

Edwards Aquifer Water Quality Protection from Catastrophic and
Low to Mid-level Effects of Discharge of Hazardous and Polluting
Materials from Contaminated Water Runoff during Emergency
Response

UNDER

The Proposition 1 Edwards Aquifer Protection Projects within
Urbanized Areas of Bexar County's Recharge and Contributing
Zones Program

EXECUTIVE SUMMARY REPORT

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I. Project Description

This project directly and immediately helps to protect Edwards Aquifer (EA) water quality within urbanized areas of Bexar County's aquifer recharge zone by providing Best Management Practices (BMPs) and training for First Responders for protecting the EA's recharge and contributing zones during emergency events. Protection will come from preventing or reducing discharge into the aquifer of potentially catastrophic and low- to mid-level amounts and kinds of hazardous and polluting materials in water runoff from response to emergencies such as ordinary accidental fire and fire or potential fire caused by arson, flood, high wind, lightening, and explosion in structures and along transportation corridors.

In 2007 the Texas Legislature directed the Edwards Aquifer Authority (EAA) to protect the water quality of the EA from the impact of fire control in the EA's recharge zone (Act of May 30, 2007, 80th Leg., R.S., ch. 510, 2007 Tex. Gen. Laws 900). The legislature was responding to concern over potentially catastrophic aquifer pollution events that can occur in the recharge zone during fire control or other emergency response in situations where there are hazardous materials present.

The event that prompted action by the legislature was a fire known as "Mulchie" that burned for three months in an eight-story high mulch and debris pile on the edge of the EA recharge zone near Helotes. This fire ultimately cost taxpayers about \$6 million to extinguish. The EAA ultimately filed suit to recover direct costs of over \$80,000 spent on efforts to protect water quality during the Mulchie incident, including over \$50,000 in staff costs and \$22,000 in water quality laboratory analysis.

The mandate from the legislature covered reducing impacts on aquifer water quality of catastrophic and mid- to low-level pollution of the aquifer from day-to-day fire control activities in the presence of hazardous and other polluting materials in the recharge zone. This includes locations where there are existing threats to water quality due to on-site storage, production, or transport exchanges of polluting or hazardous materials, as well as along all corridors of transport such as roadways, rail lines, and airports.

Areas of concern for such pollution are pervasive throughout the recharge zone in urbanized Bexar County and elsewhere across the entire aquifer recharge and contributing zones. While first thought may be of concern over chemical manufacturing or storage locations in Bexar County industrial areas, hazardous and polluting materials are present almost everywhere one looks. Huge inventories are in every hardware and garden store, every major grocery store, every gas station, every pharmacy, in many trucks and rail cars along every transportation route, and even in the garages and garden sheds in residential areas. Making San Antonio and Bexar County particularly susceptible to potentially catastrophic contamination events are two unique factors: 1) the presence of major military and medical facilities along with associated support businesses that typically use or store a large quantity and wide range of highly and moderately hazardous materials, and 2) San Antonio is a transportation hub and corridor for high volumes of rail and truck traffic coming from and going to Mexico through Laredo, the nation's largest inland port of

entry (<https://comptroller.texas.gov/economy/economic-data/ports/laredo.php>). These factors make urbanized areas of Bexar County subject to potential impact from virtually any of the over 600 hazardous substance listed under section 311(b)(2)(A) of the Clean Water Act.* While location and nature of many contaminants in the recharge zone are known, EAA and Bexar County HazMat officials believe location and nature of some contaminants are currently unknown. For example, the nature and location of contaminants in truck, rail, and air traffic is constantly changing, with information access during an event variable.

