The University of Texas Rio Grande Valley™

Texas Commission on Environmental Quality

Characterization of Northern and Central Lower Rio Grande Valley (LRGV) Watersheds

Project Deliverable ID Final Report

Andrew N.S. Ernest, Ph.D., P.E., BCEE, D.WRE

Oct 14, 2022

Funding for the development of this watershed protection plan project was provided through a federal Clean Water Act Section 319 h grant to the University of Texas Rio Grande Valley, administered by the Texas Commission Environmental Quality from the U.S. Environmental Protection Agency

CONTENTS

CHAPTER

ONE

PROJECT SIGNIFICANCE AND BACKGROUND

The Laguna Madre is an estuarine wetland system along the Gulf of Mexico that receives fresh-water from the North and Central Lower Rio Grande Valley (*LRGV*) watersheds (Hernandez and Uddameri[2]). A watershed is the area of land that contributes runoff to a lake, river, stream, wet-land, estuary, or bay (USEPA[10]).

The Northern and Central LRGV watershed has three major wa-terways that provide freshwater inflows to the Lower Laguna Madre (*LLM*) namely Raymondville Drain (*RVD*), Hidalgo/Willacy Main Drain (*HWMD*), and International Boundary Water CommissionnNorth Floodway (*IBWCNF*). The *LLM* Bay is divided into two segments, and an independent monitoring site is established to monitor each segment. The *RVD* and the *HWMD* flow into the Lower Laguna Madre Bay segment being monitored by *AU* 2491_01. The *IBWCNF* flows into the *LLM* segment being monitored by *AU* 2491_02. The *RVD* and *HWMD* segment of the *LLM* Bay is considered impaired because of low Dissolved Oxygen *DO*, and the *IBWCNF* segment of the *LLM* Bay is considered impaired because of low *DO* and bacteria. The two water segments of the *LLM* are considered impaired due to high levels of bacteria and low dissolved oxygen. The North and Central waterways provide freshwater inflows along with other drainage canals to the *LLM* Bay. Prior to this study, these waterways had not been characterized. Watershed characterization can enable proper identification of existing and potential sources of pollution which will guide us to develop a Watershed Protection Plan (*WPP*) to restore and protect, and *LLM* Bay and preserve the ecosystem.

CHAPTER

TWO

STUDY AREA

The North and Central Watershed encompasses an area of 3,116.05 km^2 in the *LRGV* region, south Texas. The *LRGV* is a semiarid region in south Texas bordered by Mexico to the south and the Gulf of Mexico to the east (Mahmoud *et al.*[3]). This watershed is formed by *HWMD* in the southwest extending to the east, *RVD* in the north, and *IBWCNF* in the southeast. The study area is a large plain of *LLM* Watershed *HUC* 08:12110208. North and Central Watersheds encompasses 37% of the total area of LLM watershed (Navarro[5]).

The *LRGV* flat topography and low soil permeability causes hazardous flooding events whenever it rains in the region. Its elevation gradually slopes from 102 to 0 m with a high range of precipi-tation between 50-70 cm per year (Navarro *et al.*[7]).

In general, soils in the *LRGV* region consist of calcareous to neutral clays, clay loams and sandy loams (TWDB[9]), and clay soil is known for low permeability and poor drainage.

Its physical geography, physiography, zones include the Bordas Cuesta and the Rio Grande Delta which influences the types of vegetation (Hathcock[1]).

CHAPTER

THREE

SUMMARY OF ALL TASK REPORTS AND FINAL APPROVED QPR

3.1 Key Deliverables

- Geospatial Quality Assurance Project Plan
- Watershed Characterization Report
- Partnership Coordination Report
- Final Report (current document)

3.2 Task 1. Project Administration

- The contract was executed on September 24, 2018, with a Federal Award Amount of $98,542, Local Match of $65,695, with an end date of August 31, 2020.
- A contract ammendment was executed to extend the end date to August 31, 2022
- A Budget Revision Request (BRR) was requested on December 8, 2021 and approved on December 14, 2021.

This project has been impacted by a series of hurdles since prior to contract execution. These issues are the primary reasons that the project has experienced setbacks and delays. Despite these issues, with the support of Texas Commission on Environmental Quality (TCEQ) staff, the project team has been able to complete the project deliverables and bring this project to a successful conclusion.

3.2.1 Project Engagement with UTRGV

This project was proposed during the summer of 2017, awarded and fully executed in early fall of 2018 (September 24, 2018). The project was conceived and proposed with significant 3rd party contributions. The Principle Investigator was proposed to be Javier Guerrero, Director of Water Studies at the University of Texas Rio Grande Valley (*UTRGV*), founder and liaison to the Lower Rio Grande Valley Stormwater Taskforce (*SWTF*), at that time an operational unit within the Center for Water Studies at *UTRGV*. The *SWTF* membership, committed in-kind resources to ensure the success of the project, including support for the collection of background data and stakeholder engagement, consistent with the *SWTF* core expertise. Reaserch, Applied Technology, Education and Service, Inc. (*RATES*) was proposed as a subcontractor to provide the Cyberinfrastructure development consistent with *RATES* core expertise.

During the Spring of 2018, *UTRGV* experienced a significant change in executive leadership, in-cluding the appointment of new Provost and subsequently Dean of the College of Engineering and Computer Science. Cascading effects of these leadership changes included, in sequence, the exit of the *SWTF* from *UTRGV* and the exit of the staffing of the Center for Water Studies (Director, technical and administrative staff). This resulting void in technical and administrative capacity in-tended to support this project, anticipated to kick-off in the Fall of that year, required identification of a new Principal Investigator (PI), source of 3rd party cost-share and technical and administrative support.

Another consequence of the executive leadership change was the demotion of the Civil Engineering department chair, Andrew Ernest. The PI role for this project was also assigned to the former department chair. In an attempt to partially replace the technical capacity of the *SWTF*, a post-doctoral associate, Ahmed Mahmoud, was recruited. *SWTF* cost-share commitments were replaced with the PI salary.

In the Spring of 2019, upon the demise of the *RATES* founder, Andrew Ernest was appointed the 2nd President and Chief Executive Officer of *RATES*. Upon disclosure to *UTRGV*, a Financial Conflict Of Interest Management Plan was put into place, effectively precluding *RATES* from subcontracting the Cyberinfrastructure work, which then had to be absorbed pro-bono by *RATES* to ensure the success of the project.

At the end of Spring 2021, the graduate student assigned to the project, Linda Navarro, completed the watershed delineation subtask also assigned as her thesis, graduated and left *UTRGV*. At the end of the Summer of 2021, Ahmed Mahmoud left *UTRGV* leaving the project team without the necessary technical support staff to successfully complete the project. At the end of Spring 2022, a second graduate student who also trained under Ahmed and Linda, Ivan Santos-Chavez, completed the modeling subtask from the *LLM/BSC* project assigned as his thesis, graduated and left *UTRGV*. A third graduate student, unfortunately with no prior training, Abdulkabir Aduragba has since been recruited to complete this project.

3.3 Task 2. Quality Assurance

The Geospatial Data Quality Assurance Project Plan (QAPP) was approved and fully executed on November 7, 2019 (Mahmoud *et al.*[4]).
See the Appendix for Attachment. An executive summary is provided below. The Northern and Central Lower Rio Grande Valley (LRGV) watersheds are north of the Arroyo Colorado watershed in Hidalgo, Cameron, and Willacy counties. The watersheds include several TCEQ segments: North Floodway (2494B_01), Hidalgo Main Floodwater Channel (2491C_03), Raymondville Drain (2491C_01), Willacy Main Drain (2491C_02), and remaining perennial fresh-water drainage ditches flowing into main drains (2491C_04). The Raymondville Drain and the Hidalgo Main flow into the Lower Laguna Madre Bay assessment unit (AU) 2491_01 which is im-paired for low dissolved oxygen (DO). The North Floodway flows into the Lower Laguna Madre AU 2491_02 which is impaired for low DO and bacteria. The North Floodway has concerns for bacteria, nitrate, and chlorophyll-a according to Draft 2018 Texas Integrated Report. Water quality monitoring of the Hidalgo Main and Raymondville Drains began in 2018.

The project area is comprised of subwatersheds associated with the Raymondville Drain, the Hidalgo Floodway, and the IBWC pilot channel (IBWC North Floodway). These major waterways contribute freshwater and stormwater to the Laguna Madre. This project will begin the assessment of these subwatersheds. It is anticipated that these three distinct subwatersheds will need to be assessed, quantified, and identified as separate major watersheds in the Lower Rio Grande Valley.

The Raymondville Drain collects stormwater runoff and return flows from the subwatershed with predominant agriculture activity. The North Floodway pilot channel constantly drains WWTP effluent and during large storm events, collect excess runoff from urbanized areas of Hidalgo County and agriculture land in Cameron and Willacy County. The Hidalgo Main Drain carries urban stormwater runoff from central and northern Hidalgo County, and agricultural runoff from northeast Hidalgo County and Willacy County. The hydrology on the east end of these three watersheds has been severely impacted in recent years due to the expansion of the wind power farms; the access roads to the turbines have changed the runoff patterns in east Willacy County (based on anecdotal information).

Stakeholders also need to be engaged to determine what existing data is available and to define the goals and objectives of potential future watershed-based plans. Through the stakeholder engage-ment process, as well as a series of public meetings to solicit public input, a course of action for addressing potential pollutant loads can be determined. There is a lack of water quality data collection within the target region and limited data has been collected to assess the project watershed(s) impairments and concerns or determine the contributing sources. The watershed has not been characterized and stakeholders are unaware of the concerns and impairments. Stakeholders need to be educated on the potential causes of the impairments to assist in determining goals and objectives for reducing pollutants in their watershed. Part of raising awareness is to provide watershed characterization information including geographic boundaries and available water quality data. Identification of existing data will take place to provide to stake-holders so that future planning and implementation activities can take place.

3.4 Task 3. Watershed Characterization

The Watershed Characterization Report and Next Steps Report was approved on August 17, 2022 (Navarro *et al.*[6]). See the Appendix for Attachment. An executive summary is provided below.

Deliverables completed in this project represent the initial step in the development of an approved EPA nine element watershed protection plan. Partially fulfilling, Element A, Causes/Source of Pollution Identified, this project identified: (i.e., delineated) the region's sub-watersheds; relevant watershed data sources; NPS pollutants of concern; and potential point and non-point sources of pollutants of concern. Partially fulfilling Element E, Education and Outreach, this project included a Public Participation Plan, which resulted in: the formation of Stakeholder Groups for each Hidalgo Main Drain, Raymondville Drain, and North Floodway; and public outreach events where UTRGV worked closely with stakeholders we informed about project activities and findings and given opportunities to openly express their respective needs and concerns regarding the health of N&C watersheds.

With respect to fulfilling, Element A, additional observational data is required to definitively de-termine N&C waterway impairments. More extensive data sets to characterize flow rates and NPS pollutant concentrations at different flow rates are needs to quantify NPS loads and aid valida-tion/determination of pollutant origins as either point or non-point source pollutions. Accurate NPS load data is directly applicable and required to effectively comply with Element B-Expected Load Reductions for Solution Identified. Thus, limited availability of flow, including biased flow data, represents a significant data gap hindering Element B. The causes/sources of pollution identified in Element A is a fundamental data need for Element C-Nonpoint Source Management Measures, where BMPs are initially planned and located logically for effective implementation. Subsequent elements, D-Technical and Financial Assistance; F-Implementation Schedule; G-Milestones Iden-tified; H-Load Reduction Evaluation Criteria; and I-Monitoring, are all a function of identified pollutants, sources, and BMP selected for implementation.

As such, the next step in the Watershed Protection Planning process is the implementation of a comprehensive monitoring program capable of characterizing NPS dynamics as a function of vari-able flow conditions. The TCEQ has recently contracted Phase II monitoring for the N&C waters that will extend a monitoring program originally funded by the Texas Water Development Board-Freshwater In-Flows program that includes: quarterly sampling events to characterize water quality (bacteria, nutrients, pH, water temperature, specific conductance, and dissolved oxygen) and stream flow. Phase II monitoring will the TWDB program with the implementation of continuous water quality monitoring component whereby RATES, Inc. Real-Time-Hydrologic-System (RTHS) sta-tions that continuously measure (Stream stage height, air temperature, water temperature) will be augmented with multi-parameter sondes to continuously (i.e., hourly) measure water quality pa-rameters including: dissolved oxygen, ammonia, nitrate, and specific conductance. The ability to continuously monitor water quality data will enable characterization of water quality dynamics that would otherwise be missed through quarterly sampling campaigns. For example, the ability to continually measure dissolved oxygen is able to capture diurnal photosynthesis cycling where supersaturated conditions can exist during daylight hours and hypoxic and/or anoxic conditions can exist during the dark cycle. Additionally, the ability to continuously measure nutrients makes it possible to assess NPS load during high water events as they occur. Thus, removing bias from the measurements. The ability to combine water quality data with continuous stream flow data, de-rived from stage height measurements, can provide a true measure of the NPS load in each of the studied water ways and thereby aid determination NPS pollutant causes and sources as well provide benchmarks from which to determine load reduction needs.

The implementation of Phase II monitoring program will effectively establish baseline conditions defining each waterway's water quality and flow characteristics. These baseline condition, essen-tially serve as experimental controls necessary to evaluate the effectiveness of implement Best Man-agement Practices (BMPs). Considering the inherent variability of natural systems suggest the need for long-term monitoring programs to establish a stable baseline and identify the existence of nat-urally occurring variability (e.g. daily, seasonal, long-term weather events (droughts and extended wet period). As such it is strongly suggested that any monitoring program be continued to the fullest extent possible either through the CWA Section 319 program or through the Clean Rivers Program. To ensure the sustainability of this monitoring program, it is suggested disseminate the monitoring program data products and their applicability through active Education and Outreach activities that reach our water resource decision makers and LRGV residents who value the ecosystem services provided by N&C waterways.

Although N&C waterways were created as stormwater conveyances, they represent important recre-ational water bodies for the region's residents. Anecdotal observations indicate fisherman routinely harvest and consume fish from N&C waterways, despite monitoring data indicating that water con-centrations of bacteria exceed screening levels. It is suggested that N&C waterway monitoring be applied to Recreational Use Attainability Analysis to determine what category of recreation uses is appropriate for each water way as a function of water quality and flow characteristics. Outreach activities should extend invitations to recreational user of these waterways to better understand how these water resources are used.

3.5 Task 4. Partnership Coordination

The Partnership Coordination Report was approved on August 30, 2022 (Santos-Chavez et al.8). See the Appendix for Attachment. An executive summary is provided below. The Northern and Central Rio Grande Watersheds are the sub-watersheds of the Raymondville Drain, Hidalgo Floodway, and International Boundary & Water Commission North Floodway. Each of these sub-watersheds are tributaries to the Lower Laguna Madre assessment units (AUs) 2491_01 and 249_02 which are classified as impaired due to low dissolved oxygen and low dissolved oxygen and presence of pathogenic bacteria, respectively.

To address concerns and impairments of the Lower Laguna Madre (2491) assessment units 01 and 02, the watersheds of the Raymondville Drain, the Hidalgo Floodway, and the IBWC Floodway were characterized to determine potential causes and sources of impairments. This project identified existing watershed data and determined what data gaps needed to be filled to fully assess each of the sub-watersheds. characterization as well as a path forward by selecting an analytical method for estimating pollutant loads. The project also engaged, educated, and asked for input from stakeholders on the goals, aims, and indicators to address the impairments and concerns. Up-dates to determine the Causes/Sources of Pollution Identified (A) and Expected Load Reductions for Solutions Identified (B) were discussed at meetings.

This project started the watershed characterization by getting existing data from various sources, finding potential causes of water quality impairments and issues, sources of pollution and relative contribution, and completing an inventory of data. Through the International Boundary & Water Commission (IBWC), Hidalgo County Drainage District No. 1 and the Willacy County Drainage District, UTRGV gathered all the flow and water quality data that these agencies have collected over the years. This data was analyzed, categorized, and evaluated (based on reliability and accuracy) to find information that could be used to assess current conditions. A conceptual model was developed to show the linkage between the water quality problems and sources of impairments. This analysis, to the extent possible, included a spatial and temporal exploration of water quality problems and sources of pollution in the watershed. The identification and analysis of data will aid in finding data gaps and what data needs to be collected in the future. Additionally, all the data helped choose the analytical method that was used for estimating pollutant loads.

3.6 Task 5. Final Report

The current document constitutes the Draft Final Report.

CHAPTER

FOUR

AMOUNT OF PROJECT FUNDING AND AMOUNT SPENT

The budget has been spent through UTRGV staff from 2018 to 2021. UTRGV staff throughout the duration of the project had been channing as stated under the "Project engagement in UTRGV" 3.2.1 section. Therefore, fluctuations within the budget were reflected along with the wave of COVID problems that affected the planned tasks/activities.

