GROUP A. PROJECT MANAGEMENT

A.1 Title and Approval Sheet

Quality Assurance Project Plan

Bluewater Creek Riparian Improvement Project near Bluewater, New Mexico

Submitted by:
New Mexico Environment Department

Surface Water Quality Bureau

APPROVAL SIGNATURES

Alan Klatt
Digitally signed by Alan Klatt
Date: 2021.09.09 12:06:07 -06'00'

Alan Klatt
Project Officer, SWQB — Date

Miguel Montoya
Digitally signed by Miguel Montoya
Date: 2021.09.09 13:08:18 -06'00'

Miguel Montoya
Quality Assurance Officer, SWQB — Date

Abraham Franklin
Digitally signed by Abraham Franklin
Date: 2021.09.09 12:55:01 -06'00'

Abraham Franklin
Program Manager, SWQB Watershed Protection Section — Date

Kyla Chandler
Digitally signed by Kyla Chandler
DN: cn=Kyla Chandler, o, ou, email=chandler.kyla@epa.gov, c=US
Date: 2021.10.07 16:46:14 -05'00'

Kyla Chandler
Environmental Protection Specialist, WDAS, EPA Region 6 — Date

NELLY SMITH
Digitally signed by NELLY SMITH
DN: c=US, o=U.S. Government, ou=Environmental Protection Agency, cn=NELLY SMITH, 0.9.2342.19200300.100.1.1=68001003655673
Date: 2021.10.19 14:31:03 -05'00'

10/19/21

Nelly Smith
Chief, State and Tribal Programs Section, WDAS, EPA Region 6 — Date

THIS PAGE INTENTIONALLY LEFT BLANK

A.2 Table of Contents

Contents

List of Tables and Figures

Acronyms

BWHR	Bluewater Heritage Ranch
DQO	Data Quality Objectives
EPA	United States Environmental Protection Agency
NMED	New Mexico Environment Department
QA	Quality Assurance
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
SOP	Standard Operating Procedures
SWQB	Surface Water Quality Bureau
TMDL	Total Maximum Daily Load

A3. Distribution List

Table 1. below contains the distribution list, project roles, and responsibilities of individuals involved for this project. The Quality Assurance Officer (QAO) will ensure that copies of this QAPP and any subsequent revisions are distributed to members who have signature authority to approve this QAPP. The Project Coordinator will ensure that copies of the approved QAPP and any subsequent revisions are distributed to all other project personnel listed in Table 1. 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 QAO for filing with the original approved QAPP.

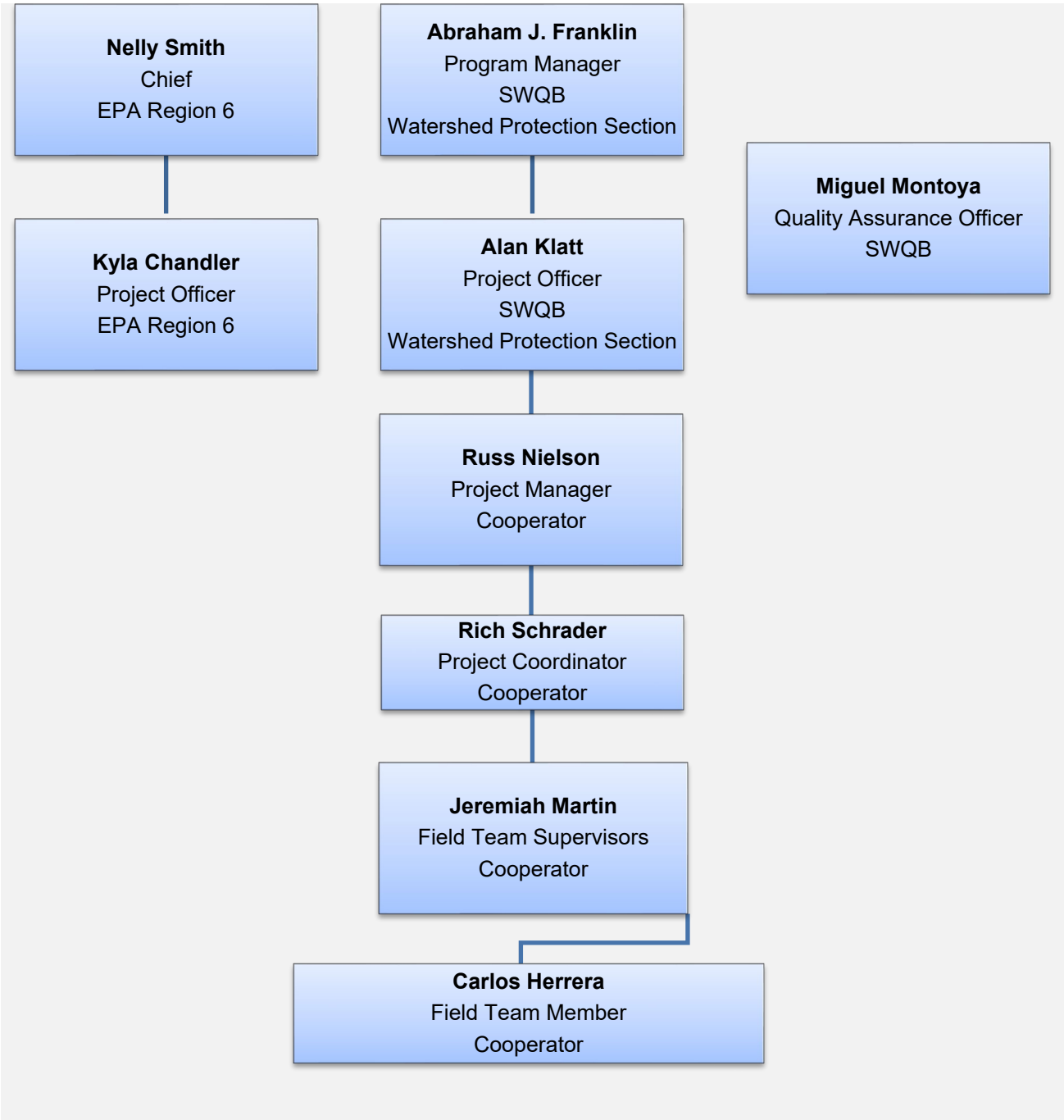
Table 1 Distribution list, Project Roles, and Responsibilities

