

# **INVESTIGATIONS AND ABATEMENT OF PRODUCED WATER IMPACTS AND SEEPS TO SURFACE WATER**

## **SECTION 319 NONPOINT SOURCE GRANT PROJECT**

### **Petronila Creek**

### ***Nueces-Rio Grande Coastal Basin (Segment 2204)***

### **Nueces County, Texas**

### **Quarterly Report**

### **4th Quarter, FY 2009**

### **June 2009 to August 2009**

## **Introduction**

The Environmental Protection Agency (EPA) and Texas Commission on Environmental Quality (TCEQ) have awarded a nonpoint source grant to the Railroad Commission of Texas (RRC) for the investigation of the nature and extent of known salinity contamination contributing to water quality problems in Petronila Creek, for the development of remediation/abatement alternatives or Best Management Practices (BMPs), and the implementation of the BMPs. The TCEQ has placed River Segment 2204, Petronila Creek in the Nueces-Rio Grande Coastal Basin, on the State's 303(d) list because it does not meet water quality standards. The project encompasses an area of Nueces County referred to as the Clara Driscoll Oil Field. As Petronila Creek flows through the Clara Driscoll Oil Field an increase in the salinity of the creek water has been observed. The project will focus on the reach from US Hwy 77 downstream to the upper limit of tidal influence on the creek near FM 70. It has been reported that the chloride concentration and total dissolved solid (TDS) content in the creek increase significantly between gauging station number 13098 and the next downstream sampling point, gauging station number 13096. The Hydrologic Unit Code for this study is 12110205.

Possible sources associated with oil and gas operations include improperly completed oil and gas wells; abandoned, unplugged oil and gas wells; wells that are improperly or inadequately plugged with respect to current plugging regulations; saltwater injection and/or disposal wells; failed gathering and transporting pipelines; historical and recent unlined pit locations; historical tidal discharge practices; and abandoned surface facilities.

A mutual objective of the RRC and the TCEQ is to locate sources and to mitigate the high salinity that contributes to water quality degradation.

The RRC will conduct various activities to achieve the goal of reducing nonpoint source pollutant loading to Petronila Creek. The RRC will implement assessments and remediation projects through the following means:

- 1) Review the Bureau of Economic Geology (BEG) airborne geophysical survey and land-based confirmation sampling project for the Petronila Creek Total Maximum Daily Load (TMDL) program and determine the most effective source investigation approach. (Completed)
- 2) Determine locations using the geophysical survey data and selected soil borings and install monitoring wells up-gradient and downstream of saltwater seepage into Petronila Creek and its tributaries and downstream of known or suspected discharge points. (Completed)

- 3) Select soil boring locations in abandoned pit and suspected release areas and collect samples for analysis. (Completed)
- 4) Sample newly installed monitoring wells and surface water at strategic points along Petronila Creek, its watershed, and the hurricane canals that flow into the creek. (Completed)
- 5) Conduct a study to choose the BMPs. (Completed)
- 6) Implement BMPs in order to reduce the high TDS loading. (Pending)

### **Progress and Results by Specific Work Task:**

**Task 1.1: Organize a Projects Management Team (PMT).** The PMT has been established and includes personnel from the RRC's Site Remediation section in Austin and personnel from the Corpus Christi District. Emmett Hudson, Technical Coordinator in the Austin Office of Site Remediation is the primary contact.

First Quarter 2008 Update:

Heidi Bojes is the new primary contact.

**Task 1.2: The PMT will negotiate with one or more of the contracted environmental engineer companies for investigative work.** The PMT has contracted with TRC Environmental Corporation (TRC), Austin Texas, to investigate along Petronila Creek, particularly in the Clara Driscoll Oil Field area.

**Task 1.3: The PMT will submit quarterly status reports.** The 3<sup>rd</sup> quarter fiscal year 2006 was the initial status report of the project. The grant period includes portions or all of fiscal years 2006, 2007, 2008, and 2009.

**Task 2.1: Petronila Creek (Segment 2204) Surface and Subsurface Flow Assessment.** TRC has been authorized to conduct preliminary site investigation activities along Petronila Creek. Preliminary activities include the submittal of a QAPP, records research and review, site reconnaissance, and data evaluation and recommendations memorandum.