Budget			
Category	TCEQ Reimbursable Portion (Federal)	Grantee Match Portion (Non-Federal)	Total
a. Personnel /Salary	$63,802.73	$10,807.00	$74,609.73
b. Fringe Benefits	$13,481.32	$3,362.00	$16,843.32
c. Travel	$3,988.91	$1,844.00	$5,832.91
d. Supplies	$2,293.54	$1,827.00	$4,120.54
e. Equipment	$-	$-	$-
f. Contractual	$-	$-	$-
g. Construction	$-	$-	$-
h. Other	$2,121.50	$-	$2,121.50
i. Subtotal (Sum a to h)	**$85,688.00**	**$17,840.00**	**$103,528.00**
j. Indirect Cost	$12,854.00	$25,963.00	$38,817.00
k. Other In kind/ Third Party		$21,892.00	$21,892.00
Total Project Costs (sum i, j, &k)	**$98,542.00**	**$65,695.00**	**$164,237.00**

Figure 4.1: Budget

Actual			
Category	TCEQ Reimbursable Portion (Federal)	Grantee Match Portion (Non-Federal)	Total
a. Personnel /Salary	$57,451.65	$10,807.00	$68,258.65
b. Fringe Benefits	$11,131.70	$3,362.00	$14,493.70
c. Travel	$3,441.96	$1,844.00	$5,285.96
d. Supplies	$1,283.24	$1,827.00	$3,110.24
e. Equipment	$-	$-	$-
f. Contractual	$-	$-	$-
g. Construction	$-	$-	$-
h. Other	$521.50	$-	$521.50
i. Subtotal (Sum a to h)	**$73,830.05**	**$17,840.00**	**$91,670.05**
j. Indirect Cost	$13,110.87	$24,237.61	$37,348.48
k. Other In kind/ Third Party		$15,883.01	$15,883.01
Total Project Costs (sum i, j, &k)	**$86,940.92**	**$57,960.62**	**$144,901.54**

Figure 4.2: Actual Expenses

Balance			
Category	TCEQ Reimbursable Portion (Federal)	Grantee Match Portion (Non-Federal)	Total
a. Personnel /Salary	$6,351.08	$-	$6,351.08
b. Fringe Benefits	$2,349.62	$-	$2,349.62
c. Travel	$546.95	$-	$546.95
d. Supplies	$-	$1,010.30	$1,010.30
e. Equipment	$-	$-	$-
f. Contractual	$-	$-	$-
g. Construction	$-	$-	$-
h. Other	$1,600.00	$-	$1,600.00
i. Subtotal (Sum a to h)	**$10,847.65**	**$1,010.30**	**$11,857.95**
j. Indirect Cost	$753.43	$715.09	$1,468.52
k. Other In kind/ Third Party		$6,008.99	$6,008.99
Total Project Costs (sum i, j, &k)	**$11,601.08**	**$7,734.38**	**$19,335.46**

Figure 4.3: Avaliable Balance

CHAPTER

FIVE

DISCUSSION AND CONCLUSIONS

5.1 Incomplete Deliverables

1. Key Stakeholder and Steering Committee Meetings: Several Key Stakeholder and Steering Committee Member meetings were not held during the course of the project. There was no impact on the attainment of the project objectives. There are several factors that influenced the intentional and unintentional missing of these meetings.

    1. This project is broken into 3 sub-watersheds that have significantly different hydrologic and socio-economic characteristics. However, despite these differences, the engagement of stakeholders resulted in significant overlap in individuals. As a result, the potential for “meeting fatigue” was high.

    2. Leadership of these groups was intentionally selected from elected officials in the region to promote institutional buy-in. However, scheduling these individuals for these meetings has proved difficult, requiring more lead-time than was originally anticipated.

    3. COVID-19 impaired the team’s ability to meet in person with stakeholders for a signifi-cant portion of the project period. Although video conference meetings were scheduled, there was a lag before participants were able to fully engage via this medium.

2. Delayed Deliverables: The project team unfortunately was unfortunately unable to meet de-liverable deadlines during the latter part of the project. This primarily due to high turn-over in qualified staffing and an increasing reliance on graduate students. The reasons for this are explained earlier in this document. Maintaining qualified staffing is a critical element in ensuring the seamless execution of Section 319 (h) projects with thier associated neces-sary burden of Quality Assurance and Reporting requirements. The project leadership has decades of demonstrated successful execution of these projects with technical infrastructure provided by RATES and the Stormwater Taskforce. With the exclusion of these entities from the project performance team, unfortunately the critical technical staffing underpinning was removed, resulting in poor performance in deliverable production rates.

5.2 Lessons Learned

1. Stakeholder meetings must be scheduled well in advance, with a keen eye to new content delivery.
2. Weekly and bi-weekly conference call with TCEQ Project Managers are invaluable, however the project performance team must take a leadership role in structuring the meetings according to the project activities and upcoming milestones.
3. Institutional buy-in at the performing party is as critical as community engagement. Community leadership should play a more engaged governance role in this area.
4. Stable technical staffing is a critical to Quality Assurance.
5. Water Quality trends in the sub-basins being characterized is of sufficient concern to the community stakeholders to warrant further investigation.
6. Anecdotal evidence in these subwatersheds, and other nearby watershed, indicate that Dissolved Oxygen levels may experience extreme diurnal variations, going from anoxic to saturated in each cycle. This can have significant impacts on biota and the potential mitigation approaches.

5.3 Recommendations

1. Continued characterization of these sub-watersheds is strongly recommended.
2. Utilization of continuous monitoring for available water quality parameters is necessary to understand the causes and impacts of rapid fluctuations in water quality.

APPENDIX

A

BUDGET REVISION REQUEST

https://rates-inc-nandcphase1.readthedocs-hosted.com/en/latest/_static/90196_BRR_1.pdf

Contract Number: 582-19-90196

Attachment C

BUDGET REVISION REQUEST FORM# 1

Purpose: To document recipient organization's proposed budget changes to ensure project deliverables are met and fiscal accountability. Prior TCEQ review and approval is required before incurring specific costs resulting in cumulative transfers of more than 10% of the total budget.

Instructions: Complete 1. - 8. Total the amounts in 9., i., and k.

1. Recipient Organization (Name & Complete Address Including Zip Code):

The University of Texas Rio Grande Valley
1201 W University Dr Edinburg, Tx 78539

2. Grant/ Contract Title: Characterization of Northern Central Lower RGV Watersheds		3. Payee Identification No.: 37467467462	
4. TCEQ Contract No.: 582-19-90196		5. Total Project/ Grant Period: $164,237/ 9/1/18-8/31/22	
6. Budget Categories:	7. Approved Budget	8. Change Requested (+ or -)	9. New or Revised Budl!et
a. Personnel/Salaries	$ 58,187.00	$ 16,422.73	$ 74,609.73
b. Fringe Benefits	$ 18,109.00	($ 1,265.68)	$ 16,843.32
c. Travel	$ 10,968.00	($ 5,135.09)	$ 5,832.91
d. Supplies	$ 5,318.00	($ 1,197.46)	$ 4,120.54
e. Equipment	$ 0.00	$ 0.00	$ 0.00
f. Contractual	$ 0.00	$ 0.00	$ 0.00
g. Construction	$ 0.00	$ 0.00	$ 0.00
h. Other	$ 10,946.00	($ 8,824.50)	$ 2,121.50
i. Total Direct Costs (sum a - h)	$ 103,528.00	$ 0.00	$ 103,528.00
j. Indirect Costs (__% x $____ Salary)	$ 38,817.00	$ 0.00	$ 38,817.00
k.Total (sum i & j)	$ 142,345.00	$ 0.00	$ 142,345.00

Justification (Attach additional sheets, if necessary): See attachment.

"** Budget Revision Request must contain all signatures to be approved/valid "**

Suelema Gonzalez — Digitally signed by Suelema Gonzalez Date: 2021.12.08 08:59:37 -06'00'

Signature of Recipient's Representative and Date — Type or Printed Name and Title

Kristin DeBone — Digitally signed by Kristin DeBone Date: 2021.12.14 08:32:25 -06'00'

Signature of TCEQ Project Manager and Date — Kristin DeBone — Type or Printed Name and Title

Darrin Jones

Signature of TCEQ Contract Manager and Date — 12.22/2021 — Type or Printed Name and Title

Budget Revision Request – Justification

TCEQ Contract # 582-19-90196

Budget Categories:	Approved Budget	Change Request	Revised Balance
salaries	58,187.00	16,422.73	74,609.73
fringe	18,109.00	(1,265.68)	16,843.32
travel	10,968.00	(5,135.09)	5,832.91
supplies	5,318.00	(1,197.46)	4,120.54
equipment	-	-	-
contractual	-	-	-
construction	-	-	-
other expenses	10,946.00	(8,824.50)	2,121.50
total direct cost	103,528.00	-	103,528.00
indirect cost	38,817.00	-	38,817.00
total grantee cost	142,345.00	-	142,345.00
other inkind	21,892.00	-	21,892.00
total project costs	164,237.00	-	164,237.00
recipient cost share 40%	65,695.00	-	65,695.00
total reimbursement	98,542.00	-	98,542.00

Salaries – To pay labor hours to complete Modeling and Characterization activities.

Fringe Benefits – Actual fringe benefit were less for some faculty and student workers. We are requesting to leave sufficient budget, around 10% of salaries, to be paid out for the remainder of the project period.

Travel – To cover travel costs to attend meetings.

Supplies – To purchase material and supplies to complete the scope of work.

Other Expense – We are requesting to redistribute budget to appropriate budget categories and complete the scope of work.

APPENDIX

B

QUALITY ASSURANCE PROJECT PLAN

https://rates-inc-nandcphase1.readthedocs-hosted.com/en/latest/_static/90196_QAPP_geospatial_executed.pdf

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

November 7, 2019

Ahmed Mahmoud, Ph.D.
The University of Texas Rio Grande Valley
1201 West University Drive
Edinburg, TX 78539

Re: Approval: Characterization of Northern and Central Lower Rio Grande Valley Watersheds Geospatial Quality Assurance Project Plan (QAPP)

Federal Grant Number: 99614623

Dear Dr. Mahmoud:

The above-referenced QAPP was approved today, November 7, 2019. A pdf version of the QAPP and approval letter will be sent to your e-mail address.

Please ensure the QAPP and any subsequent amendments are distributed in a timely manner to the appropriate entities listed in Section A3 of the QAPP. This approval letter must be available for review during a quality system audit.

Should you have questions, feel free to contact me at (512-239-6340) or at sharon.coleman@tceq.texas.gov .

Sincerely,

Sharon R. Coleman
TCEQ Quality Assurance Manager and Acting Lead Nonpoint Source (NPS) Program Quality Assurance Specialist

Enclosure

Cc: Tim Cawthon, TCEQ NPS Project Manager, MC-203

Characterization of Northern and Central Lower Rio Grande Valley Watersheds Geospatial Quality Assurance Project Plan (QAPP)

The University of Texas Rio Grande Valley (UTRGV)
Edinburg, Texas 78539

Funding Source:

Nonpoint Source (NPS) Program CWA §319(h)
Prepared in cooperation with the
Texas Commission on Environmental Quality and
the U.S. Environmental Protection Agency
Federal ID # 99614623
QTRAK# 20-053

Effective Period: Three years from date of final approval

Questions concerning this QAPP should be directed to:

Ahmed Mahmoud, Ph.D.
Project Manager
1201 West University Drive
Edinburg TX 78539
956-331-9847
ahmed.mahmoud@utrgv.edu

A1 APPROVAL PAGE

By signing this document, signatories acknowledge their respective organizations' awareness of and adherence to requirements contained in this QAPP in accordance with roles and responsibilities as described in Section A4 Project/Task Organization and throughout.

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Monitoring Division
Laboratory and Quality Assurance (QA) Section

Sharon R. Coleman 11/7/2019
Sharon R. Coleman — Date
TCEQ QA Manager

Sharon R. Coleman 11/7/2019
Sharon R. Coleman — Date
Acting Lead NPS QA Specialist
Quality Assurance Team

Water Quality Planning Division

Faith Hambleton 11/6/19
Faith Hambleton, Team Leader — Date
Nonpoint Source (NPS) Program

Jessica Uramkin 11/5/19
Jessica Uramkin, NPS QA Coordinator — Date
NPS Program

Tim Cawthon 11/4/19
Tim Cawthon, NPS Project Manager — Date
NPS Program

The University of Texas Rio Grande Valley

Ahmed Mahmoud, Project Manager — Date 11/04/19

Abdoul Oubeidillah, Ph.D., QAO/Data Manager — Date 11/04/2019

UTRGV will secure written documentation from additional project participants stating the organization's awareness of and commitment to requirements contained in this QAPP and any amendments or revisions of this plan. UTRGV will maintain this documentation as part of the project's quality assurance records. This documentation will be available for review. Copies of this documentation will also be submitted as deliverables to the TCEQ NPS Project Manager within 30 days of final TCEQ approval of the QAPP. (See sample letter in Attachment 1 of this document.)

A2 TABLE OF CONTENTS

AU	Assessment Unit
BSEACD	Barton Springs Edwards Aquifer Conservation District
CAR	Corrective Action Report (CAR)
CWA	Clean Water Act
DO	Dissolved Oxygen
ECHO	Environmental Compliance History Online
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
GIS	Geographic Information System
HCDD	Hidalgo County Drainage District
IBWC	International Boundary and Water Commission
LRGV	Lower Rio Grande Valley
MS4	Municipal Separate Storm Sewer Systems
NCEI	National Centers for Environmental Information
NHD	National Hydrography Dataset
NHD	National Hydrology Dataset
NLCD	National Land Change Database
NOAA	National Oceanic and Atmospheric Administration
NPS	Non-Point Source
NRCS	Natural Resources Conservation Service
OSSF	On-Site Sewage Facility
QA	Quality Assurance
SELECT	Spatial Explicit Load Enrichment Calculation Tool
SOP	standard operating procedures
SSO	Sanitary Sewer Overflows
SSURGO	Soil Survey Geographic Database
TAMUK	Texas A&M University-Kingsville
TIGER	Topologically Integrated Geographic Encoding and Referencing database
TMDL	Total Maximum Daily Load
TNRIS	Texas Natural Resources Information System
TPDES	Texas Pollutant Discharge Elimination System
TPWD	Texas Parks and Wildlife Department
TSDN	Technical Support Data Notebook
TSS	Total Suspended Solids
TWDB	Texas Water Development Board
TWRI	Texas Water Research Institute
TxDOT	Texas Department of Transportation
USDA	US Department of Agriculture
USGS	United States Geological Survey
UTRGV	University of Texas Rio Grande Valley
WPP	Watershed Protection Plan

WQMP	Water Quality Management Plans
WWTP	Waste Water Treatment Plant

A3 DISTRIBUTION LIST

The Acting Lead NPS QA Specialist will provide approved versions of this QAPP and any amendments or revisions to the TCEQ NPS Project Manager. The TCEQ NPS Project Manager will provide approved copies to the UTRGV Project Manager and EPA Project Officer within two weeks of approval. The TCEQ NPS Project Manager will document transmittal of the plan and maintain this documentation as part of the project's quality assurance records. This documentation will be available for review in the event of an audit.

Anthony Suttice, Project Officer
EPA Region 6
(214) 665-8590

The UTRGV will provide copies of this project plan and any amendments or revisions of this plan to each project participant defined in the list below. The UTRGV will document receipt of the plan by each participant and maintain this documentation as part of the project's quality assurance records. This documentation will be available for review in the event of an audit.

The University of Texas Rio Grande Valley
Ahmed Mahmoud, Ph.D., Project Manager
1201 West University Drive
Edinburg TX 78539
956-331-9847
Ahmed.mahmoud@utrgv.edu

Abdoul Oubeidillah, Ph.D., Quality Assurance Officer/ Data Manager
1201 West University Drive
Edinburg TX 78539
abdoul.oubeidillah@utrgv.edu

A4 PROJECT/TASK ORGANIZATION

TCEQ

Monitoring Division

Sharon R. Coleman
Acting Lead NPS QA Specialist
Assists the TCEQ NPS Project Manager in QA related issues. Participates in the planning, development, approval, implementation, and maintenance of the QAPP. Determines conformance with program quality system requirements. Coordinates or performs audits, as deemed necessary and using a wide variety of assessment guidelines and tools. Concurs with proposed corrective actions and verifications. Provides technical expertise and/or consultation on quality services. Recommends to TCEQ management that work be stopped in order to safe guard project and programmatic objectives, worker safety, public health, or environmental protection.

Water Quality Planning Division

Faith Hambleton, Team Leader
NPS Program
Responsible for management and oversight of the TCEQ NPS Program. Oversees the development of QA guidance for the NPS program to be sure it is within pertinent frameworks of the TCEQ. Monitors the effectiveness of the program quality system. Reviews and approves all NPS projects, internal QA audits, program corrective actions, work plans, and contracts. Enforces program corrective action, as required. Ensures NPS personnel are fully trained and adequately staffed.

Tim Cawthon TCEQ NPS Project Manager
Maintains a thorough knowledge of work activities, commitments, deliverables, and time frames associated with projects. Develops lines of communication and working relationships between the contractor, the TCEQ, and the EPA. Tracks deliverables to ensure that tasks are completed as specified in the contract. Responsible for ensuring that the project deliverables are submitted on time and are of acceptable quality and quantity to achieve project objectives. Serves on planning team for NPS projects. Provides contractor with most recent version of QAPP shell document. Participates in the development, approval, implementation, and maintenance of the QAPP. Conducts independent technical review of the QAPP to ensure compliance with project needs and requirements. Responsible for verifying that the approved QAPP is implemented by the contractor. Notifies the TCEQ Lead NPS QA Specialist of particular circumstances which may adversely affect the quality of data derived from the collection and analysis of samples. Monitors and enforces corrective action.

Jessica Uramkin

TCEQ NPS Modeling QAPP Shell, Last Updated: March 2017

NPS Quality Assurance Coordinator
Assists Lead NPS QA Specialist with NPS QA management. Serves as liaison between NPS management and Agency QA management. Responsible for NPS guidance development related to program quality assurance. Assists with development and maintenance of data management-related standard operating procedures (SOP) for NPS data management. Participates in the development, approval, implementation, and maintenance of the QAPP. Provides input and oversight regarding corrective actions. Maintains record of corrective actions.

Ahmed Mahmoud, Ph.D.
UTRGV Project Manager
Responsible for ensuring tasks and other requirements in the contract are executed on time and are of acceptable quality. Monitors and assesses the quality of work. Coordinates attendance at conference calls, training, meetings, and related project activities with the TCEQ. Responsible for verifying the QAPP is followed and the project is producing data of known and acceptable quality. Ensures adequate training and supervision of all data collection activities. Complies with corrective action requirements.