Name	Organization	Title/Role	Responsibility	Contact Information
Abraham J. 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
Alan Klatt	SWQB	Project Officer	Preparing and revising QAPP, distribution of QAPP, project reporting, coordinating with contractors, oversight of data collection, and EPA reporting	505-819-9623 Alan.klatt@state.nm.us
Russ Nielson		Project Manager	Project oversight, data management, and submittal of quarterly reports	480-694-9918 russniel@gmail.com
Rich Schrader		Project Coordinator and Project Leader	Project design, construction oversight, and effectiveness monitoring (data collection, record keeping, and reports	505-660-7928 rich@riversource.net
Jeremiah Martin		Field Team Supervisor	Project construction and riparian improvements installation	505-692-4738, wildlandstewardship@gmail.com
Carlos Herrera		Field Team Member	Project support & data collection	505-231-4860, carlos@riversource.net
Kyla Chandler	EPA	Environmental Protection Specialist WQPD, Region 6	Reviewing and approving QAPP	214-665-2166 chandler.kyla@epa.gov
Nelly Smith	EPA	Chief, State and Tribal Programs Section WQPD, Region 6	Reviewing and approving QAPP	214-665-7109 smith.nelly@epa.gov

A.4 Project Organization

The SWQB Quality Management Plan (NMED/SWQB 2021) documents the independence of the QAO from this project. The QAO is responsible for maintaining the official approved QAPP, the QAPP will be stored in the QAQC folder on the SWQB server. Figure 1 presents the organizational structure for the "Bluewater Creek Riparian Improvement Project " referred to in this document as the "Project".

Figure 1. Organization Chart



A.5 Problem Definition /Background

Background

The purpose of this Quality Assurance Project Plan (QAPP) is to describe the quality assurance and control steps and the monitoring methodology for work that evaluates the effectiveness of the Bluewater Creek Riparian Improvement Project. The project aims to increase riparian canopy cover, reduce incision, and increase sinuosity in a 0.75 mile reach of Bluewater Creek. This will be done with grade controls, baffle deflectors, one-rock-dams, beaver dam analogs, and riparian vegetation planting. These actions will be taken to decrease temperature and reduce nitrogen loading in Bluewater Creek.

The Bluewater Creek Riparian Improvement Project (referred to as the "Project") is being managed by Russ Nielson, General Manager of Bluewater Heritage Ranch, who identified riparian restoration as a high priority action item for the Ranch and has already undertaken planting of hundreds of cottonwoods and willows in the area and also has not allowed grazing on the stream reach for many years. Despite the ranch's shift to progressive watershed management, the stream continues to experience channel incision, bank erosion and the diminishment of riparian plant communities. This project includes the installation of grade controls, baffle deflectors, one-rock-dams, beaver dam analogs, and riparian vegetation planting. These actions will decrease temperature and reduce nitrogen loading in Bluewater Creek.

The drainage area above the project is 39 m^2 or 103 km^2. The catchment size is 8 square miles for the sub-watershed that drains the area below the dam and occurs above the restoration reach.

Between 1890 and 1940, extensive logging using narrow-gauge railroad technology cut over much of the Bluewater watershed. Extensive grazing of livestock, uncontrolled fires, and some mining activity also occurred. Earthen dam building was started in the same location at the current dam in the late 1880s by descendants of the Nielson family who settled the area after initially starting in the Ramah area. Following logging by private enterprises, large portions of the watershed were sold to the USDA Forest Service in the early 1940s. Grazing, some logging, extensive road building, and increased recreational use continued in the watershed. https://www.ser-rrc.org/project/usa-new-mexico-restoration-of-bluewater-creek/. According to New Mexico Tech, the last time water spilled over the dam was in 1941 (https://geoinfo.nmt.edu/tour/state/bluewater_lake/home.html).

The dam failed catastrophically in 1909 according to the 2018 New Mexico State Hazard Mitigation Plan and potentially destroyed by explosives according to Russ Nielson who reports that an old-timer and neighbor told him once of catastrophic flood rushing down the valley and causing road and infrastructure damage along the way. No direct information about the integrity of the dam was found during a literature search. The Plan states that, "the region mapped as highly to extremely susceptible to collapsible soils, particularly in San Juan County, in northern McKinley County, and along the I-40 corridor in McKinley and Cibola counties. In San Juan and northern McKinely County, the extremely susceptible regions are associated with badlands, broad ephemeral streams, clay-rich sedimentary rocks and extensive eolian deposits. Along the I-40 corridor, high to extreme susceptibilities are found in alluvial fans coming off of the Zuni Mountains."

The history of dam building and failure in the area likely led to large debris flows coming through the canyon and spreading material over the alluvial fan where most of the project reach occurs. Irrigators have repeatedly re-channeled the Creek to the east towards the Village of Bluewater through the alluvial fan. Community members often mobilized labor and equipment to keep the channel clear and, in some cases, moving straight down the valley through the debris fan that would accumulate after flooding events. Russ Nielsen noted that the current dam was put in place in 1937 to finally stop the perennial flooding problem.

Objective

Bluewater Creek contributes significant surface and groundwater inputs to the Rio San Jose watershed downstream. The project will improve riparian habitat, reduce channel incision, and increase sinuosity of 0.7 miles of the Creek.

A.6 Project/Task Description

The Project Coordinator will draft a restoration design for the project with guidance and oversight by Craig Sponholtz of Watershed Artisans for review by the Project Manager and submittal to the SWQB Project Officer in October 2021. The QAPP preparation and submittal will happen in September. Once QAPP approvals are received, the Field Team supervisor and Field Staff will begin baseline data collection for development of project design and physical layout of the structure locations on the ground.

