



JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.

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February 20th, 2020

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Mark Apel
Cochise County Engineering & Natural Resources
1415 Melody Lane
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RE: Proposal – Palominas Year 6 and
Ephemeral Streamflow and Groundwater Monitoring Year 4

Dear Mark:

Per your request, JE Fuller/Hydrology & Geomorphology (JE Fuller) is providing you with this proposal for the referenced services. This proposal is based on the Scope of Work (SOW) attached as Attachment A. Note that our current contract for Palominas Monitoring and Ephemeral Streamflow & Groundwater Monitoring ends March 31, 2020.

The following items are attached:

- A. Cochise County Scope of Work, Palominas Recharge and Flood Control Facility Year 6, and Ephemeral Streamflow and Groundwater Monitoring Year 4, dated February 18, 2020 (hereafter referred to as the SOW);
- B. Summary Cost Sheet for the Palominas Year 6 and Ephemeral Streamflow and Groundwater Monitoring Year 4 SOW;
- C. JE Fuller cost estimate; and,
- D. GeoSystems Analysis, Inc. (GSA) cost estimate.

Noteable cost increases from last year are due to the following: stabilization of sensors using deeper installations and securing of Palominas facility sensors in anticipation of public access to the site. JE Fuller appreciates the opportunity to provide you with this proposal. You may indicate your acceptance of this proposal and provide notice to proceed by forwarding the applicable Professional Services Agreement (PSA) for signature. As always, please feel free to contact me by email (cyrus@jefuller.com) or by phone at 520-623-3112 if you have any questions regarding this proposal.

Sincerely,
JE Fuller/Hydrology & Geomorphology, Inc.

Cyrus D. Miller, P.E., CFM
Vice President



ATTACHMENT A
Cochise County, Arizona
Palominas Recharge and Flood Control
Facility Monitoring Year 6 and Ephemeral
Streamflow and Groundwater Monitoring
Year 4
Scope of Work
Dated February 18, 2020



COCHISE COUNTY, ARIZONA
SCOPE OF WORK (SOW)
PALOMINAS RECHARGE AND FLOOD CONTROL FACILITY MONITORING YEAR 6
EPHEMERAL STREAMFLOW AND GROUNDWATER MONITORING YEAR 4
Date: February 18, 2020

Introduction and Background

With the successful July, 2014 construction of the Palominas Flood Control and Recharge Facility on the County-owned parcel and downstream channel, the pilot project entered the operations and monitoring phase of its service life. Instrumentation of the facility monitored since installation has led to conclusions regarding the amount of stormwater recharged, the relative effectiveness of technologies used, management practices, etc. Although the system was designed to minimize erosion, sediment transport and sediment deposition, periodic inspection and maintenance will be required. Program components that will be critical to the continued successful future operation of this facility are: continued monitoring/ analysis and reporting of the system inflow/outflow data, inspection, and maintenance.

JE Fuller along with sub-consultant GeoSystems Analysis, Inc. (GSA) who designed and installed the Palominas facility monitoring program, have provided monitoring data collection, retrieval, and analysis under contract to the County beginning with the July, 2014 completion of construction. The current contract (PSA 19-33-HFP-01) specifies a monitoring period ending December 31, 2019. Monitoring of the facility for a period of five years after construction was one stated expectation of the project outcomes, identified during application for grant funding from the Walton Family Foundation (WFF), which initiated the project work efforts undertaken to-date. Five years from the completion of facility construction occurred in mid-July, 2019.

Following the 2016 installation of a network of surface flow monitoring sensor stations along ephemeral watercourses tributary to the Upper San Pedro River at or near project site locations, Cochise County (County) will maintain that network and support the acquisition and processing of data provided by the sensors during the fourth year of monitoring activities. Measurements of groundwater depths at selected locations are also included in this Scope of Work (SOW).

The goal of establishing this network of monitoring stations is to estimate the natural surface water runoff flow depths, rates and volumes that are conveyed by the tributary watercourses on an annual basis in order to facilitate understanding of the rainfall/runoff characteristics of the subject watersheds, guiding improvements in potential future aquifer recharge facility design. Another goal of the network is to document groundwater depth changes over time at selected locations at or near project sites.