II. Delineation of Tasks and Deliverables

Per the Funding Agreement, Funding Recipient (Texas A&M University-San Antonio) shall use reasonable efforts to produce the following deliverables:

- a. Training curriculum, program, and educational materials for 12-hour, 2-day course for first responders on reducing or eliminating emergency runoff into the Edwards Aquifer recharge zone.
- b. Delivery of said training course to first responders.
- c. Emergency response BMPs tailored for the Edwards Aquifer recharge zone Evaluation of course curriculum, BMPs, and associated materials.
- d. Edwards Aquifer Water Quality Protection Information Base and User-Friendly Interface for First Responders and Fire Emergencies providing essential guidance and site-specific information about recharge zone locations.
- e. Emergency response BMP effectiveness assessment protocol.
- f. Integration of assessment protocol into regular EAA sampling/monitoring programs.
- g. Video providing first responders and public easily understood information about sensitivity of karst recharge zone and need for aquifer protection against hazardous materials during emergency response.
- h. General outreach and education materials.
- i. Workshop on emergency response experiences and practices in karst watersheds Workshop proceedings report.
- j. Final Project report.

The Project's major milestones and tasks are completion of the following:

1. Training curriculum, program, and educational materials for First Responders on use of Emergency Response BMPs, instruction on use of containment tools and supplies, and how to use the Edwards Aquifer Water Quality Protection Information Base and User-Friendly Interface for First Responders and Fire Emergencies.

Task 1: Develop 12-hr, 2-day course curriculum and program materials.

Task 2: Conduct First Responder training for Stations 1 and 34.

Task 3: Seek and support efforts to secure additional funding to continue training for up

* <https://www.gpo.gov/fdsys/pkg/CFR-2011-title40-vol22/xml/CFR-2011-title40-vol22-sec116-4.xml>

to five additional years upon Project completion.

Task 4: Update and adjust course curriculum as needed for future trainings based on initial application, if possible, within the term of this Agreement.

2. Best Management Practices (Emergency Response BMPs for Karst Aquifers) for use in the EA recharge zone that will provide specific guidance to and be the basis for training of First Responders on actions that may be taken and on use of measures to protect the aquifer from contamination from emergency response water runoff.

Task 5: Review existing BMPs for fire response.

Task 6: Adapt or develop BMPs to address the unique nature of protecting water quality in urbanized Bexar County.

Task 7: Provide SAFD and Bexar County HazMat with review.

Task 8: Incorporate Emergency Response BMPs into the first responder training curriculum.

Task 9: Support First Responders' use of BMPs during Emergency Response.

Task 10: Update BMPs, if applicable, as a result of study of effectiveness and use by First Responders, and after the workshop on emergency response experiences and practices in karst watersheds.

3. Develop "Edwards Aquifer Water Quality Protection Information Base and User-Friendly Interface for First Responders and Fire Emergencies."

Task 11: Assemble non-digital records for review and begin records review and verification.

Task 12: Complete design of the database, user-friendly interface, and inventory of map, software, and hardware needed to complete this Project activity.

Task 13: Build database and user-friendly interface, initiate testing and get user feedback as development proceeds.

Task 14: Work with TEEX to include use of the database and user-friendly interface in the training curriculum.

Task 15: Gather user feedback and update database and user-friendly interface.

4. Emergency Response BMP effectiveness assessment protocol and integration of assessment of aquifer contaminant/pollution reduction due to employment of emergency response BMPs into regular EAA sampling/monitoring programs for aquifer water quality.

Task 16: Develop study protocol upon completion of emergency response BMPs and review of the First Responder training curriculum.

Task 17: Where possible, Study Emergency Response BMP effectiveness on reducing impact on aquifer water quality in urbanized Bexar County from hazardous materials in runoff.

Task 18: Continue this work on an event-by-event basis as an in-kind long-term contribution to the Project.

5. Education and Information Support

Task 19: Develop video script and identify location of production sites.

Task 20: Film and edit video.

Task 21: Complete video production and make available for TEEEX training curriculum.

Task 22: Leverage and link outreach and educational materials into the EAA's and partners' regular outreach and education feeds to websites, Twitter, and news throughout Project timeline and after it is completed.