Description

The Project will utilize One Rock Dams, Baffles/deflectors, Beaver Dam Analogues (BDA), and cottonwood and willow plantings to accomplish the improvement objectives. Progress will be measured using baseline data collected before project restoration in comparison to post-restoration data towards meeting several measures of success described in the approved workplan:

1) Increase in canopy shading of surface water as indicator of the reduction in solar loading on the stream.

The Project Coordinator along with field staff will use a convex densiometer to take canopy measurement utilizing the Percent Canopy procedure described in SWQB SOP 5.0, Physical Habitat Measurements (NMED/SWQB 2019). The data collection for percent canopy will be completed in the restoration project reach where planting will occur or has previously occurred. The procedures described in SWQB SOP 5.0 for determining reach layout will be utilized during canopy data collection.

2) Increase in wetland vegetation by area and stream length

The Project Coordinator will use aerial imagery to identify and measure the area and extent of wetland vegetation. Wetland area will be measured by hand-drawing polygons on a computer GIS using a vegetation index that associates the spectral features of each major wetland vegetation type with the colors expressed in the drone imagery and as compared to groundtruthed imagery at the site with cameras and GPS units. For instance, the specific wetland community types such as Baltic rush (Juncus balticus) or coyote willow (Salix exigua) will have unique spectral signatures (colors) that will be classified

in the vegetation index which will be refined by expert field knowledge and groundtruthing which is described below. The Project Coordinator will collect the baseline vegetation data with aerial imagery from a drone, create a vegetation index with the major wetland types applying expert knowledge (empirical rules) and ancillary data from the groundtruthing to extract thematic features such as vegetation groups by spectral color (Yichun, X. 2008). The Project Coordinator will measure the wetland areas using the drone imagery and field observations to draw polygons and calculation total wetland area to then be compared to observations made in the same way in the fall 2022.

The groundtruthing will be conducted by subsampling a 800 foot length of stream (about 20% of the total channel length) on the ground with GPS with accuracy of +/- 12 feet. The data (vegetation identification) collected during groundtruthing using GPS will be compared to the data captured by drone imagery and analyzed against GIS vegetation layers and aerial photography, such as Google Earth. By using aerial photos (e.g. Google Earth) and aerial imagery captured by drone and the vegetation index for the site, River Source will be able to measure and compare wetland vegetation areas in fall 2021 and fall 2022 by using GIS to draw wetland area polygons and calculating areas.

3) Repeat photography and videography showing level of construction effort in improving riparian vegetation and increased wetland extent.

River Source will use repeat aerial imagery collected by drone in 2021 and 2022 and will also utilized repeat photography (photo-documentation). Photo-documentation using repeat photography will be completed at existing monitoring locations (Pictureposts-established and monumented in previous project) and will create new monumented locations for proposed planting areas and restoration locations. River Source field staff along with the Project Coordinator will go to each established photo-documentation location, take 9 photos, log the photos on a photo-log, and then upload to PicturePost webpages. River Source staff will set monuments in addition to the Pictureposts using rebar & PVC. River Source will repeat the photos from the same points, during the same season and will log using a data form.

4) Increase in beaver activity (signs of dams and active cuttings)

River Source will georeference the presence of historical and current / active beaver sign before and after the project construction. River Source field staff and the Project Coordinator will look for fresh cuttings of woody riparian shrubs and trees such as coyote willow to document current beaver activity along with active beaver dam construction. Both of these signs would indicate the presence and use of the Creek for beaver habitat. Beaver have been observed in the past at this reach of the Creek by Heritage Farm family and staff. River Source will use ESRI's Survey 123 application in conjunction with a walk through on both banks of the Creek to make observations in fall 2021 and fall 2022. Survey 123 is a proven tool for surveying natural resource conditions. River Source has created a file to show use of application for monitoring beaver sign. An example of the ESRI platform can be viewed at this site ~ https://arcg.is/0LPCLL0.

5) Increase in sinuosity

River Source will measure & map the longitudinal profile of the channel thalweg before and after the project construction. Sinuosity will be calculated by taking on the ground measurement of the thalweg distance in feet and dividing that number by the valley length distance measured by GIS calculation.

6) **Before/After/Upstream/Downstream study for water temperature showing a decrease in water temperature.**

An independent project will be conducted by with Daniel Guevara, who is the Effectiveness Monitoring Coordinator for the NMED SWQB. The data collection performed by Daniel Guevara is conducted under an approved Field Sampling Plan that is developed and approved yearly by WPS Program Manager and SWQB QAO, which is a requirement of the NMED SWQB QAPP for Water Quality Monitoring Programs. Data collection will utilized SWQB SOPs such as SOP 5.0, 6.3, 6.4 and 15.0, the protocols defined in NMED SWQB SOPs can be found at https://www.env.nm.gov/surface-water-quality/sop/. The data collected by Daniel for Effectiveness Monitoring will be used for conducting a study of the impact of the project on surface water temperatures using an ANCOVA analysis to detect changes of surface water temperature due implementation of Best Management Practices (BMPs) used for restoration.

Schedule

The design and monitoring work will be initiated upon the approval of this QAPP. Table 2 list project task, products, responsible party, and project timeline.

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

Task	Product	Responsible Party	Approximate State Date	Approximate Completion Date
Quality Assurance Project Plan	Approved QAPP	Rich Schrader, Russ Nielson, Alan Klatt	July 2021	September 2021
Pre-treatment/restoration fluvial geomorphology assessment	Cross sections, longitudinal profile, pebble counts, slope and flow	Rich Schrader, Carlos Herrera, Jeremiah Martin	September 2021	October 2021
Pre-treatment riparian vegetation monitoring	Aerial imagery, GPS field data collection, GIS area estimates	Rich Schrader, Carlos Herrera	September 2021	October 2021
Pre-treatment/restoration Surface water temperature data collection	Stream temperature	Daniel Guevara (NMED) (independent project),	On-going	Fall 2023
Develop restoration design	Restoration Design	Rich Schrader	September 2021	October 2021

Implementation of restoration design	Restoration implementation	Jeremiah Martin, Russ Nielson	November 2021	February 2022
Post-treatment fluvial geomorphology assessment	Cross sections, longitudinal profile, pebble count, slope and flow	Rich Schrader, Carlos Herrera	August 2022	October 2022
Post-treatment riparian vegetation monitoring	Aerial imagery, GPS field data collection, GIS area estimates	Rich Schrader, Carlos Herrera	August 2022	October 2022
Reporting to SWQB Project Officer	Biannually	Russ Nielson, Rich Schrader	October 2021	December 2022
Reporting to EPA	Quarterly and Final Report to EPA	Alan Klatt	December 2021	March 2023

Project Area

The project reach on Bluewater Creek occurs downstream of Bluewater Lake in the foothills of the Zuni Mountains in West-Central New Mexico.