Attachment A

The data collected by this network of surface- and groundwater monitoring stations will provide the context within which future aquifer recharge projects will be conceptualized, designed, constructed and operated. It is intended that the results of these monitoring efforts will provide a comprehensive pre-project monitoring program to continue following project development, allowing for direct measurement of the effects of future recharge project implementation. It is also intended that the results of these monitoring efforts will be used to guide and refine modeling practices for estimating rainfall/runoff responses for future projects.

Project deliverables will include maintenance/replacement of monitoring equipment at the selected stations, topographic survey of the monitoring stations (if required), data collection and analysis, and reporting.

Consultants will perform the tasks listed in the SOW. The SOW includes participation in the regularly-scheduled quarterly Cochise County Recharge Network (CCRN) Technical Team meetings for a calendar year following contract award. Contract administration will be conducted by the County.

It is understood that the intent of this monitoring network is to estimate annual runoff flow volumes, typically reporting to the stations under low-stage conditions. These monitoring installations are considered temporary, and damage to the installed stations may occur if the sites are subjected to large (high-stage) flows.

Note that this SOW relates to a monitoring period covering calendar year 2020. Also note that this SOW follows the previous year's format by combining efforts previously separated into two contracts: Palominas Monitoring and Ephemeral Streamflow and Groundwater Monitoring. Descriptions of proposed work for each task are provided in the Scope of Work Outline, below.

Scope of Work Outline

The tasks listed below are the identified elements to this SOW. Palominas Monitoring tasks are denoted by a 'B' prefix, and Ephemeral Streamflow/Groundwater Monitoring activities are denoted by a 'C' prefix.

Task A1: Project Management

The Consultant shall:

- Identify a project manager who will be responsible for managing the budget, schedule, and deliverables throughout the project, including the management of budget, schedule, and deliverables of any Subconsultants, as well as report directly to the County's project manager;
- Identify all Subconsultants who will be involved in the project;
- Schedule and coordinate field work, including equipment installation, data collection, and periodic data downloads;

Attachment A

- Participate in and lead conference calls/meetings for the duration of the contract, including the regularly-scheduled quarterly Cochise Conservation and Recharge Network (CCRN) Technical Team Meetings (6 meetings assumed);
- Assign roles and communication system for Consultant and Subconsultant project team members; and
- Identify key stakeholders groups, contacts for each group, and timing for project participation with assistance from the Project Team.

Deliverable 1: Monthly Reports and Invoices and Quarterly Conference Calls/Meetings

Task B: Palominas Monitoring

Task B1: Palominas Monitoring System Data Collection and Management

Dataloggers at the Palominas recharge facility record sensor measurements of groundwater elevation (4-hour intervals); basin water level elevations (15-minute intervals); drywell and infiltration trench water level elevations (15-minute intervals); and soil moisture content in one vadose zone borehole (4-hour intervals). Three rain gauges record total precipitation and average temperature precipitation on 15-minute intervals.

USDA-ARS staff will download data quarterly during the monitoring period (4 events from January to December 2020). One data download site visit is budgeted for staff to allow for concurrent maintenance and calibration of monitoring equipment, as needed (Task B2). Data will be checked and processed at least quarterly. Spreadsheet processing will include calibrations, corrections, and time-series plotting of sensor measurements, and modeled estimates of stormwater capture and groundwater recharge. The monitoring period ends December 31, 2020.

Assumptions include:

- 2 field days per data download trip (1 person)
- 2 field days to troubleshoot and replace datalogger equipment as needed in 2020 (1 person)
- One field day for preventative maintenance to replace stilling well end caps to reduce the likelihood of vandalism
- USDA-ARS will download data from the Palominas facility on a quarterly basis

Task B2: Palominas Monitoring System Maintenance

Monitoring station maintenance will consist of up to two site visits, as necessary, to troubleshoot and fix any problems. To the extent practicable, maintenance visits will be scheduled together with data downloading visits. For budgeting purposes, and because equipment is now six years old, \$3,500 for instrument replacement during the annual monitoring period is estimated.

Task B3: Palominas Data Analysis and Annual Report

Data analysis will include estimates of precipitation, evaporation, basin-specific infiltration volumes using the mass balance and field-based approaches, duration of ponding, water flow between basins, recharge enhancement feature infiltration volumes, groundwater elevations and gradients, and soil moisture trends at the Detention Basin.