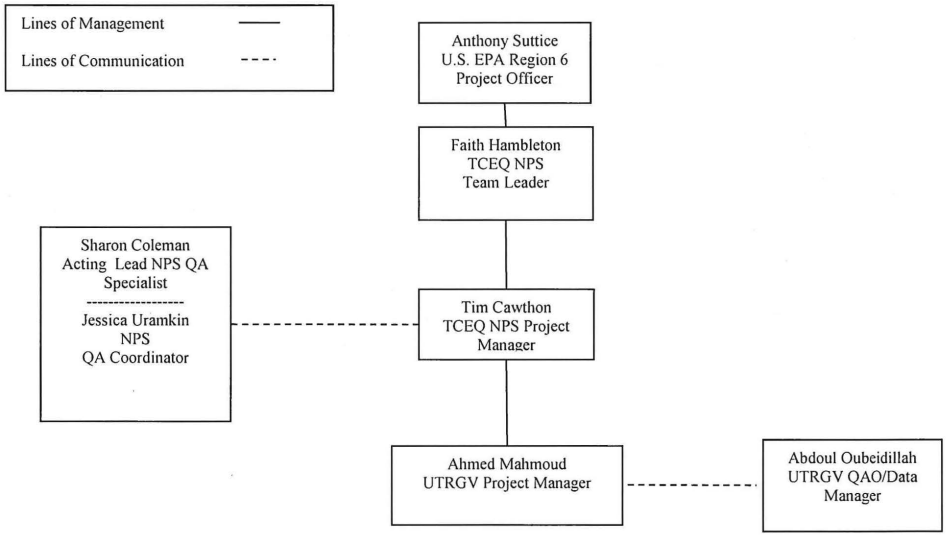
Abdoul Oubeidillah, Ph.D.
UTRGV QAO and Data Manager
Responsible for coordinating development and implementation of the QA program. Responsible for ensuring the most recent version of the NPS QAPP shell document is acquired from the TCEQ NPS Project Manager and used for writing and maintaining the QAPP. Responsible for maintaining records of QAPP distribution, including appendices and amendments. Responsible for maintaining written records of sub-tier commitment to requirements specified in this QAPP. Responsible for identifying, receiving, and maintaining project quality assurance records. Responsible for coordinating with the TCEQ NPS Project Manager to resolve QA- related issues. Notifies the UTRGV Project Manager and TCEQ NPS Project Manager of and documents particular circumstances which may adversely affect the quality of data. Responsible for validation and verification of all data modeled, collected and acquired. Coordinates the research and review of technical QA material and data related to water quality monitoring system design and analytical techniques. Facilitates, conducts, and documents any technical systems audits.

The Project Data Manager is responsible for acquisition, verification, and analysis of secondary data, documentation of acquired data sources, ensuring the accuracy of data, and for the transfer of acquired data to the TCEQ as deemed necessary by TCEQ Project Manager. Oversees data management for the QAPP. Responsible for maintaining project quality assurance records. Oversees data management for the study. Provides the point of contact for the TCEQ Data Manager to resolve issues related to the data.

U.S. EPA Region 6
Anthony Suttice
EPA Project Officer

Responsible for managing the CWA Section 319 funded grant on behalf of EPA. Assists the TCEQ in approving projects that are consistent with the management goals designated under the State's NPS management plan and meet federal guidance. Coordinates the review of project work plans, draft deliverables, and works with the State in making these items approvable. Meets with the State at least annually to evaluate the progress of each project and, when conditions permit, participates in project site visits. Fosters communication within EPA by updating management and others, both verbally and in writing, on the progress of the State's program and on other issues as they arise. Assists in grant close-out procedures ensuring all deliverables have been satisfied prior to closing a grant.

Figure A4.1. Organization Chart - Lines of Communication



A5 PROBLEM DEFINITION/BACKGROUND

The Northern and Central Lower Rio Grande Valley (LRGV) watersheds are north of the Arroyo Colorado watershed in Hidalgo, Cameron, and Willacy counties. The watersheds include several TCEQ segments: North Floodway (2494B_01), Hidalgo Main Floodwater Channel (2491C_03), Raymondville Drain (2491C_01), Willacy Main Drain (2491C_02), and remaining perennial freshwater drainage ditches flowing into main drains (2491C_04).The Raymondville Drain and the Hidalgo Main flow into the Lower Laguna Madre Bay assessment unit (AU) 2491_01 which is impaired for low dissolved oxygen (DO). The North Floodway flows into the Lower Laguna Madre AU 2491_02 which is impaired for low DO and bacteria. The North Floodway has concerns for bacteria, nitrate, and *chlorophyll-a* according to Draft 2018 Texas Integrated Report. Water quality monitoring of the Hidalgo Main and Raymondville Drains began in 2018.

The project area is comprised of subwatersheds associated with the Raymondville Drain, the Hidalgo Floodway, and the IBWC pilot channel (IBWC North Floodway). These major waterways contribute freshwater and stormwater to the Laguna Madre. This project will begin the assessment of these subwatersheds. It is anticipated that these three distinct subwatersheds will need to be assessed, quantified, and identified as separate major watersheds in the Lower Rio Grande Valley.

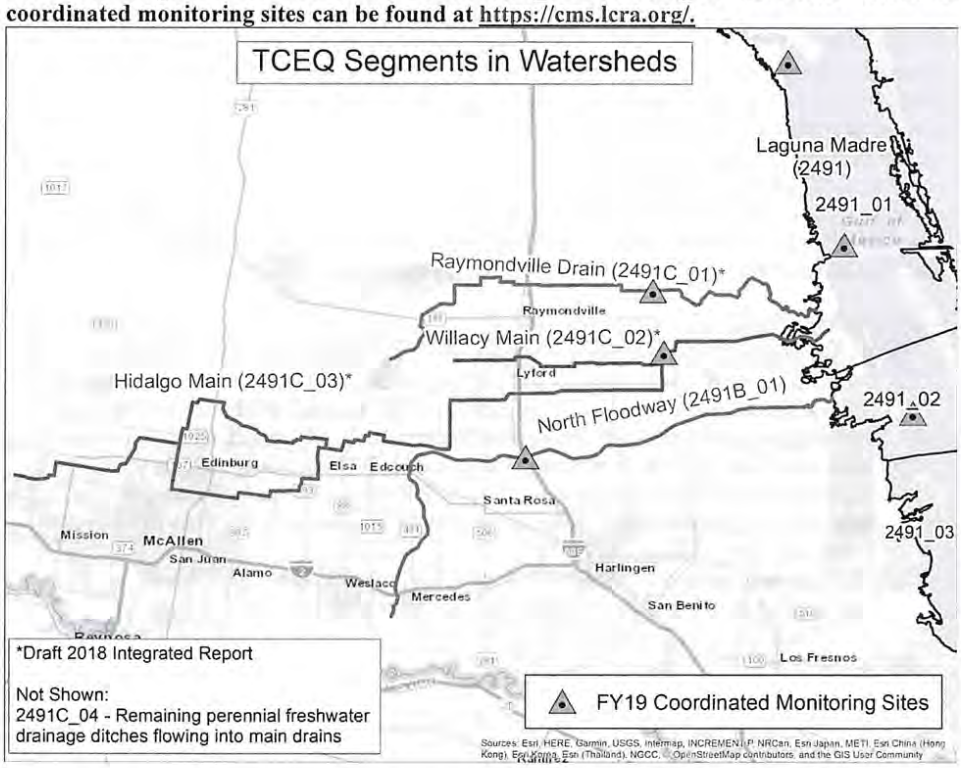
The Raymondville Drain collects stormwater runoff and return flows from the subwatershed with predominant agriculture activity. The North Floodway pilot channel constantly drains WWTP effluent and during large storm events, collect excess runoff from urbanized areas of Hidalgo County and agriculture land in Cameron and Willacy County. The Hidalgo Main Drain carries urban stormwater runoff from central and northern Hidalgo County, and agricultural runoff from northeast Hidalgo County and Willacy County. The hydrology on the east end of these three watersheds has been severely impacted in recent years due to the expansion of the wind power farms; the access roads to the turbines have changed the runoff patterns in east Willacy County (based on anecdotal information).

There is a lack of water quality data collection within the target region and limited data has been collected to assess the project watershed(s) impairments and concerns or determine the contributing sources. The watershed has not been characterized and stakeholders are unaware of the concerns and impairments. Stakeholders need to be educated on the potential causes of the impairments to assist in determining goals and objectives for reducing pollutants in their watershed. Part of raising awareness is to provide watershed characterization information including geographic boundaries and available water quality data. Identification of existing data will take place to provide to stakeholders so that future planning and implementation activities can take place.

Stakeholders also need to be engaged to determine what existing data is available and to define the goals and objectives of potential future watershed-based plans. Through the stakeholder

engagement process, as well as a series of public meetings to solicit public input, a course of action for addressing potential pollutant loads can be determined.

Figure A5.1. Map of TCEQ defined segments and coordinated monitoring sites flowing into the Lower Laguna Madre assessment units 2491_01 and 2491_02. More information on coordinated monitoring sites can be found at https://cms.lcra.org/.



A6 PROJECT/TASK DESCRIPTION AND SCHEDULE

In an effort to address the concerns and impairments of the Lower Laguna Madre (2491) assessment units 01 and 02, the watersheds of the Raymondville Drain, the Hidalgo Floodway, and the IBWC Floodway must be characterized to identify potential causes and sources. This project will identify existing data and identify data gaps for characterization as well as identify a path forward by selecting an analytical method for estimating pollutant loads. This project will also engage, educate, and solicit input from stakeholders on the goals, objectives, and indicators for addressing the impairments and concerns. Ultimately, it is the goal of this project to partially

accomplish Element A and initiate Element E of EPA's nine elements for watershed-based plans found in the Handbook for Developing Watershed Plans to Restore and Protect our Waters. This project will start the watershed characterization by acquiring existing data from various sources, identifying potential causes of water quality impairments and issues, identifying potential sources of pollution and relative contribution, and completing an inventory of data. Through the IBWC, Hidalgo County Drainage District No. 1 and the Willacy County Drainage District, UTRGV will gather all the flow and water quality data that these agencies have collected over the years. This data will be analyzed, categorized and evaluated (based on reliability and accuracy) to identify information that can be used to assess current conditions. A conceptual model will be developed to show the linkage between the water quality problems and sources of impairments. This analysis, to the extent possible, will include a spatial and temporal exploration of water quality problems and sources of pollution in the watershed. Identification and analysis of existing data will assist in determining data gaps and what data needs to be collected in the future. Additionally, the existing data and new data will drive the selection of the analytical method that will be used for estimating pollutant loads.

Specific Tasks to be accomplished include:

1) **Delineation of Subwatersheds** – The 3 watersheds will be split into subwatersheds for visualization of drainage patterns and potential future modeling effort (no modeling will be conducted under this project). Delineation of the subwatersheds will include LIDAR data analysis, individual city drainage delineations (e.g. Edinburg), local knowledge, and other sources as needed. A Watershed Delineation Documentation document will be developed documenting the process of how subwatersheds were delineated and areas that need future refinements (e.g. more on the ground studies). FGDC metadata will be developed for the GIS layer.
2) **Map Development** - Development of maps for inclusion in the Watershed Characterization Report and for presentation to stakeholders. Maps will include subwatersheds layer to visually show stakeholders drainage patterns and potential sources within those subwatersheds.
3) **USGS NHD Markup Application** – At the end of the project, UTRGV will suggest edits to the National Hydrography dataset using local information gathered during the course of the project. More information on the application is found here. https://www.usgs.gov/core-science-systems/ngp/national-hydrography/tools#Markup
4) **Flow and Water Quality Graphs** – UTRGV will gather all water quality and flow related data within the watersheds and conduct exploratory data analysis. Graphs and results will be presented to stakeholders and incorporated into the Watershed Characterization Report.
5) **Cyberinfrastructure and Database** – A regional database will be established and a web user interface developed. This database will incorporate local data received by Texas A&M University at Kingsville for the Arroyo Colorado watershed.

The main goal of the project is to collect and analyze data for the characterization of the three watersheds USIBWC North floodway, Hidalgo/Willacy Main Drain, and Raymondville Drain. This goal will be achieved through compiling geospatial and non-geospatial data for each watershed from various sources. UTRGV team will use the geospatial data to develop several maps and form a GIS database of each parameter to understand the predominant landscaping of each area contributing in the watershed. The non-geospatial data will be collected to assess the flow and water quality status and studying the different sources that affect the water flow to each floodway. By developing a database for each watershed, it can be used for further identification and future quantification of different potential pollutant sources which is a part of the WPP development. Activities in this project will create, coordinate, and facilitate a local stakeholder group that will determine the goals, objectives, and indicators for addressing the water quality impairments and concerns within the Raymondville Drain, the Hidalgo Floodway, and the IBWC Floodway watershed. Education programs will be delivered to the stakeholder group so they can understand what contributes to bacteria impairments, as well as, the parameters of concern in the project area and ways that they can be mitigated. Stakeholders will be engaged in developing the three WPPs for each watershed so that management measures are cost-effective, holistic, and supported at the local level.

To assist in helping stakeholders make decisions within their watershed, UTRGV will acquire, compile, and evaluate all existing relevant data, historical information, engineering studies, and other related information from State agencies, regional TMDLs, USIBWC, Hidalgo, Willacy and Cameron Counties; and all the cities within the boundaries of the watersheds for use in watershed characterization, stakeholder education and WPP development. UTRGV will coordinate project partners' ongoing data collection to support the development of the WPP, work to address any gaps in existing water quality data and to determine specific impacts of stormwater on areas with notable pollution. Information on acquired data is addressed in Element B9 of this document. Data analyses and maps of the project area, including sampling stations will be provided in the project final report.

UTRGV, in collaboration with other project partners, will work to compile, assess, and quality assure any existing, updated, or new data, information, and reports that may be used in characterizing the watershed, determining current and future levels and sources of pollution, and identifying management needs. UTRGV and project partners will assess existing water quality data and current monitoring efforts to determine if available data allows for comprehensive determination of sources and quantities of pollution.

If additional routine or stormwater sampling is required, UTRGV will conduct sampling site reconnaissance at prospective sample sites to determine the suitability. Once site selection has been finalized, UTRGV will coordinate with the Willacy, Hidalgo, Cameron Counties and other partners to conduct monitoring. These monitoring efforts, if required, will be performed in accordance with partner QAPPs or quality assurance protocols and will not utilize federal Clean Water Act Section 319 grant funds.

UTRGV will submit data reports and presentations for review and approval at least two weeks prior to any scheduled public release.

Mapping and modeling efforts to predict future watershed conditions will not be covered under this QAPP. A separate Mapping and Modeling QAPP will be developed for estimating, mapping, and modeling future development/watershed conditions and associated water quality impacts using future development scenarios.
Some map data may not be available in GIS format. To convert the map information to a digital GIS layer UTRGV may georeference the map and trace the features. This will be done for some local subwatershed delineations if UTRGV is unable to obtain a GIS layer but there is a map available. If only a paper map is available, then the map would be scanned and then georeferenced

The purpose of this QAPP is to clearly delineate the roles and responsibilities of UTRGV as project manager as well as QA policy, management structure and procedures to implement the QA requirements during this project.

This project started in September 2018 and is estimated to be completed in August 2020. All task and deliverable dates are estimates.

See Appendix A for the contract scope of work and schedule of deliverables for a description of work defined in this QAPP.

Revisions to the QAPP

Amendments
Amendments to the QAPP must be approved to reflect changes in project organization, tasks, schedules, objectives, and methods; address deficiencies and non-conformances; improve operational efficiency; and accommodate unique or unanticipated circumstances. Requests for amendments are directed from the UTRGV Project Manager to the TCEQ NPS Project Manager in writing using the QAPP Amendment shell. The changes are effective immediately upon approval by the TCEQ QA Manager, TCEQ NPS Project Manager, and Lead NPS QA Specialist, or their designees.

Amendments to the QAPP and the reasons for the changes will be documented, and full copies of amendments will be forwarded to all persons on the QAPP distribution list by the UTRGV QAO. Amendments shall be reviewed, approved, and incorporated into a revised QAPP during the annual revision process or within 120 days of the initial approval in cases of significant changes.

Annual QAPP Reviews and Revisions This QAPP shall be reviewed in its entirety and certified annually by the UTRGV Project Manager and NPS Project Manager. A letter certifying

this annual review must be submitted to the TCEQ NPS Project Manager no later than 90 days prior to the QAPP anniversary date. Amendments approved since QAPP approval (or most recent annual review, if applicable) willbe included as an attachment along with the letter. Only non-substantive changes not affecting the project design or quality or quantity of work to be performed can be included in the annual certification letter. This includes organizational changes or schedule changes based on a contract amendment that do not impact data deliverables. If changes beyond these are necessary, a QAPP amendment must be submitted and approved before the annual review may be certified. The TCEQ NPS Project Manager is required to review the QAPP and provide certification of annual reviews to the TCEQ QA Manager and EPA Region 6 Project Officer no later than 30 days before QAPP anniversary date. If the QAPP expires, work described within this document must be halted.

If the project will extend beyond the third QAPP anniversary date, a full QAPP revision is required. This is accomplished by submitting a cover letter, a document detailing changes made if any, and three copies of the fully updated QAPP (including three sets of signature pages).