Figure 2. Project Area Map

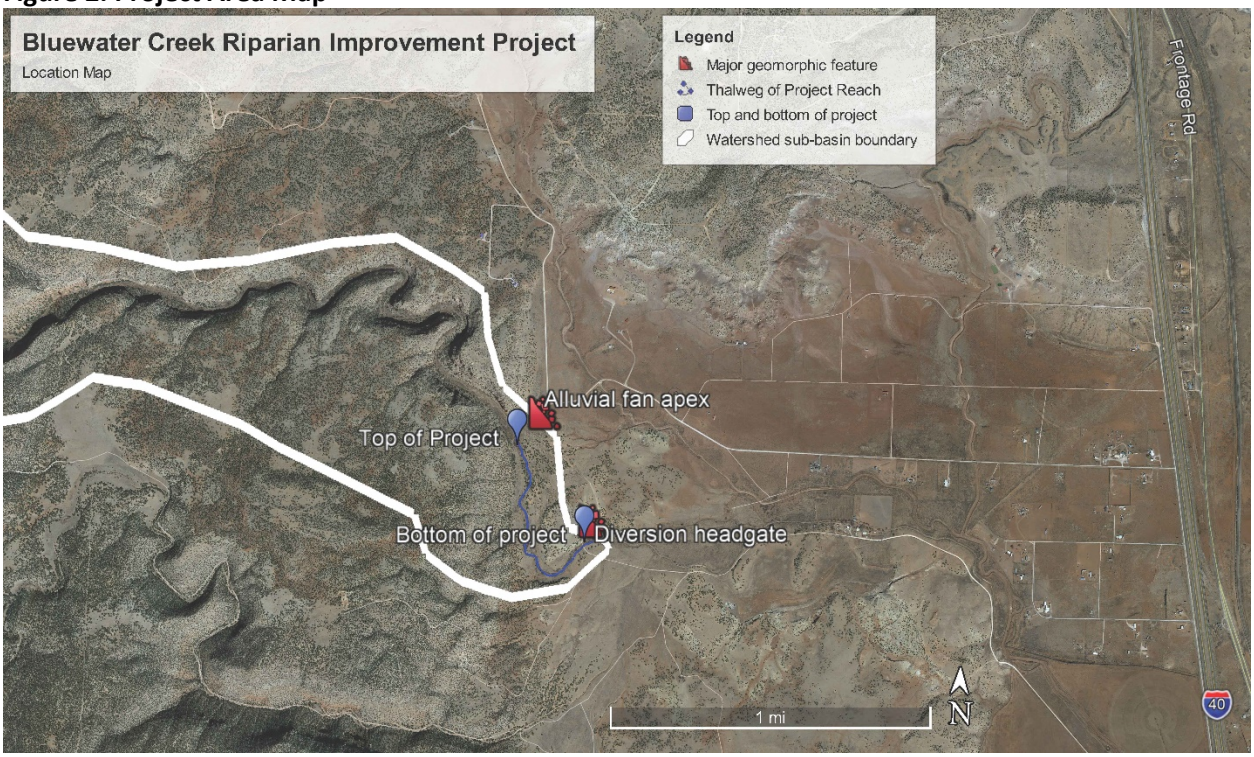
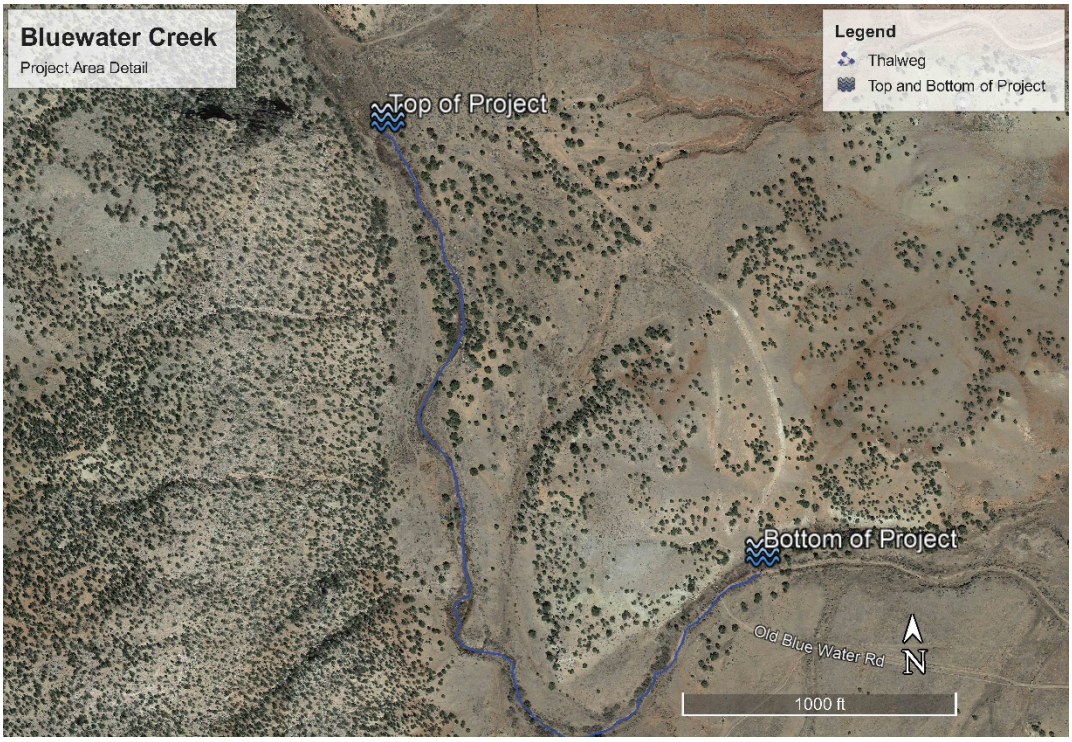