A 2020 calendar year annual report will be provided by March 31, 2021 (**Deliverables 2 and 3**). Preliminary tabular data summaries will be provided as requested by CCRN members following any of the quarterly monitoring data downloads.

Task C: Ephemeral Streamflow and Groundwater Monitoring

Task C1: Survey of Monitored Channel Reaches/Stations

Ephemeral streamflow monitoring stations installed during the first year of monitoring activities were surveyed using real-time kinematic (RTK) satellite positioning during installation. Stream flow events have the potential to alter cross section geometry, presenting the need to update the cross section geometry used in the analyses. Each sensor location will be visually assessed for changes since installation/survey to evaluate the need for re-survey. Where re-survey is warranted, the sensor locations will be re-surveyed using RTK.

Information gathered during site surveys will be used to modify monitoring sensor placement locations as needed, and to generate data necessary for input into the CSA2SAC computer model, the HEC-RAS files, and the roadway crossing analyses.

Task C2: Ephemeral Streamflow and Groundwater Monitoring and Reporting

Task C2a: Quarterly and Mid-Monsoon Data Downloads

Data will be manually downloaded from all monitoring equipment at Bella Vista, Riverstone, Horseshow Draw and Palominas watershed five times during the annual monitoring period. Also included is download of pressure transducer data installed at the Babocomari River groundwater well installed on The Nature Conservancy (TNC) property, twice during the monitoring period. All pressure transducers, rain gauges, and the surface water imagery stations will be assessed for functionality, battery life, and sensor and clock drift. Data trends will be examined in the field to assure data quality, and any necessary adjustments will be made. Precipitation data from on-site rain gages will also be downloaded during the data downloads.

Five data download visits (March 2020, June 2020, August 2020, October 2020, and January 2021) are assumed with one staff for two days each visit. Two downloads are assumed for the TNC Babocomari River well site, due to vehicular access conditions.

Task C2b: Preliminary Equipment Maintenance Visit

Following the installation and operation of ephemeral streamflow sensors at Coyote Wash (CY-1), Carr Canyon (CC-1) and Schoolhouse Wash (MV-1), those sites have experienced frequent damage from flow events, leading to data loss and increased maintenance costs from the need to re-establish the sensor installations. A greater degree of stabilization was achieved at the CY-2 station by digging deeper installations using a backhoe. Assuming the County provides backhoe and operator services, the CY-1, CC-1, and MV-1 stations will be stabilized by digging 6-foot deep installation pipes. Also included is sediment removal from the Horseshoe Draw well using rented reclaim pump from Geotech. This task assumes one staff for one day to complete the work.

Task C2c: Equipment Maintenance

Flow events at the sensor stations may create the need to routinely clear vegetation and other debris from the sensors in order to allow for accurate measurement readings. Minor debris removal will occur coincidentally with the data downloads. Large flow events have the potential to scour channel bottoms and erode channel banks, which may necessitate adjustments to sensor installation locations and depths, as well as re-survey of channel cross sections and characteristics (roughness, uniformity, etc). Two additional site visits shall be assumed to allow for such maintenance, as changes may not be evident until data has been processed and analyzed.

Task C2d: Data Processing and Analysis

Data from the fourth year monitoring period at all CSA stations will be analyzed following methods provided in Smith et al (2010), and using HEC-RAS, depending on the station. Data for individual runoff events will be pre-processed and formatted as necessary for input into the SAMDC program developed by Trent University or HEC-RAS. Output files provide instantaneous stream discharge estimates which will be used to develop complete event hydrographs of discharge.

Data from the fourth year of monitoring activities at roadway crossing stations will be analyzed following accepted engineering methods provided by the FHWA. At roadway crossing stations (Palominas watershed), culvert and/or roadway overtopping rating curves/tables will be generated to provide stage-discharge relationships to estimate flow volumes.

Data collected at the stock pond installations within the Riverstone property will be analyzed using the County's 2-foot contour resolution mapping, in order to develop a stage/storage relationship to translate recorded depths to volumes. The Ramsey drop structure data will be analyzed through the use of a broad-crested weir rating, to translate recorded flow depths to volumes.