A7 QUALITY OBJECTIVES AND CRITERIA

No data will be collected specifically for this project. Existing data from other sources will be used, and are described in Section B9. Data used for analyses will undergo quality assurance checks and review. The best available (and most defensible) data will be used based on the following criteria:

1) **Data source:** Datasets publicly distributed by local, regional, state or federal agencies and entities will be considered acceptable for the required data analyses. Unpublished data considered trustworthy by local governments and universities in the general watershed area will also be considered acceptable for use on this project. Other data not publicly distributed will be considered acceptable if they have been published and distributed in citable publicly available formats, such as books or journal publications, if no better sources for that data are available. The other data not publicly distributed will be the object of discovery activities by UTRGV.
2) **Currency:** More recently produced datasets will be considered superior to older datasets; datasets derived from primary data collected recently will be considered better than datasets derived from older data.
3) **Defensibility:** Metadata, or other descriptions of data quality and how the data were collected or developed, will be compiled when available for data sources.
4) **Accuracy:** Given the wide range of data types to be used, it is difficult to specify uniform criteria for positional or attribute accuracy. However, when more than one source of a given type of data is available, the data source with higher accuracy (as stated in the metadata) will be used.
5) **Resolution:** Data of higher spatial resolution are generally preferred for this project.

6) **Spatial and Temporal Representativeness:** Data should be representative of current conditions within the project watershed. For some data types that are unlikely to change on a large scale with time, such as elevation and soil type, older data may be considered representative of the more recent period. Where possible, only the most recent 20 years of data will be used to support findings and calculations.
7) **Completeness:** Datasets with fewer missing data are preferred over those with more missing data.
8) **Format:** Data should be available in electronic format. Files should be either: 1) in a grid or shape file type that can be read by ESRI ArcGIS; 2) in a text, database, or spreadsheet format with geographic coordinates, such as latitude and longitude or other defined coordinate system, that can be used in GIS; or 3) in a text, database, or spreadsheet format with spatial reference information, such as county name, that can be spatially joined to existing ESRI ArcGIS shapefiles.

See Section B10 for information on how data acquired under this QAPP will be managed.

A8 SPECIAL TRAINING REQUIREMENTS/CERTIFICATION

Work conducted by UTRGV for this project is covered under a documented quality management system. Personnel conducting work associated with this project are deemed qualified to perform their work through educational credentials, specific job/task training, required demonstrations of competency, and internal and external assessments. Records of educational credentials, training, demonstrations of competency, assessments, and corrective actions are retained by UTRGV and are available for review.

A9 DOCUMENTS AND RECORDS

The document and records that describe, specify, report, or certify activities, requirements, procedures, or results for this project are listed in table A9.1.

Table A9.1 Project Documents and Records

Document/Record	Location	Retention*[a]	Form*[b]
QAPPs, amendments, and appendices	UTRGV	5 years	Paper
QAPP distribution documentation	UTRGV	5 years	Paper
Progress report/final report/ data	UTRGV/TCEQ	5 years	Paper/Electronic
Training records to include educational credentials and demonstration of competency	UTRGV	5 years	Paper/Electronic
Data Collection Summary	UTRGV	5 years	Electronic
Corrective Action Reports	UTRGV	5 years	Electronic

*a – After the close of the project
*b – Electronic files should be ASCII (DOS) pipe delimited text files or MS Word/Excel; model input and output files can be archived in the format used by the modeling software, provided the capability of conversion to ASCII

(DOS) pipe delimited text files or MS Word/Excel (TCEQ compatible version) is maintained over the time of retention.

The TCEQ may request records at any time and/or elect to take possession of records at the conclusion of the specified retention period.

B1 SAMPLING PROCESS DESIGN (EXPERIMENTAL DESIGN)

Does not apply to this QAPP.

B2 SAMPLING METHODS

Does not apply to this QAPP.

B3 SAMPLE HANDLING AND CUSTODY

Does not apply to this QAPP.

B4 ANALYTICAL METHODS

Does not apply to this QAPP.

B5 QUALITY CONTROL

Does not apply to this QAPP.

B6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION AND MAINTENANCE

Does not apply to this QAPP.

B7 INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

Does not apply to this QAPP.

B8 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

Does not apply to this QAPP.

B9 NON-DIRECT MEASUREMENTS

Geospatial data available from various local, regional, state, and federal organizations may be used for cartographic purposes. Maps developed for reports will be for illustrative purposes. Geospatial data utilized in maps of the study area may include land use, precipitation, soil type,

ecoregion, TCEQ monitoring location, TCEQ permitted outfall, gage location, city/county/state boundary, stream hydrology, reservoir, drought, road, watershed, municipal separate storm sewer system, urbanized area, basin, railroad, recreational area, area landmark, aerial photography, and park information. The above data come from the following reliable sources: United States Geological Survey (USGS), Texas Natural Resources Information System (TNRIS), TCEQ, US Census Bureau, Hidalgo, Willacy and Cameron Counties; USIBWC and all the cities within the boundaries of the watersheds including Edinburg, La Villa, Mercedes, Weslaco and San Juan. Geospatial data from these sources are accepted for use in this project maps based on the reputability of these data sources and the fact that there are no known comparable sources for these data. Geospatial data sources will be cited in reports and are listed in Table B9.1.

Other data that are compiled and published by other entities may also be used in preparing project reports. This may include long-term precipitation, census, ecoregion, and stream flow data, sanitary sewer overflows (SSOs), Texas Pollutant Discharge Elimination System (TPDES) permit violations, agricultural census data on livestock, emergency services data, wildlife population estimates, and groundwater resource information such as aquifer boundaries and well locations. Sources of these data are the USGS, National Weather Service, US Census Bureau, US Department of Agriculture USDA National Agricultural Statistics Survey, EPA Environmental Compliance History Online (ECHO), Texas Parks and Wildlife Department (TPWD), Arroyo Colorado Watershed Partnership and the Texas Water Development Board (TWDB). Data collected by these entities are assumed to have been verified and validated according to the requirements of the respective programs. Data compilations created for this project will be visually screened for errors. Geospatial data from these sources are accepted for use in project maps based on the reputability of these data sources and the fact that there are no known comparable sources for these data. Data will be cited in reports.

Data will be acquired via web portal when possible, however, email or in-person requests may be required to secure some of the listed data sources.

Qualified data will be evaluated for acquisition and used on a case-by-case basis using best available information.

Both routine monitoring data and targeted monitoring (ex. storm event) data will be acquired through this QAPP; however, only comparable data will be included in project reports.

All data used, including the source of the data, will be clearly identified in the final project report and listed in Table B9.1 and B9.2.

Table B9.1 Geospatial Data Sources

GIS Data	Source	Date	Comments

GIS Data	Source	Date	Comments
LIDAR Data	USGS Willacy and Hidalgo https://data.tnris.org/collection/6a825941-a80b-4a61-a2b2-1da205f2f28b IBWC Cameron County https://data.tnris.org/collection/27f30e8a-115a-4ad5-ace1-5e2aa4a53a70	2011	Subwatershed Delineation
Subwatersheds	Hidalgo Countywide Flood Map Modernization Project Hydrology Analysis TSDN Report (Hidalgo County and FEMA)	2005	Subwatershed Delineation
Hydrography	National Hydrography Dataset (NHD)Pre-staged Subregions https://tnris.org/stratmap/hydrography/	N/A	Subwatershed Delineation and Map Development
Local Drainage Network	City and County drainage network layers. HCDD Layers – Link Pharr Layers - Link Edinburg Layers - Link Weslaco Layers - Link Brownsville Layers - Link	Most recent	Subwatershed Delineation and Map Development
Irrigation Canals	GIS layers available from Irrigation Districts and TAMU HCID#2 Layer - Link TAMUK LRGV Maps – Link HIDCC1 - Link	Most recent	Subwatershed Delineation and Map Development
IBWC Gauge Locations	IBWC TCEQ provided GIS layer to UTRGV	N/A	Map development
Land Use/Land Cover	National Land Cover Database 2016 https://www.mrlc.gov/	2016	Map development

GIS Data	Source	Date	Comments
Land Use	Cities in each watershed	Most recent	Map development
Soil Map Unit Boundaries and Properties	NRCS SSURGO databases <https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx> Web Soil Survey	various	Map development
Geology Units	USGS Geologic Atlas of Texas Environmental Geologic Atlas of the Texas Coastal Zone--Brownsville-Harlingen Area (Texas Bureau of Economic Geology)	Most recent 1980	Map development and watershed characterization
Urbanized Areas (2010)	U.S. Census Bureau TIGER/Line® Shapefiles <http://www.census.gov/cgi-bin/geo/shapefiles2010/layers.cgi> <http://cfpub.epa.gov/npdes/stormwater/urbanmaps.cfm>	2010	Map development; define regulated stormwater
TCEQ Permitted Wastewater Outfalls	TCEQ GIS Site Layers Download Page <http://www.tceq.texas.gov/gis/download-tceq-gis-data>	N/A	Map and hydrology development and pollution source analysis
TCEQ Assessment Units	TCEQ GIS Hydrology Layers <http://www.tceq.texas.gov/gis/download-tceq-gis-data>	N/A	Map and hydrology development
Water Rights Diversion Points	TCEQ Water Rights Diversion Points <http://www.tceq.texas.gov/gis/download-tceq-gis-data>	N/A	Map and hydrology development
Water and sewer service areas	TCEQ GIS Regulatory/ Administrative Boundaries, Water & Sewer Certificates of Convenience and Necessity Service Areas, <www.tceq.texas.gov/gis/boundary.html>	Present	Pollution source analysis

TCEQ NPS Modeling QAPP Shell, Last Updated: March 2017

GIS Data	Source	Date	Comments
Census Data	U.S. Census https://www.census.gov/cgi-bin/geo/shapefiles/index.php	2018	Determine population per subwatershed.
Census Urban Areas	U.S. Censushttps://www.census.gov/cgi-bin/geo/shapefiles/index.php	2018	Determine regulated MS4 areas.
Roadways	TxDOT	Most recent	Map development
Roadways	Cities in each watershed	Most recent	Map development
Wells	TWDB Well locations http://www.twdb.texas.gov/mapping/gisdata.asp	Most recent	Map development
TCEQ Surface Water Quality Monitoring Stations	TCEQ GIS Site Layers Download Page <http://www.tceq.texas.gov/gis/download-tceq-gis-data>	N/A	Map development
Address Points	Hidalgo, Willacy, and Cameron Counties available at https://tnris.org/stratmap/address-points/	2018	
Parcels	Hidalgo, Willacy, and Cameron Counties available at TNRIS https://tnris.org/stratmap/land-parcels/	2018	
Sewer Service Areas	Coastal Zone – Texas AgriLife Extension Hidalgo and Cameron Counties – TWRI	2019	
OSSF Points	Coastal Zone – Texas AgriLife Extension Hidalgo and Cameron Counties - TWRI	2019	
PAD Database	Protected Areas database Department of the Interior <Link>		Define areas that are protected such as National Wildlife Refuge.

GIS Data	Source	Date	Comments
Large Ranches South Texas	TCEQ NPS Team	2018	Show large South Texas ranch areas on maps.
Seagrass	TPWD https://tpwd.texas.gov/gis/	2016	Show seagrass in Laguna Madre.
Wildlife Management Areas	TPWD https://tpwd.texas.gov/gis/	2018	
Water Districts	TCEQ https://www.tceq.texas.gov/gis/download-tceq-gis-data	2015	
Colonias	Rural Community Assistance Partnership Link	2015	
Coastal Zone Boundary	General Land Office http://www.glo.texas.gov/land/land-management/gis/	2011	Map development
Existing Urban BMP locations	Information of existing BMPs will be gathered from cities	Most recent	
Areas of drainage project locations	Areas of existing and future drainage projects will be obtained from cities and drainage districts.	Most recent	Assess impact on subwatershed boundaries and flow

Table B9.2 Non-Geospatial Data Sources

Data	Source	Date	Comments
NPDS Wastewater Facility Pollutant Discharge data	Enforcement and Compliance History (ECHO) Online https://echo.epa.gov/	Most recent	Assessment of potential sources and identification of permit limits
Sanitary Sewer Overflows	TCEQ Field Office	Most recent complete fiscal year	Assessment of potential sources

Data	Source	Date	Comments
MS4 Permit List	TCEQ website https://www2.tceq.texas.gov/wq_dpa/index.cfm	Entire period of record	List of MS4 permits in watersheds
Wildlife numbers	Local TPWD and USFWS offices	Most recent information	Assessment of wildlife numbers in watershed
Livestock Numbers	USDA National Agriculture Statistics Service County-level agricultural census data https://www.nass.usda.gov/Publications/AgCensus/2017/index.php	2017	Assessment of potential sources
Local city environmental data	Information such as tires collected, illegal dumping, and street sweeping will be gathered.	Most recent	Assessment of potential sources and assessment of existing BMPs
Existing Acres covered under WQMP	Existing acres covered under Water Quality Management Plans (WQMP) will be obtained from Texas Water Resources Institute in Weslaco	Most recent	Assessment of existing BMPs
Biological Assessments	Hidalgo, Cameron, Willacy Counties	Entire period of record	Spatial and temporal trends
Climatic Data	IBWC, NCEI, and NOAA. Rain gages near and within watershed.	Entire period of record	Characterization of historical and recent climatic conditions associated with routine and storm monitoring events
Drinking Water Data	Cities	Entire period of record	Temporal water quality trends
Flooding	Local groups information on flooding	Available studies	
Groundwater Levels	TWDB Statewide Program	Entire period of record for all stations	Analysis of recharge, Desired Future Conditions, Trend analysis of groundwater level fluctuations
Groundwater Quality	Various Studies from BSEACD, USGS, TWDB, TWON, Different Cities		Spatial and temporal trends

Data	Source	Date	Comments
Hydrology	USGS Flow Data	Entire period of record	Loading calculations, flow-adjustment of water quality data. Characterization of long-term flow conditions
Monitoring Data	TCEQ SWQMIS Database (Entire period of record for all project stations. TCEQ ID 22004, 22003, 20930, and 20879)	Entire period of record	Spatial and temporal trends, water quality parameters
Flow Data	USIBWC (Entire period of record for all project stations. IBWC ID 08470100, 08470050, 08470200 and 08470301)	Entire period of record	Entire period of record for all project stations. IBWC ID 08470100, 08470050, 08470200 and 08470301
Flow Data	Hidalgo, Cameron, Willacy Counties and Cities on each watershed	Entire period of record for all project stations	Stormwater quality trends
Wells	TWDB	Entire period of record	Well location, owner, driller, and data

All data sources will be clearly documented in final project report and within annual updates to the QAPP.

B10 DATA MANAGEMENT

Systems Design
At UTRGV, the data processing and management equipment are DELL computers with standard UTRGV Center software/security configuration and use the Windows 7 operating system. The data acquired for this project will be maintained in Microsoft Access database and/or Excel spreadsheet format and visually screened for errors. GIS data will be maintained in individual shapefiles or geodatabases.

Record-keeping and Data Storage
UTRGV record keeping and document control requirements are contained in this QAPP. A copy of the database is backed up regularly on an external hard drive. If necessary, disaster recovery will be accomplished by information resources staff using the backup database. The database will be backed up on a quarterly basis.

Archives/Data Retention

All UTRGV data are kept on an external backup hard drive as well as a UTRGV provided shared hard drive throughout the university network. All acquired data related to this project will be kept within the shared drive on UTRGV servers as well as on backup within the external hard drive.

Data Verification/Validation

The control mechanisms for detecting and correcting errors and for preventing loss of data during data reduction, data reporting, and data entry are contained in Sections D1 and D2.

Data Handling

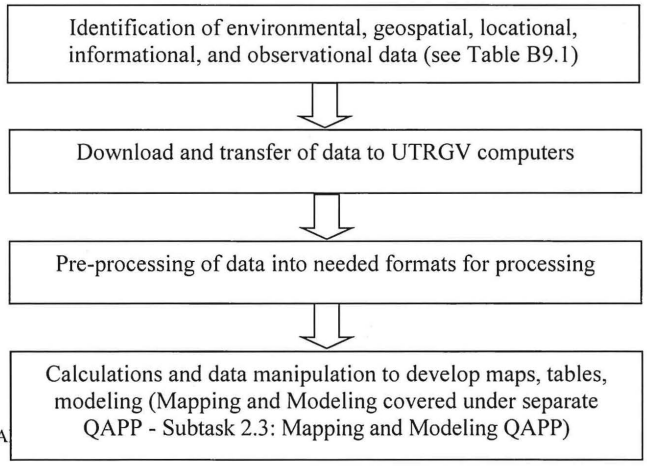
Data are processed using the Microsoft Access 2013 suite of tools and applications. Data integrity is maintained by the implementation of password protections which control access to the database and by limiting update rights to a select user group. No data from external sources are maintained in the database. The database administrator is responsible for assigning user rights and assuring database integrity.

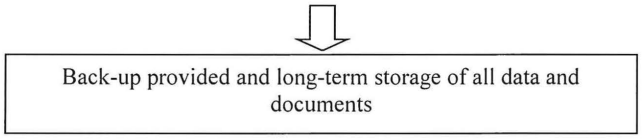
Hardware and Software Requirements

Table B10.1 Listing of Project Hardware and Software

Equipment & software name	Type	Specification	Use
Dell PC desktop/laptop computers	Hardware	Intel Core 2 DUO, CPU 3.00 GHz 4.0 GB RAM, Windows 7	Support monitoring data storage and uploading activities
ArcGIS 10.4.5 plus Spatial Analyst Extension	Software	Windows interface	View and compile monitoring results
Microsoft Office Software 2013 (Excel, Word, Powerpoint, Access)	Software	Windows platform	Data preparation, load calculations, report writing, presentations

Figure B10.1 A flow chart is provided below that traces the path of the data from acquisition to final use and storage.





All project data are stored in a unique directory established for the project with additional subdirectories as needed for organization of data and files.

Document control is provided by all project staff only using data and files in the project directory and providing different file names along when editing or manipulating the files. Staff retain older versions of documents and workbooks in the project directory in the event errors are detected, which may necessitate use of earlier versions of the documents and data for expedient correction. Daily backup provides additional safeguards in this area of document control.
The computations and data in Excel workbooks used to develop charts and tables are checked by the UTRGV Project Manager prior to development of draft reports. Any errors detected are noted and appropriate project staff directed to make needed corrections. Tables in reports are checked for accuracy by the UTRGV Project Manager prior to submitting the draft report to TCEQ.