Figure 3. Project Area Detail



Monitoring Location Selection Criteria

The Ranch boundary is located at the top of the project, and a diversion headgate provides a hard and fixed location just downstream of the bottom of the project (see Figures 1 and 2). All the proposed treatment locations will be conducted in the project area as described above using BMPs listed in Table 4. Monitoring will be developed to satisfy both CWA Sections 319 and 404 requirements. The target reach begins on the Ranch boundary just downstream from the alluvial fan apex located at 35.290252 degrees north, -108.024362 degrees west (latitude, longitude) and at the downstream end at 35.286042 degrees north, -108.020417 degrees west. Linear stream distance is approximately 0.75 miles. Waterbody attributes for the stream reach located in the project area are listed in Table 3.

Table 3. Waterbody Attributes for the Project

Assessment Unit (AU	AU ID	WQS Citation	8-Digit HUC	AU IR Category
Bluewater Creek (Perennial prt R San Jose to Bluewater Rsvr)	NM-2107.A_00	20.6.4.109	13020207	4a

Restoration Activities

Table 4. Best Management Measures for Restoration and Rehabilitation Plan

BMPs	Purpose	Number of locations
Rock baffle	Grade control + increase sinuosity	8
Boulder cross-vane	Grade control	4
Beaver Dam Analogue	Grade control and water infiltration	3-4
One-rock dam	Grade Control and water infiltration	30
Rock sill	Grade control	1
Cottonwood & willow revegetation	Reduce incision & create shade for Creek water	100

A7. Quality Objectives and Criteria for Measurements

Question/Decision

The information gathered as part of the Bluewater Creek Riparian Improvement project will be used to:

1) Develop a restoration and rehabilitation plan; and
2) Monitor the effectiveness of BMP implementation and document changes in stream morphology.

The information gathered as part of the field assessment will be used in the development of a restoration and rehabilitation plan. Photo-documentation, pre and post-construction, will be used to determine BMP implementation effectiveness and to document changes in riparian vegetation and stream morphology in terms of the percentage of canopy shading the water, increase in wetland area, increase in stream sinuosity, and increase in beaver activity.

Data Quality Objective (DQO)

The quality of the data will be adequate to provide a high level of confidence in determining the effectiveness of the project in terms of the percentage of canopy shading the water, increase in wetland area, increase in stream sinuosity, and increase in beaver activity.

Data Quality Indicators

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

DQI	Determination Methodologies
Precision	Will be ensured by following the procedures identified in this QAPP and having two monitoring participants present during all data collection activities.
Bias	The basis for determining accuracy will be staff's expertise of the survey method for collecting data and ensuring the accuracy of the equipment being used is within the required range of a particular survey.
Accuracy	Location of Rosgen Level II, canopy cover, drone flight path and photo-documentation sites will have monument references (if with rebar, the monument will be covered with a white PVC pipe to protect people and wildlife) so that data is consistent and repeatable.
Representative	Canopy cover data will be distributed relatively evenly across the stream length to adequately represent the thermal stress conditions. Rosgen Level II surveys will be completed at stream restoration sites. Drone data collection will be completed in areas where plantings have occurred, or will occur, and where wetland vegetation is expected to increase due to project restoration.
Comparability	Monitoring locations at restoration implementation sites will be monumented for repeat sampling events to compare data. Methods listed under this QAPP for data collection are standardized and reproducible with the intent to be comparable to other studies.
Completeness	Surveys and methodologies will be completed in their entirety as identified in this QAPP.
Sensitivity	The sensitivity of metrics used will be analyzed during analysis and recalibration of data and instruments.

A.8 Special Training/Certification

The design and monitoring of the project will be primarily implemented by Rich Schrader of River Source which specializes in monitoring ecological restoration projects. Mr. Schrader along with his associates at River Source have over 23 years of experience in watershed assessment, stream and wetlands restoration, and rangeland monitoring in New Mexico.

Rich Schrader will be consulting with the Project Officer, Alan Klatt, along with Daniel Guevara who is

monitoring stream temperatures near the site under approved NMED protocols.

A.9 Documents and Records

The SWQB Project Officer will make copies of this approved QAPP and any subsequent revisions available to the Project Coordinator. The Project Coordinator will distribute to all individuals on the distribution list who do not have signature authority for approving the QAPP.

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 Project Coordinator to determine the need for revision.

Project documents include this QAPP, field notebooks, calibration records, validation and verification records, recorded field data, records of data in hard copy and in electronic form, and QC records. 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 a River Source computer or an external hard drive at the end of each day.

All digital project data will be kept in a project file on a Rich Schrader's work computer and on a separate cloud storage back up system (iDrive). Hard copy project documents will be kept in a project folder in a 3-ring binder at the River Source office. All hard copy documents will be digitized and stored on a River Source computer and backup cloud service (see Table 5). Copies of the data will be distributed by River Source to NMED SWQB Project Officer after each filed season, typically at the end of December.