Task C2e: Reporting-Ephemeral Streamflow and Groundwater Monitoring

Following analysis of monitoring data, an annual report will be generated which summarizes project findings. The following metrics will be calculated for each of the monitoring stations:

- Complete event hydrographs of discharge
- Total annual and individual event flow volumes (acre-feet)
- Peak channel discharge (cfs)
- Event flow durations (hours)

Data from the surface water imagery station will be summarized to provide estimates of water depth and extent during flow events.

Groundwater data for the annual monitoring period will be summarized in a data memo, and provided to Cochise County and The Nature Conservancy in support of development of the Walton Family Foundation's Groundwater Metric. This Memo will also be included in the Task C2e Annual Report.

Task C2f: Annual Results Presentation

Following report submittal, a meeting will be held with the CCRN technical team to present results for Palominas, Ephemeral Streamflow and Groundwater Monitoring.

Deliverable 2: A Draft Annual Monitoring Report will be submitted to the project team at the end of the one year monitoring period. All project activities will be clearly documented, including data interpretation and analysis. All associated data will be provided in electronic format, as an appendix to the draft and final reports.

Deliverable 3: A Final Annual Monitoring Report will be submitted within one month of receipt of comments from the project team.

Schedule

It is anticipated that the contract will be awarded in February 2020 in order to provide a monitoring period continuous from the end of the previous year monitoring period. The Consultant shall work closely with the County's project manager to develop a schedule for review and approval by the Project Team within 10 days of contract award.

Manual data downloads (Task C2a) will occur during March 2020, June 2020, August 2020, September 2020, and January 2021). All reporting for this monitoring project will be completed before March 2021.



ATTACHMENT B
Summary Cost Sheet for the
Monitoring SOW



PROJ: Cochise County/Ephemeral Streamflow and Groundwater Monitoring Year 3 and Palominas Monitoring Year 5 Project
 DETAIL: Total Project Cost Calculation
 DATE: January 29, 2020
 Prepared by: JE Fuller/Hydrology & Geomorphology (JE Fuller)

Task Key:
 A: Project Management
 B: Palominas Facility
 C: Ephemeral Streamflow/
 Groundwater

ATTACHMENT B - Summary Cost Sheet for the Palominas, Ephemeral Streamflow and Groundwater Monitoring SOW

Task	Sub-Task	Title	Deliverable (see SOW for task details)	Costs		
				JE Fuller	GSA	TOTAL
A	1	Project Management	Deliverable 1: Monthly Reports and Invoices and Quarterly Meetings/Conference Calls	\$11,700	\$9,398	\$21,098
B	1	Monitoring System Data Collection and Management	Deliverables 2 and 3: See Below	\$280	\$5,595	\$5,875
	2	Monitoring System Maintenance		\$600	\$12,007	\$12,607
	3	Data Analysis and Annual Report		\$1,212	\$15,041	\$16,253
C	1	Survey of Monitored Channel Reaches/Stations	-	\$6,480	\$0	\$6,480
	2a	Quarterly & Mid-Monsoon Data Downloads	Deliverables 2 and 3: A Draft Annual Monitoring Report will be submitted to the project team at the end of the one year monitoring period. All project activities will be clearly documented, including data interpretation and analysis. All associated data will be provided in electronic format, as an appendix to the draft and final reports. (Deliverable 2) A Final Annual Monitoring Report will be submitted within one month of receipt of comments from the project team. (Deliverable 3)	\$844	\$16,878	\$17,722
	2b	Preliminary Maintenance Visit		\$346	\$6,928	\$7,274
	2c	Equipment Maintenance		\$1,537	\$10,349	\$11,886
	2d	Data Processing and Analysis		\$9,382	\$9,234	\$18,616
	2e	Reporting-Ephemeral Streamflow and Groundwater Monitoring		\$3,368	\$6,768	\$10,136
	2f	Annual Results Presentation		\$1,097	\$1,547	\$2,644
TOTALS				\$36,847	\$93,745	\$130,592

Notes:
 5.00% Subconsultant markup included in JE Fuller Cost
 All fee estimates are approximate.
 The total fee is a not-to-exceed (NTE) amount and individual task fees may vary within the total NTE.
 Where needed tasks may be performed concurrently or out of the sequence indicated above.



