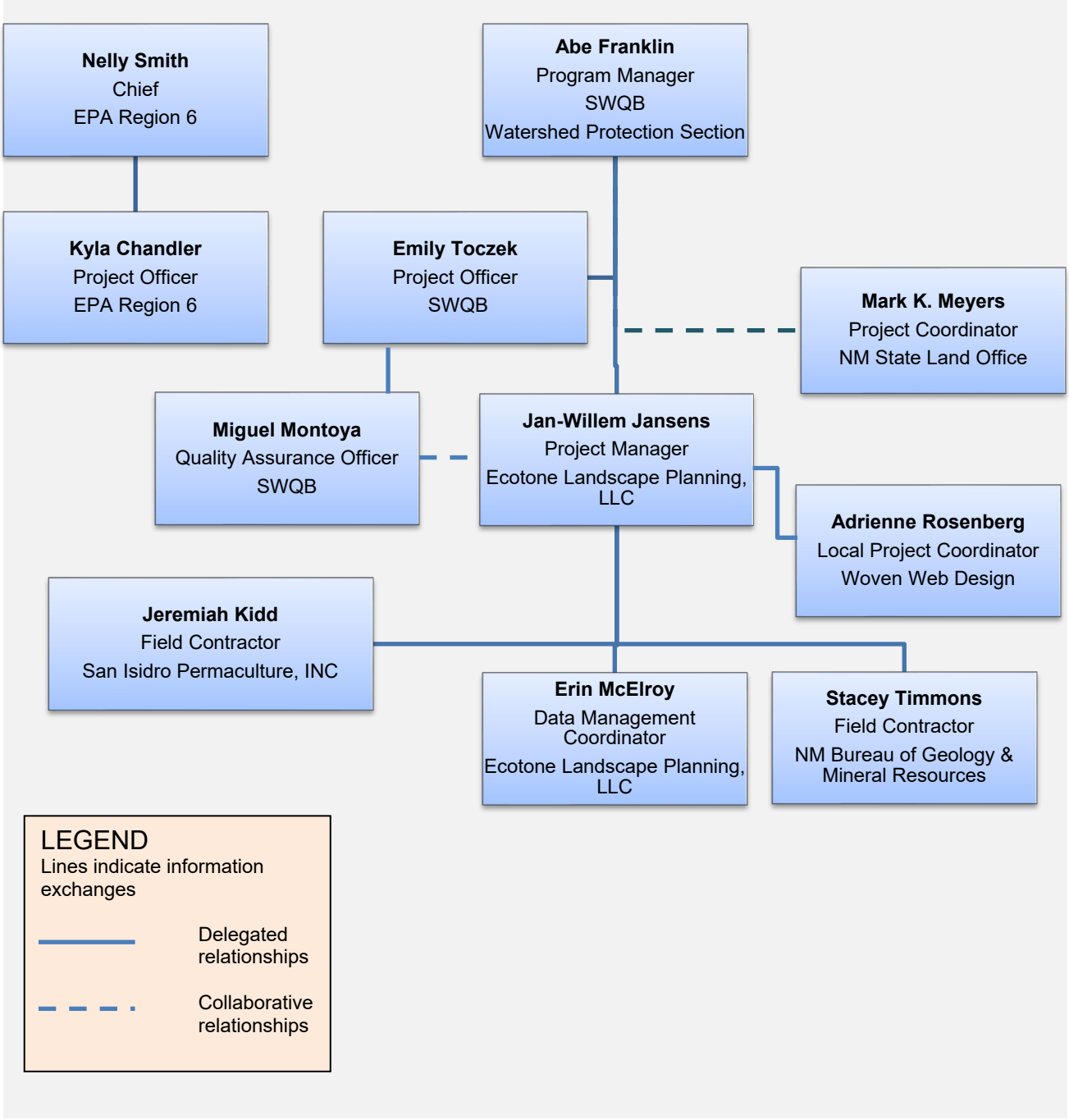
A.4 Project Organization

The SWQB Quality Management Plan (NMED/SWQB 2021) documents the independence of the Quality Assurance Officer (QAO) from this project. The QAO is responsible for maintaining the official approved QAPP. Figure 1 presents the organizational structure for the project Restoring the Springs and Wetlands on State Trust Lands in the Lower Embudo Valley.

Figure 1. Organization Chart



A.5 Problem Definition/Background

The purpose of this Quality Assurance Project Plan (QAPP) is to provide the quality assurance and control methodology for monitoring of work that aims to reduce soil erosion from upland slopes, halt channel degradation, raise the channel elevation, improve channel and wetland functionality, restore riparian and wetland vegetation, and protect the restoration area from ORV and cattle trespassing. This QAPP refers to the project as the *"*Lower Embudo Valley Springs and Wetlands Restoration Project*."* The Lower Embudo Valley Springs and Wetlands Restoration Project is being managed by Ecotone Landscape Planning, LLC in direct collaboration with the NM State Land Office staff as a counterpart, representing the NM State Land Office which is the landowner.

The reach of the Cañada Aqua in the proposed project area encompasses scattered springs, seeps, slope wetlands, and riverine wetlands. Throughout the project area, springs and wetlands have been degraded in the last century due to channel modifications, grazing impacts, mining, wood removal, extreme weather conditions (drought and flash floods), erosion, wildfire, off-road vehicle traffic, and/or Russian olive and tamarisk encroachment. The wetlands are currently listed as impaired due to sedimentation/siltation and turbidity in respect to Marginal Coldwater Aquatic Life in Embudo Creek (AU ID NM-2111.41, Rio Grande to Cañada de Ojo Sarco; NMED, 2005).

Channel modifications are primarily a result of using the springs as water sources for acequias, livestock, and pipelines. Riparian vegetation has died back in some instances because of channel degradation and drought, causing non-native species, such as Russian olive (*Eleagnus angustifolia*), Saltcedar (*Tamarisk spp*.), to invade the riparian area. In the Arroyo la Mina, part of the arroyo has been used as a road, exacerbating erosion and subsequent sedimentation/siltation and turbidity problems.

Known relevant information:

- An Updated Watershed-Based Plan (WBP) for the Lower Rio Embudo Watershed from November, 2019 describing overall impairments, likely causes, and proposed actions to reduce impairments in the various sub-watershed of the Lower Rio Embudo watershed.
- A Watershed Management Plan (WMP) for the area identified as the Upper Rio Grande: La Jicarita through Embudo Valley (Environmental Health Consultants and NMED 2010), addressing seven watershed issues (forest health, arroyos/drainages, wetlands and riparian areas, illegal dumping, education/outreach, agriculture and acequias, and wastewater management), management objectives for each, potential challenges, and recommended best management practices.
- A Spring Survey (using Springs Stewardship Institute level-2 survey methodology) conducted by the BLM, providing an in-depth assessment of multiple characteristics of springs, including flow rate, water quality, flora, fauna, geomorphology, and substrate. This assessment also includes site descriptions, maps, and notes on human impacts. Together this information helps to establish a comprehensive baseline of the physical

state of five of the northernmost potential springs within Section 2 (Figure 2B) and each spring identified in Section 32 (Figure 2C).

- Cultural Resource Survey to be completed by NM SLO, following QAPP approval and prior to the implementation phase of the project.

Unknown relevant information:

- Overbank flow frequencies onto the wetlands and wet meadows
- Recent stream flow regime data
- Recent site-specific pollutant sources (e.g., temperature, sediment)
- Stream channel canopy cover percentage and spatial variability and its role in shading and water temperature reduction
- Current cover of noxious weeds
- Anticipated cattle movements and impact intensities for 2021 and future years in and across the project area
- Inventory of off-road vehicle impacts, locations, and intensities currently and for future years in and across the project area
- Pedestrian access and disturbance of wetlands, channels, and slopes and impacts contributing to erosion

Background

The Embudo Creek (Rio Grande to Cañada de Ojo Sarco) is known with Waterbody Identifier NM-2111_41 and NM Standards Segment 20.6.4.114, as part of the Upper Rio Grande Watershed (USGS HUC 13020101). In 2005, the NM Environment Department (NMED) Surface Water Quality Bureau (SWQB) included the 6.2-mile segment of the Embudo Creek (Rio Grande to Cañada de Ojo Sarco) in a TMDL report for the Upper Rio Grande Watershed (approved by EPA on June 2, 2005) with turbidity and sedimentation/siltation as the parameters of concern[1]. The TMDL report indicates that the affected use is "Marginal Coldwater Fishery and Warmwater Fishery". The turbidity and sedimentation/siltation impairments were first listed in 1998.

The Embudo Creek waterbody of concern has a watershed size of 317 square miles which drains into the Upper Rio Grande in northern New Mexico. The stream segment of concern is located in the Arizona/New Mexico Plateau ecoregion (22h – North Central New Mexico Valleys and Mesas) (Griffith et al. 2006). The watershed's land cover and land use consist of 89% forest, 4% agriculture, 3% tundra, 2% rangeland, 1% build-up, <1% barren, <1% water, and <1% wetlands. Land management and ownership are identified as 74% US Forest Service, 9%

[1] https://www.env.nm.gov/surface-water-quality/wp-content/uploads/sites/25/2017/07/TMDL-master-list-with-links_111919.pdf

private, 8% native, 7% BLM, and 2% state[2]. The Embudo Creek reach of concern is owned by NM State Land Office and located in Sections 2 and 32.

The TMDL report for the Embudo Creek segment lists possible probable sources of pollution as: channelization, dredging (e.g., for navigational channels), loss of riparian habitat, natural sources, off-road vehicles, rangeland grazing, site clearance (site development or redevelopment), and streambank modifications/destabilization. The stream segment's priority ranking is classified as "High". The TMDL for turbidity is calculated as WLA + LA + MOS = TMDL, resulting in a TMDL of 22,173 lbs/day (0+16,630+5,543). The TMDL for sedimentation/siltation (stream bottom deposit, or SBD) is calculated as WLA + LA + MOS = TMDL, resulting in a TMDL of 20% fines (0+15+5).