Personnel

Section A4 lists responsibilities and lines of communication for data management personnel.

Andrew Ernest is UTRGV Principal Investigator and will provide overall project management for the project. Ahmed Mahmoud is the UTRGV project manager and responsible for ensuring that the data are managed according to the data management plan and QAPP.

Abdoul Oubeidillah is the UTRGV Center QAO and Data Manager. The Data Manager will have primary responsibility for performing all tasks related to data management. The UTRGV Data Manager/QAO will coordinate the cooperating agencies to obtain data files needed for the project and to ensure that the data provided in the source files is accurate and unambiguous. The Data Manager/QAO will be assisted, on an as-needed basis, by other UTRGV personnel. Dr. Oubeidillah is responsible for ensuring that project data are scientifically valid, legally defensible, of known precision, accuracy, integrity, meet the data quality objectives of the project, and are reportable to TCEQ.

Tim Cawthon is the TCEQ Project Manager and is responsible for providing state oversight of the project and for receiving the project reports.

Quality Assurance/Control
See Section D of this QAPP.

C1 ASSESSMENTS AND RESPONSE ACTIONS

The following table presents types of assessments and response action for activities applicable to the QAPP.

Table C1.1 Assessments and Response Requirements

Assessment Activity	Approximate Schedule	Responsible Party	Scope	Response Requirements
Status Monitoring Oversight, etc.	Continuous	UTRGV Project Manager	Monitoring of the project status and records to ensure QAPP requirements are being fulfilled. Monitoring and review of subcontractors performance and data quality	Report to TCEQ in Quarterly/Monthly Report. Ensure project requirements are being fulfilled.
Technical Systems Audit	Dates to be determined by TCEQ	TCEQ QAS	The assessment will be tailored in accordance with objectives needed to assure compliance with the QAPP	30 days to respond in writing to the TCEQ to address corrective actions

Internal Assessment

Since this project is primarily a geospatial data and secondary data analysis endeavor, traditional performance and system audits are not appropriate. Instead, the information generated as part of the project will be evaluated by TCEQ with submitted deliverables according to the contract.

Project deliverables will be internally quality controlled by the TCEQ NPS Project Manager's in-house review. The TCEQ NPS Project Manager will maintain overall responsibility for examining the contracted work to ensure methodologies and processes are consistent with the procedures outlined in this QAPP.

Corrective Action

Deficiencies are any unauthorized deviations from the approved QAPP and procedures referenced in the QAPP. Deficiencies may invalidate resulting data. All deficiencies from the QAPP require documentation of the nonconformance and corrective action. Deficiencies must be documented in a Corrective Action Plan (See Appendix B for the form and an example) and corrected in a timely manner. Corrective action may include for data to be discarded and re-collected. Deficiencies are documented in logbooks by project staff. It is the responsibility of the UTRGV Project Manager, in consultation with the UTRGV QAO, to ensure that the actions and resolutions to the problems are documented and that records are maintained in accordance with this QAPP. Nonconformances and corrective actions will be conveyed to the TCEQ NPS Project Manager, in a manner fitting the severity of the deficiency:

- **For deficiencies that impact the quality or quantity of data:** If the UTRGV Project Manager, in consultation with project staff, determines that the deficiency can have serious effect on the validity, integrity, quality, or quantity of the data, then a nonconformance must be communicated to the TCEQ NPS Project Manager and Lead NPS QAS immediately in writing. A Corrective Action Plan Form (See Appendix B for the form and an example) must be submitted to the TCEQ NPS Project Manager and Lead NPS QAS within 14 days of the deficiency occurring.
- **For deficiencies that do not impact the quality or quantity of data:** If the UTRGV Project Manager, in consultation with project staff, determines that the deficiency will not have a serious effect on the validity, integrity, quality, or quantity of the data, then the nonconformance and corrective action must be documented in a timely manner. The deficiency will be communicated to the TCEQ NPS Project Manager through the Corrective Action Status Table (see Appendix C for the table and an example) to be included with the quarterly progress report.

The UTRGV Project Manager is responsible for implementing and tracking corrective actions. All Corrective Action Plans will be documented on the Corrective Action Status Table, which will be submitted to the TCEQ NPS Project Manager with the quarterly progress report for review and approval. Records of TCEQ audit findings and corrective actions are maintained by both the TCEQ and the UTRGV QAO. Documentation of corrective action to address audit findings will be submitted to the TCEQ within 30 days of receipt of audit report.

If audit findings and corrective actions cannot be resolved, then the authority and responsibility for terminating work are specified in the TCEQ QMP and in agreements in contracts between participating organizations.

Corrective Action Plans

Corrective Action Plans should:

- Identify the deficiency, problem, nonconformity, or undesirable situation
- Identify immediate remedial actions if possible
- Identify the underlying cause(s) of the problem
- Identify whether the problem is likely to recur, or occur in other areas
- Include a description of the need for Corrective Action
- Include a description of cause(s), determine solution, and propose an action plan
- Identify personnel responsible for action
- Establish timelines and provide a schedule
- Document the corrective action

C2 REPORTS TO MANAGEMENT

Reports to TCEQ Project Management

All reports detailed in this section are contract deliverables and are transferred to the TCEQ in accordance with contract requirements and the contract schedule of deliverables.

Progress Report - Submittal of progress reports will be quarterly. Format of the submitted progress report will be as specified in the contract or work orders. Reports should provide enough information so the TCEQ NPS Project Manager can evaluate the effort.

Task Reports - Summarize the activities conducted under individual Tasks for the project period including a description and documentation of major Task activities and the evaluation any results.

Watershed Characterization Report – This report will present data collected, compiled, and analyzed to characterize watershed conditions.

Final Report - Summarizes the UTRGV's activities for the entire project period including a description and documentation of major project activities; evaluation of the project results and environmental benefits; and a conclusion.

Corrective Action Report (CAR) – Identifies any deficiencies and nonconformances. The cause(s) and program impacts are discussed. The completed corrective actions are documented, and the report is submitted to the TCEQ NPS Project Manager with the first progress report occurring after the deficiencies and/or nonconformance was identified.

Audit Report and Response - Following any audit performed by UTRGV, a report of findings, recommendations, and responses are sent to the TCEQ NPS Project Manager in the quarterly/monthly progress report. Such reports will include model performance assessments, calibration, and validation performance determination.

Reports to UTRGV Project Management

Progress report – Summarizes the UTRGV activities for each task; reports monitoring status, problems, delays, and corrective actions; and outlines the status of each task's deliverables.

Reports by TCEQ Project Management

Contractor Evaluation - The UTRGV participates in a Contractor Evaluation by the TCEQ annually for compliance with administrative and programmatic standards. Results of the evaluation are submitted to the UTRGV Financial Administration Division, Procurement, and Contracts Section.

D1 DATA REVIEW, VERIFICATION, AND VALIDATION

For the purposes of this document, data verification is a systematic process for evaluating performance and compliance of a set of data to ascertain its completeness, correctness, and consistency using the methods and criteria defined in the QAPP. Validation means those processes taken independently of the data-generation processes to evaluate the technical usability of the verified data with respect to the planned objectives or intention of the project. Additionally, validation can provide a level of overall confidence in the reporting of the data based on the methods used.

The UTRGV Data Manager is responsible for ensuring that data are properly reviewed, verified, and submitted in the required format for the project database. Finally, the UTRGV QAO is responsible for validating that all data collected meet the DQOs of the project and are suitable for reporting.

Data collected by the TCEQ, the USGS, USIBWC, Hidalgo, Cameron, Willacy Counties and all the cities on each watershed; and Texas Clean Rivers Program partners have been reviewed, verified, and validated according to the requirements of the respective programs prior to their use in this project. The sources of GIS data for the project, i.e., TCEQ, National Hydrology Dataset (NHD), National Land Change Database (NLCD), NRCS, and U.S. Census Bureau, undergo review, verification, and validation of the shapefiles and other spatial resources by their respective programs before the data and information are publicly available and prior to use in this project. Non-geospatial data include SSOs, livestock from the agricultural census, and regulated dischargers.

D2 VERIFICATION AND VALIDATION METHODS

Data collected from noted program partners have been verified and validated according to the requirements of the respective programs prior to their use in this project. Data compilations created for this project will be visually screened for errors by the UTRGV.

All other data for this portion of the project (e.g., land use, urban areas, population projections, DEMs, stream layers, and population projections) as provided in Table B9.1 and B9.2 have been collected and made publicly accessible by authoritative sources such as the USGS, USDA, EPA, Hidalgo, Cameron, Willacy Counties and all the cities on each watershed; and U.S. Census Bureau. Data from these sources will be considered as verified and validated by the various agencies providing the data. However, data compilations created for this project will be visually screened for errors. Any errors detected by project staff will be reported to the UTRGV Project Manager and, if necessary, to the TCEQ Project Manager for resolution. Issues which can be readily corrected, e.g., removal of outlier data, will be documented and the data either removed or corrected prior to further analysis.
The UTRGV Project Manager and QAO are each responsible for validating that the verified data are scientifically valid, defensible, of known precision, bias, integrity, meet the data quality objectives of the project, and are reportable to TCEQ. One element of the validation process involves evaluating the data again for anomalies. Any suspected errors or anomalous data must be addressed by the manager of the task associated with the data, before data validation can be completed.

A second element of the validation process is consideration of any findings identified during the assessments listed in Table C1.1. Any issues requiring corrective action must be addressed, and the potential impact of these issues on previously collected data will be assessed by the UTRGV QAO. The UTRGV Project Manager, with the concurrence of the UTRGV QAO validates that the data meet the data quality objectives of the project and are suitable for reporting to TCEQ.

D3 RECONCILIATION WITH USER REQUIREMENTS

Data acquired under this QAPP will be used for education and outreach, mapping, and modeling efforts. The mapping and modeling efforts to predict future watershed conditions will not be covered under this QAPP. In the future, a separate Mapping and Modeling QAPP will be developed for estimating, mapping, and modeling future development/watershed conditions and associated water quality impacts through the use of future development scenarios (Geographical Information System (GIS) based tools), load duration curves for total suspended solids (TSS), nutrients and bacteria, and Spatial Explicit Load Enrichment Calculation Tool (SELECT) calculations for Bacteria.

APPENDIX A. CONTRACT SCOPE OF WORK AND SCHEDULE OF DELIVERABLES

TCEQ Contract No.: 582-19-90196

Task 1: Project Administration

Objective: To effectively administer, coordinate, and monitor all work performed under this project including technical and financial supervision and preparation of status reports.

Subtask 1.1: Project Oversight — The Performing Party will provide technical and fiscal oversight of the staff and/or subgrantee(s)/subcontractor(s) to ensure Tasks and Deliverables are acceptable and completed as scheduled and within budget. With the TCEQ Project Manager's authorization, the Performing Party may secure the services of subgrantee(s)/subcontractor(s). Project oversight status will be provided to TCEQ with the Quarterly Progress Reports (QPRs).

Subtask 1.2: QPRs — The Performing Party will submit QPRs to the TCEQ Project Manager by the 15th of the month following each state fiscal quarter for review by the TCEQ Project Manager and incorporation into the United States Environmental Protection Agency's (EPA) Grant Reporting and Tracking System. QPRs will include reporting on status of Deliverables and proposed revisions to due dates, narrative description of progress by Task, and status of nonconformances/corrective actions. A template for the QPR will be provided to the Performing Party by the TCEQ Project Manager.

Subtask 1.3: Reimbursement Forms — See the Special Terms and Conditions, 8. Invoice Submittal.

Subtask 1.4: Contract Communication — The Performing Party will participate in a post-award orientation meeting with TCEQ within 30 days of Contract execution.

The Performing Party will maintain regular telephone and/or e-mail communication with the TCEQ Project Manager regarding the status and progress of the project and any matters that require attention between QPRs. This will include a quarterly conference call to discuss Project Tasks, financial status, Quality Assurance Project Plan (QAPP), corrective actions and any other matters that require attention. The TCEQ Project Manager may request additional information from the Performing Party prior to the call or meeting. The Performing Party will submit meeting notes (action items at a minimum) to the TCEQ Project Manager within seven days.

The quarterly conference call held the first quarter of each fiscal year of the project will be used to discuss, at a minimum, any staff changes, the previous year's performance, budget estimates, invoicing issues, quality assurance issues, overall project progress, and a plan for the current fiscal year. The Performing Party will submit meeting notes (action items at a minimum) to the TCEQ Project Manager within seven days.

Matters that will be communicated to the TCEQ Project Manager include, but are not limited to:

- Notification a minimum of 14 days before the Performing Party has scheduled public meetings or events, initiation of construction, or other major Task activities.
- Notification within two working days regarding events or circumstances that may require changes to the Budget, Scope of Work, or Schedule of Deliverables.

Subtask 1.5: Coordination Meeting with EPA — The Performing Party will attend a project update and coordination meeting with EPA in Dallas upon request by TCEQ and EPA to share progress on goals, measures of success, challenges, and opportunities.

Page 29 of 57

Subtask 1.6: Annual Report Article — The Performing Party will provide an article for the Nonpoint Source (NPS) Annual Report upon request by TCEQ. The article will include a brief summary of the project and describe the activities of the past fiscal year.

Subtask 1.7: Contract Budget Updates — The Performing Party will discuss annual fiscal year budgets with the TCEQ Project Manager on a quarterly basis. Starting in the second year of the project, the Performing Party will provide an Annual Budget Update that details state fiscal year spending projections as associated with planned project activities. These updates will be discussed quarterly at a minimum. They will be revised when fiscal year spending projections change by ten percent or more, or upon request by the TCEQ Project Manager. The update in the final year of the project will include a budget for all remaining project activities. The template for the Annual Budget Update will be provided by the TCEQ Project Manager.

Deliverables:

- QPRs
- Reimbursement forms
- Post Award Meeting and notes
- Conference call notes and action items
- Coordination meeting with EPA (upon request)
- Annual Report article and pictures (upon request)
- Contract Budget updates
- Annual Budget updates

Task 2: Quality Assurance

Objective: To refine, document, and implement data quality objectives (DQOs) and quality assurance/quality control (QA/QC) activities that ensure data of known and acceptable quality are generated by this project.

Subtask 2.1: QAPP Planning Meetings — The Performing Party will schedule a QAPP planning meeting with the TCEQ Project Manager, QA staff, technical staff, and contractors within 30 days of Contract execution, to implement a systematic planning process based on the elements in the TCEQ NPS QAPP Shell. The information developed during this meeting will be incorporated into a QAPP. The storage location of data records, and how data will be coded, will also be determined during these meetings. The Performing Party may conduct additional meetings to determine whether changes to an existing QAPP are needed.

Subtask 2.2: QAPP — The Performing Party will develop and submit to TCEQ a QAPP with project-specific DQOs and other components consistent with the following documents:

- TCEQ NPS QAPP Shell(s)
- EPA Requirements for QAPPs (QA/R5)
- EPA Guidance for Geospatial Data QAPPs (QA/G-5G)
- EPA QAPP Requirements for Secondary Data Research Projects
- TCEQ Surface Water Quality Monitoring (SWQM) Procedures

The Performing Party will develop the QAPP in consultation with the TCEQ Project Manager, QA staff, and contractors. The Performing Party will submit the QAPP to TCEQ at least 120 days prior to the scheduled initiation of environmental data operations. The QAPP will be signed/fully approved by TCEQ and, if necessary, EPA, before any environmental data operations begin.

Activities covered under this QAPP:
- Acquisition of existing water quality and quantity date from project partners
- Analysis of existing data

Tasks covered under this QAPP:
- Tasks 2, 3, and 5

Tasks NOT covered under this QAPP:
- Tasks 1 and 4

Subtask 2.3: QAPP Annual Reviews and Revisions — The Performing Party will submit documentation certifying its annual review of QAPPs no less than 90 days prior to the QAPP anniversary date. Amendments approved since the initial QAPP approval or a subsequent certified annual review (if applicable) will be submitted along with the certification. If extensive changes to a QAPP are necessary, a full revision is required. Once TCEQ certifies the annual review or approves the full revision, the QAPP effective period is extended an additional year. No work described in a QAPP will be conducted outside the effective period of the QAPP.

Subtask 2.4: QAPP Amendments — The Performing Party will submit Draft QAPP Amendments for TCEQ's review when changes to QAPPs are necessary. Draft QAPP Amendments will be submitted no less than 90 days prior to the scheduled initiation of changes and will be accompanied with a justification, summary of changes, and detail of changes. The Performing Party will submit Final QAPP Amendments within 30 days of receipt of any comments provided by TCEQ. The Performing Party will ensure that changes conveyed within Amendments are not implemented until the Amendment is fully approved by TCEQ.

Deliverables:
- QAPP Planning Meeting notes
- Draft and Final QAPP
- QAPP Annual Reviews and Revisions
- Draft and Final QAPP Amendments

Task 3: Watershed Characterization – Data Evaluation and Analysis

Objective: To collect data and information to identify the causes of water quality impairments and issues in the watersheds and to identify the potential sources of pollution.

Subtask 3.1: Assemble Existing Data and Information — The Performing Party will gather existing data and information pertaining to water quality impairments and issues in the watersheds. This data and information will, to the extent possible:
- Describe relevant watershed characteristics;
- Support Geographic Information Systems analysis;
- Support preliminary delineation of subwatershed boundaries;
- Support identification of the causes of water quality impairments and issues; and
- Support identification of potential sources of pollution.

This data and information will be assembled into a data inventory for the watersheds. The data and information will be presented in appropriate formats including graphs, tables, and maps. (See EPA Handbook, Chapter 5).