ATTACHMENT C **JE Fuller Fee Estimate**



PROJ: Cochise County/Ephemeral Streamflow and Groundwater Monitoring Year 3 and Palominas Monitoring Year 5 Project
 DETAIL: JE Fuller Cost Calculation
 DATE: January 29, 2020
 Prepared by: JE Fuller/Hydrology & Geomorphology (JE Fuller)

Task Key:
 A: Project Management
 B: Palominas Facility
 C: Ephemeral Streamflow/
 Groundwater

ATTACHMENT C - JE Fuller Cost Sheet for the Palominas, Ephemeral Streamflow and Groundwater Monitoring SOW

Task	Sub-Task	Title	Deliverable (see SOW for task details)	JE Fuller Hours		JE Fuller Labor Cost	JE Fuller Direct Costs	JE Fuller Total Cost
				PM II	PE II			
				\$135.00	\$115.00			
A	1	Project Management	Deliverable 1: Monthly Reports and Invoices and Quarterly Meetings/Conference Calls	6	88	\$10,930	\$300	\$11,230
B	1	Monitoring System Data Collection and Management	Deliverables 2 and 3: See Below	0	0	\$0	\$0	\$0
	2	Monitoring System Maintenance		0	0	\$0	\$0	\$0
	3	Data Analysis and Annual Report		0	4	\$460	\$0	\$460
C	1	Survey of Monitored Channel Reaches/Stations	-	0	52	\$5,980	\$500	\$6,480
	2a	Quarterly & Mid-Monsoon Data Downloads	Deliverables 2 and 3: A Draft Annual Monitoring Report will be submitted to the project team at the end of the one year monitoring period. All project activities will be clearly documented, including data interpretation and analysis. All associated data will be provided in electronic format, as an appendix to the draft and final reports. (Deliverable 2) A Final Annual Monitoring Report will be submitted within one month of receipt of comments from the project team. (Deliverable 3)	0	0	\$0	\$0	\$0
	2b	Preliminary Maintenance Visit		0	0	\$0	\$0	\$0
	2c	Equipment Maintenance		0	8	\$920	\$100	\$1,020
	2d	Data Processing and Analysis		4	72	\$8,820	\$100	\$8,920
	2e	Reporting-Ephemeral Streamflow and Groundwater Monitoring		2	24	\$3,030	\$0	\$3,030
	2f	Annual Results Presentation		0	8	\$920	\$100	\$1,020
TOTALS				12	256	\$31,060	\$1,100	\$32,160

Notes:
 All fee estimates are approximate.
 The total fee is a not-to-exceed (NTE) amount and individual task fees may vary within the total NTE.
 Where needed tasks may be performed concurrently or out of the sequence indicated above.



ATTACHMENT D GSA Fee Estimate



Table 1 - Cost Summary By Task

	Total Costs
0 - Project Management	\$2,758
No Subtask	\$2,758
1 – Monitoring System Data Collection and Management	\$5,595
1.1 - Data Collection (1 event, 2020)	\$2,295
1.2 - Data Processing (4 events, 2020)	\$3,300
2 – Monitoring System Maintenance	\$12,007
2.1 - Preventative Maintenance and Vandalism Protection	\$4,138
2.2 - Station Maintenance and Sensor Calibration	\$7,869
3 – Data Analysis and Annual Report	\$15,041
3.1 - Data Analysis and Interpretation	\$7,560
3.2 - 2020 Calendar Year Annual Report	\$7,481
Proposal Grand Total	\$35,401

Table 1 - Cost Summary By Task

	Total Costs
1 - Project Management	\$6,640
1a - Project Coordination and Management	\$2,362
1b - CCRN Technical Team Meetings (Qty 3, 2 in person)	\$4,278
2 - Monitoring and Reporting	\$51,704
2a - Quarterly and Mid-Monsoon Data Downloads (5 total)	\$16,878
2b - Preliminary Equipment Maintenance Visit	\$6,928
2c - Equipment Maintenance (2 visits)	\$10,349
2d - ESM & Groundwater Data Processing and Analysis	\$9,234
2e - ESM Annual Report	\$6,768
2f - Present Annual Results	\$1,547
Proposal Grand Total	\$58,344