Task 23: Continue education and information support during and after Project activity ends as an in-kind long-term contribution to the Project.

(Task 24)[†]

6. Hold a workshop on emergency response experiences and practices in karst watersheds to validate, improve, maintain, and share activities of the Project among water quality protection professionals.

Task 25: Initiate work on planning for arrangements, agenda, invitees, and timeline.

Task 26: Issue workshop announcement and invitation.

Task 27: Hold workshop.

Task 28: Complete and publish workshop report.

Proposals to modify task items were approved during the course of the project, including:

1. Extend Tasks #20-22 to expand on-line information and training materials in response to the impact of COVID-19 on face-to-face training by allocation of \$25,000 in contingency funding.

We request allocation of contingency funding to expand on-line materials and the instructional video. This request comes in response to the impact of COVID-19 to expand on-line instructional and educational materials that can be used in place of traditional face-to-face first responder training. These materials will be designed for on-line use as information and for training of first responders and others who may be unable to participate in traditional face-to-face instruction or who may serve in a support role to first responders. This video covers (a) the threat of fire-control runoff to the aquifer, (b) best management practices for protecting the aquifer during firefighting, (c) tell the story of training first responders, and (d) introduce emergency responders and public officials to new tools made available by the project to help protect the aquifer.

2. Extend Tasks #5, #6, #7, #10, and #17 by allocation contingency funding to further develop the emergency response protocol and best management practices to cover response options to protect the aquifer and better inform the public should emergency responder efforts fail to block discharge of contaminants into the aquifer.

[†] Task 24 was not assigned in the contract. It was likely a numeric error. For the purpose of aligning with the contract, we used the same assigned numbers in this report.

During expert peer-review on Best Management Practices (BMPs) for firefighting in the Edwards aquifer[‡], it was recommended that the authors consider what steps first responders should take in the event that contaminants enter the aquifer during firefighting. The original project and scope of training are focused on actions first responders can reasonably take during an emergency event. The protocol and BMPs proposed extends the project's effectiveness during first response beyond firefighting measures. This extension would detail what steps immediately come next if aquifer contamination is suspected. For such next steps to be effective, they must take place quickly. Too often, response to aquifer contamination is delayed, potentially making effective response a matter of too little too late. Having basic guidance and planning as part of the current first responder training and protocol, perhaps coupled with prepositioning of emergency supplies, will allow for rapid response. For developing this protocol we propose a process similar to that used in Tasks #5-8 to develop the BMPs, with (a) a quick review of relevant past work, (b) development of a draft protocol/BMPs, (c) review by a group of experts and revision as needed, (d) incorporation into the training curriculum as possible, and (e) coupling with response planning materials for use by emergency responders, health and safety officials, water agencies, and community leaders.

3. Substitute Tasks #12, #13, and #15 with the evaluation of impact and damage to the Edwards Aquifer that an actual emergency in the recharge zone of WUI would cause.

These tasks were originally designed to work with the EAA to integrate their developed GIS-based interactive tools. However, we have identified gaps in the data and information sharing between multiple aquifer protection stakeholders that prevent the implementation of the tools. As a result, we have shifted the focus of our effort to streamlining information flow rather than integrating existing tools that each entity has already developed and used. While BMPs for pre-planning and post-contamination events have been developed, questions remain as to what incidents would trigger an emergency response, the type of HazMat to be dealt with, and the potential impacts on the aquifer's water quality. The main tasks are literature survey on the fate and transport of industrial contaminants into karst aquifers and identify the potential hazards and investigate the presence of hazardous materials correlated to land use and development in Edwards Aquifer's recharge and contributing zones within Bexar County. We will deliver a report of literature surveys on the impact of hazardous contaminants to karst aquifers and implications to the Edwards Aquifer.