Subtask 3.2: Cyberinfrastructure Establishment and Database Development — The Performing Party will convert the existing interactive map (developed by the Stormwater Task Force) into cyberinfrastructure to establish a database for the watershed areas. Example data and analysis that may be incorporated into the database includes:

- Land use/Land Cover Data;
- Water quality and flow data;
- Flood studies;
- Subwatershed boundaries;
- Urban and stormwater drainage information;
- Irrigation and drainage district information;
- Wastewater treatment facility (WWTF) information;
- Colonia wastewater information; and
- On-site sewage facility (OSSF) information.

Subtask 3.3: Analyze Existing Data and Information — The Performing Party will analyze the existing data and information and, to the extent possible, characterize water quality conditions, watershed conditions, and sources of pollution contributing to water quality impairments and issues. The analysis will:

- Produce a conceptual model of the linkage (cause and effect relationship) between instream water quality problems and sources of pollution in the watersheds;
- Lead to an understanding of where and when water quality impairments and/or issues occur and what could be causing the impairments and issues; and
- Provide the basis for the selection of the analytical method that will be used to estimate pollutant loadings from sources in the watersheds that contribute to water quality impairments and issues conducted in future projects.

Subtask 3.4: Watershed Characterization and Next Steps Report — The Performing Party will develop a report summarizing information developed to characterize the watersheds and identify potential causes and sources of pollution. The report will partially satisfy Element A, be submitted for approval to the TCEQ Project Manager, and be presented to stakeholders for feedback. Components of the report will include but is not limited to:

- Identification, mapping, and description of the potential sources of pollution;
- Preliminary delineation of subwatersheds based on information gathered;
- Flow and water quality graphs for existing or historical stations;
- Quantification of loads from permitted point sources;
- Identify additional data and information that is needed to support a future analytical method for estimating pollutant loadings;
- Citation and explanation of data sources, estimates, and assumptions;
- Conceptual model of the cause and effect linkage between pollutant sources and instream water quality data; and
- Provide details about the next steps to be taken for each of the three waterbodies, such as filling data gaps, selected analytical methods for estimating pollutant loads, and WPP development.

Deliverables:

- Summary of existing data and information
- Cyberinfrastructure establishment and database development

- Interim Existing Data and Information Analysis Report
- PowerPoint for presentation to stakeholders
- Draft and Final Watershed Characterization and Next Steps Report

Task 4: Partnership Coordination

Objective: To engage watershed partners, involve stakeholders in participation of planning and educational activities, conduct local stakeholder meetings, and provide regular updates to stakeholders. The Performing Party will facilitate meetings of three Watershed Stakeholder Groups for the future development of WPPs.

Subtask 4.1: PPP — The Performing Party will develop one PPP, that covers each of the three watersheds, which details the strategy for engaging the public and stakeholders in the watershed planning process. The PPP will include, but is not limited to, stakeholder group ground rules, stakeholder group structure, an outline of the goals of future meetings, topics, targeted outreach and education plan, and an estimated timeline that will provide an outline for project personnel to follow as the watershed planning and implementation process is conducted. The PPP will be presented to stakeholders for feedback, and approved by the TCEQ Project Manager.

Subtask 4.2: Facilitate and Coordinate Meetings — The Performing Party will implement the PPP by working to identify and meet individually with key stakeholders across the watersheds on an individual or small group basis. The purpose of these meetings will be to inform key stakeholders of the water quality issues and solicit their input on goals, objectives, and indicators that will help in the watershed planning process.

Subtask 4.3: Stakeholder Group Activities — The Performing Party will implement the PPP by mobilizing three stakeholder groups (one in each of the three watersheds) and their activities, including:

- Overseeing the formation and continued facilitation of the three Stakeholder Groups;
- Hosting and facilitating stakeholder group meetings two times per year for each of the three watersheds for a total of six meetings per year;
- Hosting and facilitating one annual regional watershed stakeholder meeting for the three stakeholder groups.
- Leading the stakeholder groups in developing/refining goals that will include meeting water quality standards;
- Identifying issues of concern and address significant issues where possible;
- Presenting to the stakeholder groups and soliciting feedback of major deliverables; and
- Gaining community acceptance of the project.

Subtask 4.4: Dissemination of Project Information — The Performing Party will conduct public outreach in accordance with the PPP to inform the public about the project and its status, sources of pollution, and how the public/stakeholders can address water quality issues. Activities will include but are not limited to:

- Hosting a project webpage;
- Communicating via media sources; and
- Hosting and/or participating in public education and outreach events.

Subtask 4.5: Partnership Coordination Report — The Performing Party will develop a report summarizing the public outreach activities. The report will be submitted for approval to the TCEQ Project Manager and be presented to stakeholders for feedback.

Deliverables:

- PPP;
- Documentation of individual key stakeholder meetings, including agendas, presentations, and sign in sheets, minimum of three (3) per quarter;
- Raymondville Drain Stakeholder Group - Documentation of group meetings, including agendas, press releases, presentations, and sign in sheets, minimum of two (2) per year;
- Hidalgo Main Stakeholder Group - Documentation of group meetings, including agendas, press releases, presentations, and sign in sheets, minimum of two (2) per year;
- North Floodway Stakeholder Group - Documentation of group meetings, including agendas, press releases, presentations, and sign in sheets, minimum of two (2) per year;
- Regional Watershed Stakeholder Meeting (Annual)
- Documentation of public education and outreach events, including agendas, press releases, presentations, and sign in sheets, minimum of three (3) per year;
- Documentation of project webpage development and quarterly updates; and
- Draft and Final Partnership Coordination Report

Task 5: Final Report

Objective: The Performing Party will produce a Final Report that summarizes all activities completed and conclusions reached during the project. The Final Report will describe project activities, and identify and discuss the extent to which project goals and purposes have been achieved, and the amount of funds spent on the project. The Final Report will emphasize successes, failures, lessons learned, and will include analyses estimating the projects' water quality improvements and load reductions, if applicable. The Final Report will summarize all the Task Reports in either the text or as appendices.

Subtask 5.1: Draft Final Report — At least 30 days prior to submitting the Final Report, the Performing Party will provide a Draft Final Report summarizing all project activities, findings, and the contents of all previous Deliverables, referencing and/or attaching them as web links or appendices. This comprehensive report will document all Deliverables under this Scope of Work. The Draft Final Report will be structured per the following outline:

- Title
- Table of Contents
- Project Significance and Background
- Study Area
- Summary of all Task Reports and final approved QPR
- Amount of project funding and amount spent
- Discussion; include deliverables not completed, lessons learned, recommendations
- Water quality results achieved /estimated load reductions (if applicable to project)
- Appendices (if needed)

Subtask 5.2: Final Report — The Performing Party will revise the Draft Final Report to address comments provided by the TCEQ Project Manager and EPA. At least two weeks

before the expiration of the Contract, the Performing Party will submit the Final Report to the TCEQ Project Manager, who will subsequently submit it to the EPA.

Deliverables:

- Draft Final Report
- Address TCEQ/EPA comments
- Final Report

TCEQ Contract No.: 582-19-90196

Schedule of Deliverables

Task No.	Task Deliverable	Due Date
1 Project Administration		
1.2	QPRs	The 15th of the month following each state fiscal quarter
1.3	Reimbursement Forms	See Special Terms and Conditions, 8. Invoice Submittal
1.4	Post-Award orientation meeting and notes	Meeting within 30 days of Contract execution, meeting notes within two days of meeting.
1.4	Conference call notes and action items	Quarterly, notes within seven days of meeting
1.5	EPA coordination meeting	Upon request
1.6	Annual Report Article	Upon request
1.7	Contract Budget updates	Discussed quarterly and updated as needed
1.7	Annual Budget updates	Quarter 5
2 Quality Assurance		
2.1	QAPP planning meetings notes	Meeting within 30 days of Contract execution
2.2	Draft QAPP	At least 120 days prior to the scheduled initiation of environmental data operations
2.2	Final QAPP	30 days prior to the scheduled initiation of environmental data operations
2.3	QAPP Annual Reviews and Revisions	No less than 90 days prior to the QAPP anniversary date.
2.4	Draft QAPP Amendments	No less than 90 days prior to the scheduled initiation of changes or additions to activities listed in the current QAPP
2.4	Final QAPP Amendments	Within 30 days of receipt of TCEQ comments
3 Watershed Characterization - Data Evaluation and Analysis		
3.1	Summary of existing data and information	Quarter 4, Month 1
3.2	Database Establishment	Quarter 3, Month 1
3.3	Interim Existing Data and Information Analysis Report	Quarter 4, Month 2
3.4	PowerPoint for presentation to stakeholders	Quarter 6, Month 2
3.5	Draft Watershed Characterization and Next Steps Report	Quarter 6, Month 2
3.5	Final Watershed Characterization and Next Steps Report	Quarter 8, Month 2

Page 36 of 57

TCEQ Contract No.: 582-19-90196

Task No.	Task Deliverable	Due Date
4 Partnership Coordination		
4.1	PPP	Quarter 2, Month 1
4.2	Documentation of key stakeholder meetings, including agendas, presentations, and sign in sheets (minimum 3 per quarter)	Quarterly
4.3	Raymondville Drain Stakeholder Group - Documentation of group meetings, including agendas, press releases, presentations, and sign in sheets (minimum 2 per year)	Quarters 2, 4, 6, and 8
4.3	Hidalgo Main Stakeholder Group - Documentation of group meetings, including agendas, press releases, presentations, and sign in sheets, minimum of two (2) per year;	Quarters 2, 4, 6, and 8
4.3	North Floodway Stakeholder Group - Documentation of group meetings, including agendas, press releases, presentations, and sign in sheets, minimum of two (2) per year;	Quarters 2, 4, 6, and 8
4.3	Annual Regional Watershed Stakeholder Meeting for the three stakeholder groups	Quarter 4 and Quarter 8
4.3	Documentation of public education and outreach events, including agendas, press releases, presentations, and sign in sheets (minimum 3 per year, total of 6)	Quarters 2-7
4.4	Documentation of project webpage and updates	Quarterly, in QPR
4.5	Draft Partnership Coordination Report	Quarter 8, Month 1 (with Final Report)
4.5	Final Partnership Coordination Report	At least two weeks prior to the end of the Contract (with Final Report)
5 Final Report		
5.1	Draft Final Report	Quarter 8, Month 1
5.1	Address TCEQ/EPA comments	Within 30 days of TCEQ comments
5.2	Final Report	At least two weeks prior to the end of the Contract

Page 37 of 57

Appendix B.
Corrective action plan form

Appendix B - Corrective Action Plan Form

Nonconformance Report and Corrective Action Plan
QAPP Title:_____ **QAPP Contractor:** _____ **Issued by:**_____ **Date of Occurrence:**_____ **Report No.:**_____ **Date Issued:**_____
Description of deficiency
Root Cause of deficiency
Programmatic Impact of deficiency
Does the seriousness of the deficiency require immediate reporting to the TCEQ? If so, when was it reported?
Corrective Action to address the deficiency and prevent its recurrence
Proposed Completion Date for Each Action
Individual(s) Responsible for Each Action
Method of Verification
Date Corrective Action Plan Closed?

TCEQ NPS Modeling QAPP Shell, Last Updated: March 2017

Example Corrective Action Plan Form

Nonconformance Report and Corrective Action Plan
QAPP Title: Watershed Protection Plan Implementation – LID BMP Monitoring QAPP **QAPP Contractor:** River Authority **Issued by:** Jane Doe **Date of Occurrence:** 7/15/2014 **Report No.:** 1 **Date Issued:** 7/25/2014
Description of deficiency The pavement monitoring station at the university is measuring a larger runoff volume than is estimated possible. Runoff measured is higher than the total precipitation volume calculated by multiplying the catchment area by the precipitation measured at the site.
Root Cause of deficiency (1) It is possible that the drainage area was not measured accurately, it may be larger. (2) The outfall of the monitoring station might not adequately allow runoff to flow through causing pooling around the flow-measuring point. The accumulation of non-flowing water could be confounding the flow meter since its physical principal of measurement is hydrostatic pressure caused by water depth.
Programmatic Impact of deficiency The illogical results of the pavement runoff measurement indicate that further calibration of the equipment is necessary. Data collected at this event are not able to be used in analysis or results.
Does the seriousness of the deficiency require immediate reporting to the TCEQ? If so, when was it? Yes, it was reported to the TCEQ NPS Project Manager via email on 7/18/2014.
Corrective Action to address the deficiency and prevent its recurrence A survey will be conducted on the site to determine the ridge of the catchment area. A wider and deeper channel will be dug out at the monitoring point outfall to ensure all the flow drains away from the measuring point. Storm event runoff will not be measured at this site until this work has been completed.
Proposed Completion Date for Each Action 8/15/2014
Individual(s) Responsible for Each Action David Lopez, Contractor Project Manager
Method of Verification Results of the catchment area survey will be emailed to the TCEQ NPS Project Manager. Photos of the modified measurement site will be emailed to the TCEQ NPS Project Manager.
Date Corrective Action Plan Closed? *The TCEQ NPS Project Manager will provide a closed date once the corrective action has been verified.*

TCEQ NPS Modeling QAPP Shell, Last Updated: March 2017

Appendix C.
Corrective Action Plan Status Form

Corrective Action Status Table

Corrective Action #	Date Issued	Description of Deficiency	Action Taken	Date Closed

Corrective Action Status Table Example

Corrective Action #	Date Issued	Description of Deficiency	Action Taken	Date Closed
1	7/25/2014	Runoff measured at pavement was greater than total area runoff.	The area is being surveyed to ensure the catchment area size is correct. The monitoring station location is being modified to ensure runoff flows through properly.	
2	8/1/2014	Sample residual insufficient for analysis of TSS.	Data estimated but questionable, not will not be submitted to TCEQ.	8/8/2014

Appendix D.
ADHERENCE Letter

TO: *(name)*
(organization)

FROM: *(name)*
(organization)

RE: Contractor Name, QAPP Title

Please sign and return this form by (*date*) to:

(*Address)*

I acknowledge receipt of the "QAPP Title, Revision Date". I understand the document describes quality assurance, quality control, data management, and reporting, and other technical activities that must be implemented to ensure the results of work performed will satisfy stated performance criteria.

My signature on this document signifies that I have read and will comply with the document contents pertaining to my program. Furthermore, I will ensure that all staff members participating in modeling activities will be required to familiarize themselves with the document contents and adhere to them as well.

_____

Signature Date

Note: Copies of the signed letter should be sent by the Lead Organization to the TCEQ NPS Project Manager within 30 days of the final TCEQ approval the QAPP. This letter should be submitted for all subcontractors that did not sign the QAPP (under section A1 of this QAPP).

APPENDIX

C

WATERSHED CHARACTERIZATION REPORT

https://rates-inc-nandcphase1.readthedocs-hosted.com/en/latest/_static/90196_Final_WCR.pdf

As of 10/14/2022, this report is being finalized and will be included as soon as it is ready. Please review the Executive

APPENDIX

D

PARTNERSHIP COORDINATION REPORT

https://rates-inc-nandcphase1.readthedocs-hosted.com/en/latest/_static/Partnership-Coordination-Report_v5_TCEQcomments.pdf

Partnership Coordination Report

Characterization of Northern and Central Rio Grande Valley Watersheds

FY22Q4

Table of contents

Introduction

The Northern and Central Rio Grande Watersheds are the sub-watersheds of the Raymondville Drain, Hidalgo Floodway, and International Boundary & Water Commission North Floodway. Each of these sub-watersheds are tributaries to the Lower Laguna Madre assessment units (AUs)2491_01 and 249_02 which are classified as impaired due to low dissolved oxygen and low dissolved oxygen and presence of pathogenic bacteria, respectively.

To address concerns and impairments of the Lower Laguna Madre (2491) assessment units 01 and 02, the watersheds of the Raymondville Drain, the Hidalgo Floodway, and the IBWC Floodway were characterized to determine potential causes and sources of impairments. This project identified existing watershed data and determined what data gaps needed to be filled to fully assess each of the sub-watersheds. characterization as well as a path forward by selecting an analytical method for estimating pollutant loads. The project also engaged, educated, and asked for input from stakeholders on the goals, aims, and indicators to address the impairments and concerns. Updates to determine the Causes/Sources of Pollution Identified (A) and Expected Load Reductions for Solutions Identified (B) were discussed at meetings

This project started the watershed characterization by getting existing data from various sources, finding potential causes of water quality impairments and issues, sources of pollution and relative contribution, and completing an inventory of data. Through the International Boundary & Water Commission (IBWC), Hidalgo County Drainage District No. 1 and the Willacy County Drainage District, UTRGV gathered all the flow and water quality data that these agencies have collected over the years. This data was analyzed, categorized, and evaluated (based on reliability and accuracy) to find information that could be used to assess current conditions. A conceptual model was developed to show the linkage between the water quality problems and sources of impairments. This analysis, to the extent possible, included a spatial and temporal exploration of water quality problems and sources of pollution in the watershed. The identification and analysis of data will aid in finding data gaps and what data needs to be collected in the future. Additionally, all the data helped choose the analytical method that was used for estimating pollutant loads.

Public Participation Plan

This Public Participation Plan (PPP) has several important purposes for the project. It helped find key stakeholders in the watershed and supplied a format for their participation in the Watershed Protection Plan (WPP) process. The PPP also helped raise public awareness and outreach for the project. Finally, it developed a structure for continued input and interaction with the public and stakeholders for this project.

Increasingly, public participation in decision making is vital to the success of community projects. This PPP showed how the North and Central Lower Rio Grande Valley Watershed Partnership communicated and engaged the community in an ongoing effort to develop a WPP. Stakeholder input during this project was gathered on the North and Central Lower Rio Grande Valley watershed and its pollutant sources. As part of the collaborative process, the University of Texas Rio Grande Valley (UTRGV) worked with stakeholders and partners to create a vision, goals, and action items that incorporated the environmental, economic, and social values of stakeholders and partners, as well as to reconcile different values and viewpoints of the various participants to arrive at mutually acceptable management recommendations.

