MEMORANDUM OF AGREEMENT
BETWEEN
THE NEW MEXICO ENVIRONMENT DEPARTMENT
AND
THE UNITED STATES GEOLOGICAL SURVEY

AMENDMENT #1

This AMENDMENT #1 TO THE ABOVE-REFERENCED **MEMORANDUM OF AGREEMENT** ("Agreement") is entered into by and between the **State of New Mexico, Environment Department**, hereinafter referred to as the "Department" or "NMED," and the **United States Department of the Interior, U.S. Geological Survey**, hereinafter referred to as "USGS," and is effective as of the date of the last signatory authority.

The purpose of the Amendment is as follows:

1. Modify Section 3. Disbursement of Funds to reflect the additional funding for the additional tasks in the amended Scope of Work (Attachment A).

2. Modify Scope of Work – Attachment A to include two additional project tasks; update any existing sections, budget, and timeline tables associated with added tasks; and clarify project timeline and budget language as Federal Fiscal Year.

IT IS MUTUALLY AGREED BETWEEN THE PARTIES THAT THE FOLLOWING PROVISIONS OF THE ABOVE-REFERENCED CONTRACT ARE AMENDED AS FOLLOWS:

Section 3. <u>Disbursement of Funds</u>.

A. NMED shall transfer to USGS funds in an amount not to exceed **$1,533,700** to reimburse USGS for costs actually incurred in carrying out the Project in accordance with the Scope of Work.

<u>Attachment A – Scope of Work</u>

Assessment of Per- and Polyfluoroalkyl Substances in Water Resources of New Mexico

Pg. 1, Title Page: Amended to read as follows:

- *Modified date and additional language inserted*: "December, 2020…Amended from proposal submitted July 2020".

Pg. 2, Summary*:* Subsection-Objectives: Amended to read as follows:

- Sentence 3, *additional language inserted***:** "The samples will be collected, analyzed, and reviewed in Federal Fiscal Year (FFY) 2020 and FFY2021."

- Sentence 5, *additional language inserted*: **"**A summary of data analysis and interpretation will be presented in a final study report in FFY2022."

Pg. 2, Summary: Subsection-Approach*:* Amended to read as follows

- Para 1, Sentence 3, additional language inserted added*:* "Springs may be sampled in some locations in Otero County."

- Para 1, Sentence 10, additional language inserted language: "The project will be conducted in cooperation with the New Mexico Environment Department (NMED). The project is broken into 5 Tasks; Tasks 1-3 involve statewide sampling, Task 4 involves sampling in Curry and Otero Counties, and Task 5 involves targeted sampling Curry and Roosevelt Counties. The cost of proposed Tasks 1-3 is $190,862 for July through September FY2020, $169,138 for October through December 2020, $200,000 for January through September 2021, and $100,000 for FFY2022."

- Para 1, Sentence 11, additional language inserted: "The total cost of proposed Tasks 1-3 is thus $660,000. The total cost of proposed Task 4, to be completed in FFY2021, is $773,700. The total cost of proposed Task 5, also to be completed in FFY2021, is $100,000."

Pg. 4, Objectives and Scope: Amended to read as follows:

- Para 1, Sentences 2 and 3, additional language inserted: "The samples will be collected in Federal Fiscal Year (FFY) 2020 and FFY2021 and released as preliminary data to the publicly available NWIS database and then will be reviewed and approved. Following collection of water quality data, the data will be analyzed in a comprehensive interpretive report in FFY2022."

Pg. 4, Approach: Amended to read as follows:

- Para 1, Sentence 1 additional language inserted: "Water-quality samples will be collected in FFY2020 and FFY2021 throughout the state of New Mexico from both surface water and groundwater sites."

- Pg. 5, Task 1: Statewide Sample Collection, Figure 1 caption, additional language inserted: "Map showing proposed sampling locations and areas for *Task 1* (circles with X inside represent surface water sites with associated USGS site identification number; orange shaded counties will include groundwater sampling in 2020, blue in 2021 and green in both years)."

- Pg. 6, Task 1: Statewide Sample Collection, Table 1 caption, additional language inserted: "Task 1 surface-water sampling sites (Rv, River; nr, near; blw, below)."

- Pg. 7 , Task 1: Statewide Sample Collection, Table 2 caption, additional language inserted: "Proposed *Task 1* groundwater sample collection by county in New Mexico."

- Pg. 9, Insertion of additional task – Task 4 to read as follows:

  Task 4: Additional Curry and Otero County Sampling and Analysis: Additional samples will be collected from active community public water supply systems, defined as non-profit systems that provide year-round service to the same population of greater than 15 service connections or greater than 25 people, within Curry and Otero Counties. Systems in the Sacramento Mountains of Otero County include spring sources and potentially some confined groundwater conditions. Spring samples will be collected as close to the emergence of groundwater or from a raw water tap if the infrastructure routing the spring water has covered the natural source.

  One sample from each source presented in Table 4 will be collected in FFY21. Samples will be analyzed for the same suite of compounds for groundwater samples defined in Tasks 1 and 2. Sampling results will be publicly available in NWIS, included in quarterly reports to the New Mexico Environment Department, and will be included in the interpretations and reporting listed under Task 3."

Pg. 10, Table insertion for Task 4: Additional Curry and Otero County Sampling and Analysis, and represented as follows:

*Note-Table numbering has been modified for Table 4 to Table 6, Table 5 to Table 7, and Table 6 to Table 8.