In November of 2019, an Updated Watershed Based Plan (WBP) for the Lower Embudo Watershed was developed by Ecotone Landscape Planning, LLC in collaboration with the Forest Stewards Guild, Embudo Valley Regional Acequia Association (EVRAA), many Lower Embudo watershed residents, and New Mexico Environment Department Surface Water Quality Bureau (NMED-SWQB) staff. The WBP identifies surface water impairments and their specific causes, describes prioritization methods for action and estimates associated load reductions for management measures, identifies specific management measures to alleviate impairments, and discusses technical needs for implementing and monitoring management measures, as well as identifying success criteria.

Despite the entire Rio Embudo-Rio Pueblo watershed constituting less than 4% of the Rio Grande basin at the confluence of both rivers, the WBP found it to contribute a significant proportion of suspended sediment to the Rio Grande (varying between 7% and 78%). These sediment loads represent substantial water quality limitations and purification costs for water users and water management agencies downstream. Additionally, watershed residents and the Ecotone team have observed that sediment removal from acequias, fields, roads, and culverts come at high cost to the community, Rio Arriba County, and State of New Mexico (Jansens, 2019). The sub-watershed of Embudo Creek included in this project (Arroyo la Mina / Embudo Creek, NM-2111_41), was described in the WBP as a likely source for sediment flux in extreme precipitation years, which are projected to increase with climate change. However, load reduction targets were calculated to be more than 100% for this sub-watershed, indicating a high potential payoff for restoration work focused in this area.

The WBP recommends management measures for the Arroya la Mina/Embudo Creek sub-watershed focus on soil stabilization and road modification measures to reduce bare soil in the largest of the many small drainages. Specific management measures recommended for the sites of concern in this project include bio-technical slope stabilization, stabilizing streams, and gully and headcut treatments, which are further described in Appendix 6 of the WBP. The WBP update also described monitoring methods necessary to track project success in relation to

[2] https://www.env.nm.gov/surface-water-quality/wp-content/uploads/sites/25/2017/07/TMDL-master-list-with-links_111919.pdf

benchmark targets described in the plan (Table 6.1), which directly inform monitoring methods proposed for the Lower Embudo Valley Springs and Wetlands Restoration Project.

Objective

The project addresses three main stressors and has three associated goals:

(1) **Stressors:** Excessive soil erosion from slopes. **Goal:** It is a goal of the project to reduce soil loss by building bio-technical slope stabilization structures on denuded and eroded slopes and in rills and small gullies. Disturbed areas will also be seeded with native grass seed. The selection and use of practices will be site specific.

(2) **Stressors:** Channel degradation leading to drying of wetlands and excessive sediment deposition. **Goal:** It is a goal to stabilize stream channels, reduce sediment loading into the Embudo Creek, and restore channel and wetland function. At select channel and wetland locations, mildly unstable banks will be stabilized using vegetative approaches, while larger destabilization sites will be addresses using bioengineering techniques. The project will also include removal of invasive plant species, where appropriate. The selection and use of practices will be site specific.

(3) **Stressors:** Unpaved road and off-road vehicle use. **Goal:** It is a goal of the project to protect wetlands from degradation by closing unpaved roads and target areas to ORV access. Where necessary and agreed upon with stakeholders, informal tracks will be closed. This is to deter vehicular access to restoration sites, allowing the sites time to heal, and directing traffic in different directions. Where possible, signage may be installed as well, if the NM SLO deems this method feasible in the area.

A.6 Project/Task Description

Description

The Project will:

1. Build a series of bio-technical slope stabilization structures to minimize upstream soil loss and improve riparian ecological conditions. The project will build a selection of rock structures (one-rock dams, Zuni bowls, rock rundowns, rock contour lines, etc.), log and brush material (e.g., brush mats, stick dams, logs and brush on contour lines, lop and scatter, etc.), and earthen structures (e.g., plug and spread, berm and swale, etc.) to increase soil cover, reduce and spread stormwater runoff, and improve micro-climate conditions for plant regeneration. Disturbed areas will also be seeded with native grass seed. The project aims to build around 300 small structures and treat a total of approximately 3 acres of land with these techniques with an expected direct beneficial effect on sediment stabilization and riparian ecological conditions over 6 acres.
    a. This will require estimations of baseline and post-restoration sediment pollutant loads, using STEPL modeling and sediment retention measurements.

b. This will require baseline and post-restoration visual and photographic assessment of biotechnical slope stabilization structure performance in treatment areas. See Appendix B.

c. These activities and pieces of information pertain to Goal 1.

2. Build a series of up to 10 bank stabilizing structures to reduce sediment pollution loads and restore channel function. At select channel and wetland locations, mildly unstable banks will be stabilized using vegetative approaches (thinning with lop and scatter, removal of invasive plants, protection of native plants, etc.). Larger destabilization sites will be addressed using bioengineering techniques, such as rock rundowns, log palisades or racks, rock and /or post vanes, root wads, logs, brush mats, log or rock revetments, and terracing to stabilize the banks and restore channel function. The project aims to construct up to ten such bank stabilization structures, which should act to counter channel incision and restore moisture to drying wetlands.

    a. This will require analysis of water samples taken for the hydrogeologic assessment to determine the age and origin of spring and wetland water sources and priority areas for construction of restoration structures.

    b. This will require estimations of baseline and post-restoration sediment pollutant loads, using STEPL modeling and sediment retention measurements.

    c. This will require baseline and post-restoration visual and photographic assessment of bank stabilization structure performance in treatment areas, including collection of cross-section elevation data with a laser level. See Appendix B.

    d. This will require assessment of baseline and post-restoration overall wetland condition using NM RAM methods with a simplified Winward greenline assessment.

    e. These activities and pieces of information pertain to Goal 2.

3. Close unpaved roads and target areas to ORV access to minimize sediment loading and associated wetland degradation. This will likely be some of the more contentious work of the project and therefore will include conversations with stakeholders regarding which informal tracks are priorities for closure. Closures will utilize boulders, jack falls of logs and brush, and/or earthen berms. This is to deter vehicular access to restoration sites, allowing the sites time to heal, and directing traffic in different directions. Where possible, signage may be installed as well, if the NM SLO deems this method feasible in the area. The project will also assess whether grazing impacts are apparent on the landscape. If determined, the project will address these issues by entering in conversations with the permittee and possibly by installing fencing and monitoring of critical sites using the same methods as for ORV impacts.

a. This will require baseline and post-restoration visual and photographic assessment of unpaved roads and ORV use in target areas. See Appendix B.

b. These activities and pieces of information pertain to Goal 3.

The study/project consists of the following data gathering and monitoring activities:

a. Measure sediment retention volumes behind structures using sediment area estimates and STEPL modeling.

b. Conduct implementation monitoring of successful installation of bio-technical slope stabilization structures and implementation of vegetation treatments measured with visual inspection and photo documentation.

These activities and pieces of information (in a-b) pertain to Goal 1.

c. Conduct hydrogeologic assessment to help determine priority springs/wetlands for bank stabilization structures.

d. Measure sediment retention volumes behind structures using cross sections, sediment area estimates, and STEPL modeling.

e. Using the monitoring protocols of the New Mexico Rapid Assessment Method (NM RAM) for Montane Riverine Wetlands, monitor invasive plant cover and native riparian and wetland vegetation, and qualitative improvements to wetland health expressed through NM RAM ecological condition scores (www.env.nm.gov/surface-water-quality/wetlands-rapid-assessment-methods/), including an additional simplified Winward greenline assessment. The project will not conduct – and is not required to conduct – a jurisdictional wetland delineation. The greenline assessment will serve to measure changes in the extent of the riverine wetland and cienegas in the main channels where project activities are expected to influence wetland conditions.

f. Conduct implementation monitoring of successful installation of bank stabilization structures measured with visual inspection and photo documentation.

g. Measure elevation cross-sections to verify rise in channel bottom elevation using a laser level.

These activities and pieces of information (in c-g) pertain to Goal 2.

h. Identify the absence of ORV impacts- assessed by visual and photographic monitoring

i. Identify the absence of livestock impacts and human access impacts on the riparian and wetland areas (targets are 0 occurrences and 0 sq. ft affected; we will tally occurrences and area affected).

These activities and pieces of information (in h-i) pertain to Goal 3.

Information from previous studies, as identified in previous sections, will be used as historical baseline information for the project-based pre-treatment and post-treatment measurements.

This will be elaborated in more detail in Data Generation and Acquisition section B1.

Schedule

The project will start in October 2021 and be completed by December 31, 2024, and can be subdivided in four phases: (1) an administrative start-up phase (October-December 2021); (2) a permit preparation, assessment and planning phase (January-September 2022); (3) a permit-approved final design and implementation phase (September 2022-March 2023); and (4) a post-restoration phase (March 2023-December 2024).

No data collection will take place in phase 1. In phase 2 (January-September 2022), the project will collect baseline data by conducting baseline monitoring of abovementioned monitoring activities, including the STEPL modeling assessment, NM RAM, collection of water samples for the hydrogeologic assessment, and any other specific data to satisfy permitting requirements. NM State Land Office will provide the necessary regulatory cultural resource data and biological data surveys for the area. In phase 3 (September 2022 – March 2023), the project will collect implementation (progress accomplishment) data and photographic evidence for purposes of implementation monitoring. In phase 4 (March 2023 – December 2024), the project will collect post-treatment monitoring data and photographic evidence according to the abovementioned monitoring activities. Project reporting will follow a quarterly schedule, with due dates on January 31, April 30, July 31, and October 31 for the preceding quarters in each of the project years. See Table 2 for more details.