UTRGV, with input from the Stakeholder groups wrote the existing watershed data assessment and other associated reports. The reports were written in such a manner that all stakeholders would easily be able to understand the information and the reports to supply feedback and implement the management measures of the Watershed Protection Plan. The WPP will satisfy portions of the EPA's 9 Elements of Watershed-Based Plans, as laid out in EPA's "Handbook for Developing Watershed Plans to Restore and Protect Our Waters". These Nine-element WPP's will be needed for all TCEQ 319- funded Watershed Protection Plans. More water quality and flow data collection will be necessary in this watershed to develop the nine-element Watershed Protection Plan.

Stakeholder Groups

Stakeholders are defined asthose who make and implement decisions, those who are affected by decisions made or those who can assist with the implementation of decisions.

The North and Central Lower Rio Grande Valley Stakeholder Group is a coalition of organizations and stakeholders committed to restoring and/or protecting the aquatic resources of the waterbodies in the North and Central Lower Rio Grande Valley. The Stakeholder Group consists of funding agencies, project partners, stakeholders, and technical advisors. It also aided in developing the goals and Management Measures for the WPP.

All stakeholders involved in the planning process fell under the structure of the Watershed Partnership. There were two types of committees with the following roles and responsibilities.

- **Steering/Stakeholder Committee**: The Steering/Stakeholder Committee handled making decisions and approving the final Watershed Characterization Report. Input from the Work Groups, UTRGV, and state and federal partners was taken into consideration for decisions. UTRGV facilitated the Steering/Stakeholder Committee. Multiple workgroups ended up becoming one.
- In the beginning of the project, the Steering Committee set up four workgroups to ease discussion and receive input from local stakeholders. These workgroups originally were: Technical Advisory Committee, Non-Urban, Habitat, Urban and Infrastructure. As the time passed by these work groups ended up being one by decision of the stakeholders to ease the work.

Each Stakeholder Group member attended meetings and was expected to take part fully in all group deliberations. Members offered insights, suggestions, and concerns from a community, environmental, or public interest perspective. Committee members were expected to work together to achieve a consensus.

Key Stakeholder Group Meetings

Key Stakeholder Meetings were supposed to occur three times a year. This did not always happen due to distinct reasons, like the stakeholder's availability, or the COVID-19 pandemic, where many of the meetings could not be able to be held for safety reasons. Part of the members of the committees are elective officials, so scheduling appointments with them was not always easy as well.

The Partnership found and prioritized programs and practices to achieve the goals of the project. The members stand for stakeholder groups who are most affected by this project.

Agencies and organizations that are considered potential stakeholders are listed below.

- Texas Commission on Environmental Quality
- U.S. Environmental Protection Agency
- Agency Arroyo Colorado Watershed Partnership
- Cameron County
- Willacy County
- Hidalgo County
- Hidalgo and Willacy Drainage Districts
- All irrigation districts
- U.S. International Boundary Water Commission
- School Districts
- All the cities within the boundaries of the watersheds Nueces River Authority
- Laguna Atascosa Wildlife Refuge
- LRGV Stormwater Task Force
- Texas Parks and Wildlife Department
- Texas Water Development Board
- Texas Department of Transportation
- Texas AgriLife Extension Service
- Texas State Soil and Water Conservation Board
- United States Department of Agriculture
- Sierra Club – Rio Grande Valley Chapter
- University of Texas at Rio Grande Valley
- Texas A&M-Kingsville
- Research, Applied Technology and Education, Service (RATES)
- Texas State
- Technical College

The project partners have identified major land uses and business types in the watershed for inclusion in the stakeholder process as listed below.

- Rural landowners, ranchers, and producers
- City Residents
- Local Land Developers
- Local Homebuilders
- Local Homeowners Associations
- Local Engineering Associations/Local Engineering Consultants

Major Business Owners (represented by area Chamber of Commerce)

Table 1. Enlists all the meetings held by the Key Stakeholders to discuss matters related to the project.

Meeting	Date	Description
Key Stakeholder Meeting	09/09/19	Hidalgo/Willacy Floodway trip.
Key Stakeholder Meeting	09/26/21	North Floodway Field Trip
Planning project Key Stakeholder Meeting (Raymondville Drain Watershed)	10/25/2021	Linda Navarro presented the status of the Program: review and analysis of data collected, watershed delineation, current and future efforts.
Planning Project Key Stakeholder Meeting (Hidalgo/Willacy Main Drain Watershed)	11/03/21	Linda Navarro presented the status of the Program: review and analysis of data collected, watershed delineation, current and future efforts.
Key Stakeholder Meeting (USIBWC Floodway Watershed Planning Project)	11/10/2021	Linda Navarro presented water quality data collected from 2011 to 2019 on the Hidalgo/Willacy Main Drain Watershed Planning Project).
319 Clean Water Act Nonpoint Source Program Lower Laguna Madre & Brownsville Ship Channel, USIBWC Floodway, Hidalgo/Willacy, and Raymondville Drain Floodway Watershed Planning Projects	06/09/2022	Linda Navarro gave an overview of the North and Central Watersheds.

Figure 1. Hidalgo/Willacy Floodway Field Trip

Hidalgo Main Stakeholder Group

Hidalgo/Willacy County Floodway Watershed - Includes region above the Arroyo Colorado to the south watershed boundary of the Raymondville Drain, and from the Starr County border to the Laguna Madre. The Hidalgo Main Drain carries urban stormwater runoff from central and northern Hidalgo County, and agricultural runoff from northeast Hidalgo County and Willacy County.

The Steering/Stakeholder Committee was composed of representatives from a diversity of interests and geographic locations in the watershed. The members represented stakeholder groups who were the most affected by this project. These meetings were supposed to be eased two times per year, for each of the three watersheds for a total of six meetings per year. UTRGV facilitated the Stakeholder Committee. As mentioned before, not all the meetings could be held due to stakeholders' availability, COVID-19 pandemic, or elective official's timeline.

Steering Committee members:

a. Chair David Fuentes, Hidalgo County Commissioner
b. Vice Chair Eduardo Gonzalez, Willacy Commissioner
c. Marci Oveido, Lower Rio Grande Valley Development Council
d. Andrew Ernest, UTRGV
e. Melisa Gonzales, City of Alamo
f. Chris Fuller, Ph.D., RATES/RGV
g. Tushar Sinha, Ph.D., TAMUK
h. Ahmed Mahmoud, Ph.D., UTRGV
i. Jose Hinojosa, LRGV TPDES Stormwater Task Force
j. David Alaniz, City of La Villa
k. Javier Guerrero, UTRGV

Table 2. Meetings held by the Hidalgo Main Stakeholder group.

Meeting	Date	Description
Hidalgo Main Stakeholder Group Meeting	03/25/19	Meeting held to discuss the Project Overview, identification of SCM Members; Population of Technical Committee: Identification of Other Committees and Meeting Schedules.
Steering Committee (Hidalgo/Willacy County Floodway)	09/25/19	Dr. Ahmed Mahmoud presented a project update.

Q6 Hidalgo Main Stakeholder Group Meeting	02/29/20	This meeting was canceled due to COVID-19 pandemic.
319 Clean Water Act NPS Program Hidalgo/Willacy Main Drain Watershed Planning Project Key Stakeholder Meeting	11/03/2021	Linda Navarro and Ivan Santos presented the status of the project, a review & analysis of data collected and watershed delineation.
Fiscal Year 2022 Quarter 4 Meeting		A meeting is scheduled for September 1st , 2022.

North Floodway Stakeholder Group

USIBWC Pilot Channel/Floodway Watershed - From the Rio Grande River region, including regions not included in the Arroyo watershed, along the Rio Grande River continuing north and then east to the Laguna Madre. The North Floodway pilot channel constantly drains Waste Water Treatment Plant effluent and during large storm events, collects excess runoff from urbanized areas of Hidalgo County and agriculture land in Cameron and Willacy County.

The Steering/Stakeholder Committee was composed of representatives from a diversity of interests and geographic locations in the watershed. The members represented stakeholder groups who were the most affected by this project. These meetings were supposed to be eased two times per year, for each of the three watersheds for a total of six meetings per year. UTRGV facilitated the Stakeholder Committee. As mentioned before, not all the meetings could be held due to stakeholders' availability, COVID-19 pandemic, or elective official's timeline.

Steering Committee members:

a. Chair Andrew Ernest, UTRGV
b. Vice Chair Juan Uribe, USIBWC
c. Marci Oveido, LRGVDC
d. Augusto Sanchez, Cameron County
e. Eduardo Gonzalez, Willacy Commissioner
f. David Fuentes, Hidalgo County Commissioner
g. Jose Figueroa, City of Mercedes
h. Juan Cesar Bezares-Cruz, TAMUK
i. Benjamin Worsham, City of Weslaco
j. David Salinas, City of San Juan
k. David Alaniz, City of La Villa

Table 3. Enlists all the meetings held by the North Floodway Stakeholder group to discuss matters related to the project.

Meeting	Date	Description
Steering Committee (USIBWC Floodway)	02/26/19	Meeting held to discuss the Project Overview, Refinement of Project Scope, identification of SCM Members and SC Charge; Population of Technical Committee: Identification of Other Committees and Meeting Schedules.

Steering Committee (USIBWC)	09/11/19	Ahmed Mahmoud, Ph.D., made a presentation about the USIBWC Floodway Watershed Partnership, where the Steering Committee, Subcommittees, and project website were discussed.
Q6 North Floodway Stakeholder Group Meeting	02/29/2020	This meeting was canceled due to COVID-19 pandemic.
Q13 North Floodway Stakeholder Group Meeting	11/10/2021	Linda Navarro and Ivan Santos presented the status of the project, a review & analysis of data collected and watershed delineation.
FY22Q4 Meeting		A meeting is scheduled for August 24, 2022.

Raymondville Stakeholder Group

Raymondville Drain Watershed - Includes region above the Hidalgo/Willacy Floodway northern watershed boundary to the northern LRGV County limits, and from the Starr County border to the Laguna Madre. The Raymondville Drain collects stormwater runoff and return flows from the subwatersheds that are close to areas with predominant agriculture activity.

The Steering/Stakeholder Committee was composed of representatives from a diversity of interests and geographic locations in the watershed. The members represented stakeholder groups who were the most affected by this project.

These meetings were supposed to be held two times per year, for each of the three watersheds for a total of six meetings per year. As mentioned before, not all the meetings could be held due to stakeholders' availability, COVID-19 pandemic, or elective official's timeline. The arrival of the pandemic put a stop to most of the activities that were planned for the project due to protocol safety reasons.

Steering Committee members:

a. Chair Eduardo Gonzalez, Willacy County Commissioner
b. Vice Chair Jose Hinojosa, SCID#15
c. Ellie Torres, Hidalgo County Commissioner
d. Mardoqueo Hinojosa, P.E. City of Edinburg
e. Andrew Ernest, Ph.D., P.E., UTRGV
f. Marcie Oveido, LRGVDC
g. Kim Jones, P.E., TAMUK
h. Chris Fuller, RATES/RGV
i. Javier Guerrero, UTRGV

Table 4. Enlists all the meetings held by the Raymondville Stakeholder Group to discuss matters related to the project.

Deliverable	Date	Description
Steering Committee (Raymondville Drain)	03/14/19	Meeting held to discuss the Project Overview, Refinement of Project Scope, identification of SCM Members and SC Charge; Population of Technical Committee: Identification of Other Committees and Meeting Schedules.
Steering Committee (Raymondville Drainage)	11/06/19	Hidalgo County and City of Edinburg presented their Drainage projects.

Q6 Raymondville Stakeholder Group Meeting	02/29/20	This meeting was canceled due to COVID-19 pandemic.
Raymondville Steering Committee Meeting	03/24/2021	Project Status provided by Dr. Mahmoud; Linda Navarro presented North and Central Watersheds Data.
319 Clean Water Act NPS Program Lower Laguna Madre & Brownsville Ship Channel, USIBWC Floodway, Hidalgo/Willacy, and Raymondville Drain Floodway Watershed Planning Projects	2/28/22	Linda Navarro gave an overview of the North and Central Watersheds.
FY22Q4 Meeting		A meeting is scheduled for August 30, 2022.

Regional Watershed Stakeholder Meetings

Regional Watershed Stakeholder Meetings were intended to be hosted once a year for the three watershed groups. In these meetings, all Stakeholders were reunited to discuss project overviews, data demonstrations and presentations of projects.

There is a gap between 2018 and 2021 in the meetings because of COVID-19. The arrival of the pandemic put a stop to most of the activities that were planned for the project due to protocol safety reasons. Scheduling these meetings into an online setting and then switching into a hybrid model was a challenge and a set-back to all the proposed scheduled activities for the project.

Table 5. Meetings held by the Regional Watershed Stakeholders to discuss matters related to the project.

Meeting	Date	Description
North and Central Watershed Characterization Projects	12/04/18	Project overview provided by Augusto Sanchez Gonzalez; presentation of TCEQ's 319 Projects by Tim Cawthon.
FY21 Regional Watershed Stakeholder Meeting	06/25/2021	Meeting held to discuss the overview of the North and Central Watersheds Protection Plan.
319 Clean Water Act NPS Program (North and Central Watersheds)	02/16/22	RATES supplied an Overview on the North and Central Watersheds Protection Plan Phase II Project; M.S. Navarro and Ph.D. Kirkey made TWDB-FIF: RGV Flood Data Demonstrations, and a choice of RTHS Station Locations to address regional hydrologic modeling effort.

Public Outreach Events

An outreach and education campaign were started to create public awareness for the Watershed Planning Project. A variety of methods, such as newsletters or public outreach events, were used to distribute information about the project and ways in which individuals could become involved. The program's purpose was to educate citizens about local water quality issues, NPS pollution, watershed functions, and how individual actions can influence local water quality.

UTRGV worked closely with stakeholders to communicate project goals, activities, and findings to ensure that decision-making about the waterbody was stakeholder driven. To communicate project goals, activities, results, and accomplishments to affected parties, UTRGV facilitated public Steering Committee/Stakeholder meetings.

As part of this project, UTRGV created an effective plan to reach target audiences with specific information and social marketing solutions to inform the public, garner support and change behaviors throughout the watershed. There was some planned activities included on the PPP that could not be held because of the COVID-19 pandemic.

Some of these activities were:

- Partnerships with schools to conduct outreach water quality education;
- Campaigns to distribute water protection brochures and market the outreach plan;
- Urban growth /Low Impact Development workshops;
- Texas Watershed Steward training;
- Texas Stream Team education events and training;
- Septic system workshops;
- Campaigns about illegal dumping and litter

Even with the difficulties this project had due to the COVID-19 pandemic, Public Outreach events could be carried out differently than expected.

Table 6. Public Outreach Events held.

Meeting	Date	Description
Public Outreach Event 1 of 6	12/14/19	Dr. Mahmoud presented in Edinburg North High School the water issues in the valley.
Lower Rio Grande Valley 21st Annual Water Quality	05/23/19	Ahmed Mahmoud gave a presentation at the LRGV stormwater conference, an update on Hidalgo County North and Central Watershed

Management and Planning Conference		Protection Plan Project funded by the TCEQ NPS Clean Water Act Chapter 319 Project.
Lower Rio Grande Valley Development Council Watershed Protection Plan Meeting	07/10/19	Ahmed Mahmoud gave a presentation in the LRGVDC meeting on the Northern and Central Watershed Characterization Project.
Public Outreach Event 4 of 6	12/17/19	LRGV Texas Pollutant Discharge Elimination System Stormwater Task Force: 3 City Summit Harlingen, Mercedes, and Weslaco. Nov 1, 2019; 2) LRGV TPDES Stormwater Task Force: City Summit Meeting Nov. 8
Lower Rio Grande Valley Development Council Watershed Protection Plan Meeting	6/15/2020	319 Projects in the Valley: Lower Rio Grande Valley Development Council Watershed Protection Plan Meeting.
Lower Rio Grande Valley 23rd Annual Water Quality Management and Planning Conference.	05/19/21	Linda Navarro presented the Development of Cyberinfrastructure for Assessment of the Lower Rio Grande Valley North and Central Watersheds Characteristics.
Public Outreach Event 7 of 8	06/25/21	Presented at the annual Watershed Protection Plan Meeting.
Public Outreach Event 8 of 8		This public outreach event was not held due to time restrictions.

Communicating with the Public

UTRGV currently keeps a website for the North and Central Lower Rio Grande Valley Watersheds Partnership. The project webpage, Rio Grande Valley Stormwater Management[1], supplies an overview of water quality concerns within the watershed and links to project partners. It also has information about the project; including media coverage, maps, factsheets, photos, meeting agendas and meeting minutes. UTRGV maintained the project webpage on its website.

The Rio Grande Valley Stormwater Management website has been currently working since April 1st, 2019. The website was updated quarterly as needed with the information about the Steering Committee and Workgroup Meetings and Outreach Activities that happened during that time.

The UTRGV Project Manager, in cooperation with the project partners, handled identifying proactive opportunities for media outreach. The UTRGV Project Manager was able to use press releases to announce partnership meetings, events, general information, and opportunities for public involvement.

News releases were developed as needed to communicate key points regarding the project, announce meeting dates and times and Outreach & Education events/workshops. Press releases were produced by the Project Team and were issued on the project webpage. The UTRGV Project Manager also sent email press releases to stakeholders. The use of advertising was used to promote events and activities related to the project as well as to ensure proper information was being released to the public. Public participation was encouraged at every opportunity.

This information was proven on the PPP, a document that worked as a guideline to develop the project. As it developed, many things changed or were done in a separate way. Many of these news releases, website updates and media coverage were not completed due to the lack of information to share and where to share it. COVID 19 pandemic also was a major set-back for most of the activities that were proposed in the beginning of the project.