Table 5. Data Records for the Project

Documents and Records	Type of Form	Storage Location	Field Sheet Used
QAPP	Electronic (.doc) & Hard Copy	Hard drive and on cloud storage (iDrive for Contractor)	EPA Requirements for Quality Assurance Project Plan. EPA QA/R-5.
Temperature data logger Calibration Records	Electronic (.doc) & Hard Copy	Hard drive and on cloud storage (iDrive for Contractor)	see Daniel Guevara
Temperature Data	Electronic (.xlsx) and HOBOware files	Hard drive and on cloud storage (iDrive for Contractor) and NMED SWQB network server	Thermograph deployment forms.
Temperature Effectiveness Analysis	Electronic Macro files (.xlsm)	Hard drive and on cloud storage (iDrive for Contractor) and NMED SWQB network server	ANCOVA & Thermograph Excel forms. Available from Dan Guevara, NMED SWQB.
Rosgen Level II Measurements (Cross-section, longitudinal profile, pebble count and plan-form measurements)	Electronic (.doc and .xlsx) & Hard Copy	Hard drive and on cloud storage (iDrive for Contractor)	River Stability Field Guide, and River Stability Forms and Worksheets Second Edition and field notebook.

Beaver Data	ESRI's Survey 123 application	Hard drive and on cloud storage (iDrive for Contractor	ESRI's Survey 123 application
Percent Canopy Cover	Hard Copy and Electronic (.xlsx)	Hard drive and on cloud storage (iDrive for Contractor)	Percent Canopy Cover Field Sheet located in Physical Habitat Field Forms.
Photo-documentation	Electronic (.jpg)	Hard drive and on cloud storage (iDrive for Contractor)	University of Oklahoma's Picturepost Method, logged on photo-log form
Aerial Imagery (drone)	Electronic (.JPG)	Hard drive and on cloud storage (iDrive for Contractor)	photo-log form
Verification and Validation Forms	Hard copy and electronic (.pdf)	Hard drive and on cloud storage (iDrive for Contractor	Verification and Validation Worksheet
Interim and Final Reports	Electronic (.doc) & Hard Copy	Hard drive and on cloud storage (iDrive for Contractor)	NA

GROUP B: DATA GENERATION AND ACQUISITION

B1. Sampling Plan

Rich Schrader (Project Coordinator) will travel to the site and conduct an initial project area-wide investigation that includes a field assessment with Rosgen Level II measurements (cross-section, longitudinal profile and plan-form measurements) over the course of one or several days. The Rosgen Level II data will utilize a laser level for the collection of measurements. Rosgen Level II monitoring is expected to occur once for the initial field assessment and again in Fall 2022. Rosgen Level II surveys conducted in Fall 2022 will be conducted after summer monsoon runoff to assess BMP effectiveness and document stream morphology changes. Visual inspection of the watershed restoration measures (BMPs) will take place immediately after construction and post-implementation of BMPs (Table 6). If major flood events occur, the Project Manager will alert the Project Officer and Project Coordinator, the Project Coordinator may conduct additional monitoring after these flood event as time permits and resources allow. Maintenance of BMPs may occur if any damage to structures or plantings is noticed during visual inspections. Visual inspections will be documented with photo-documentation monitoring at each of the BMPs that includes multiple photos of structure type and planting (if needed). In addition, River Source will observe and document canopy cover, beaver sign, and wetland area before and after the project. Photo-documentation locations will be monumented and/or recorded with GPS so that data is consistent and repeatable. All rebar monuments will be capped with a PVC pipe to visibly identify and reduce the potential hazard for wildlife and people. Table 6 provides monitoring specifics that include responsible party, type of monitoring, location and frequency.

Table 6. Project Monitoring Specifics

Responsible Party	Monitoring	Location	Frequency
River Source	Rosgen Level II: cross-section longitudinal profile, pebble count and plan-form measurements	Project Area	pre-implementation of BMPs October 2021 and Fall 2022. Post-implementation of BMPs Fall 2022
River Source	Beaver sign	Project area	October 2021, and Fall 2022
River Source	Canopy cover	Project area	October 2021, and Fall 2022

River Source	Photographic- documentation	Restoration locations including structures and plantings.	October 2021, and Fall 2022
River Source	Aerial Imagery by drone	Project Area. Restoration locations including structures and plantings.	October 2021, and Fall 2022
River Source	Wetland vegetation (groundtruthing)	see Elements A6 and B2.	October 2021 and Fall 2022

B2. Sampling Methods

Cross-section, longitudinal profile, pebble count and plan-form measurements will be conducted in accordance with Rosgen Level II survey using methods and protocols established in the River Stability Field Guide. The field guide and River Stability Forms and Worksheets Second Edition will be utilized to collected data. (Rosgen, Dave. 2014)

The presence of past and current beaver sign will be georeferenced through field observation conducted by a walkthrough of both stream banks in the project area while using ESRI's Survey 123 application in fall 2021 (before project restoration) and fall 2022 (after project restoration). River Source field staff and the Project Coordinator will look for cuttings of woody riparian shrubs and trees (e.g. coyote willow) to document current beaver activity along with any active beaver dam construction observed.

Percent canopy cover will be collected according to the protocols in SWQB SOP 5.0. *Physical Habitat Measurements*. All applicable sections of SWQB SOP 5.0 will be adhered to including determination of reach layout for the collection for percent canopy cover (NMED/SWQB 2019).

Photographic-documentation will be conducted using the protocols identified by the University of Oklahoma's Picturepost method found at https://picturepost.ou.edu/.

Aerial imagery will be captured by a DJI Phantom or Mavic drone. Drone will be flown with GPS location active, starting from a monumented home point, ensuring home point GPS coordinates has been recorded, and all firmware and flight map data has been updated with manufacturer's specifications. The data collection performed by pilot, using the drone, will be conducted as described in applicable sections of the *Unmanned aerial vehicles produce high-resolution, seasonally-relevant imagery for classifying wetland vegetation* (et al. J.V Marcaccio)

Data for quantification of wetland/riparian vegetation area will be collected by capturing drone imagery and calculating wetland vegetation area using GIS as well as subsampling on the ground on approximately 20% of the length of the stream with GPS line and polygon features. Approximately six major wetland community types occur in the existing floodplain (coyote willow, cattail, Baltic rush, cottonwood/Goodings willow trees) which will be classified in a vegetation index by their unique color signature on the ground and associated with colors found in the drone imagery. Wetland forbs, shrubs and trees found in the floodplain are easily identified by visible color signature combined with the groundtruthing to effectively associate on-the-ground vegetation cover to photos with the colors shown in aerial photos. In addition, upland vegetation patches consisting of mesic and xeric grasses and junipers are easily separated from the wetland vegetation patches and fringes (et al. J.V Marcaccio).