**Task 2.1.1: Review well completion, plugging, and workover data; area pit locations; pipeline and tank battery releases; abandoned O&G well locations; former discharge points; and other exploration and production activities in the Clara Driscoll Oil Field.** TRC's authorization includes records research of present and past oil and gas activities.

**Task 2.1.2. Non-Invasive Field-Wide Geophysical Survey, if necessary (selective, utilizing data from the BEG airborne survey).** The need for more geophysical data will be determined by the preliminary investigation.

**Task 2.1.3. Ground-Based Preliminary Investigation and surface water sampling.** Sampling procedures will be in accordance with the QAPP.

Third Quarter 2007 Update: Collected thirteen surface/shallow soil samples during the completion of Task 2.1.4.

Seasonal surface water sampling has occurred during previous quarters.

Fourth Quarter 2007 Update: TRC provided Draft Technical Memorandum to RRC that summarizes the seasonal surface water sampling results collected in February 2007.

Seasonal surface water sampling and surveying will be conducted again first quarter fiscal year 2008.

First Quarter 2008 Update: Developed and collected groundwater samples from all RRC installed monitor wells and the Driscoll #2 monitor well MW-12 and Driscoll #3 monitor well MW-27. Collected stream flow measurements and surface water samples.

Second Quarter 2008 Update: Collected groundwater level measurements from monitor wells and stream gauging stations.

Task 2.1.3 is completed.

**Task 2.1.4. Drill 20 to 30 soil borings in selected areas determined by Tasks 2.1.1, 2.1.2 and 2.1.3.**

Third Quarter 2007 Update: Completed cone penetrometer test (CPT) investigation and soil sampling fieldwork. This included completion of 36 CPT borings, installation of temporary wells in the CPT borings and sampling of the temporary wells for field chloride analysis.

TRC provided draft data from the field investigation to RRC and BEG and conducted a technical meeting with TRC, RRC and BEG to determine possible monitor well locations besides those being converted from chosen CPT borings.

Fourth Quarter 2007 Update: TRC provided Draft Technical Memorandum to RRC that summarizes the CPT investigation work and associated soil sampling fieldwork activities conducted in March through April 2007.

First Quarter 2008 Update: Results will be presented in an investigation report. To be completed second quarter fiscal year 2008.

Second Quarter 2008 Update: TRC provided Draft Phase III Investigation Report to RRC. The report summarizing fieldwork activities conducted from June 2007 through December 2007.

Third Quarter 2008 Update: TRC provided Final Phase III Investigation Report to RRC.

Task 2.1.4 is completed.

**Task 2.1.5. Convert selected soil borings into monitor wells and install monitor wells when necessary (number and locations determined by data from Task 2.1.4.)**

Fourth Quarter 2007 Update: Notified property owners about the installation of monitor wells on their property.

Installed 12 monitor wells at locations determined from Task 2.1.4.

First Quarter 2008 Update: Installed monitor wells were developed and groundwater was sampled.

Task 2.1.5 is completed.

**Task 2.1.6. Second Mobilization to Petronila Creek and Clara Driscoll Oil Field, if necessary.**

Fourth Quarter 2007 Update: Installed ten monitor wells at locations determined from Task 2.1.4.

Groundwater sampling of the monitor wells was delayed because of inaccessible conditions.

First Quarter 2008 Update: Installed monitor wells were developed and groundwater was sampled.

Task 2.1.6 is completed.

**Task 2.1.7. Petronila Creek Impact Investigation Final Report.**

Second Quarter 2008 Update: RRC provided Draft Phase III Investigation Report to RRC. The report summarizes fieldwork activities conducted from June 2007 through December 2007.

Third Quarter 2008 Update: RRC finalized the Phase III Investigation Report. The report summarizes fieldwork activities conducted from June 2007 through December 2007. The report is posted on RRC website.