"Table 4. Water systems and sources in Curry and Otero counties to be sampled for *Task 4"*

System ID	System Name	Number of Sources
Curry County		
NM3510005	DESERT RANCH MDWCA	1
NM3527405	GRADY WATER SYSTEM	3
NM3520005	LONGHORN ESTATES WATER SYSTEM	1
NM3527505	MELROSE WATER SYSTEM	4
NM3527605	TEXICO WATER SYSTEM	4
NM3550905	TURQUOISE ESTATES WATER COOP	2
CURRY TOTAL	***6***	***15***
Otero County		
NM3568919	ALAMO HEIGHTS WUA	1
NM3513319	ALAMOGORDO DOMESTIC WATER SYSTEM	22
NM3513419	BOLES ACRES WATER SYSTEM	4
NM3565419	CHIPPEWAY PARK WATER ASSOCIATION	1
NM3574519	CIDER MILL FARMS MDWCA	2
NM3563019	CLOUD COUNTRY ESTATES WUA	3
NM3511019	CLOUD COUNTRY WEST WATER SYSTEM	1
NM3513519	CLOUDCROFT WATER SYSTEM	19
NM3550019	DUNGAN MDWCA	1

NM3563319	ENCHANTED VALLEY WUA	1
NM3500219	KARR CANYON ESTATES	1
NM3513719	LA LUZ MDWCA	5
NM3562919	LABORCITA WATER USERS ASSOCIATION	1
NM3563619	MOUNTAIN ORCHARD MDWCA	1
NM3513919	OROGRANDE MDWCA[1]	--
NM3529207	Lake Section Water Company[1]	5
NM3546019	PINEY WOODS WATER USERS ASSOCIATION	1
NM3537219	PINON MDWCA	1
NM3564219	ROLLING HILLS WUA	1
NM3510019	SILVER CLOUD WATER ASSOCIATION	1
NM3546419	TIMBERON W AND SD	7
NM3514019	TULAROSA WATER SYSTEM	2
NM3571119	TWIN FORKS MDWCA	2
NM3564319	WATERFALL COMMUNITY WUA	1
NM3500119	WEED WATER USERS ASSOCIATION	2
OTERO TOTAL	***24***	***86***
OVERALL TOTAL	**30**	**101**

[1]Orogrande MDWCA purchases groundwater from Lake Section Water Company in neighboring Doña Ana County. However, Orogrande MDWCA is eligible for sampling because it is in Otero County.

Pg. 11, Insertion of additional task 5 and table 5 to read to read as follows:

- **"Task 5: Well Sampling in Curry and Roosevelt Counties**

  Samples complementing efforts in Tasks 1-4 will be collected from private and public wells in Curry and Roosevelt Counties. This additional sampling effort is taking place as a cooperative project between NMED and Clean Water Partnership-Cannon (CWPC) under a Memorandum of Understanding. These samples will advance understanding of PFAS contamination in relation to complex hydrogeologic conditions and will fill critical data gaps due to the relative scarcity of local public water systems. Sample sites may include wells producing water for private domestic, irrigation, livestock watering, or public uses. Access agreements will be provided to private well owners who elect to participate in sampling.

  USGS estimates that 28 samples will be collected for this task (Table 5). This number is based on the total project budget (Table 12) and does not account for the possibility that some well owners may choose not to participate in the sampling effort. Sampling will occur in two phases with select wells resampled during the second phase.

  Personnel hours for Task 5 are estimated from typical hourly wages for USGS samplers. USGS may be able to collect additional samples if junior staff are available to conduct sampling at lower rates corresponding to their general schedule (GS) grade.

  Four samples (estimated) will be analyzed for the same suite of compounds for

groundwater samples defined in Tasks 1 and 2. The remaining 24 samples (estimated) will be analyzed only for the PFAS compounds listed in Table 3. Sampling results will be publicly available in NWIS, included in quarterly reports to the New Mexico Environment Department, and will be included in the interpretations and reporting listed under Task 3.

"Table 5. *Task 5* sample numbers by county"

Groundwater Sample Analysis	Estimated Number of Samples (may increase)
First Sampling Effort (PFAS only)	12
Repeat Sampling Effort (PFAS only)	12
Full Geochemistry Analysis Suite	4
OVERALL TOTAL	**28**

Pg. 13, Quality Assurance Plan: Amended to read as follows:

- Para 4, Sentences 5 and 6 , additional language inserted: "For the additional Task 4 samples in Curry and Otero Counties 4 blanks and 4 replicates will be collected in FFY21. USGS estimates that 4 blanks and 4 replicates will be collected for the additional Task 5 samples in Curry and Roosevelt counties in FFY21."

Pg. 13, Deliverables, modified language to read as follows:

- Para 1, Sentence 1, language modified*:* "Deliverables will follow Tasks 1-5 as described above, including: sample collection, sample results, and a final interpretive report."

- Para 1, Sentence 5, additional language inserted*:* "This publication will cover data from Tasks 1, 4, and 5."

Pg. 13, Timeline and Budget, Table 6: Amended to read as follows:

*Note - Specified Tasks 1-3 in Tables 6-8 captions.

"Table 6. Timeline for *Tasks 1-3* based on federal fiscal year where Q1 starts October 1 and Q4 ends September 30. Proposed work will begin after finalization of Joint Funding Agreement."

Task	FFY2020				FFY2021				FFY2022			
	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sept	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sept	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sept
Task 1: Data Collection												
Task 2: Data Analysis and Review												
Task 3:Interpretations and Reporting												

Pg. 13, Section: Timeline and Budget, Table 7: Amended to read as follows:

"Table 7. Budget summary for *Tasks 1-3"*

	FFY2020	FFY2021		FFY2022	Total
		Oct-Dec	Jan-Sept		
Laboratory Analysis	**$66,000**	**$66,000**	**$69,400**	**$0**	**$201,400**
Travel	**$15,325**	**$15,325**	**$17,300**	**$0**	**$47,950**
Supplies/ Shipping	**$2,600**	**$2,600**	**$2,200**	**$0**	**$7,400**
Personnel Hours	**$106,937**	**$85,213**	**$111,100**	**$90,000**	**$393,250**
USGS Publication	**$0**	**$0**	**$0**	**$10,000**	**$10,000**
Total	**$190,862**	**$169,138**	**$200,000**	**$100,000**	**$660,000**

Pg. 13, Section: Timeline and Budget, Table 8: Amended to read as follows:

Note -Changed "Cooperator" to "NMED-DWB" in Table 8 and defined "NMED-DWB" in Table 8 footnote

"Table 8. Contributing source funding for *Tasks 1-3"*

	FFY2020	FFY2021		FFY2022	Total
		Oct-Dec	Jan-Sept		
NMED-DWB*	**$190,862**	**$169,138**	**$200,000**	**$100,000**	**$660,000**
USGS	**$0,000**	**$0,000**	**$0,000**	**$0,000**	**$0,000**
Total	**$190,862**	**$169,138**	**$200,000**	**$100,000**	**$660,000**