Table 2. Project tasks, products, responsible party, timeline

Phase/Task	Product	Responsible Party	Approximate Start Date	Approximate Completion Date
(1) Administrative	[no data collection] Approved QAPP; MoU NMED and NM SLO; Hiring of contractors; Stakeholder outreach and education activities	NMED; NM SLO; Ecotone LP, LLC	10/18/21	12/31/21
(2) Planning	Surveys and assessment reports; NMED approved conceptual design; permit applications	NM SLO; Ecotone LP, LLC; NM BGMR	1/1/22	9/30/22
(3) Implementation	NMED approved, completed construction designs; contract with contractor(s); staking, flagging, River terrace grading; Removal of invasive plants; Construction of in-stream structures; Tree planting; Detailed site completion	Ecotone LP, LLC; SIP	9/1/22	3/15/23
(4) Post-restoration activities	Post-restoration inspections and monitoring; Adaptive management and follow-up; WAP Update; Reporting	Ecotone LP, LLC; NM SLO; SIP	3/15/23	12/31/24

Project Area

The project area encompasses approximately 3.5 stream miles located on NM State Trust Lands in the Cañada Aqua (Arroyo la Mina / Embudo Creek), as part of Embudo Creek (Rio Grande to Cañada de Ojo Sarco; USGS HUC 13020101; Figure 2A). The upper reach of the project is within Section 2 of State Trust Land located at 36°10'08.17"N, 105°50'48.91"W (Figure 2B), and the lower end of the project reach is within Section 32 at 36°10'57.62"N, 105°54'00.26"W (Figure 2C). The project area comprises approximately 30 acres of scattered seeps, springs, sloped wetlands, and riverine wetlands. The project area is only accessible on foot from the bottom of the arroyos.

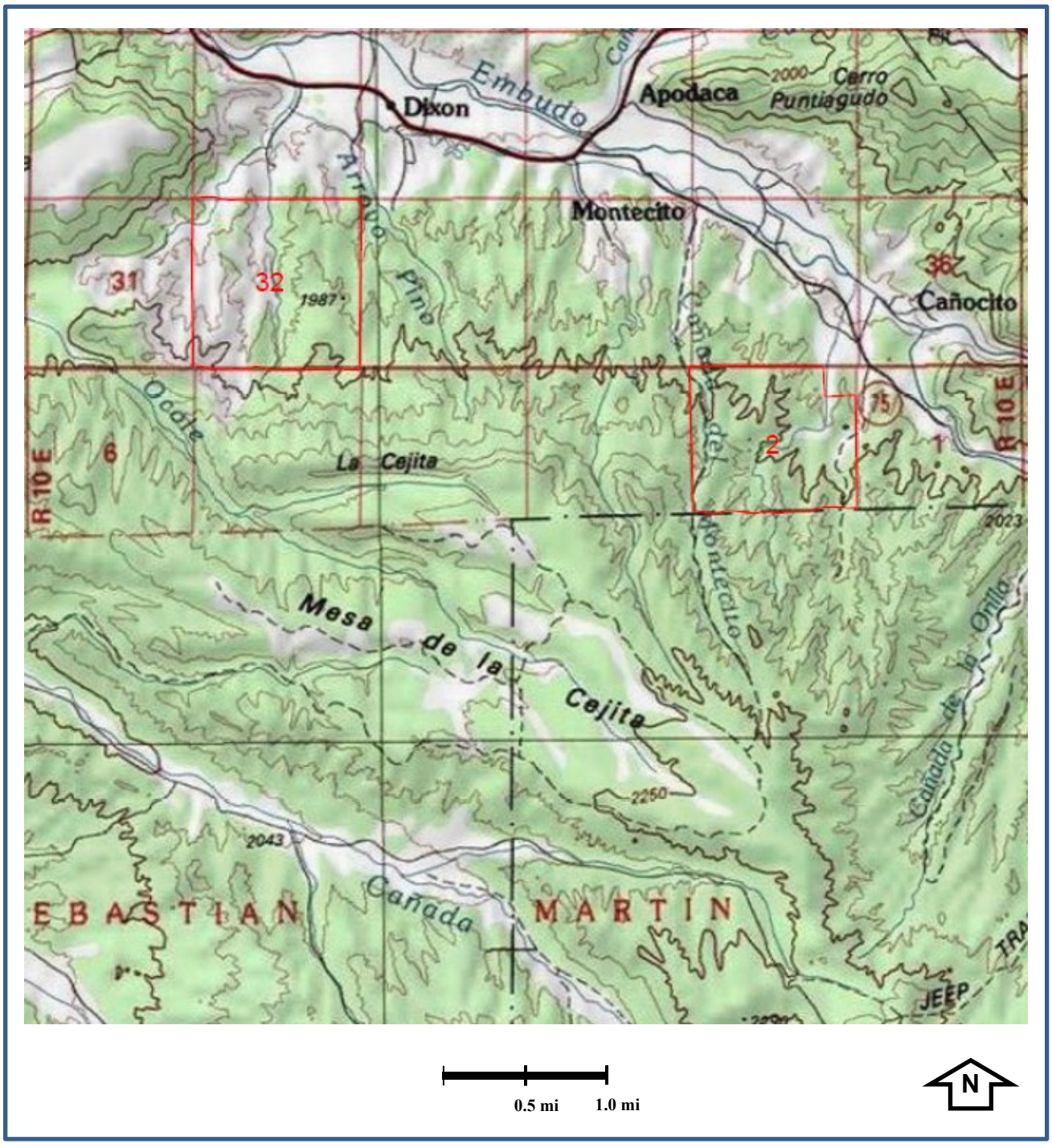


Figure 2A. Project Area Map – Vicinity Overview

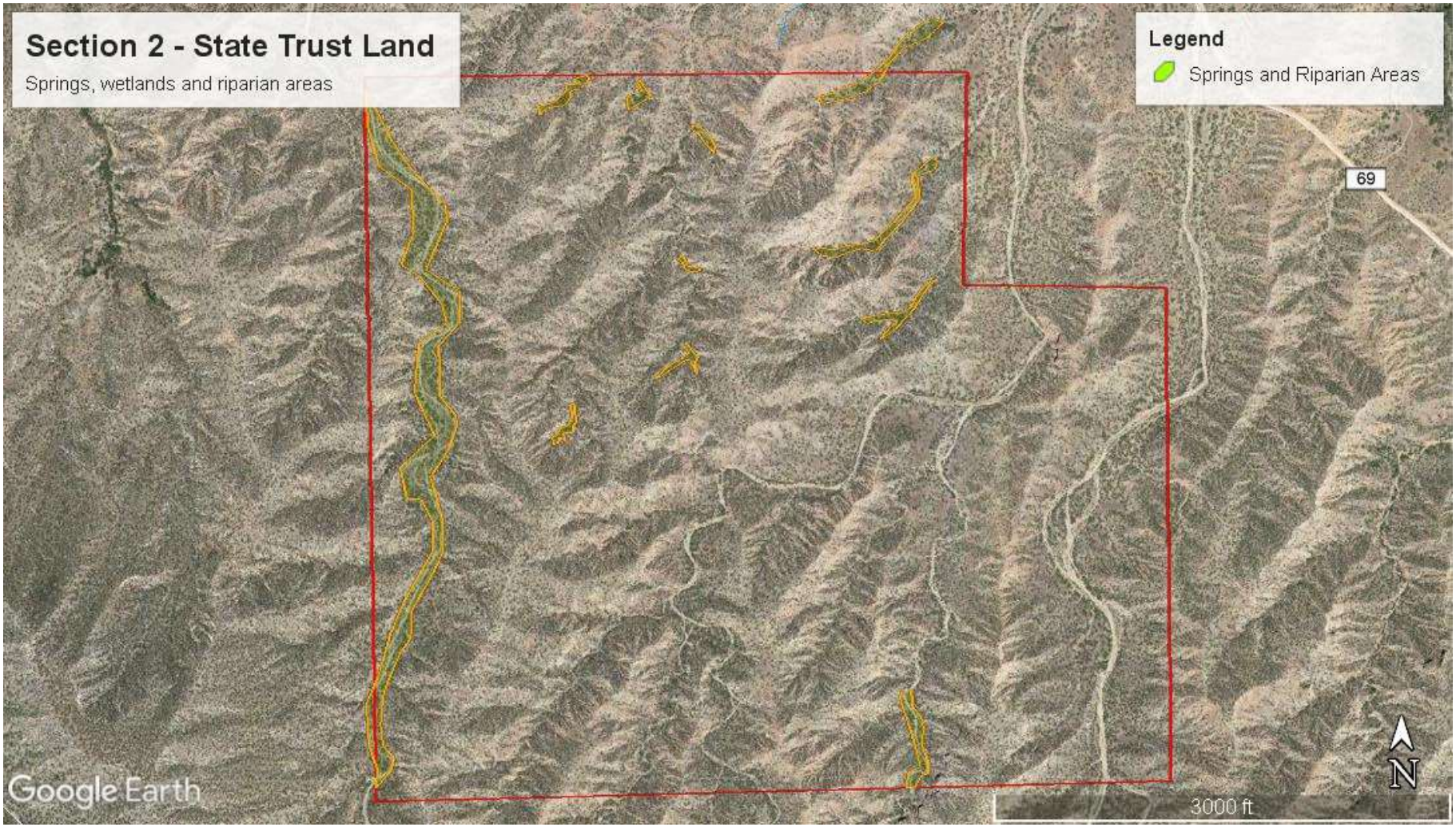


Figure 2B. Project Area Map – Section 2 – State Trust Land. Each of the areas outlined in yellow may contain springs and riparian areas and will be evaluated for restoration in this project.