The results revealed widespread contamination of salinity in soils, surface water, and groundwater. In soils, elevated salinity in Petronila Creek within the project area is likely due to seven main contributing areas: 1) oil wasteland area south of Petronila Creek near monitor well P-MW-16; 2) oil wasteland area south of Petronila Creek near monitor well P-MW-6; 3) oil wasteland area north of Petronila Creek near monitor well P-MW-03; 4) unknown source near the El Paso Merchant Company Driscoll #2 release site; 5) former disposal pit near the El Paso Merchant Company Driscoll #3 release site; 6) North Clara Driscoll drainage ditch; and, 7) County Road 18 drainage ditch.

Task 2.1.7 is completed.

**Task 3.1: BMP evaluation, selection, and work plan development.** To be completed during 4<sup>th</sup> quarter fiscal years 2008 and 2009.

Third Quarter 2008 Update: Received and approved work plans to 1) develop a conceptual site model to gain a better understanding of how contaminated soil and groundwater are influencing salinity along Petronila Creek; and 2) vertically and laterally delineate contaminated soil in the seven main contributing areas for remediation design and to develop a soil feasibility study.

RRC notified property owners about additional soil sampling.

Fourth Quarter 2008 Update: TRC collected soil samples from seven areas identified as the main contributing areas of contamination. Soil samples were collected to further define the full extent of contamination. Based on these results, TRC prepared a Soil Feasibility Study.

In August 2008 TRC submitted a draft *Soil Feasibility Study*. TRC recommended that drainage ditches, North Clara Driscoll ditch and the Clara Driscoll ditch, along County Road 18, be excavated and that a surface cap be implemented in area two.

TRC received a letter from the Army Corp of Engineers regarding jurisdiction over the North Clara Driscoll ditch and the Clara Driscoll ditch, along CR 18. The Army Corp of Engineers determined that both ditches are not subject to Army Corp jurisdiction. Any excavation of the ditches would not require Section 404 permitting.

RRC notified property owners about additional soil sampling.

In August 2008 RRC met with TRC to discuss groundwater conceptual site model. TRC is in the process of preparing a report that describes the groundwater conceptual site model.

First Quarter 2009 Update: TRC submitted the final version of the *Soil Feasibility Study* (September 2008). Based on the results of the study TRC determined that Area 2 (oil wasteland area south of Petronila Creek near monitor well P-MW-6), Area 6 (North Clara Driscoll drainage ditch), and Area 7 (County Road 18 drainage ditch) are most likely to contribute salinity to Petronila Creek based on relatively higher average chloride and conductivity concentrations and shorter migration pathways and transport mechanisms than the other areas identified. TRC recommended excavation of contaminated soils from areas six and seven (drainage ditches) and implementation of a surface cap in area two. TRC estimated that the cost to excavate, haul and dispose of soils at the areas six and seven is approximately \$2,346,000. TRC estimated that the cost to implement a surface cap at area two is \$250,000.

The RRC conducted further BMP evaluation at each area and determined the following:

Installation of a surface cap in areas adjacent to Petronila Creek (areas two and three) is not a viable BMP option because potential flooding may compromise the integrity of the surface cap.

Excavation costs of contaminated soils from areas Two and Three are approximately \$1,501,500 and \$4,774,770, respectively.

Soils in area Four can remain in place because of low chloride concentrations.

Based on the review of historic aerial photographs and RRC records, identification of previous responsible operators at areas Two, Three and Five is likely.

In November 2008 the RRC met with the Nueces County Drainage District #2 and US Ecology Texas, Robstown Texas, to determine if local stakeholders could help leverage BMP costs. Nueces County Drainage District #2 indicated that they did not have any land or equipment the RRC could use for BMP implementation. US Ecology Texas indicated the availability of several acres of land on a temporary basis for ex situ remediation. Ex situ remediation methods, such as immobilization of contamination and soil flushing, require large areas for treatment operations.

Second Quarter 2009 Update: TRC submitted the final version of the *2009 Conceptual Site Model*. The conceptual site model identified a main lithologic unit that has high hydraulic conductivity (sands), high salinity concentrations, and intersects Petronila Creek. TRC in conjunction with RRC staff determined that the unit might be the most effective area to implement BMPs. Based on the modeling results, RRC staff proposes that specific areas located north and south of the creek contaminate groundwater by downward percolation from saline-impacted soils, and the contaminated groundwater then intersects Petronila Creek downgradient from these areas between Segments 5 and 8 and Segments 13 and 15 of the creek. Because the data is limited, the distribution of salinity and its intersection to groundwater is not fully understood. Additionally, the lateral continuity of the main sand unit has not been confirmed. Based on this information, RRC staff determined that additional data is needed to address these uncertainties and to develop BMPs.