* New Mexico Environment Department - Drinking Water Bureau

Pg. 14, Timeline and Budget, additional table insertion - Table 9:

*Note-Added new Tables 9-14:

"Table 9. Budget summary for *Task 4"*

	FFY2021	Total
	Task 4	
Laboratory Analysis	**$283,700**	**$283,700**
Travel	**$41,600**	**$41,600**
Supplies/ Shipping	**$5,900**	**$5,900**
Personnel Hours	**$442,500**	**$442,500**
USGS Publication	**$0**	**$0**
Total	**$773,700**	**$773,700**

Pg. 14, Timeline and Budget, additional table inserted - Table 10:

"Table 10. Timeline for *Task 4* based on federal fiscal year where Q1 starts October 1 and Q4 ends September 30. Proposed work will begin after finalization of amended Joint Funding Agreement."

Task	FFY2021				FFY2022			
	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sept	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sept
Task 3: Interpretations and Reporting								
Task 4: Additional Curry and Otero Sampling and Analysis								

Pg. 14, Timeline and Budget, additional table inserted - Table 11:

"Table 11. Contributing source funding for *Task 4"*

	FFY2021	Total
	Task 4	
NMED-CPB*	$773,700	$773,700
USGS	$0,000	$0,000
Total	$773,700	$773,700

* New Mexico Environment Department - Construction Programs Bureau

Pg. 14- 15, Timeline and Budget, additional table added - Table 12:

"Table 12. Budget summary for *Task 5*"

	FFY2021	Total
	Task 5	
Laboratory Analysis	$29,400	$29,400
Travel	$10,450	$10,450
Supplies/ Shipping	$1,200	$1,200
Personnel Hours	$58,850	$58,950
USGS Publication	$0	$0
Total	$100,000	$100,000

Pg. 15, Timeline and Budget, additional table inserted - Table 13:

"Table 13. Timeline for *Task 5* based on federal fiscal year where Q1 starts October 1 and Q4 ends September 30. Proposed work will begin after finalization of amended Joint Funding Agreement."

Task	FFY2021				FFY2022			
	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sept	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sept
Task 3: Interpretations and Reporting								
Task 5: Well Sampling in Curry and Roosevelt Counties								

Pg. 15, Timeline and Budget, additional table inserted - Table 14:

"Table 14. Contributing source funding for *Task 5"*

	FFY2021	Total
	Task 5	
NMED-DWB*	**$100,000**	**$100,000**
USGS	**$0,000**	**$0,000**
Total	**$100,000**	**$100,000**

* New Mexico Environment Department - Drinking Water Bureau"

All other articles of this contract remain the same.

THE PARTIES HERETO HAVE EXECUTED THIS AGREEMENT:

STATE OF NEW MEXICO, ENVIRONMENT DEPARTMENT

By: Jennifer Pruett Digitally signed by Jennifer Pruett Date: 2020.12.10 11:41:04 -07'00' Date:_____

James C. Kenney, Secretary
New Mexico Environment Department

By: Marlene Velasquez Digitally signed by Marlene Velasquez Date: 2020.12.10 08:20:43 -07'00' Date:_____

Marlene Velasquez, Chief Financial Officer
New Mexico Environment Department

Approved as to Form and Legal Sufficiency:

By: Jennifer Hower Digitally signed by Jennifer Hower Date: 2020.12.10 09:45:43 -07'00' Date:_____

Jennifer L. Hower, General Counsel
New Mexico Environment Department

U.S. DEPARTMENT OF THE INTERIOR, U.S. GEOLOGICAL SURVEY

By: MEGHAN ROUSSEL Digitally signed by MEGHAN ROUSSEL Date: 2020.12.10 16:08:55 -06'00' Date:_____

Meghan C Roussel, Director (Acting)
United States Geological Survey
New Mexico Water Science Center

MOA No. 21 667 2080 0001A1
Attachment A

A PROPOSAL AND SCOPE OF WORK SUBMITTED TO:
New Mexico Environment Department

Assessment of Per- and Polyfluoroalkyl Substances in Water Resources of New Mexico

https://www.usgs.gov/media/images/indian-paintbrush-front-rio-chama-new-mexico

U.S. Geological Survey
New Mexico Water Science Center
USGS Contact: Robert Henrion, Kimberly Beisner and Rebecca Travis
December 2020 *Amended from proposal submitted July 2020*

Summary

Problem. Per- and polyfluoroalkyl substances (PFAS) are a group of anthropogenic chemicals that are present in a number of consumer products and industrial applications and have been found in a variety of water resources throughout the United States (Boone and others, 2019). PFAS have been detected in public and private drinking water supplies, springs, and surface waters in New Mexico (New Mexico Environment Department, 2020; Intellus New Mexico, 2020). While there are known areas in New Mexico that are affected by PFAS, the presence and distribution of per- and polyfluoroalkyl substances in water resources across the state of New Mexico are not well characterized.

Objectives. The objectives of this proposed work are to collect water samples from surface water and groundwater resources throughout New Mexico, from areas that are known to be affected by PFAS (New Mexico Environment Department, 2020) and areas that have not been characterized, and determine the extent of PFAS, if present, in those resources. The samples will be collected, analyzed, and reviewed in Federal Fiscal Year (FFY) 2020 and FFY2021. Data will be made publicly available as preliminary results are released from the laboratories, reviewed, and approved. A summary of data analysis and interpretation will be presented in a final study report in FFY2022.