[‡] Schindel, G.M. and R.A. Rosen. 2020. Best Management Practices for Fire Fighting in the Karstic Edwards (Balcones Fault Zone) Aquifer of South-Central Texas. Texas Water Journal. https://digitalcommons.tamusa.edu/water_faculty/9/

III. Delineation of Project Completion

The progress for the project deliverables outlined in Section II are described as follows. Please refer to the actual documents for the deliverable. Notably, deliverables in the form of products are presented in the final product form (e.g., BMPs, training curriculum, videos, etc.), whereas deliverables that are activity-oriented (e.g., training, outreach, workshop, etc.) are presented in reporting form for documentation and publications purposes.

- a. Training curriculum, program, and educational materials for 12-hour, 2-day course for first responders on reducing or eliminating emergency runoff into the Edwards Aquifer recharge zone.

We developed a 12-hr, 2-day course curriculum and program materials, including the BMPs. Please see Exhibit “**Deliverable A**”.

- b. Delivery of said training course to first responders.

We completed the training to San Antonio Fire Department Stations 1 and 34. Please see Exhibit “**Deliverable B**” for details of the training results.

- c. Emergency response BMPs tailored for the Edwards Aquifer recharge zone Evaluation of course curriculum, BMPs, and associated materials.

Exhibit “**Deliverable C**”. We developed two sets of BMPs to address the unique nature of protecting water quality in urbanized Bexar County. These are:

Part 1. Recommended Best Management Practices for Response to Spill in the Edwards Aquifer of South Central Texas.

Part 2. Best Management Practice to Standards, Training, and Tools to Increase Resilience of the Edwards Aquifer Water Supply During Emergency Fire Control.

- d. Edwards Aquifer Water Quality Protection Information Base and User-Friendly Interface for First Responders and Fire Emergencies providing essential guidance and site-specific information about recharge zone locations.

This deliverable is developed, owned, and maintained by the Edwards Aquifer Authority, who developed the GIS interactive tool and maintained an updated database as in-kind contribution to the project. As EAA owns the GIS tools and wishes to maintain strict access control, we ask that the deliverable be presented by EAA.

EAA staff made a presentation about their First Responder Program at the Board of Director’s meeting in July 2021. The presentation starts at about 15:30/1:41:14, including the introduction of the GIS interactive tool developed for the First Responder Program. This presentation lays out the details of the GIS tool.

http://edwardsaquifer.granicus.com/MediaPlayer.php?view_id=2&clip_id=593

Per Task Modification 3 described in Section II, we conducted research to review and develop risk assessment framework for Edwards Aquifer contamination. Please refer to “**Deliverable S1**”.

Please refer to “Deliverable F” which provides documentation as to how the developed emergency response BMPs and associated materials can be tailored for the Edwards Aquifer recharge zone.

e. Emergency response BMP effectiveness assessment protocol.

We developed study protocols upon completion of emergency response BMPs and review of the First Responder training curriculum. Please refer to “**Deliverable E**” for the materials developed.

f. Integration of assessment protocol into regular EAA sampling/monitoring programs.

Please see “**Deliverable F**” for the guidelines to integrate the associated materials, including the emergency response BMPs we developed for the Edwards Aquifer recharge zone, for practices in EAA’s aquifer protection programs.

g. Video providing first responders and public easily understood information about sensitivity of karst recharge zone and need for aquifer protection against hazardous materials during emergency response.

We completed video development including scripting, filming, editing, and production. We have made the videos available as part of the training curriculum. Please refer to “**Deliverable G**” containing two videos, including Part 1 (original Tasks 20-22) and Part 2 (Modified Task 1 as described in Section II):

Part 1. Emergency Responder’s Guide to Protecting the Edwards Aquifer.

https://digitalcommons.tamusa.edu/water_videos/1

Part 2. Edwards Aquifer Water Protection from Contaminated Firefighting Runoff.

https://digitalcommons.tamusa.edu/water_videos/14/

h. General outreach and education materials.