[1] Link for the project website: https://rgvstormwater.org/tceq-319-characterization-of-northern-and-central-rio-grande-valley-watersheds/

Conclusion

The Characterization of the North and Central Lower Rio Grande Valley Watersheds Phase I was an important project to identify data gaps of water quality concerns and sources of impairments to the Lower Laguna Madre. There were several findings that show areas of improvement for the next phase with respect to data collection and public participation from the stakeholders. For instance, there was a lack of water quality and flow data available to fully characterize the watersheds. Only eight (8) data samples were collected from Clean Rivers Program. These data points are limited to support a thorough watershed characterization while ongoing projects and future projects such as the Texas Water Development Board Freshwater program and TCEQ North and Central Watershed Characterization Phase II will support filling these data gaps. The North and Central Watershed Characterization Phase II, funded by TCEQ 319 program, will commence in September 2022. RATES is the lead in this project where data collection will be part of this phase and contribute to more data points while enhancing water quality and flow data of the study area.

Public participation and public outreach activities are important tasks to be improved. One of the augmentations in public engagement is to implement an active social media platform to interact with the community and stakeholders within the North and Central Watersheds. There has been a lack of public participation from the stakeholders on this project for the duration of the project since COVID-19 occurred and very limited participation from remote/online meetings.

From past stakeholder meetings, some of the watershed stakeholders provided positive feedback on the outcome of “one-on-one” in person meeting basis. They realized the importance of water quality and how recreational activities can be affected by certain high water quality parameters. They expressed their interest in the ongoing efforts in their region and are looking forward to future projects.

. Previous workgroup meetings, where information about the entire region’s watersheds was included, turned out to be very overwhelming for the audience resulting in their lack of participation/interest. In-person and one-on-one meetings were determined to be more engaging for the audience as they felt comfortable asking questions and contributing to the findings. Phase II workgroup meetings will be arranged per watershed and face to face to make meetings more effective and engaging.

APPENDIX

E

GLOSSARY

API
Application Programming Interface

API.RGVFlood.com
RGVFlood.com data assimilation service.

AU
Assessment Unit

AWS
Amazon Web Services

Azure
Microsoft's Cloud Computing Platform

Bernoulli
The Bernoulli equation is a simplification of the Navier-Stokes equations assuming inviscid fluid and steady (non-time-variant) flow.

BLE
Base Level Engineering

Celery
A task scheduling and messaging application used to maximize parallel task processing.

CentOS
A *Linux* distribution

CI
Cyberinfrastructure

CLI
Command-Line Interface

Clover
Cloud Virtual Water Model Executor

COP
Common Operating Picture

CPU
Centralized Processing Unit

Crowdsource
Data collection from open, relatively un-controlled, sources.

CUAHSI
Consortium of Universities for the Advancement of Hydrologic Science

Cyberinfrastructure
computing systems, data storage systems, advanced instruments and data repositories, visualization environments, and people, all linked by high speed networks

DEM
Digital Elevation Model

Deterministic
Approaches to describing processes that do not rely on randomness.

DFIRM
Digital Flood Insurance Rate Map

DHS
Department of Homeland Security

DIKW
Data, Information, Knowledge, Wisdom

Django
<https://www.djangoproject.com/>

DO
Dissolved Oxygen

Docker
Docker is a container deployment platform that allows for the rapid deployment of a applications in the cloud, independent of the physical infrastructure.

DRF
Django ReST Framework

DSS
Decision Support System

EC2
AWS Elastic Cloud Compute

Eeyore
URL: Eeyore.ratesresearch.org CPU: Dual Intel(R) Xeon(R) E-2124 CPU @ 3.30GHz Memory: 16GB HD: 4TB OS: Ubuntu Linux 20.04

FEMA
Federal Emergency Management Agency

FIF
: Flood Infrastructure Fund

FOSS
: Free and Open Source Software

GCE
: Google Compute Engine

GCP
: Google Cloud Platform

GCS
: Google Cloud storage

GeoNode
: <https://geonode.org/>

GeoNode/db
: *PostgreSQL* with *PostGIS* extensions database server storing *GeoNode* *Django* and *GeoServer* data.

GeoServer
: Open source server for sharing geospatial data.

GeoTIFF
: A public domain metadata standard which has the georeferencing information embedded within the *TIFF* file.

GIS
: Geospatial Information System

GKE
: Google *Kubernetes* Engine

H&H
: Hydrologic and Hydraulic

HAND
: Height Above Nearest Drainage <http://handmodel.ccst.inpe.br/>

HEC
: Hydrologic Engineering Center

HEC-DSS
: *HEC* Data Storage System

HEC-HMS
: Hydrologic Engineering Center Hydrologic Modeling System. <https://www.hec.usace.army.mil/software/hec-hms/>

HEC-RAS
: Hydrologic Engineering Center River Analysis System. <https://www.hec.usace.army.mil/software/hec-ras/>

HEC-RTS
: Hydrologic Engineering Center Real Time Simulation

HPC
: High Performace Computing

HPCC
: *HPC* cluster

HTML
: Hypertext Markup Language

HUC
: Hydrologic Unit Code

HWMD
: Hidalgo/Willacy Main Drain

IBWCNF
: *USIBWC* North Floodway

IDV
: Integrated Data Viewer from *UniData*

InfoWorks ICM
: <https://www.innovyze.com/en-us/products/infoworks-icm>

IT
: Information Technology

K8s
: *Kubernetes*

Kubernetes
: An orchestration system facilites the deployment and management of containerized applications, with a specific focus on scaling to increase demand for the provided services.

LaTeX
: A high-quality typesetting system including features designed for the production of technical and scientific documentation

LiDAR
: Light Detection and Ranging

Linux
: An open source operating system that is made up of the kernel, the base component of the OS, and the tools, apps, and services bundled along with it.

LLM
Lower Laguna Madre

LLM/BSC
Lower Laguna Madre/Brownsville Ship Channel watershed.

LRGV
Lower Rio Grande Valley

LRGVDC
Lower Rio Grande Valley Development Council

LSM
Land Surface Models focus on describing the processes driving the exchange of terrestrial water with atmospheric.

Mechanistic
Formulations describing physical, biological or chemical processes based on a theoretical understanding.

MIKE Urban+
<https://www.mikepoweredbydhi.com/download/mike-2019/mike-urban-plus?ref=%7B5399F5D6-40C6-4BB2-8311-37B615A652C6%7D>

MPI
Message Passing Interface

NAT
Network Address Translation

Navier-Stokes
The Navier-Stokes equations are mathematically representations of conservation of mass and momentum for simple fluids such as water.

NCAR
National Center for Atmospheric Research

NetCDF
NetCDF (Network Common Data Form) is a set of software libraries and machine-independent data formats that support the creation, access, and sharing of array-oriented scientific data. It is also a community standard for sharing scientific data. The Unidata Program Center supports and maintains netCDF programming interfaces for C, C++, Java, and Fortran. Programming interfaces are also available for Python, IDL, MATLAB, R, Ruby, and Perl. Reproduced from NetCDF.

NGINX
High performance web server.

NIC
Network interface controller

NLDAS
North American Land Data Assimilation System

NOAA
National Oceanic and Atmospheric Agency

NWC
National Water Center

NWM
National Water Model

NWS
National Weather Service

ODM
Observations Data Model

PostGIS
Spatial database extender for *PostgreSQL*

PostgreSQL
Open source object-relational database system, available with *PostGIS* extensions

Primo
Parallel raster inundation model

PWA
Progressive Web Application, an application format that allows installation as native applications onto mobile devices and desktop PCs directly from the web.

Python
<https://www.python.org/>

R
A language and environment for statistical computing and graphics

RabbitMQ
An open-source inter-process message broker

RATES
Research, Applied Technology, Education and Service, Inc., a non-profit technology-based company.

RBAC
Role Based Access Control

REON
River and Estuary Observation Network. A partnership of organizations, supported by cloud software, committed to furthering the Democratization of Water Intelligence by sharing water data, analytics and models for local and regional decision making.

REON.cc
Cloud-based cyber-infrastructure that supports *REON*'s goals.

REON/db

PostgreSQL with *PostGIS* extensions database server storing *REON* specific data for *RTHS*, *REON/WM* & *REON.cc* data.

REON/RGV
Instantiation of *REON* with specific application to the Lower Rio Grande Valley - this includes the collection of *RTHS* stations, the *REON* partners with a stake in the LRGV, and the application of the *REON/WM* to the *LRGV*.

REON/WM
REON Water Model

ReST
REpresentational State Transfer

RGVFlood
Instantiation of the *REON* Cyberinfrastructure specific to the *LRGV*.

RGVFlood.com
The domain name and *URL* for *RGVFlood*.

RTHS
Real Time Hydrologic System

RTHS.us
Cloud server of *RTHS* network data

RVD
Raymondville Drain

RWRAC
Regional Water Resources Advisory Committee

SA
Situational Awareness

SaaS
Software as a Service

SMT
Simultaneous Multi-Threading

SONAR
Sound Navigation Ranging, a technique for detecting and determining the distance and direction of underwater objects by acoustic means.

Sphinx
Documentation generator supporting multiple output formats

SPRNT
Simulation Program for River Networks

Spyce
Smartphone Python Computing Environment

Stochastic
Approaches to describing processes in statistical terms.

SWMM
Stormwater Management Model

SWTF
Stormwater Taskforce

Tastypie
a webservice *API* framework for *Django*

TGLO
Texas General Land Office

Tier I
Tier I Real-Time Regional Hydrologic Modeling Framework

Tier II
Tier II On-Demand Sub-Regional Hydraulic Modeling Framework

Tier III
Tier III Off-Line Urban Stormwater Modeling Framework

TIFF
Tag Image File Format, a computer file used to store raster graphics and image information.

Tigger
URL: Tigger.water-wizard.org CPU: Dual Intel(R) Xeon(R) CPU E3-1245 v3 @ 3.40GHz Memory: 16GB HD: 4TB OS: Ubuntu Linux 20.04

TIN
Triangular Irregular Networks are a form of vector-based digital geographic data and are constructed by triangulating a set of vertices.

TWDB
Texas Water Development Board

TWDB/FIF
The Texas Water Development Board Flood Infrastructure Fund.

Ubuntu
A *Linux* distribution

UCAR
University Corporation for Atmospheric Research

UI
User Interface

UniData
A *UCAR* community program focused on sharing geoscience data and the tools to access and visualize that data.

URL
Uniform Resource Locator

USACE
United States Army Corps of Engineers

USGS
United States Geological Survey

USIBWC
United States International Boundary Water Commission

UTRGV
University of Texas Rio Grande Valley

vCPU
Virtual *CPU*

VIC
Variable Infiltration Capacity (VIC) Macroscale Hydrologic Model. <https://vic.readthedocs.io/en/master/>

VM
Virtual Machine

Water Wizard
A suite of decision support tools designed for regional decision makers.

Wizard.RGVFlood.com
A web, mobile and desktop client-side application that, working with the server-side components at *RGVFlood.com*, provides the end-user with the up-to-date analytics, visualization and decision support services from the core *REON.cc CI*.

WPP
Watershed Protection Plan

WPS
WRF Preprocessing System

WRDA
Water Resources Development Act

WRF
Weather Research and Forecasting Model

WRF-Hydro

WRF Hydrological modeling system. <https://ral. .edu/projects/wrf_hydro/overview>

APPENDIX

F

BIBLIOGRAPHY

BIBLIOGRAPHY

[1] Chris Hathcock. Inventory and monitoring strategies and using qualitative data to evaluate the effectiveness of long-term restoration along the lower Rio Grande. In *Conference on ecological and ecosystem restoration*. University of Florida, July 2014. URL: https://conference.ifas.ufl.edu/CEER2014/Speaker%20Presentations/July%2029,%20Tuesday_Sessions%2001%20-%2030/Salon%20K_sessions_10_20_30/1400_Chris%20Hathcock.pdf (visited on 2022-08-18).

Chris Hathcock. Inventory and monitoring strategies and using qualitative data to evaluate the effectiveness of long-term restoration along the lower Rio Grande. In *Conference on ecological and ecosystem restoration*. University of Florida, July 2014. URL: https://conference.ifas.ufl.edu/CEER2014/Speaker%20Presentations/July%2029,%20Tuesday_Sessions%2001%20-%2030/Salon%20K_sessions_10_20_30/1400_Chris%20Hathcock.pdf (visited on 2022-08-18).

[2] E. Annette Hernandez and Venkatesh Uddameri. An assessment of optimal waste load allocation and assimilation characteristics in the Arroyo Colorado River watershed, TX along the US–Mexico border. *Clean Technologies and Environmental Policy*, 15(4):617–631, August 2013. URL: https://doi.org/10.1007/s10098-012-0546-6 (visited on 2022-08-17), doi:10.1007/s10098-012-0546-6.

E. Annette Hernandez and Venkatesh Uddameri. An assessment of optimal waste load allocation and assimilation characteristics in the Arroyo Colorado River watershed, TX along the US–Mexico border. *Clean Technologies and Environmental Policy*, 15(4):617–631, August 2013. URL: https://doi.org/10.1007/s10098-012-0546-6 (visited on 2022-08-17), doi:10.1007/s10098-012-0546-6.

[3] Ahmed Mahmoud, Taufiqul Alam, Augusto Sanchez, Javier Guerrero, Tamer Oraby, Eman Ibrahim, and Kim D. Jones. Stormwater Runoff Quality and Quantity from Permeable and Traditional Pavements in Semiarid South Texas. *Journal of Environmental Engineering*, 146(6):05020001, June 2020. URL: https://ascelibrary.org/doi/10.1061/%28ASCE%29EE.1943-7870.0001685 (visited on 2022-08-18), doi:10.1061/(ASCE)EE.1943-7870.0001685.

[4] Ahmed Mahmoud, Linda Navarro, and A. N. S. Ernest. Characterization of Northern and Central Lower Rio Grande Valley Watersheds Geospatial Quality Assurance Project Plan. Technical Report, University of Texas Rio Grande, 2019. URL: https://rates-inc-nandcphase1.readthedocs-hosted.com/en/latest/_static/90196_QAPP_geospatial_executed.pdf (visited on 2022-08-19).

Ahmed Mahmoud, Linda Navarro, and A. N. S. Ernest. Characterization of Northern and Central Lower Rio Grande Valley Watersheds Geospatial Quality Assurance Project Plan. Technical Report, University of Texas Rio Grande, 2019. URL: https://rates-inc-nandcphase1.readthedocs-hosted.com/en/latest/_static/90196_QAPP_geospatial_executed.pdf (visited on 2022-08-19).

[5] Linda Navarro. Development of a Cyberinfrastructure for Assessment of the Lower Rio Grande Valley North and Central Watersheds Characteristics. Master's thesis, University of Texas Rio Grande Valley, Edinburg, TX, October 2021.

Linda Navarro. Development of a Cyberinfrastructure for Assessment of the Lower Rio Grande Valley North and Central Watersheds Characteristics. Master's thesis, University of Texas Rio Grande Valley, Edinburg, TX, October 2021.

[6] Linda Navarro, Abdulkabir Aduragba, and A. N. S. Ernest. Watersheds Characterization And Next Steps Report For Lower Rio Grande Valley North And Central Watersheds. Technical Report, University of Texas Rio Grande, 2022. URL: https://rates-inc-nandcphase1.readthedocs-hosted.com/en/latest/_static/Draft_WCR_Abdul_kd_LN.pdf (visited on 2022-08-19).

[7] Linda Navarro, Ahmed Mahmoud, Andrew Ernest, Abdoul Oubeidillah, Jessica Johnstone, Ivan Rene Santos Chavez, and Christopher Fuller. Development of a Cyberinfrastructure for Assessment of the Lower Rio Grande Valley North and Central Watersheds Characteristics. *Sustainability*, 13(20):11186, October 2021. URL: https://www.mdpi.com/2071-1050/13/20/11186 (visited on 2022-08-18), doi:10.3390/su132011186.

Linda Navarro, Ahmed Mahmoud, Andrew Ernest, Abdoul Oubeidillah, Jessica Johnstone, Ivan Rene Santos Chavez, and Christopher Fuller. Development of a Cyberinfrastructure for Assessment of the Lower Rio Grande Valley North and Central Watersheds Characteristics. *Sustainability*, 13(20):11186, October 2021. URL: https://www.mdpi.com/2071-1050/13/20/11186 (visited on 2022-08-18), doi:10.3390/su132011186.

[8] Maria Rebeca Santos-Chavez, Linda Navarro, and A. N. S. Ernest. Partnership Coordination Report Characterization of Northern and Central Rio Grande Valley Watersheds. Technical

Report, University of Texas Rio Grande, 2022. URL: https://rates-inc-nandcphase1.readthedocs-hosted.com/en/latest/_static/Partnership-Coordination-Report_v5_TCEQcomments.pdf (visited on 2022-08-19).

[9] Region M TWDB. Rio Grande Regional Water Plan. Technical Report, Texas Water Development Board, 2016. URL: https://www.twdb.texas.gov/waterplanning/rwp/plans/2016/M/Region_M_2016_RWPV1.pdf (visited on 2022-08-18).

Region M TWDB. Rio Grande Regional Water Plan. Technical Report, Texas Water Development Board, 2016. URL: https://www.twdb.texas.gov/waterplanning/rwp/plans/2016/M/Region_M_2016_RWPV1.pdf (visited on 2022-08-18).

[10] USEPA. Handbook for Developing Watershed Plans to Restore and Protect Our Waters. Technical Report, United States Environmental Protection Agency, 2008. URL: https://www.epa.gov/sites/default/files/2015-09/documents/2008_04_18_nps_watershed_handbook_handbook-2.pdf (visited on 2022-08-17).

USEPA. Handbook for Developing Watershed Plans to Restore and Protect Our Waters. Technical Report, United States Environmental Protection Agency, 2008. URL: https://www.epa.gov/sites/default/files/2015-09/documents/2008_04_18_nps_watershed_handbook_handbook-2.pdf (visited on 2022-08-17).

INDEX

V

W