RRC staff met with TCEQ on December 9, 2008, to discuss the results of the *2008 Soil Feasibility Study* and *2009 Conceptual Site Model*. TCEQ staff agreed with the RRC staff that the remaining grant funds should focus on addressing data gaps to develop the most cost-effective and defensible BMPs. Specifically the remaining grant work will include the following:

- 1) Develop soil BMPs in those areas with the highest ranked potential for salinity loading, specifically Areas 6 and 7.
- 2) Collect data to address uncertainties identified in the *2009 Conceptual Site Model*. RRC staff will conduct seasonal water monitoring, monitor well installation, pizeometer installation, and aquifer testing.

TRC submitted a work plan to the RRC in February 2009. The objectives of the work plan are to 1) collect additional data on salinity distribution within the drainage ditches that were identified in the 2008 Soil Feasibility Study; and 2) collect additional information on groundwater salinity to address the uncertainties identified in the *2009 Conceptual Site Model*.

RRC staff notified property owners about additional field activity. The property owners gave their consent, both verbally and in writing, to allow RRC staff (and its representative and contractors) on to their property during the month of March 2009. Additionally, RRC staff received consent from El Paso Corporation to collect groundwater samples from El Paso's monitor wells located at the Driscoll #3 site.

#### Third Quarter 2009 Update:

TRC on behalf of the RRC 1) collected additional data on the salinity distribution within the drainage ditches that were identified in the *2008 Soil Feasibility Study*; and 2) collected additional information on groundwater salinity to address the uncertainties identified in the *2009 Conceptual Site Model*.

#### *Soil BMPs*

The RRC, with concurrence from the TCEQ, focused soil BMPs on those areas with the highest ranked potential for salinity loading, specifically Areas 6 and 7 (North Clara Driscoll and Clara Driscoll drainage ditches, respectively). These areas were identified in the *2008 Soil Feasibility Study*. Due to the large extent of contamination in these drainage ditches and potential cost of a BMP(s) to remedy the entire area, the RRC further characterized the salinity distribution by collecting additional sediment samples. Twenty-seven sediment samples were collected in the areas of the highest salinity and analyzed for chlorides and conductivity. The results indicate four distinct areas with elevated salinity (chlorides greater than 20,000 mg/kg) in Area 6 and six areas with elevated salinity (chlorides greater than 20,000 mg/kg) in Area 7. The estimated volume ranges from 1,986 to 50,640 cubic feet. The depth of the contamination does not extend beyond two feet below ground surface.

#### *Groundwater BMPs*

Several data gaps were identified in the *2009 Conceptual Site Model*. These data gaps include areas to the north and south of Petronila Creek around Segments 6 through 8, where the distribution of salinity and intersection of groundwater with the creek is not well understood; the area between P-CPT-26 and P-CPT-19, where the lateral continuity of the main sand unit is not confirmed; and along the west side of Petronila Creek between Segments 13 and 15, where additional understanding of the salinity distribution and presence of the main sand unit is necessary. In order to fill these data gaps the RRC installed 11 monitoring wells along the north and south areas of Petronila creek at depths of either 65 feet or 25 feet below ground surface and installed nine piezometers in the bed of Petronila Creek and in the drainage ditches.

A seasonal monitoring event was conducted that included sampling from 32 monitoring wells, eight piezometers, and eight surface water locations at Petronila Creek and drainage ditches. Samples were analyzed for TDS, anions (chloride,

bromide, sulfate, and nitrate), cations (calcium, sodium, magnesium, potassium, iron, and barium), and alkalinity (carbonate and bicarbonate). The groundwater volume was limited in a couple of piezometers (i.e., low yield). Samples from these wells were analyzed for chlorides, TDS and conductivity.