Approach. Water quality samples will be collected from surface water and groundwater sites throughout New Mexico. Locations were selected to include areas that may already be affected and areas of unknown impact. Surface water sampling will occur at U.S. Geological Survey (USGS) stream gaging stations, and groundwater sampling will occur in unconfined water-table aquifers at wells with known depth and screened interval. Springs may be sampled in some locations in Otero County. Some of the surface water samples will be water quality samples already planned to be collected for other studies, which will now include the addition of sample collection for per- and polyfluoroalkyl substances. Additional sampling trips will be made to collect per- and polyfluoroalkyl substances and wastewater tracers along the Rio Grande, Pecos, San Juan, and Animas Rivers. Groundwater will be sampled for a geochemical suite in addition to per- and polyfluoroalkyl substances to help provide context for groundwater age and groundwater evolution. Following two years of sample collection, the data will be compiled and analyzed in a USGS Scientific Investigations Report or Journal article. The project will be conducted in cooperation with the New Mexico Environment Department (NMED). The project is broken into 5 Tasks; Tasks 1-3 involve statewide sampling, Task 4 involves sampling in Curry and Otero Counties, and Task 5 involves targeted sampling Curry and Roosevelt Counties. The cost of proposed Tasks 1-3 is $190,862 for July through September FFY2020, $169,138 for October through December 2020, $200,000 for January through September 2021, and $100,000 for FFY2022. The total cost of proposed Tasks 1-3 is thus $660,000. The total cost of proposed Task 4, to be completed in FFY2021, is $773,700. The total cost of proposed Task 5, also to be completed in FFY2021, is $100,000.

Relevance and Benefits. Sampling of water resources for per- and polyfluoroalkyl substances on this scale has never before been conducted in New Mexico and information gained from sampling is crucial for understanding the distribution throughout the state. The proposed work also includes comprehensive analytical suites in addition to per- and polyfluoroalkyl substances to provide

context for the geochemical evolution and possible sources of water contributing to the sampled water. The study directly supports the USGS Water Science Strategy by gaining an understanding of the effects of human activities on water quality.

Introduction

In New Mexico, water resources are scarce and can be particularly vulnerable to input from anthropogenic compounds. Water quality is a function of local geology as well as discharges from urban and agricultural regions. Drinking water in the state is obtained from both surface water and groundwater sources.

Per- and polyfluoroalkyl substances (PFAS) are widespread anthropogenic chemicals that have been in use for the past 70 years (Lindstrom and others, 2011). This class of compounds comprises thousands of chemicals including perfluoro sulfonates (PFSAs) such as perfluorooctane sulfonate (PFOS), perfluorocarboxylic acids (PFCAs), and perfluorooctanoic acid (PFOA; Wang and others, 2017). As the use of these chemicals has grown so has their ubiquity in the environment due to their highly persistent nature (Lindstrom and others, 2011). PFOAs and PFOS have been investigated by the U.S. Environmental Protection Agency (EPA) and are considered harmful to human health and the environment (EPA, 2020). Point sources, such as firefighting training grounds, industrial facilities, and wastewater plant effluent have been found to contribute PFAS into the water cycle, including runoff and groundwater infiltration (Hu and others, 2016). At 25 drinking water plants across the United States, Boone and others (2019) analyzed paired samples from sources and after treatment, and detectable PFAS were found in all samples. There is evidence that exposure may lead to reproductive and developmental problems as well as liver, kidney, and immunological effects (EPA, 2020).

Problem

Per- and polyfluoroalkyl substances are a group of anthropogenic chemicals that are present in a number of consumer products and industrial applications and have been found in a variety of water resources throughout the United States (Boone and others, 2019). PFAS have been detected in public and private drinking water supplies, springs and surface waters in New Mexico (New Mexico Environment Department, 2020; Intellus New Mexico, 2020). While there are known areas in New Mexico that are affected by PFAS, the presence and distribution of per- and polyfluoroalkyl substances in water resources across the state of New Mexico are not well characterized.

Objectives and Scope

The objectives of this proposed work are to collect water samples from surface water and groundwater resources throughout New Mexico, from areas that are known to be affected by PFAS (New Mexico Environment Department, 2020) and areas that have not been characterized, and determine the extent of PFAS, if present, in those resources. The samples will be collected in Federal Fiscal Year (FFY) 2020 and FFY2021 and released as preliminary data to the publicly available NWIS database and then will be reviewed and approved. Following collection of water quality data, the data will be analyzed in a comprehensive interpretive report in FFY2022.

Approach

Water-quality samples will be collected in FFY2020 and FFY2021 throughout the state of New Mexico from both surface water and groundwater sites. Locations were selected to cover urban, agricultural, and undeveloped areas to encompass a spectrum of anthropogenic activities (New Mexico Environment Department, 2020; Intellus New Mexico, 2020).

Task 1: Statewide Sample Collection

Water samples will be collected at sampling sites throughout the state of New Mexico at both surface water and groundwater sites (Figure 1). Some samples will be collected at sites that are already being sampled by USGS for other studies and others will be at sites not currently sampled. Additional samples may be collected based on water-quality results obtained from planned sampling.