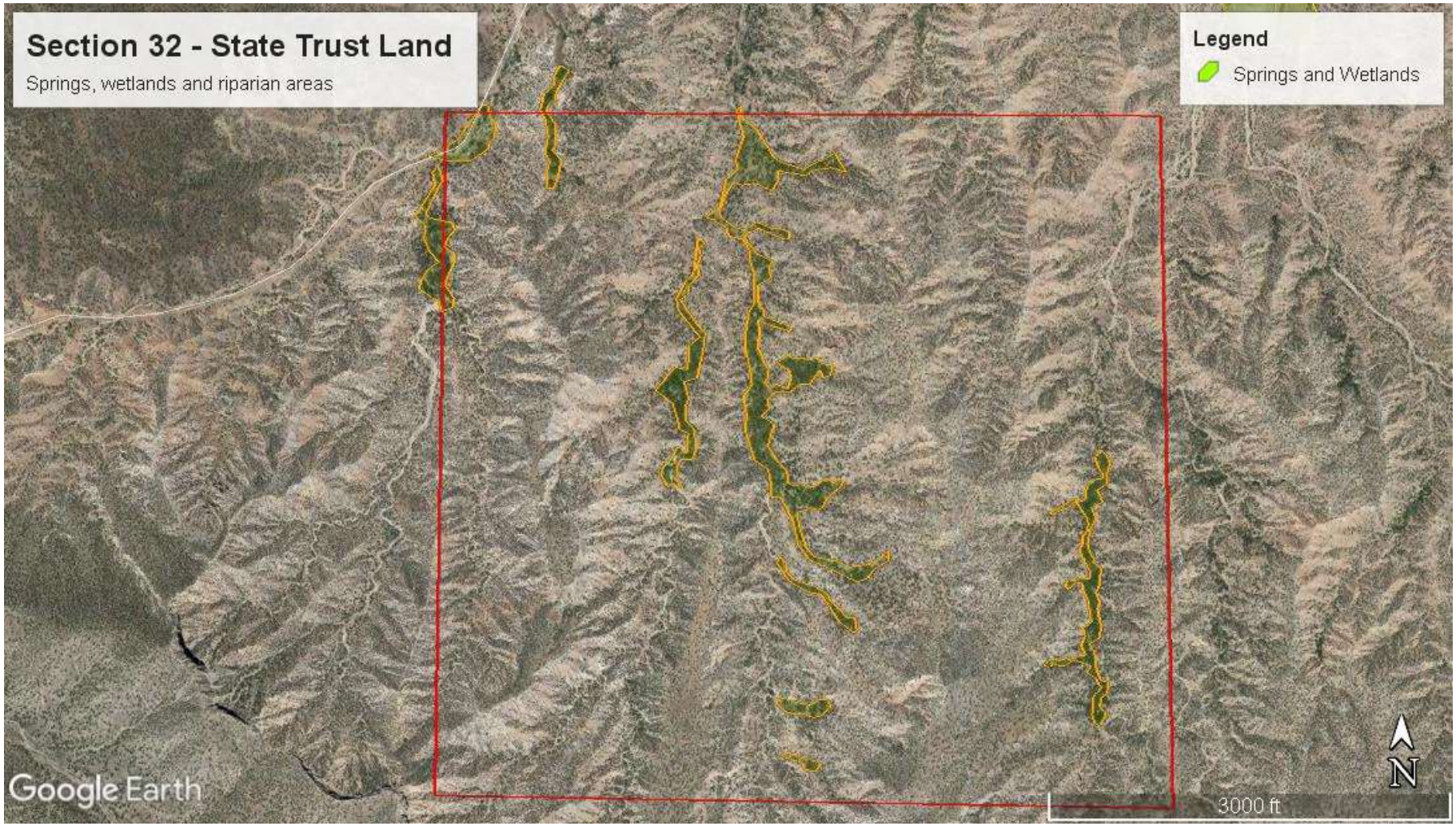


Figure 2C. Project Area Map – Section 32 – State Trust Land. Each of the areas outlined in yellow may contain springs and riparian areas and will be evaluated for restoration in this project**.**

Monitoring Location Selection Criteria

The exact locations of monitoring sites will be determined in the course of the project based on priority locations for construction of slope, streambank, gully and headcut stabilization structures. NM BGMR will perform basic hydrogeological assessment of up to 6 springs/wetlands within the project area to help determine water sources for various springs and wetlands. In combination with data from the BLM springs assessment regarding spring typology and macroinvertebrate populations, Web Soil survey results pertaining to soil and vegetation characteristics, and site conditions such as accessibility and slope, locations will be selected for restoration treatments. Monitoring locations are chosen for the purpose of comparing wetland morphological and riparian vegetation responses for each specific spring or wetland segment with new sediment retention structures within the 30-acre wetlands and springs area or on upland hillsides above wetlands and springs. Monitoring of treatment sites will include data gathering for STEPL, wetland monitoring associated with the NM RAM including a simplified greenline assessment, and implementation monitoring including cross-sections for collection of elevation data. Monitoring activities including the use of cross sections will take place at an upstream and downstream location relative to treatment sites, with a total of 6 to 10 cross sections.

Restoration Activities

The project will complete the following restoration activities:

1. Goal #1: Reduce soil erosion and from slopes: Approximately 300 small biotechnical slope stabilization structures will be constructed on denuded and eroded slopes and in rills and small gullies, utilizing locally sources materials (October 2022-March 2023). This will consist of a selection of rock structures (one-rock dams, Zuni bowls, rock rundowns, rock contour lines, etc.), log and brush material (e.g., brush mats, stick dams, logs and brush on contour lines, lop and scatter, etc.), and earthen structures (e.g., plug and spread, berm and swale, etc.). Specific treatment areas will be determined following site assessments.
2. Goal #2: Stabilize stream channel and restore channel and wetland function: Approximately 10 large bank, headcut, or gully stabilization structures will be constructed using bioengineering techniques, such as rock rundowns, log palisades or racks, rock and /or post vanes, root wads, logs, brush mats, log or rock revetments, and terracing to stabilize the banks (October 2022-March 2023). Specific treatment areas will be determined following site assessments and only locally sourced materials will be utilized. .
3. Goal #2: Stabilize stream channel and restore channel and wetland function: Invasive plant species will be removed where appropriate, stumps will be treated in ways that are sensitive to aquatic life forms, and slash will be utilized for slope or channel stabilization (October 2022-March 2023).
4. Goal #1: Reduce soil erosion and loss from slopes: Disturbed areas along slopes will be seeded with native grass species (March-May 2023). .

5. Goal #2: restoration of wetland function: Disturbed wetland areas will be planted with local willow cuttings. (March-May 2023).
6. Goal #3: Protect wetlands from degradation from off-road vehicle impacts: Closing unpaved roads and target areas to ORV access (March-December 2023). Where necessary and agreed upon with stakeholders, informal tracks will be closed, using boulders, jack falls of logs and brush, and/or earthen berms. This is to deter vehicular access to restoration sites, allowing the sites time to heal, and directing traffic in different directions. Specific locations will be determined following initial site assessments and only locally sourced materials will be utilized.

A.7 Quality Objectives and Criteria for Measurement Data

Question/Decision

The baseline data collection and monitoring components of the Lower Embudo Valley Springs and Wetlands Restoration Project are intended to answer the following questions:

1. Did we reduce sediment erosion and loss from slopes? (Goal #1).
    - ✓ Implementation monitoring of successful installation of soil stabilization structures will involve the visual inspection of structures, estimations of sediment retention behind structures, and photography of the structures using the photo monitoring protocol established in Appendix B of this QAPP.
    - ✓ STEPL modeling will take place in drainages with restoration treatments and will involve the collection field data relating to the USLE equation including vegetation, litter, and bare ground cover, as well as topographical measurements of slope percent and length along transects, and BMP efficiencies.
    - ✓ The results will help the project team understand whether goal #1 is reached in terms of realizing the structures needed to reduce slope erosion, minimizing sediment inputs into the Rio Embudo while increasing soil cover, spreading stormwater runoff, and improving micro-climate conditions for plant regeneration.
2. Did we halt headcut and gully formation and channel degradation, and successfully raise the channel elevation to improve the wetland function? (Goal #2).
    - ✓ Hydrogeologic assessment of groundwater sources will help to determine priority areas for restoration treatments to best improve wetland conditions
    - ✓ STEPL modeling will take place in drainages with restoration treatments and will involve the collection of field data including measurements of gullies and streambank dimensions and other features (time to form and lateral recession rate, respectively), and BMP efficiencies.
    - ✓ Implementation monitoring of successful installation of grade control structures will involve the visual inspection of structures, elevational verification with a

laser level, and photography of the structures using protocols established in Appendix B of this QAPP.

- ✓ The results will help the project team determine whether goal #2 is reached in terms of stabilizing channel banks, headcuts and gullies to reduce channel incision and restore wetland function by reducing active erosion and increasing channel elevation.

3. Did we restore native riparian and wetland vegetation and its associated aquatic and wildlife habitat?
    - ✓ The monitoring protocols of the NM RAM for Montane Riverine Wetlands[3] will help the project team collect data to complete the specific rubrics of the RAM. This will require a limited amount of field assessment work as well as map (or Google Earth imagery) analysis, relative to each element of the RAM protocol, and a simplified greenline assessment to monitor wetland extent
    - ✓ The results will help the project team ascertain whether goal #2 is reached regarding the channel and wetland function by documenting the relative ecological condition of selected sites based on a suite of landscape, biological, and abiotic attributes that vary along a disturbance gradient, as well as documenting changes in the overall size of wetlands in treatment areas.
4. Did we protect the riparian areas, seeps, springs, wetlands, and alluvial fan wetland areas from off-road vehicle impacts, any identified cattle grazing impacts, and reduce potential sediment inflows into the streams, in order to improve the water quality of the streams and reduce the impacts of the stressors on general wetland health?
    - ✓ The project team will track the absence of ORV impacts, unmanaged livestock and human access and impacts on the riparian and wetland areas (targets are 0 occurrences and 0 sq. ft affected; we will tally occurrences and area affected) through regular site visits by SLO staff and project team members. Observations will be logged on a documentation form accompanied with photography at established photo points, using the protocol detailed in Appendix B, as well as random points when and where unmanaged access occurs.
    - ✓ The results will help the project team ascertain whether goal #3 is reached regarding the protection of the riparian areas, riverine wetland, and alluvial fan (slope) wetland areas from ORV impacts and/or cattle trespassing so that water quality of the streams are improved and the impacts of the stressors on general wetland health are reduced.

Data Quality Objective (DQO)

[3] https://www.env.nm.gov/wp-content/uploads/sites/25/2018/01/NMRAM_Montaine-Riverine-Wetlands.pdf

The quality of the data will be adequate to provide a high level of confidence in determining stream channel stability and functionality, wetland integrity, and ecological diversity and resilience of the Lower Embudo Valley Springs and Wetlands Restoration Project.