We published peer-review articles, generated media-friendly materials, maintained a project website, participated in conferences to present our work or to network with other participants in relevant professional fields, and provided virtual training and outreach to emergency responses groups outside of SAFD. Please see “**Deliverable H**” for details.

i. Workshop on emergency response experiences and practices in karst watersheds
Workshop proceedings report.

We completed a decision-making roundtable workshop on April 4, 2024 with participants representing the City of San Antonio, EAA, SARA, SAFD, SAOEM, and other invitees. Please see “**Deliverable I**” for the workshop proceedings report.

j. Final Project report.

The present report (pending approval).

IV. Summary and Recommendations

Summary

The funding recipient for this Edwards Aquifer Water Quality Protection program successfully developed multiple sets of BMPs, training curricula, and outreach/education materials. If implemented, these materials will significantly enhance the resilience of the aquifer amid rapid development in the sensitive and vulnerable aquifer's recharge and contributing zones. Ultimately, the purpose of this project are to prevent catastrophic emergency events, either natural disasters (e.g., wildfires caused by extreme weather) or man-made causes (spills, illegal storage/dumping) from contaminating the aquifer, and to minimize the impact of a contamination episode if it does happen.

On the pre-planning side, the BMPs we developed highlight (i) the development of accurate, secure, updated, visually interactive GIS tool with database (surface karst features, runoff containment structures, types and amount of chemicals stored) easily accessible information to emergency responders. (ii) identification of susceptible water supply systems and irrigation systems for regular monitoring and site inspection. (iii) prepositioning of fire control barrier materials. On mitigation during emergency response, the BMPs we proposed contain regular containment tactics (diking, damming, diverting) but emphasize prioritizing the prevention of hazardous materials from being discharged into potential pathways (sinkholes, fractures and faults, sinking streams, caves, grass swales, and other limestone features) into the subsurface. We also recommended the decontamination of retention structures after the event.

If hazardous materials are suspect to have entered the aquifer, we recommended dye tracing through the use of non-toxic fluorescent dyes to determine the fate and transport of the contaminants. Fluorescent dyes have low detection limits and are relatively inexpensive, quick, and easy to use for tracking water movement through the subsurface and aquifer. However, this practice requires pre-planning, training, and preposition dye materials. Fluorescent dyes should be administered and tracked under the direction of a professional experienced in their use.

A key piece of best practices is the effective line of communication and coordination to quickly respond to an emergency incident potentially detrimental to the aquifer's water quality. This is particularly critical as the Edwards Aquifer's recharge zone spans across six counties, required cross-jurisdictional communication and aid. A communication chart was developed to streamline emergency response agencies and entities at the federal, state, and regional (municipal) level.

Recommendations

Part of the project is to support first responders' use of BMPs during emergency response, and to update BMPs, if applicable, after the emergency response experiences. While there has not been a reported emergency incident triggering the emergency response BMPs, discussions during workshops brought forth several questions pertaining to the implementation of the BMPs. We reflected on these discussions and organized them into the following recommendations:

Communication

We developed a chart showing necessary Whole of Governance (WoG) approach to protect the Aquifer's water quality. This chart included state agencies needed to be included in the communication (TDEM, Texas Division of Emergency Management; TFS, Texas Forest Services; TEEX, Texas A&M Engineering Extension Service; TIFMAS, Texas Intrastate Fire Mutual Aid System; TCEQ, Texas Commission of Environmental Quality; DPS, Department of Public Safety, among others), county-level agencies (OEM, Office of Emergency Management; LEPC, Local Emergency Planning Committee; FD, Fire Department) across the six counties within the Aquifer's recharge zone. These counties include Kinney and Uvalde (part of Middle Rio Grande Development Council, MRGDC), Medina, Bexar, and Comal (part of Alamo Area Council of Governments, AACOG), and Hays (a member of Capital Area Council of Governments, CAPCOG). At the municipal level where the Aquifer's recharge zone has been heavily developed, the entities involved include the City of San Antonio's (and other incorporated cities within Bexar County) fire department and Parks and Recreation, as well as the Edwards Aquifer Authority and San Antonio River Authority. Additionally, the San Antonio Water System and the U.S. Geological Services are included as they both own and operate monitoring wells. JBSA Camp Bullis, situated in the Aquifer's contributing zone and active in military training, is also included in the communication.