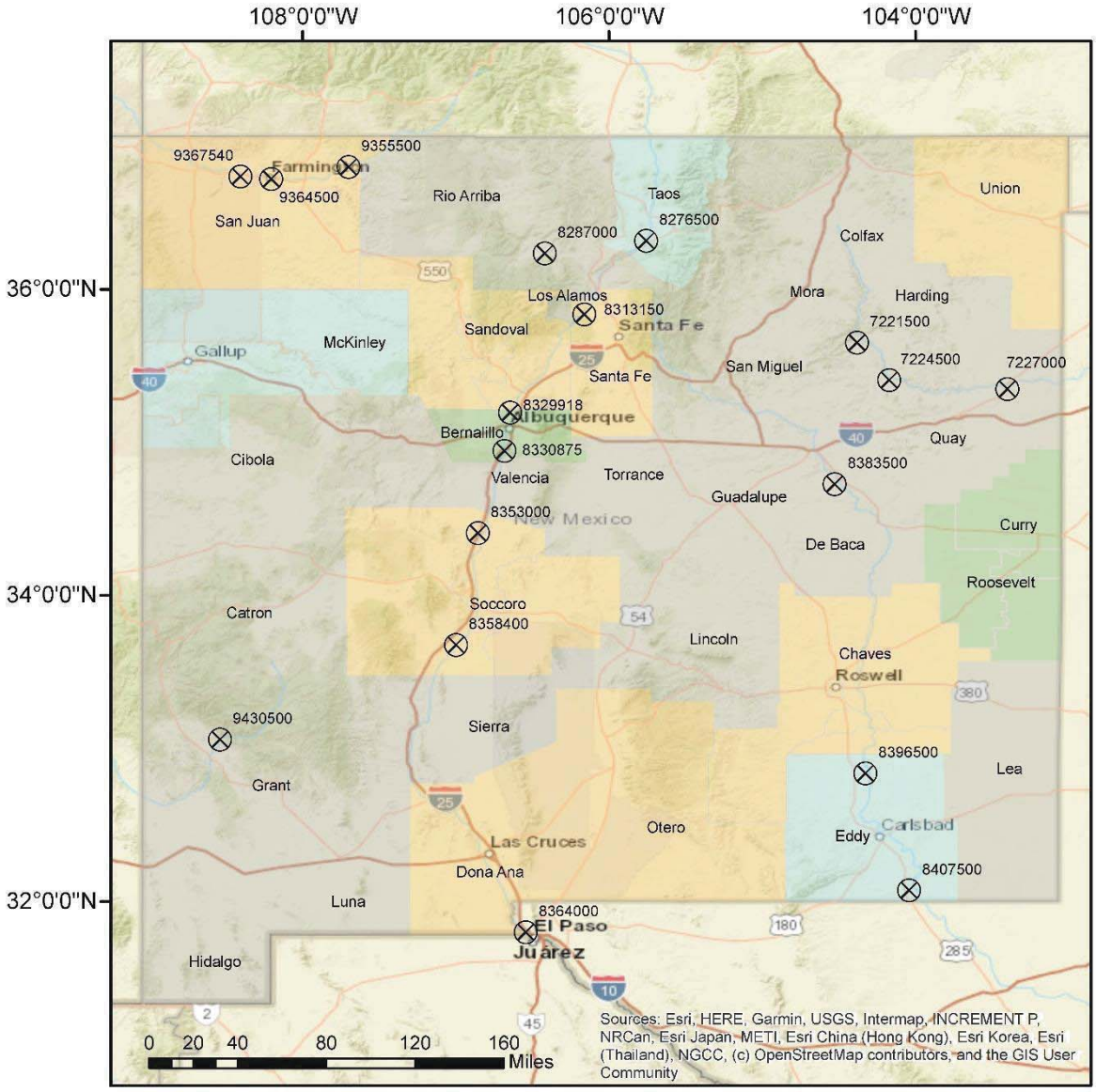

Figure 1. Map showing proposed sampling locations and areas for *Task 1* (circles with X inside represent surface water sites with associated USGS site identification number; orange shaded counties will include groundwater sampling in 2020, blue in 2021 and green in both years)

Surface water samples will be collected from established USGS stream gage stations where a stage-discharge relationship has been established, and samples will be collected during stable flow when possible. Surface water sampling sites with established sampling history and data will be

sampled for PFAS analysis and are listed in black in Table 1. Additional samples will be collected at upstream and downstream locations along the Rio Grande, Pecos, and San Juan Rivers to have a monthly record of PFAS concentrations at those sites (green samples in Table 1). The additional samples will include field parameters (temperature, pH, specific conductance, dissolved oxygen, and turbidity), PFAS, boron isotopes, and wastewater tracers.

Table 1. *Task 1* surface-water sampling sites (Rv, River; nr, near; blw, below).

Site	**Site Name**	**Number of Samples (black – existing additional water quality data site and green – additional water quality data site)**	
		2020*	2021
07221500	Canadian Rv nr Sanchez, NM	1	0
07224500	Canadian Rv blw Conchas Dam, NM	1	0
07227000	Canadian Rv nr Logan, NM	2	2
08276500	Rio Grande blw Taos Junction Bridge nr Taos, NM	1	1
08313150	Rio Grande above Buckman Diversion, NM	5	5
08329918	Rio Grande Alameda Bridge at Alameda, NM	2 (3)	3 (2)
08330830	Rio Grande at Valle de Oro, NM	4	4
08353000	Rio Puerco nr Bernardo, NM	1	1
08358400	Rio Grande Floodway at San Marcial, NM	1	1
08364000	Rio Grande at El Paso, TX	7	5
08383500	Pecos Rv nr Puerto de Luna, NM	1 (3)	1 (2)
08396500	Pecos Rv nr Artesia, NM	1 (3)	1 (2)
08407500	Pecos Rv at Red Bluff, NM	1	0
09430500	Gila Rv nr Gila, NM	1	0
09364500	Animas Rv at Farmington, NM	1 (3)	1 (2)
09355500	San Juan Rv nr Archuleta, NM	2 (3)	3
09367540	San Juan Rv nr Fruitland, NM	5	6
08287000	Rio Chama below Abiquiu Reservoir	2	2
	Total	**34 (20)**	**31 (13)**

* Samples collected in 2020 will be distributed equally through the last quarter of FY2020 (July through September) and the first quarter of FY2021 (October through December 2020).

Groundwater sampling areas are listed in Table 2 and will include an additional suite of analytes to understand more holistically the groundwater evolution and potential sources of water. The distribution of groundwater samples is spread throughout New Mexico to encompass urbanized, agricultural, and undeveloped areas (Figure 1). Groundwater samples will be collected from unconfined water-table aquifers at sites with known drillers' logs and screened interval information. Groundwater-level measurements will be made prior to collection of water quality samples at sites with accessible groundwater level measurement ports. Preference will be to sample groundwater wells with a dedicated pump, but samples can be collected with portable pumps if needed. Groundwater samples will be collected as raw water prior to inline chlorination and storage tanks.

Additional analytes for groundwater samples will include major ions, trace elements (Al, Ag, As, Ba, Be, Cd, Cr, Cu, Fe, Mn, Mo, Ni, Pb, Sb, Se, U, V, and Zn), nutrients, dissolved organic carbon, boron isotopes, stable isotopes of oxygen and hydrogen, tritium, and carbon-14.