Several slug tests were conducted in groundwater wells that were screened in a sand unit to determine aquifer parameters.

#### *Stakeholder Notification*

The Nueces County Drainage District #2 was notified of the salinity contamination in the drainage ditches by phone and by written correspondence. The Nueces County Drainage District #2 verbally indicated that it would not require backfilling of any excavated area as long as the floor of the excavations followed, to the extent possible, the slope of the existing ditches. Not having to backfill excavated areas will reduce BMP costs.

TRC on behalf of RRC met with US Ecology Texas to discuss the storage or disposal of contaminated soils at their Robstown, Texas facility. Disposal at this facility will reduce BMP costs because transportation costs will be less.

#### *Responsible Operators*

On May 1, 2009, RRC sent letters to ExxonMobil, Gulf Exploration and Sparks Petroleum. These operators were identified as having former oilfield operations, including a brine disposal pit and tank battery, in the area north of Petronila Creek and west of the North Clara drainage ditch. The RRC requested that the operators evaluate their historic oilfield operations in the area to determine if they have contributed to the groundwater contamination.

#### Fourth Quarter 2009 Update:

TRC and RRC staff analyzed the additional data that was collected within the drainage ditches and in groundwater during the 3<sup>rd</sup> quarter 2009. The data was analyzed to estimate the potential chloride load into Petronila Creek, alternative BMP costs, and feasibility of a groundwater BMP. The results and analyses are summarized in *Soil Feasibility Study Addendum*, August 2009, and *Conceptual Site Model Addendum*, August 2009, reports.

#### *Soil BMPs*

The potential chloride load into Petronila Creek was estimated for each segment identified as having chloride levels that exceed 20,000 mg/kg in Area 6 and Area 7. It was estimated that a total reduction in potential chloride loading of 70,930 kg (156,374 pounds) would occur following the removal of contaminated segments identified in Area 6 and 294,780 kg (649,879 pounds) following the removal of contaminated segments identified in Area 7. Total cost for BMP implementation was estimated to be \$367,000 and \$978,000 for Area 6 and Area 7, respectively.

#### *Groundwater BMPs*

Additional groundwater investigation activities were conducted in March 2009 to identify a specific area to implement a BMP. Because of the large size of the chloride-impacted groundwater zone, specific areas with high chloride concentrations and high potential to impact the creek, i.e. narrow sand units like

channel sands that intersect the creek bed, were further investigated. The results identified a sand unit along the north side of Petronila Creek and downgradient of Area 5. The groundwater chloride distribution also revealed a high chloride plume, greater than 10,000 mg/L, in this area. Alternatively, continuous sand units at other portions of the creek, i.e. between P-MW-26 and P-MW-30/Petronila Creek, were not identified and lower groundwater chloride levels, less than 10,000 mg/L, were noted in the downstream portions of the creek. Collectively, these results suggest a potential location south of Area 5 for groundwater BMP implementation.

The results also showed that in the downstream areas of the creek, south of segment 10, the potentiometric groundwater surface is higher than or nearly equal to surface water elevation. While in the upstream areas of the creek, north of segment 10, the difference between the potentiometric groundwater surface and surface water elevation is greater. These results suggest that discharge into Petronila Creek as base flow is not present or at least is not as prevalent upstream as compared to downstream portions and may be more dependent on seasonal variations such as high rainfall events. A high rainfall event is hypothesized to recharge the water bearing unit so that there would be base flow into the creek.

Although a specific area with high chloride concentrations and high potential to impact the creek was identified, Area 5, implementation of a groundwater BMP in this location was determined not to be feasible for several reasons. One reason is that the groundwater area requiring mitigation is large. In addition, the difficulty of removing chlorides from groundwater from such a large area in a cost effective manner further limits the BMP options capable of meeting the chloride reduction goals. For example, the most effective BMP technology capable of meeting the BMP objective would be recovery of contaminated groundwater, i.e. pump and disposal by a series of recovery wells or a trench, before it impacts surface water. The length of the trench and the number of recovery wells would make these BMPs prohibitive. These systems would require significant energy and monetary resources for application, sustained operation, maintenance, and disposal of saline water.