A valley length of a total minimum of 800 feet will be sampled in at least two locations to represent the diversity of wetland communities on the ground for groundtruthing of vegetation. GPS marking and recording of polygons will be conducted and 4 cross-sections will be established perpendicular to the grade of the Creek to measure across the entire riparian area. A decimal foot measuring tape will provide a continuous line intercept length to identify the dominant wetland community covering that transect (for instance, Coyote willow covers the transect from 2.1 feet to 38.2 feet, or 36.1 feet long section of the 110 foot long transect #3). In addition, a small portion of the adjacent upland vegetation will be identified on the 4 cross sections. The areas measured on the ground using the GPS will be calculated in square feet. The width of wetland vegetation will be calculated in linear feet. On the-ground-measurements will be compared to the GIS vegetation classification and drawing of polygons.

B3. Sample Handling Custody

Because there are no plans to collect samples for laboratory analysis, there are no handling requirements.

B4. Analytical Methods

Because there are no plans to collect samples, no analytical methods are needed.

B5. Quality Control

Quality control (QC) activities are technical activities, including data verification and validation procedures, that measure the attributes and performance of a process, item or service against a defined standard performed on a routine basis to quantify the inherent variability of any environmental data measurement activity. The purpose of implementing QC activities is to reduce variability and uncertainty in the decision-making process. Additionally, the results obtained from the QC analysis, or data quality assessment, may identify areas where the variability can be reduced or eliminated in future data collection efforts, thereby improving the overall quality of the project. Quality Control mechanisms are implemented as described under the Quality Objectives and Criteria for Measurement Data as well as the SWQB SOPs identified under this QAPP.

The criteria accepting or rejecting data results produced by GPS and line groundtruthing is -/+ 30% relative percent difference (RPD) as calculated by:

$$RPD = \frac{|R1 - R2|}{\left(\frac{R1 + R2}{2}\right)} \times 100,$$

where

$R1$ is sample 1, and

$R2$ is sample 2.

If the RPD is greater than 30%, the project will use the Greenline vegetation monitoring method (Windward, 2000) for wetland area and extent measurements.

Additional Quality Control includes the professional expertise of the personnel working under this project. Additional QC activities include:

- Data will be recorded on forms that identify the location, date, and description of observations and recommendations for all data collection including Rosgen Level II

measurements and photo- documentation.

- River Source personnel will be familiar with the general principles of photo-documentation, Rosgen Level II surveying and specific requirements of this QAPP. Site maps, flagging, and GPS locations will ensure monitoring sites are relocated.
- River Source personnel will be knowledgeable of the monitoring protocol for surveying and will be able to identify changes to, or caused by, installed BMPs.
- The data will be recorded on specialized data sheets and transferred to electronic spreadsheets for analysis.
- Annual reports will be developed after each monitoring season by River Source.
- The field data sheets, inspection forms and reports will be archived in River Source offices and sent to SWQB Project Officer.

B6. Instrument/Equipment Testing, Inspection and Maintenance

Rich Schrader and Carlos Herrera of River Source are responsible for the inspecting of equipment and supplies prior to data collection. All field equipment will be inspected before each monitoring event. All instruments and equipment will be tested, inspected and maintained in accordance with the manufacturer's specifications as included in the associated instrument/equipment manual. The equipment is listed in Table 7.

Table 7. Instruments and Equipment to be Tested and Inspected

Camera	DJI Phantom Drone	Mavic Drone
Video lens	Computer	GPS
Laser Level and Rod	Convex Densiometer	Compass

B7. Instrument/Equipment Calibration and Frequency

The calibration of the laser level will be verified according to the manufacturer’s specifications.

The drones will only be flown when with GPS location is active, a home point has been recorded, and all firmware and flight map data has been updated with manufacturer's specifications.

B8. Inspection/Acceptance for Supplies and Consumables

If there is reasonable evidence that the laser level, GPS, drone or camera has been damaged or is not up to manufacture specification, the equipment will not be used for the Project. There are no other supplies or consumables that could affect the quality of data related to this project.

The DJI drones (Phantom 4 and Mavic 2 Pro) will be inspected for damage and fully charged before each flight. In addition, flight restriction maps will be updated before each flight.

B9. Non-Direct Measurements

The aerial imagery (i.e. Google Earth) showing vegetation cover in the riparian zone is considered a non-direct measurement. Google Earth remote sensing imagery, as well as the latest Global Image Database (GID) imagery and historical data layers will be used for comparison and to understand changes over time. Google Earth is an acceptable application used by many state and federal agencies and utilized their own QAQC protocols in data mapping.

Temperature data collected by the NMED SWQB Effectiveness Monitoring Coordinator in 2019, 2021 and 2022 will be used to determine and detect changes in temperature using an ANCOVA analysis. The data collection performed by Daniel Guevara is conducted under an approved Field Sampling Plan that is developed and approved yearly by WPS Program Manager and SWQB QAO, which is a requirement of the NMED SWQB QAPP for Water Quality Monitoring Programs. Data collection will utilize SWQB SOPs such as SOP 5.0, 6.3, 6.4 and 15.0, the protocols defined in NMED SWQB SOPs can be found at https://www.env.nm.gov/surface-water-quality/sop/. The data collected by the Effectiveness Monitoring Coordinator for Effectiveness Monitoring will be used for studying the project's impact on surface water temperatures. The study uses an ANCOVA analysis to detect changes of surface water temperature due to implementation of BMPs used for restoration.

B10. Data Management

Rich Schrader and Carlos Herrera will be responsible for data management. All data will be converted to electronic format, stored and backed up by River Source, and sent to SWQB Project Officer when associated project tasks and deliverables are completed. Computer hard drives are backed up daily. Hard copies of field sheets will be maintained in a project binder organized by assessment and date and will be stored in a filing cabinet in the office of River Source and SWQB.