Table 2. Proposed *Task 1* groundwater sample collection by county in New Mexico

County	**Proposed number of samples**	
	2020*	2021
Bernalillo	1	2
Chaves	3	
Curry	8	4
Dona Ana	2	
Eddy		1
McKinley		2
Otero	6	
Roosevelt	8	4
Sandoval	2	
San Juan	3	
Santa Fe	2	
Socorro	2	
Taos		2
Union	1	
Total	**38**	**15**

* Samples collected in 2020 will be distributed equally through the last quarter of FY2020 (July through September) and the first quarter of FY2021 (October through December 2020).

Task 2: Data Analysis and Review

PFAS analysis will include a group of 28 per- and polyfluoroalkyl substances (Table 3) analyzed by SGS, a subcontract laboratory through RTI, using EPA Method 537.1 (US Environmental Protection Agency, 2018). Since per- and polyfluoroalkyl substances show variability between analytical laboratories, a subset of the samples could be sent to the USGS National Water Quality Laboratory in Lakewood, CO (USGS-NWQL) for analysis by their PFAS method if USGS matching funds are available to cover the cost of analysis. Major ion, trace element, nutrient, and dissolved organic carbon will be analyzed at the USGS-NWQL. Boron isotopes will be analyzed at the USGS research laboratory at Moffett Field, CA. Stable isotopes of oxygen and hydrogen will be analyzed at the USGS Stable Isotope Laboratory in Reston, VA. Tritium will be analyzed at the University of Miami (contract lab for USGS-NWQL). Carbon-14, in addition to carbon-13/carbon-12 ratios, will be analyzed at Woods Hole Oceanographic Institute (contract laboratory for USGS-NWQL). Wastewater tracers will be analyzed at the USGS Aqueous Chemical Contaminants and Hydrological/Ecological Interactions research laboratory in Boulder, CO.

Table 3. Per- and polyfluoroalkyl substances analyzed by SGS.

Analyte	Analyte Abbreviation	CAS Number*
Perfluorobutanoic acid	PFBA	375-22-4
Perfluoropentanoic acid	PFPeA	2706-90-3
Perfluorohexanoic acid	PFHxA	307-24-4
Perfluoroheptanoic acid	PFHpA	375-85-9
Perfluorooctanoic acid	PFOA	335-67-1
Perfluorononanoic acid	PFNA	375-95-1
Perfluorodecanoic acid	PFDA	335-76-2
Perfluoroundecanoic acid	PFUnDA	2058-94-8
Perfluorododecanoic acid	PFDoDA	307-55-1
Perfluorotridecanoic acid	PFTrDA	72629-94-8
Perfluorotetradecanoic acid	PFTeDA	376-06-7
Perfluorobutanesulfonic acid	PFBS	375-73-5
Perfluoropentanesulfonic acid	PFPeS	2706-91-4
Perfluorohexanesulfonic acid	PFHxS	355-46-4
Perfluoroheptanesulfonic acid	PFHpS	375-92-8
Perfluorooctanesulfonic acid	PFOS	1763-23-1
Perfluorononanesulfonic acid	PFNS	474511-07-4
Perfluorodecanesulfonic acid	PFDS	335-77-3
4:2 Fluorotelomer sulfonate	4:2FTS	757124-72-4
6:2 Fluorotelomer sulfonate	6:2FTS	27619-97-2
8:2 Fluorotelomer sulfonate	8:2FTS	39108-34-4
Perfluorooctane sulfonamide	PFOSA	754-91-6
N-Methyl perfluorooctanesulfonamidoacetic acid	MeFOSAA	2355-31-9
N-Ethyl perfluorooctanesulfonamidoacetic acid	EtFOSAA	2991-50-6
Hexafluoropropylene oxide dimer acid (GenX)	HFPO-DA	13252-13-6

4,8-dioxa-3H-perfluorononanoic acid	ADONA	919005-14-4
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid	9Cl-PF3ONS	756426-58-1
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	11CL-PF3OUdS	763051-92-9

*This table contains CAS Registry Numbers®, which is a Registered Trademark of the American Chemical Society. CAS recommends the verification of the CASRNs through CAS Client ServicesSM.

Data collected during the sample collection campaign in 2020 and 2021 will be released as preliminary data to the publicly available NWIS database and then will be reviewed and approved. Rerun and verification requests will be made for data with issues that arise during the review process and will be documented and values updated as necessary.

Task 3: Interpretations and Reporting

Quarterly reports will be sent to the New Mexico Environment Department describing sample collection with links to the publicly available data in NWIS. Approved data will be analyzed and interpreted in a USGS Scientific Investigations Report or Journal article. The report will assess the comprehensive geochemical and anthropogenic data collected during this project.

Task 4: Additional Curry and Otero County Sampling and Analysis

Additional samples will be collected from active community public water supply systems, defined as non-profit systems that provide year-round service to the same population of greater than 15 service connections or greater than 25 people, within Curry and Otero Counties. Systems in the Sacramento Mountains of Otero County include spring sources and potentially some confined groundwater conditions. Spring samples will be collected as close to the emergence of groundwater or from a raw water tap if the infrastructure routing the spring water has covered the natural source.

One sample from each source presented in Table 4 will be collected in FFY21. Samples will be analyzed for the same suite of compounds for groundwater samples defined in Tasks 1 and 2. Sampling results will be publicly available in NWIS, included in quarterly reports to the New Mexico Environment Department, and will be included in the interpretations and reporting listed under Task 3.