Data Quality Indicators

The measurement quality objectives will be sufficient to achieve the Data Quality Objective (DQO) and will be in conformance with those listed in the SWQB's QAPP (NMED/SWQB 2021). The Data Quality Indicators (DQI) listed in the SWQB's QAPP and applicable to the data collected for this project are precision, bias, accuracy, representative, comparability, completeness, and sensitivity.

Following methods in Stream Channel Reference Sites: An Illustrated Guide to Field Technique (Harrelson et al. 1994), cross section elevation data for the stream channel will be collected using a laser level and stadia rod. Data collection equipment will be verified or calibrated in accordance with manufacturer's recommendations prior to field work activity. For cross section elevation data, the manufacturer's directions for the laser level and rod and their instrument calibration checks, and the NM RAM protocol, Ecotone LP will ensure that the collected data meet the needs for the DQOs. When weather conditions or flow rates are hazardous, work will be postponed to times when conditions are beneficial to meet safe working conditions and data that are representative and comparable between data sets.

DQI	**Determination Methodologies**
Precision	For elevation cross-sections: measuring at exactly the same locations, referenced with GPS coordinates, rebar stakes, and stable reference benchmarks. For photo points: taking pictures following the same protocol at each location. For the NM RAM: following the same version of the NM RAM protocol each year and assessing the same area each year. For hydrogeologic assessment: Location / geospatial data will be collected using high quality GPS, running repeated measurements over at least 5 minutes. From the first site visit, a photo-log will be kept for locations and activities, and photo identifications are confirmed at each repeat site visit. If there are deviations from this QAPP or applicable SOPs, including the decision to not sample a location because conditions are either unsafe or there are accessibility problems, these changes will be recorded in the study-dedicated field notebook or field forms. For STEPL modeling: Modeling the exact same extent of land by recording drainage size in GIS and recording modelled features (streambanks, gullies, & transects) with GPS coordinates.

Bias	For elevation cross-sections: using high quality instrumentation that is calibrated and properly referenced to known elevation reference point (if applicable). For photo points: using a high-resolution camera with color imagery; each time at the exact same locations, the same directions, angles, and image frames, referenced by GPS coordinates and rebar stakes or picture posts. For the NM RAM: ensuring that the RAM assessment is conducted by the same person(s), at approximately the same time of year and under the same terrain conditions. For hydrogeologic assessment: Field team will use high quality field instruments, including GPS, YSI multi-parameter meter for data such as pH and temperature. Instrumentation is calibrated and properly referenced to known elevation reference point for Dissolved Oxygen. Laboratory analyses provide independent QA/QC procedures following EPA methodology and/or other comparable standards for isotope analyses. For STEPL modeling: ensure that field measurements are completed by the same person(s), measuring the same features, and at the same locations every year.
Accuracy	For all indicators: pursuing high precision and low bias; where necessary adding meta data descriptions of monitoring choices made that clarify precision and bias deviations.
Representative	For elevation cross-sections: choosing non-anomalous locations for the cross-sections. For photo points: ensuring that photographs are taken on approximately the same day(s) each year, with the same lighting, and stream flow regimes, and that the imagery depicts non-anomalous conditions. For the NM RAM: ensuring that RAM is executed on approximately the same day(s) each year, with the same terrain conditions are non-anomalous. For hydrogeologic assessment: Collection of samples from the source orifice or discharge point, or as close as possible, will ensure samples are representative of the groundwater system supporting the springs/

	wetlands. Samples will be collected following procedures provided in Appendix 1. For STEPL monitoring: choosing non-anomalous drainages and features to include in model, chose representative transect locations.
Comparability	For elevation cross-sections: ensuring that each cross section is always placed in the same way and same location, and that references for laser or total station settings are the same. For photo points: ensuring that photographs are taken with the same camera, same camera settings, and scale (zoom settings) For the NM RAM: ensuring that RAM is executed the same way each time. For hydrogeologic assessment: Using common or standard protocols for sampling, such as those provided by NM BGMR, modified from USGS or EPA, will provide comparability of field and lab analyses. Data will be comparable to previously conducted or similar analyses and datasets. Laboratory analytical methods will be comparable to other similar datasets. For STEPL monitoring: ensuring that field measurements are completed for the same features (gullies and streambanks), and that field measurements and model inputs are consistent between years.
Completeness	For elevation cross-sections: ensuring that all cross sections are always taken and included in the analysis. For photo points: ensuring that all photographs in the protocols are taken and analyzed. For the NM RAM: ensuring that RAM is executed the same way each time. For hydrogeologic assessment: Complete and comparable sample data will be collected for each site, to the extent possible, for all 6 sites. A full suite of analyses listed above is expected for each site. For STEPL monitoring: ensuring that all modeled drainages and features within drainages are measured and included in the model in every analysis.
Sensitivity	For elevation cross-sections: with an acceptable accuracy of 5% error, we want to measure at a scale of elevation intervals =<5% of 1 foot =< 0.05ft (1.5 cm or smaller). For photo points: we want to document that structures are built according to design and at the correct locations.

	For the NM RAM: as per RAM protocol. For hydrogeologic assessment: Method reporting limits provided in report will meet project objectives to for basic hydrogeological assessment. For STEPL monitoring: as per STEPL guidelines.

A.8 Special Training/Certification

This project will be primarily implemented by Jan-Willem Jansens of Ecotone Landscape Planning, LLC (Ecotone LP), with help from an Ecotone LP intern or associate and/or volunteers. Data collection and STEPL modeling, implementation monitoring, and NM RAM assessments will be conducted by Jan-Willem Jansens of Ecotone LP with help from an Ecotone LP associate and/or volunteers. SWQB will provide technical assistance and oversight. Volunteers will be trained and supervised by Ecotone LP staff, as appropriate for the type of monitoring. Ecotone LP team members previously participated in a three-day training workshop presented by NMED SWQB Wetlands Program in partnership with the University of New Mexico, Natural Heritage New Mexico on the NM Rapid Assessment Method for monitoring wetlands in the summer of 2021.

Jan-Willem Jansens serves as the project manager for this project. He is the owner and Principal of Ecotone Landscape Planning, LLC, located in Santa Fe, NM. Mr. Jansens holds a master of Agricultural Sciences degree from the Wageningen Agricultural University in The Netherlands in 1987, with a specialization in Landscape Architecture, Forestry, and Agricultural Engineering. After an international development career on ecological planning and restoration with extended work periods in several African countries, he moved to New Mexico in 1993. He has developed, managed, and completed at least eight projects in collaboration with EPA/NMED for stream and wetland restoration, and served in a supportive role on several other projects. He has extensive experience with all aspects of project administration, cost management, contractor management, reporting, and quality control. His projects have been completed on time and within budget. He has worked in the Lower Embudo Valley for more than ten years, conducted several projects, and authored the final Watershed-Based Plan for the area. He has collaborated with the NM State Land Office on several other projects in the watershed.

This project will be primarily implemented by project team members, with assistance from volunteers. Data collection and monitoring for this project will be implemented by project team members, with assistance from volunteers with technical assistance and oversight from the SWQB Project Officer. Hydrogeologic assessments by NM BGMR will be completed by NM BGMR field technicians who have performed water quality sampling on 100+ sites prior to this sampling. Volunteers will be trained by project team members and supervised at all times by project team members in the field during data collection efforts. Any individual collecting data for the project will be informed of proper data collection procedures prior to initiating data collection by either Jan-Willem Jansens of Ecotone LP or project staff identified in Table 1. All

members of the distribution list (Table 1) who do not have signature authority to approve this QAPP will review the QAPP and sign the Acknowledgment Statement prior to authorizing data collection by others (e.g., volunteers, etc.) for this project.

Monitoring training information will be kept by Ecotone LP in a computer, in an online digital file, and in a paper copy filing system for project team members. Jan-Willem Jansens of Ecotone LP is responsible for ensuring that these data storage guidelines are met, and that qualified personnel are available to perform the work.

A.9 Documents and Records

The SWQB Project Officer will make copies of this approved QAPP and any subsequent revisions available to the Project Manager. The Project Manager will distribute to all other individuals on the distribution list who do not have signature authority for approving the QAPP. Ecotone LP will distribute relevant documentation to other team members as appropriate. The SWQB WPS will retain project documents in accordance with applicable sections of New Mexico's Disposition of Public Records and Non-Records regulation, codified at 1.13.30 Administrative Code (NMAC) and Retention and Disposition of Public Records regulations, codified at 1.21.2 NMAC.

When changes affect the scope, implementation, or assessment of the outcome, this QAPP will be revised to keep project information current. The SWQB Project Officer, with the assistance of the QAO, will determine the effects of any changes to the scope, implementation, or assessment of the outcome on the technical and quality objectives of the project. This Project Plan will be reviewed annually by the SWQB Project Officer to determine the need for revision.

Project documents include this QAPP, field notebooks, calibration records, validation and verification records, and recorded field data in hard copy or in electronic form. Also included are project interim and final reports. Data captured on a global positioning system (GPS), camera, smart phone, tablet, or laptop will be downloaded to an Ecotone LP computer at the end of each week. Copies will be made of all data and stored separately from the original data.

All digital project data will be kept in a project file on the project manager's (JW Jansens) computer and on a separate external (online) backup drive. Hard copy project documents will be kept in a project folder in a filing cabinet at the Ecotone LP office. All hard copy documents will be digitized and stored on an Ecotone LP computer and an online backup drive (see Table 3). Copies of the data identified in Table 3 will be distributed annually by Ecotone to NMED SWQB Project Officer at the end of the spring season beginning 2022. Items identified with an asterisk in Table 3 will not need to be distributed to the NMED SWQB Project Officer.