Collectively these results suggest that instead of BMPs that focus on groundwater, a BMP that reduces the saline leaching from the major source area, Area 5 may have a significant effect in reducing the salinity levels in groundwater and therefore reduce loading into the creek. It was recommended that the salinity distribution in this area be studied in greater detail.

**Task 3:2: Implementation of the selected BMPs.** BMP implementation to be completed during fiscal year 2010 pending available funding.

**Tasks 4.1, 4.2, 4.3, and 4.4: Confirmation evaluation of BMP implementation.** Confirmation and evaluation will begin when the implementation of the BMPs has been completed and operations have been instigated.

**Tasks 5.1, 5.2, 5.3, 5.4, and 5.5: Create a special page on the RRC website, update quarterly, and share work plans reports and outside input with the public.**

The website is available and contains the *Records Review, Site Reconnaissance Results, and Recommendations 2006, Conceptual Site Model – January 2009; Soil Feasibility Study – September 2008, Final Phase III Investigation Report on Petronila Creek – May 2008, Conceptual Site Model Addendum – August 2009, and Soil Feasibility Study Addendum – August 2009* reports as well as quarterly reports. To find the NPS Petronila Grant web page follow the path: Railroad Commission of Texas Website, [www.rrc.state.tx.us/](http://www.rrc.state.tx.us/)

Environmental Services  
Oil Field Cleanup Program Reports  
Nonpoint Source Grant Projects  
Petronila Creek, Nueces County

Third Quarter 2007 Update: The third quarter fiscal year 2007 Report is on the RRC website.

Fourth Quarter 2007 Update: The fourth quarter fiscal year 2007 Report is on the RRC website.

First Quarter 2008 Update: The first quarter fiscal year 2008 Report is on the RRC website.

Second Quarter 2008 Update: The second quarter fiscal year 2008 Report is on the RRC website.

Third Quarter 2008 Update: The third quarter fiscal year 2008 Report is on the RRC website.

Fourth Quarter 2008 Update: The fourth quarter fiscal year 2008 Report is on the RRC website.

First Quarter 2009 Update: The first quarter fiscal year 2009 Report is on the RRC website.

Second Quarter 2009 Update: The second quarter fiscal year 2009 Report is on the RRC website.

Third Quarter 2009 Update: The third quarter fiscal year 2009 Report is on the RRC website.

Fourth Quarter 2009 Update: The fourth quarter fiscal year 2009 Report is on the RRC website.

**Task 6.1: Provide the Quality Assurance Project Plan (QAPP) prior to the collection of any sampling data.**

Third Quarter 2007 Update: The revision of the Petronila Creek QAPP has been approved and signed by the EPA on April 24, 2007. All future operations are subject to the April 24, 2007, QAPP revision until the document is renewed or revised.

Third Quarter 2008 Update: The revision of the Petronila Creek QAPP was submitted to TCEQ in March 2008. TCEQ indicated that EPA is currently reviewing the revised QAPP. All future operations are subject to the April 24, 2008, QAPP revision until the document is renewed or revised.

Fourth Quarter 2008 Update: The revision of the Petronila Creek QAPP was approved and signed by EPA on July 16, 2008.

Third Quarter 2009 Update: The revision of the Petronila Creek QAPP was approved and signed by TCEQ on April 27, 2009.

#### **Fourth Quarter Fiscal Year 2010 Projections:**

Funding was not adequate to cover the expenses of BMP implementation at Areas 6 and 7 and BMP design and implementation at Area 5. RRC staff anticipates receiving funding either in the form of future grants or from the Texas oilfield cleanup fund during fiscal year 2011. Therefore, the following activities will be undertaken as soon as funds are available.

- 1) Implement BMP, i.e. soil removal, at Areas 6 and 7. RRC staff will continue to work with stakeholders to reduce BMP costs.
- 2) Continue sampling of installed monitoring wells and surface water at strategic points along Petronila Creek, its watershed, and the drainage ditches that flow into the creek.
- 3) Design and implement a BMP at Area 5.
- 4) Continue ongoing efforts to identify responsible parties that have had oilfield operations in Area 5, including possible brine disposal pits and tank batteries.