An incident – for example, a major truck spill of hazardous chemicals or a warehouse fire in the recharge zone along Loop 1604 – triggering emergency response from CoSA's FD and OEM. However, each of the entities will play a role in the communication and support, depending on the nature of the incident. We recommend the following actions:

1. the Office of Emergency Management (OEM) from the City of San Antonio and Bexar County conduct aquifer contamination joint **tabletop exercise** every few years, which will account for personnel turnover and improvements in BMPs. Lessons learned from a joint tabletop exercise can be shared with county OEMs and LEPCs across the aquifer recharge zone, and the counties in the aquifer contributing zone. The benefits of tabletops are:
 - i. ensure effective communication for emergency response, coordinate the emergency response plan,
 - ii. streamline messaging to the media and the public about the informed emergency response decisions and the protection of public health and safety,
 - iii. develop scenarios and outline responsibilities of each entity,
 - iv. debrief on incident history, response decision and outcome.
2. All pertinent information should be posted on an ArcGIS or ESRI style Incident Dashboard similar to those maintained for large scale emergency responses. It will be critically important for GIS IT personnel from all relevant stakeholders to work well together under

the incident's Plans Section Chief. Each stakeholder may have data layer files that the other stakeholders do not have, and all layers may be necessary to effectively respond to an emergency.

3. Regularly scheduled meetings of both SAWS and EAA's GIS teams to merge their aquifer feature databases into one. They currently do not have active coordination of this very important task.
4. Regularly scheduled meetings of SAWS personnel involved in aquifer protection programs, along with their EAA counterparts to avoid duplication of effort and ensure that all important information is shared to best protect our aquifer.

Regulation

Ordinances are recommended to mandate business owners in the Aquifer's recharge zone to fully comply with EAA's inspection and database updates, as information accuracy and equipment operability is critically important to the decision-making of the first responders on scene. We recommend:

5. Ensure that City of San Antonio's HazMat billing ordinance allows for charging property owners for all aquifer protection actions and subsequent remediation.
6. Work with EAA and other legislative entities to mandate fire sprinklers in all new construction over the recharge zone and explore ways to incentivize and pay for retrofits with sprinklers in existing structures. Collaborate with Insurance Industry representatives to move this action forward.

BMP implementation

Effectiveness of BMP implementation hinges on resources availability and the preparedness and prepositioning of fire runoff control barrier equipment and materials. We therefore recommend the following actions to be taken:

7. Budget allocation to purchase and maintain runoff and HazMat-containment materials and equipment. Cost-sharing between stakeholders should be discussed.
8. San Antonio Public Works to stage equipment and personnel in a manner that ensures quick response to all parts of the recharge zone inside and outside of Loop 1604. Best case scenario is to stage small-medium sized dump trucks at fire stations on or near Loop 1604. Based on call-taker notes, these should respond with SAFD on the initial alarm.
9. Initiate a program to test the water quality of runoff samples collected during fire and emergency events in the recharge zone. The objective is to accumulative runoff water quality database to the type, location, and size of these emergency events. These database can become valuable for data-driven informed decision-making for future emergency response in the Aquifer's recharge zone.
10. Runoff and soil testing should be initially tested by FD and/or Hazmat at scene, but follow-up testing should be performed by EAA, local water provider, and/or independent consultants. This should be part of the local water provider's contamination contingency

plan and should be part of a set of recommendations distributed by EAA under their responsibility as a regulatory authority. Results post-fire by FD and post-event by EAA, local water provider, and/or independent teams should be collected as part of a database for future modification of procedures created from this aquifer protection program.

11. Preparation and training/contrasting experts experience in dye-tracing technique.