Table 3. Data Records for the Project

Documents/Data	Type of Form	Storage Location	Field Sheet Used
QAPP	Electronic (.doc) & Hard Copy	SWQB, and Ecotone LP	EPA Requirements for Quality Assurance Project Plan. EPA QA/R-5
***Calibration Records**	Electronic (.doc) & Hard Copy	Ecotone LP	NA
***Field sheets (elevation cross-section)**	Electronic (.xls) & Hard Copy	Ecotone LP	Field datasheet designed specifically for this project
Photos	Electronic (.jpg)	Ecotone LP	Photo Points Permanent Record. See Appendix B.
NM RAM	Electronic & Hard Copy	SWQB and Ecotone LP	The forms from the latest version of the NM RAM Field Guide
Implementation monitoring reports	Electronic & Hard Copy	SWQB and Ecotone LP	Field datasheet designed specifically for this project
Wetland Delineation data	Electronic & Hard Copy	Ecotone LP	Field datasheet designed specifically for this project
STEPL modeling data	Electronic & Hard Copy	Ecotone LP	Field datasheet designed specifically for this project
Hydrogeologic Assessment Sampling	Electronic & hard copy	NM BGRM Internal server and locked file drawers for field data sheets; electronic copies kept by Ecotone LP	Standard field data sheets used by NM BGMR on all hydrologic assessments.
WAP (WBP Amendment)	Electronic & hard copy	SWQB and Ecotone LP	NA
Interim and Final Reports	Electronic (.doc) & Hard Copy	SWQB, NM SLO, and Ecotone LP	Quarterly progress reports templates and a Final Report template.

Table 3. Data Records for the Project

GROUP B: DATA GENERATION AND ACQUISITION

B.1 Sampling Design

The project's monitoring component consists of gathering and analyzing data for (a) STEPL modeling, (b) implementation verification, (c) wetland conditions, (d) off-road vehicle and cattle impact reduction verification, and (e) hydrogeologic assessment.

a. STEPL modeling (version 4.4)

The purpose of this monitoring element is to determine whether the constructed soil stabilization structures had the desired sediment load reductions. The Spreadsheet Tool for the Estimation of Pollutant Load (STEPL) relies on simple algorithms to calculate sediment loads from different land uses, and sediment load reductions resulting from implementation of best management practices (BMPs), using known or calculated BMP efficiencies. STEPL modeling will be performed within each drainage in the project area that contain treatment areas, to be determined after initial site assessments.

Ecotone LP will be responsible for collecting all data necessary for STEPL modeling. The Ecotone team will gather field data for treatment areas in streambanks and gullies. This includes physical measurements of streambank dimensions, lateral recession rate, and BMP efficiency (0-1) for streambanks, and gully dimensions (upstream width, downstream width, depth, and length), estimated time for gullies to form, and BMP efficiency for gullies. All recorded features will be logged and recorded with GPS to enable precise replication for follow-up modeling. Additional information regarding soil hydrologic groups and soil classes will be derived from the NRCS Web Soil Survey (WSS) tool, while information regarding land use, size of treatment areas and acreage of BMPs will be derived using GIS software (QGIS version 3.20.2) and the most recently available Google satellite imagery. The STEPL spreadsheet will automatically derive rainfall data from the nearest weather station after inputting the location of drainages to be modeled.

Version 4.4 of STEPL allows user to specify USLE equation components for modeled areas which will be utilized to capture sediment load reductions resulting from restoration structures constructed on upland slopes of the project area. USLE components of slope steepness and length (LS) and vegetative cover (C) will be calculated based on data obtained from transects placed in modeled drainages where restoration structures have been constructed, with methods based on guidance from Coulloudon et al. (1999). Depending on the size of the drainage, 1-3 transects will be established. Along each 100-foot transect, ten quadrat plots (3 feet x 3 feet) will be laid out at 10-foot intervals on alternating sides right and left of the main transect offset from the line by 3 feet. Alternating sides allows more variability within the landscape to be captured while offsetting the quadrats helps to avoid disturbed areas from foot-traffic along transect. Within quadrat plot, ground cover percentages, vegetation cover and type, and slope length and percent will be recorded. Transect ends will be recorded with

GPS waypoints. Other components in the USLE equation, including rainfall erosivity (R) and soil erosivity factor (K), will be derived within the model and/or using WSS results.

Locations are chosen for the purpose of comparing downstream sediment loading in response to new soil stabilization structures constructed in each treatment area drainage. Each of these drainages also have specific geological and ecological characteristics in terms of plant cover and soil erosivity. This monitoring element will take place in the fall prior to project implementation in early 2023 and will be repeated in the fall of 2024 in conjunction with final implementation monitoring for purposes of efficiency (equipment on site and relationship between stream functions and structural integrity of implemented structures).

The STEPL modelling locations will be accessible on foot only, and any equipment will have to be carried into the field. Snow cover, ice, catastrophic flooding, or bank failure may render any of the cross-section locations temporarily or indefinitely inaccessible or invisible. If necessary, the project team will evaluate terrain conditions at the time after such events to develop an alternative data gathering approach.

b. Implementation verification

The purpose of this monitoring element is to establish whether the bio-technical slope stabilization structures and streambank, gully and headcut restoration structures and their structural integrity have been built according to the design specifications. Implementation monitoring of successful installation of slope stabilization and restoration structures will involve the visual inspection of structures, elevational verification with a laser level, and photography of the structures using protocols established in Appendix B. Implementation verification also applies to the installation of fencing or road closure structures, protection of riparian vegetation, and the seeding of native grasses.

This monitoring element will take place immediately after project implementation in early 2023 and will be repeated biannually in the spring and fall in conjunction with other monitoring elements for purposes of efficiency (equipment on site and relationship between stream functions and structural integrity of implemented structures).

Ecotone staff will be responsible for this monitoring element. The monitoring activity will take place at the location of each built structure or modified terrain feature and be part of an overall walk through of the project area.

Conducting this monitoring element can only occur on foot. Any equipment will have to be carried into the field. Snow cover, ice, catastrophic flooding, bank failure, or other events may render any of the structures temporarily or indefinitely inaccessible or invisible. The project team will evaluate terrain conditions at the time after such events to develop an alternative data gathering approach.

c. Wetland conditions

The purpose of this monitoring element is to establish whether wetland conditions have improved. Monitoring will focus particularly on ascertaining the presence of vigorous riparian buffers of native plants with desired soil stabilizing effects and floodplain vegetation of native plants (measured using visual inspection and photo documentation).

The project team will conduct the NM Rapid Assessment Method for Montane Wetlands (NM RAM) in the spring of 2022 and in the spring of 2024 to develop output data that can be compared to evaluate quantitative and qualitative improvements as a result of the project. A modification to the NMRAM will include the addition of a simplified greenline method to monitor changes in the extent of wetland size (Winward, 2000). This method will use transects to monitor the presence and extent of obligate and facultative wetland species at areas where restoration structures were constructed. This may include areas where work was completed that were not subject to the NM RAM so that wetland acreage can still be monitored.

Ecotone LP staff will be responsible for this monitoring element. Field work for this monitoring activity will take place across the entire project area. Data analysis, including analysis of Google Earth imagery, will take place in the Ecotone LP office.

Conducting the field monitoring for this monitoring element can only occur on foot. Any equipment will have to be carried into the field. Snow cover, ice, catastrophic flooding and bank failure may render the wetlands area temporarily or indefinitely inaccessible to foot traffic. An alternative approach may involve walking around the perimeter of the project area, in so far accessible, to collect information, and complete further assessment work in the office.

d. Off-road vehicle impact reduction verification

The purpose of this monitoring element is to establish whether ORV impacts and unmanaged livestock and human access has impacted the riparian and wetland areas. The project team will tally, describe (including location specifications), and photograph impacts that require adaptive management.

The monitoring activity will require an overall walk through of the project area during which observations are documented and photographed. Ecotone LP staff will be responsible to organize the inspections. Inspections will include regular site visits by Ecotone LP staff and project team members. This monitoring element will take place at least quarterly, and more frequently based on the occurrence of site visits.

Conducting this monitoring element can only occur on foot. Any equipment will have to be carried into the field. Snow cover, ice, catastrophic flooding, bank failure, or other events may render the project area temporarily or indefinitely inaccessible or invisible. The project team will evaluate terrain conditions at the time after such calamities to develop an alternative data gathering approach.

e. Hydrogeologic Assessment Sampling

The purpose of this monitoring element is to help determine hydrogeologic influences of water chemistry features along the water flow path or within aquifer(s). Results from the isotope measurements are intended to provide information about the timeframe of recharge and possibly the season of when recharge occurs.

The data that will be collected will be derived from field site visits, visual observations, measurements of onsite field parameters of the water, and water samples collected for analyses in laboratories (listed below). The samples will be collected from up to 6 sites, which will be determined based on site accessibility and water source location within the designated

study area designated by Ecotone Landscape Planning, LLC. Sites are only accessible by foot, and the water sampling needs to be collected as close to the actual groundwater source as possible.

Samples will be collected by 1-2 trained field technicians, staff of NM BGMR, following standard operating procedures. Sampling of springs or water sourcing wetlands will be grab samples, using a peristaltic pump if needed, from location of the source feature as close to its first contact with the atmosphere as possible. In other words, samples will be collected as close to the source as possible, not from a pool or pond ideally, in order to get a sample that is representative of the groundwater origin. For this project, only one sample per site is expected. NM BGMR staff will be responsible for sample collection and handling, field notes and documentation, data management for the six samples, and a short summary report on the interpretations. Sampling will be completed early in the planning phase (winter-spring 2022), as this data will inform priority areas for restoration activities.