Table 4. Water systems and sources in Curry and Otero counties to be sampled for *Task 4*

System ID	System Name	Number of Sources
Curry County		
NM3510005	DESERT RANCH MDWCA	1
NM3527405	GRADY WATER SYSTEM	3
NM3520005	LONGHORN ESTATES WATER SYSTEM	1
NM3527505	MELROSE WATER SYSTEM	4
NM3527605	TEXICO WATER SYSTEM	4
NM3550905	TURQUOISE ESTATES WATER COOP	2
CURRY TOTAL	***6***	***15***
Otero County		
NM3568919	ALAMO HEIGHTS WUA	1
NM3513319	ALAMOGORDO DOMESTIC WATER SYSTEM	22
NM3513419	BOLES ACRES WATER SYSTEM	4
NM3565419	CHIPPEWAY PARK WATER ASSOCIATION	1
NM3574519	CIDER MILL FARMS MDWCA	2
NM3563019	CLOUD COUNTRY ESTATES WUA	3
NM3511019	CLOUD COUNTRY WEST WATER SYSTEM	1
NM3513519	CLOUDCROFT WATER SYSTEM	19
NM3550019	DUNGAN MDWCA	1
NM3563319	ENCHANTED VALLEY WUA	1
NM3500219	KARR CANYON ESTATES	1
NM3513719	LA LUZ MDWCA	5
NM3562919	LABORCITA WATER USERS ASSOCIATION	1
NM3563619	MOUNTAIN ORCHARD MDWCA	1
NM3513919	OROGRANDE MDWCA[1]	--
NM3529207	Lake Section Water Company[1]	5
NM3546019	PINEY WOODS WATER USERS ASSOCIATION	1
NM3537219	PINON MDWCA	1
NM3564219	ROLLING HILLS WUA	1
NM3510019	SILVER CLOUD WATER ASSOCIATION	1
NM3546419	TIMBERON W AND SD	7
NM3514019	TULAROSA WATER SYSTEM	2
NM3571119	TWIN FORKS MDWCA	2
NM3564319	WATERFALL COMMUNITY WUA	1
NM3500119	WEED WATER USERS ASSOCIATION	2
OTERO TOTAL	***24***	***86***
OVERALL TOTAL	**30**	**101**

[1]Orogrande MDWCA purchases groundwater from Lake Section Water Company in neighboring Doña Ana County. However, Orogrande MDWCA is eligible for sampling because it is located in Otero County.

Task 5: Well Sampling in Curry and Roosevelt Counties

Samples complementing efforts in Tasks 1-4 will be collected from private and public wells in Curry and Roosevelt Counties. This additional sampling effort is taking place as a cooperative project between NMED and Clean Water Partnership-Cannon (CWPC) under a Memorandum Of Understanding. These samples will advance understanding of PFAS contamination in relation to complex hydrogeologic conditions and will fill critical data gaps due to the relative scarcity of local public water systems. Sample sites may include wells producing water for private domestic, irrigation, livestock watering, or public uses. Access agreements will be provided to private well owners who elect to participate in sampling.

USGS estimates that 28 samples will be collected for this task (Table 5). This number is based on the total project budget (Table 12) and does not account for the possibility that some well owners may choose not to participate in the sampling effort. Sampling will occur in two phases with select wells resampled during the second phase.

Personnel hours for Task 5 are estimated from typical hourly wages for USGS samplers. USGS may be able to collect additional samples if junior staff are available to conduct sampling at lower rates corresponding to their general schedule (GS) grade.

Four samples (estimated) will be analyzed for the same suite of compounds for groundwater samples defined in Tasks 1 and 2. The remaining 24 samples (estimated) will be analyzed only for the PFAS compounds listed in Table 3. Sampling results will be publicly available in NWIS, included in quarterly reports to the New Mexico Environment Department, and will be included in the interpretations and reporting listed under Task 3.

Table 5. *Task 5* estimated sample numbers

Groundwater Sample Analysis	**Estimated Number of Samples (may increase)**
First Sampling Effort (PFAS only)	12
Repeat Sampling Effort (PFAS only)	12
Full Geochemistry Analysis Suite	4
OVERALL TOTAL	**28**

Additional work (beyond the scope of this proposal)

1. Investigate per- and polyfluoroalkyl substances and other anthropogenic compounds (wastewater tracers, pesticides, artificial sweeteners) in the Rio Grande as it flows through the Albuquerque metropolitan area. The study would include sites upstream and downstream from the urbanized area and at targeted sites through the city. Sites downstream from wastewater treatment plant inflows could benefit from hourly sampling for a 24-hour or longer period at different flow regimes to understand if there are fluctuations in the anthropogenic compounds over a daily cycle and could help structure timing for future sampling. The work could benefit from USGS matching funds that support the Urban Waters Federal Partnership: https://www.epa.gov/urbanwaterspartners/urban-waters-and-middle-rio-grandealbuquerque-new-mexico
2. Sample playa lakes in Roosevelt and Curry counties for anthropogenic compounds in the water and sediment. These playa lakes may serve as focused recharge locations to the

groundwater in this area. If so, it would be important to know the water-quality of the playa lakes.
3. Add total oxidizable precursors of per- and polyfluoroalkyl substances to the analytical suite.
4. Develop a wastewater mapper tool to understand which surface water resources may have anthropogenic compounds and utilize the proposed data set to calibrate the mapper to predict concentrations for compounds of interest. An example of a wastewater mapper tool from the Shenandoah River can be found at: https://va.water.usgs.gov/webmap/shenmap/
5. Investigate use of passive samplers for both surface water and groundwater to collect time integrated samples of per- and polyfluoroalkyl substances.
6. Increase groundwater sampling numbers in 2021 to gain additional spatial coverage.
7. Sample intermittent and ephemeral surface water after precipitation events to understand per and polyfluoroalkyl substance occurrence in those water resources.

Relevance and Benefits

Sampling for per- and polyfluoroalkyl substances on this scale has never before been conducted in New Mexico and information gained from sampling is crucial for understanding the distribution throughout the state in both areas of known impact and unknown impact (New Mexico Environment Department, 2020; Intellus New Mexico, 2020). The proposed work also includes comprehensive analytical suites in addition to per- and polyfluoroalkyl substances to provide context for the geochemical evolution and possible sources of water contributing to the sampled water. The study directly supports the USGS Water Science Strategy by gaining an understanding of human interactions on water quality.

Quality Assurance Plan

Quality assurance (QA) measures will be followed to ensure completeness of the information communicated during the study. The QA objectives for collection and communication of information will:

- Withstand scientific scrutiny
- Be obtained by methods appropriate for the information and its intended use, and
- Be representative and of known completeness and comparability.