Upon receiving data, the SWQB Project Officer will store data in a project-specific folder within the WPS folders on the SWQB network drive. 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

C1. Assessment and Response Actions

The 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.

C2. Reports to Management

Annual reports will be submitted by River Source 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 final report will be submitted to the SWQB Project Officer by an estimated date of January 2023. 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

D1. Data Review, Verification and Validation

Data will be reviewed by the Rich Schrader and Carlos Herrera 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.

D2. Validation and Verification Methods

Rich Schrader will ensure that valid and representative data are acquired. Verification and validation of data will occur daily after data collection. A verification and validation checklist will be used to document the verification and validation process. In the event questionable data are found, the SWQB Project Officer will notified and will consult appropriate personnel to determine the validity of the data. Results of the verification and validation process will be included in the final reports.

D3. 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 Bluewater Riparian Improvement Project is meeting the project goals, as stated in the approved scope of work.

If the project's results do not meet this requirement, then 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.

References:

Marcaccio, James V., Markle Chantel and Chow-Fraser, Patricia, 2015. Unmanned Aerial Vehicles Produce High Resolution, Seasonally Relevant Imagery for Classifying Wetland Vegetation. International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Volume XL-1/W4, 2015. International Conference on Unmanned Aerial Vehicles in Geomatics, Toronto, Canada. https://www.researchgate.net/publication/281580943_UNMANNED_AERIAL_VEHICLES_PRODUCE_HIGH-RESOLUTION_SEASONALLY-RELEVANT_IMAGERY_FOR_CLASSIFYING_WETLAND_VEGETATION

Rosgen, Dave. 2014. River Stability Field Guide, and River Stability Forms and Worksheets Second Edition. Wildland Hydrology, Fort Collins, CO.

New Mexico Environment Department Surface Water Quality Bureau (NMED/SWQB). Standard Operating Procedures. https://www.env.nm.gov/surface-water-quality/sop/

New Mexico Environment Department Surface Water Quality Bureau (NMED/SWQB). 2019. Standard Operating Procedure (SOP) 5.0 for Physical Habitat Measurements. Available at: https://www.env.nm.gov/wp-content/uploads/sites/25/2017/06/5.0-Physical-Habitat-SOP-20190917b-approved.pdf

New Mexico Environment Department Surface Water Quality Bureau (NMED/SWQB). Thermograph SOP 6.3
https://www.env.nm.gov/wp-content/uploads/sites/25/2017/06/6.3-SOP-Thermograph-20190610i-approved.pdf

Yichun, X. 2008. Remote sensing imagery in vegetation mapping: a review. *Journal of Plant Ecology*, Volume 1, Issue 1, Pages 9–23. https://doi.org/10.1093/jpe/rtm005

New Mexico Environment Department Surface Water Quality Bureau (NMED/SWQB). 2018. Quality Assurance Project Plan for Water Quality Management Programs. Available at: New Mexico https://www.env.nm.gov/surface-water-quality/protocols-and-planning/

New Mexico Environment Department Surface Water Quality Bureau (NMED/SWQB). 2020-2022. State of New Mexico Clean Water Act 303 § 3030(d)/305(b) Integrated Report and List. Available at: https://www.env.nm.gov/surface-water-quality/303d-305b/

New Mexico Environment Department Surface Water Quality Bureau (NMED/SWQB). 2021. Quality Management Plan for Environmental Data Operations. Available at: https://www.env.nm.gov/surface-water-quality/protocols-and-planning/

Winward, Alma H. 2000. **Monitoring the vegetation resources in riparian areas**. Gen. Tech. Rep. RMRSGTR- 47. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 49 p. https://www.fs.fed.us/rm/pubs/rmrs_gtr047.pdf

Acknowledgement Statement

New Mexico Environment Department Surface Water Quality Bureau

Bluewater Creek Riparian Improvement Project

Quality Assurance Project Plan Acknowledgement Statement

This is to acknowledge that I have received a copy (in hard copy or electronic format) of the Bluewater Creek Riparian Improvement Project 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 or Electronic Signature (e-certified accepted)

_____
Name (Please Print)

_____
Date

Return to SWQB QAO Miguel Montoya

Percent Canopy Field Form

Data Entry/Upload (date/initials): _____ Verified by (date/initials): _____

Percent Canopy Cover Field Form

Station ID: _____ **DATE:** _____

Observer _____ **Recorder** _____

Transect -->>	A	B	C	D	E
LEW – Facing Left Bank					
CenUp – center looking u/s					
CenL – center looking at LEW					
CenDwn – center looking d/s					
CenR – center looking at REW					
REW – Facing Right Bank					
TRANSECT TOTAL					

Average % Canopy Cover for reach

= SUM of all transect totals / total possible Intersection points = _____

	SMALL STREAMS (average wetted width less than or equal to 4.0 m)	**LARGE STREAMS** (average wetted width greater than 4.0 m)
Reach Layout		
Canopy Cover	**5 Lettered Transects spaced 40 meters apart** Example: Average wetted width = 3m Distance between transects = 40m Total Reach Length = 160m Transect A (1st transect) = 0 meters Transect E (5th transect) = 160 meters	**5 Lettered Transects at 10X average wetted width apart** Example: Average wetted width = 6m Distance between transects = 60m Total Reach Length = 240m Transect A (1st transect) = 0 meters Transect E (5th transect) = 240 meters

SWQB SOP for Physical Habitat Measurements can be located at: https://www.env.nm.gov/surface-water-quality/sop/

Photo-Log Form

Photo-Documentation Form

Photo Point # and Site Location	Northing (GPS location)	Easting (GPS location)	Description	Comments

Data Verification and Validation Worksheets

Type of Data, Name and Date of Personnel Collecting Data	Verification of Complete Record [Y/N]	Instrument in working order [Y/N]	Checked for anomalous data [Y/N]	Validated by [name of reviewer]	Validated on [Date]