The sample analyses will provide parameters as listed below:

Water Quality Field Measurements

- Measure groundwater or surface water temperature, pH, specific conductance, dissolved oxygen, and oxidation reduction potential (ORP)

Water Quality Lab Measurements and method

- ICP-OSE – EPA Method 200.7 for Ca, Mg, K, Na, Fe, Mn Se, Sr
- ICP-MS – EPA Method 200.8 for Al, As, Be, Cd, Cr, Co, Cu, Pb, Li, Mo, Ni, Ag, Tl, Th, Sn, Ti, U, V, Zn, Ba, B, Mn, Sb, Se, Sr, Fe, Si
- IC – EPA Method 300.1 for F^-, NO_3^{2-}, NO_2^{2-}, Br^-, SO_4^{2-}, Cl^-, PO_4^{2-}
- Hardness in water – calculated, standard methods, Section 2340B
- TDS in water – calculated, standard methods, Section 1030E
- Alkalinity in water - EPA 310.1

Isotope Measurements

- Stable isotopes in water (oxygen and hydrogen) and methods of Picarro L1102-I Isotopic Water Analyzer
- Low level tritium analyses, measured by enrichment and low-level counting of ultra-low activity water sample. (Miami Tritium Lab)
- Stable carbon isotopes in DIC, measured by continuous flow Isotope Ratio Mass Spectrometry using a Gasbench device coupled to a Finnigan Mat Delta Plus Isotope Ratio Mass Spectrometer (Beta Analytical laboratory or equivalent)

Table 4. Project Monitoring Specifics

Responsible Party	Monitoring	Location	Frequency
Ecotone LP	STEPL modeling	At each drainage with restoration treatments	Prior to treatment (fall 2022) and at end of project (fall 2024)
Ecotone LP	Implementation monitoring & photo points	At each of the structures and other treatments	Biannually (spring and fall)
Ecotone LP	NM RAM	Entire treatment area and buffers	2022 and 2024 (between March and May)

Ecotone LP	Greenline wetland vegetation monitoring (simplified)	Selected riverine wetlands and cienegas where the project is expected to improve wetland conditions	2022 and 2024 (between March and May)
Ecotone LP & NM SLO	ORV impact verification	Project area entry points at northern perimeter	Quarterly
NM BGMR	Hydrogeologic Assessment	At source/ orifice of up to 6 springs within study area	One-time sampling in winter or spring 2022

B.2 Sampling Methods

Sampling methods consist of STEPL modeling, the NM RAM for Montane Riverine Wetlands, terrain observation and photo documentation, cross-sections in association with elevation data, wetland delineation, and water age dating. The methods for each include:

STEPL Modeling: STEPL modeling will be done in accordance with the instructions provided on the US EPA website, using the most recent version (4.4) of the spreadsheet tool.

NM RAM methods: We will be using the most up to date NM RAM protocols and field sheets. The SWQB Wetlands Coordinator will be contacted for the latest version of the Montane Riverine Wetlands Manual, Field Guide, and Field Sheets prior to data collection. Modification of the NM RAM will include the addition of a simplified greenline method to monitor wetland extent (Winward, 2000).

Terrain observations and photographic documentation methods: We will use the protocols identified in Appendix B. Photo points will be recorded using the Photo Points Permanent Record Form, included in Appendix B.

Elevation Cross-sections methods: Elevation cross-section surveys will each measure a single vertical plane across the stream channel between reference end points that have been monumented by the installation of ½" diameter steel rebar, flush with the ground surface. Elevation cross sections will be measured in accordance with Stream Channel Reference Sites: An Illustrated Guide to Field Technique (Harrelson et al. 1994).

Hydrogeologic Assessment: The sampling methods to collect water quality and environmental tracer data from surface water locations (springs or wetland sources) will be performed in accordance with the NM BGMR's Water Quality Sampling SOP (SOP-WATQUAL), and applicable field SOPS. Appendix A provides copies of the applicable SOPs, outlining how field activities will be performed. Field SOPs provide the sampling checklist and field equipment checklist.

B.3 Sample Handling and Custody

Hydrogeologic assessment samples in the field will have the necessary sample labeling, chain-of-custody (COC) forms, and packaging to maintain the proper integrity and custody of samples collected in the field. Samples delivered for laboratory analysis shall follow the laboratory custody requirements that starts with the receipt of samples and continues through sample storage, analysis, data reporting, and data archiving. Sample designation will consist of a series of letters and numbers to indicate the station and location (i.e., Spring Name or Letter). All water samples for major ions, trace metals, and stable isotopes of O and H will be taken to the NM BGMR laboratory in Socorro, NM.

All samples will be preserved (in accordance with appropriate methods as described above; see also Table 5) and transported back to the NM BGMR laboratory following COC protocols. The water quality samples will be relinquished to the sample custodian at the laboratory, together with the completed and signed COC forms. Appendix A includes a blank chain-of-custody form. All field measurements and observations will be recorded in a bound notebook or on appropriate data sheets by field personnel at the time they are performed. Sample field data sheets are in Appendix A. The personnel doing the recording will initial and date all measurements, observations, and any other notations made. Corrections will be performed by drawing a single line through the error accompanied by the date and the initials of the person performing the correction, followed by the proper entry. COC forms will be filled out during the time of collection. All the samples will be stored in an access-controlled sample cooler at the laboratory. An analytical chemist will log the samples in upon receipt (into Laboratory Information Management System, or LIMS). The Data Manager will enter all field and analytical data into the Aquifer database for permanent storage and archiving. In the NM BGMR water chemistry lab, each batch of samples submitted on a given day is submitted with the COC form. The original form is signed and dated by the submitting and receiving parties and is retained by the laboratory as an attachment to the laboratory Login and Routing Sheet (LRS). A photocopy of the COC is made by the laboratory and retained by the submitting party. Laboratory personnel generate an LRS for every batch of samples using a LIMS, where analyses are recorded with the date, analytical file and LIMS QC batch on the LRS. Order and sample IDs are generated by the LIMS using the format of “year/month/batch number-sample number” (for example, 170610-12). Several bottles are received for each sample, and each is labeled with the associated order / sample ID. Samples preserved with acid are then stored in the ICP lab before and after analysis. Unpreserved samples are stored in the laboratory refrigerator before and after analysis. Samples are stored at these locations for up to six months before disposal.

B.4 Analytical Methods

Tables 5 and 6 summarize the laboratory analytical instrumentation and methods to be used for water sample analysis. Appendix A includes further information about laboratories selected for analyses and their operating procedures or equipment. Water quality samples will be analyzed for total and dissolved metals, major ions and other parameters, as shown in Table 6. More

detailed information on laboratory analyses at NM BGMR and the external labs are included in Appendix A.

Table 5. Laboratory Analyte, reporting limit and EPA method applied for water samples.

Analyte	Lower reporting limit (mg/L)	Method
Fluoride (F-)	0.1	EPA Method 300.1
Chloride (Cl-)	1	EPA Method 300.1
Nitrite (NO2)	0.1	EPA Method 300.1
Bromide (Br-)	0.1	EPA Method 300.1
Nitrate (NO3)	0.1	EPA Method 300.1
Phosphate (PO4)	0.5	EPA Method 300.1
Sulfate (SO4)	1	EPA Method 300.1
Alkalinity	5	EPA Method 310.1
TDS calculated	-----	Standard Methods
Hardness calculated	-----	Standard Methods
Calcium (Ca)	0.05	EPA Method 200.7
Iron (Fe)	0.02	EPA Method 200.7
Potassium (K)	0.05	EPA Method 200.7
Magnesium (Mg)	0.05	EPA Method 200.7
Sodium (Na)	0.05	EPA Method 200.7
Silicon (SiO2)	0.1	EPA Method 200.7
Aluminum (Al)	0.001	EPA Method 200.8
Antimony (Sb)	0.005	EPA Method 200.8
Arsenic (As)	0.001	EPA Method 200.8
Barium (Ba)	0.005	EPA Method 200.8
Beryllium (Be)	0.001	EPA Method 200.8
Boron (B)	0.005	EPA Method 200.8
Cadmium (Cd)	0.001	EPA Method 200.8
Chromium (Cr)	0.001	EPA Method 200.8
Cobalt (Co)	0.001	EPA Method 200.8
Copper (Cu)	0.001	EPA Method 200.8

Lead (Pb)	0.001	EPA Method 200.8
Lithium (Li)	0.001	EPA Method 200.8
Manganese (Mn)	0.005	EPA Method 200.8
Molybdenum (Mo)	0.001	EPA Method 200.8
Nickel (Ni)	0.001	EPA Method 200.8
Selenium (Se)	0.005	EPA Method 200.8
Strontium (Sr)	0.001	EPA Method 200.8
Silicon (Si)	0.025	EPA Method 200.8
Silver (Ag)	0.001	EPA Method 200.8
Thallium (Tl)	0.001	EPA Method 200.8
Thorium (Th)	0.001	EPA Method 200.8
Tin (Sn)	0.001	EPA Method 200.8
Titanium (Ti)	0.001	EPA Method 200.8
Uranium (U)	0.001	EPA Method 200.8
Vanadium (V)	0.001	EPA Method 200.8
Zinc (Zn)	0.001	EPA Method 200.8
TOC		EPA Method 9060
DOC		EPA Method 9060

Table 6. Laboratory instruments used for analyses, EPA method and calibration used for relevant analytes.

Instrument	Method	Calibration*	Analytes
ICP-OES	EPA Method 200.7	4-point calibration	Ca, Mg, K, Na, Fe, Mn, Si, Sr
ICP-MS	EPA Method 200.8	5-point calibration	Al, As, Be, Cd, Cr, Co, Cu, Pb, Li, Mo, Ni, Ag, Tl, Th, Sn, Ti, U, V, Zn, Ba, B, Mn, Sb, Se, Sr, Fe, Si
IC	EPA Method 300.1	4-point calibration	F^-, NO_3^{2-}, NO_2^{2-}, Br^-, SO_4^{2-}, Cl^-, PO_4^{2-}
UV	EPA Method 9060 SM 5310		TOC, DOC

*A calibration blank is included as one point.

B.5 Quality Control

Quality control (QC) activities are technical activities performed on a routine basis to quantify the variability that is inherent to any environmental data measurement activity. The purpose for conducting QC activities is to understand and incorporate the effects the variability may have in the decision-making process. Quality Control mechanisms are implemented as described under the Quality Objectives and Criteria for Measurement Data as well as the sampling methodologies identified under this QAPP. Additional Quality Control includes the professional expertise of the personnel working under this project. The project manager, Jan-Willem Jansens will be responsible for all work conducted by San Isidro Permaculture, Inc. If data do not meet the QC criteria as stated in Quality Objectives and Criteria for Measurement Data as well as in the sampling methodologies identified under this QAPP, the data will not be utilized for modeling, development of a design or in environmental decision making.