All data will be collected in adherence to USGS standards and methods and water quality samples will be collected according to the USGS National Field Manual for the Collection of Water Quality Data (USGS, variously dated). Collection methods for per- and polyfluoroalkyl substances are still being evaluated prior to publication in the USGS National Field Manual and sampling will follow the best available guidance and include the use of shoulder length gloves beneath the standard nitrile gloves during sampling. Groundwater samples for per- and polyfluoroalkyl compounds will be collected directly from the sampling port at wells with a dedicated pump and utilize HDPE tubing for samples collected with a portable pump. If a portable pump is used, a blank sample will be collected from the pump prior to sample collection. Surface water samples will be collected following the USGS National Field Manual using polypropylene equipment.

All digital data will be reviewed by USGS personnel to ensure proper documentation. The project and project budget will be reviewed by USGS management on a semi-annual basis to ensure

project timelines are met. USGS products are impartial, credible, relevant, provide timely information, and are equally accessible and available to all interested parties.

Quality assurance samples provide important context for the environmental samples to understand potential contamination from sampling equipment or ambient sources near sampling sites (blanks) and variability of concentrations at each site (replicates). For surface water samples, 10 blanks and 10 replicates will be collected during 2020 including wastewater tracers during 4 sampling events. In 2021, 4 blanks and 4 replicates will be collected from surface water sampling sites. Groundwater samples will be collected at a range of urban, agricultural, and undeveloped sites with 4 blanks and 4 replicates in 2020 and 2 blanks and 2 replicates in 2021. For the additional Task 4 samples in Curry and Otero Counties 4 blanks and 4 replicates will be collected in FFY21. USGS estimates that 4 blanks and 4 replicates will be collected for the additional Task 5 samples in Curry and Roosevelt counties in FFY21.

Deliverables

Deliverables will follow Tasks 1-5 as described above, including: sample collection, sample results, and a final interpretive report. Water quality and water level data will be entered into USGS National Water Information System (NWIS), and the data will be publicly available as the results are released from the laboratories as preliminary data, then reviewed and approved. Quarterly reports will be sent to the New Mexico Environment Department providing a summary of the samples collected and links to the NWIS data. In the third year of the project, a USGS Scientific Investigations Report or Journal article will analyze and interpret the comprehensive geochemical and anthropogenic data collected during this project. This publication will cover data from Tasks 1, 4, and 5.

Timeline and Budget

Table 6. Timeline for *Tasks 1-3* based on federal fiscal year where Q1 starts October 1 and Q4 ends September 30. Proposed work will begin after finalization of Joint Funding Agreement.

Task	FFY2020				FFY2021				FFY2022			
	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sept	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sept	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sept
Task 1: Data Collection												
Task 2: Data Analysis and Review												
Task 3: Interpretations and Reporting												

Table 7. Budget summary for *Tasks 1-3*

	FFY2020	FFY2021		FFY2022	Total
		Oct-Dec	Jan-Sept		
Laboratory Analysis	$66,000	$66,000	$69,400	$0	$201,400
Travel	$15,325	$15,325	$17,300	$0	$47,950
Supplies/ Shipping	$2,600	$2,600	$2,200	$0	$7,400
Personnel Hours	$106,937	$85,213	$111,100	$90,000	$393,250
USGS Publication	$0	$0	$0	$10,000	$10,000

Total	**$190,862**	**$169,138**	**$200,000**	**$100,000**	**$660,000**

Table 8. Contributing source funding for *Tasks 1-3*

	FFY2020	FFY2021		FFY2022	Total
		Oct-Dec	Jan-Sept		
NMED-DWB*	$190,862	$169,138	$200,000	$100,000	$660,000
USGS	$0,000	$0,000	$0,000	$0,000	$0,000
Total	$190,862	$169,138	$200,000	$100,000	$660,000

* New Mexico Environment Department - Drinking Water Bureau

Table 9. Budget summary for *Task 4*

	FFY2021	Total
	Task 4	
Laboratory Analysis	$283,700	$283,700
Travel	$41,600	$41,600
Supplies/ Shipping	$5,900	$5,900
Personnel Hours	$442,500	$442,500
USGS Publication	$0	$0
Total	$773,700	$773,700

Table 10. Timeline for *Task 4* based on federal fiscal year where Q1 starts October 1 and Q4 ends September 30. Proposed work will begin after finalization of amended Joint Funding Agreement.

Task	FFY2021				FFY2022			
	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sept	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sept
Task 3: Interpretations and Reporting								
Task 4: Additional Curry and Otero Sampling and Analysis								

Table 11. Contributing source funding for *Task 4*

	FFY2021	Total
	Task 4	
NMED-CPB*	$773,700	$773,700
USGS	$0,000	$0,000
Total	$773,700	$773,700

* New Mexico Environment Department - Construction Programs Bureau

Table 12. Budget summary for *Task 5*

	FFY2021	Total
	Task 5	
Laboratory Analysis	$29,400	$29,400
Travel	$10,450	$10,450

Supplies/ Shipping	**$1,200**	**$1,200**
Personnel Hours	**$58,950**	**$58,950**
USGS Publication	**$0**	**$0**
Total	**$100,000**	**$100,000**

Table 13. Timeline for *Task 5* based on federal fiscal year where Q1 starts October 1 and Q4 ends September 30. Proposed work will begin after finalization of amended Joint Funding Agreement.

Task	FFY2021				FFY2022			
	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sept	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sept
Task 3: Interpretations and Reporting								
Task 5: Well Sampling in Curry and Roosevelt Counties								

Table 14. Contributing source funding for *Task 5*

	FFY2021	Total
	Task 5	
NMED-DWB*	**$100,000**	**$100,000**
USGS	**$0,000**	**$0,000**
Total	**$100,000**	**$100,000**

* New Mexico Environment Department - Drinking Water Bureau

Personnel

Experienced USGS Hydrologic Technicians who have taken the USGS Field Methods for Water Quality Sample Collection class will collect the surface water and groundwater samples. An experienced Hydrologist who specializes in water quality will oversee data collection and assist in groundwater site selection to ensure that relevant well depth, screened interval, and aquifer information are available for each sampling location. This Hydrologist will also partner with Jeramy Jasmann, Larry Barber, and others at USGS who specialize in anthropogenic compounds during the analysis and interpretation of the data that will result in a USGS Scientific Investigations Report or Journal article.

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