B.6 Instrument/Equipment Testing, Inspection and Maintenance

All field equipment will be inspected prior to commencing data collection. The person(s) conducting the work is responsible for ensuring that equipment is inspected, and that proper maintenance has been completed before data collection has commenced. All instruments and equipment will be tested, inspected and maintained in accordance with the manufacturer's specifications as included in their associated instrument/equipment manual. Field equipment suspected to be faulty will not be used for data collection, until required maintenance is performed, or equipment is replaced (Table 7).

Table 7. Field equipment that is anticipated to be used in the project.

Type of Equipment	Make/Model	Details
Laser level and rod	CST/Berger laser RL25h and receiver RD5	For cross section elevation measurements
Multi-parameter meter	YSI Professional Plus	For NM BGMR sampling, maintained by staff
GPS	Garmin 64s	
Photo (with GPS) camera	Sony, DSC-HX400V	Standard lens

B.7 Instrument/Equipment Calibration and Frequency

The calibration of the laser level will be verified according to the manufacturer's specifications. Documentation of calibration and verification will be maintained by Jan-Willem Jansens (Ecotone, LP).

The YSI Multi-parameter meter will be calibrated by NM BGMR staff for pH and specific conductance before each sampling trip, calibrated for dissolved oxygen at each sample location, and maintained per manufacturer's specifications during storage/between trips. Laboratory

instrumentation (analytical instrumentation) will require periodic calibration to verify function. SOPs and user's manuals for laboratory analytical instrumentation are on-file and readily available at the NM BGMR laboratory. Any variations or inability to calibrate a piece of equipment or instrument will be noted, and appropriate mitigation procedures will be followed or replacement equipment will be obtained. Recalibration of any instrument that requires mitigation of a deficiency will be performed prior to use or deployment.

B.8 Inspection Inspection/Acceptance for Supplies and Consumables

There are no supplies or consumables that could affect the quality of data related to this project.

B.9 Non-direct Measurements

No non-direct measurements used during the course of this project will affect the quality of data related to this project. The non-direct measurement data sources will include:

a. Google Earth remote sensing imagery (the latest imagery and historical data layers for purposes of comparison to understand changes over time).

Imagery will be selected based on visibility of critical landscape elements, terrain texture and color, and image resolution in relation to the specific purposes for which this data source is used.

b. Input data for STEPL modeling will be based on field collected streambank and gully data, GIS derived data, and soil data obtain from the NRCS's Web Soil Survey (WSS) tool, and weather data derived from the STEPL spreadsheet based on drainage location.

We will use the most up to date STEPL spreadsheet (4.4) and most recent Google satellite imagery. Soil information including the soil erosivity factor will be obtained from a WSS of the project area.

c. Existing data from previous studies of water quality or groundwater level information in the vicinity of the study area may be used in the hydrogeologic assessment for comparison purposes.

These data may be sourced from historic studies of surface water or groundwater conducted by NM BGMR, USGS, BLM, or NMED, if available. These data and the protocols used to collect data are considered useable and acceptable for the intended use of this project. Further QAQC may be warranted if data will be used for other purposes not mentioned in this QAPP.

Additional data provided through existing geologic mapping may also be used in building interpretations of groundwater sources to springs / wetlands. Existing mapping has been conducted, published, and reviewed, and is published by NM BGMR, BLM or USGS. References to all maps used would be provided in report.

B.10 Data Management

Jan-Willem Jansens and Erin McElroy of Ecotone Landscape Planning will be responsible for data management. All data will be converted to electronic format, stored and backed up by Jan-Willem Jansens and Erin McElroy, and sent to SWQB Project Officer. Computer hard drives are

backed up weekly or will be backed up on external hard drives or online drives, respectively. Hard copies of field sheets will be maintained in a project binder organized by assessment and date and stored in a filing cabinet in the office of Ecotone and SWQB.

Upon receiving data, the SWQB Project Officer will store data on SWQB network drive in a project specific folder. The SWQB network drive is backed up daily and maintained by the NMED Office of Information Technology. Project documents will be stored on the SWQB network drive in accordance with 1.21.2 NMAC, *Retention and Disposition of Public Records.*

GROUP C: ASSESSMENT AND OVERSIGHT

C.1 Assessment and Response Actions

The SWQB Project Officer will provide project oversight by periodically assisting with and/or reviewing data collection efforts. A review of the baseline data collection and monitoring efforts by the SWQB Project Officer will take place at the end of each monitoring season. The SWQB Project Officer will assess project progress to ensure the QAPP is being implemented, including periodic audits by the QAO, as needed. Any problems encountered during the course of this project will be immediately reported to the SWQB Project Officer who will consult with appropriate individuals to determine appropriate action. Should the corrective action impact the project or data quality, the SWQB Project Officer will alert the QAO. If it is discovered that monitoring methodologies must deviate from the approved QAPP, a revised QAPP must be approved before work can be continued. All problems and adjustments to the project plan will be documented in the project file and included in the final report.

C.2 Reports to Management

Quarterly reports will be submitted by Jan-Willem Jansens (Ecotone LP), to the SWQB Project Officer and will include progress of project and any available data. Printouts, status reports or special reports for SWQB or EPA will be prepared upon request. The WAP will be completed and accepted by the SWQB on August 31, 2022. The final report will be submitted to the SWQB Project Officer by Jan-Willem Jansens (Ecotone LP) by December 31, 2024. The SWQB Project Officer will be responsible for submitting the final project deliverables to EPA through their Grants Reporting Tracking System.

GROUP D: DATA VALIDATION AND USABILITY

D.1 Data Review, Verification and Validation

Data will be reviewed by Project Manager Jan-Willem Jansens (Ecotone LP) for erroneous data, incomplete data and transcription errors prior to demobilization from the field site. Data will be considered usable if the requirements of this QAPP were followed and the data is within acceptable range limits as defined under this QAPP. Data that appears incomplete or questionable for the parameter will be flagged for review. Flagged data will be discussed with the SWQB Project Officer to determine the potential cause and usability. If a reasonable justification for use of the data cannot be attained, those data will be not used in analysis and

implementation of activities listed under this QAPP unless the data can be recollected and assessed for usability.

Hydrogeologic assessment data will be reviewed by NM BGMR data manager for erroneous data, incomplete data and transcription errors on field notes. NM BGMR project manager will review resulting data for further verification and validation, as well as comparability with other datasets.

D.2 Verification and Validation Methods

The Project Manager Jan-Willem Jansens (Ecotone LP) with assistance from staff will ensure that valid and representative data are acquired through the actions stated in Section D1 of this QAPP. Data will be validated by the Watershed Protection Section of the Surface Water Quality Bureau prior to using the data for wetlands protection, policy, or public uses.

NM RAM data collected under this QAPP will be verified by the Surveyor (i.e., the data collector for NM RAM data) and Project Manager. The Surveyor and Project Manager will provide their initials where indicated on the Field Guide Worksheets for Montane Riverine Wetlands after ensuring there are no erroneous data, incomplete data and transcription errors. Results of the verification process for NM RAM data will be documented in the completed Field Guide Worksheets for each sampling area in the Lower Embudo Valley Springs and Wetlands Restoration Project area.

Data used for the STEPL modeling collected under this QAPP will be verified by the Surveyor (i.e., the project engineer or associates) and Project Manager. The Surveyor and Project Manager will both initial any field data sheet related to these monitoring techniques after ensuring there are no erroneous data, incomplete data and transcription errors.

Similarly, implementation monitoring data and photo monitoring meta data collected under this QAPP will be verified by the Surveyor (i.e., Ecotone, LP associates) and Project Manager. The Surveyor and Project Manager will both initial any field data sheet related to these monitoring techniques after ensuring there are no erroneous data, incomplete data and transcription errors.

The NM BGMR staff will perform verification and validation of hydrogeologic assessment data. The field team leader will perform a QC of field documentation at the completion of each day to ensure completeness of documentation. An NM BGMR technical staff person will review laboratory data to identify outliers and potential data concerns. The laboratory analyst who generates the analytical data will have the primary responsibility for the correctness and completeness of data. Each step of this verification and review process will involve the evaluation of data quality based on both the results of the QC data and the professional judgment of those conducting the review. This application of technical knowledge and experience to the evaluation of data is essential in ensuring that data of known quality is generated consistently. All data generated and produced will follow well-documented in-house protocols.

D.3 Reconciliation with User Requirements

The user requirement is a restatement of the data quality objective. The quality of the data will be adequate to provide a high level of confidence in determining whether the Lower Embudo Valley Springs and Wetlands Restoration Project is meeting the project goals, as stated in the approved scope of work.

If the project's results do not meet this requirement additional monitoring may be necessary to fill in data, which may include an extension of the monitoring period to measure effects that were not apparent during the project period. Additional funding from NMED may be required to accomplish the additional monitoring.

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Acknowledgement Statement

New Mexico Environment Department Surface Water Quality

Restoring Springs and Wetlands on State Trust Lands in the Lower Embudo Valley
Quality Assurance Project Plan Acknowledgement Statement

This is to acknowledge that I have received a copy (in hard copy or electronic format) of the "Restoring Springs and Wetlands in the Lower Embudo Valley" Quality Assurance Project Plan.

As indicated by my signature below, I understand and acknowledge that it is my responsibility to read, understand, become familiar with and comply with the information provided in the document to the best of my ability.

_____
Signature

_____
Name (Please Print)

_____
Date

Return to SWQB QAO Miguel Montoya

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APPENDIX A: Hydrogeologic Assessment Sample & Laboratory Procedures

APPENDIX B: Photo Monitoring Plan for Restoring Springs and Wetlands on State Trust Lands in the Lower Embudo Valley

See the photo monitoring procedure attached as Appendix B. Includes Photo Point Permanent Record.