CASE STUDY

Commerce/Mayer Ranch
Ottawa County, Oklahoma

August 2010

Prepared by
The Interstate Technology & Regulatory Council
Mining Waste Team

ITRC (Interstate Technology & Regulatory Council). 2010. *Commerce/Mayer Ranch, Ottawa County, Oklahoma*. Mining Waste Treatment Technology Selection Web. Washington, D.C.: Interstate Technology & Regulatory Council, Mining Waste Team. www.itrcweb.org.

Acknowledgements

The ITRC Mining Waste Team would like to acknowledge Dr. Robert W. Nairn from the University of Oklahoma, School of Civil Engineering and Environmental Science, who completed the April 2008 Mine Waste Case Study Survey, from which the information in this case study is taken.

TABLE OF CONTENTS

LIST OF FIGURES

COMMERCE/MAYER RANCH, OTTAWA COUNTY, OKLAHOMA

1. SITE INFORMATION

1.1 Contacts

Dr. Robert W. Nairn
The University of Oklahoma
School of Civil Engineering and Environmental Science
202 West Boyd Street, Room 334
Norman, OK 73019
Telephone: 405-325-3354
E-mail: nairn@ou.edu

1.2 Name, Location, and Description

The study site is located in the Tar Creek Superfund Site, part of the Picher Mining Field, and the northeastern Oklahoma portion of the former Lead (Pb) and Zinc (Zn) mining area known as the Tri-State Mining District (Figure 1-1). In this area, the ore deposit consists of Pb and Zn sulfides associated with cherty carbonate host rock. The principal ore host stratum is the Boone Formation, composed of fossiliferous dolomite, limestone and nodular chert. Principal ore minerals are sphalerite and galena, with secondary concentrations of chalcopyrite, enargite, luzonite, marcasite, pyrite, and barite. Significant quantities of Pb and Zn were produced from the Tri-State District from the 1890s through the 1960s. By the late 1950s, depressed global markets resulted in the suspension of most mining operations. By the early 1970s when mining ceased, almost 2 million tons of Pb and 9 million tons of Zn had been produced. The Tar Creek site was proposed for the Comprehensive Environmental Response, Compensation, and Liability Act (Superfund) National Priorities List (NPL) in 1981 and received final listing in 1983. Nearby are the Cherokee County Superfund Site (Kansas) and the Oronogo-Duenweg Mining Belt and Newton County Mines Superfund Sites (Missouri). The following information contains text taken directly from Nairn et al. (2009).

In the Oklahoma portion of the district, approximately 1,000 hectares (ha) are underlain by underground mines in all or part of 47 sections. During mining, large-capacity dewatering operations pumped approximately 50,000 m^3 of water per day from the mines. Upon decline and cessation of mining, groundwater began to accumulate in the mine voids. Approximately 94 million m^3 of contaminated water exist in underground voids. By late 1979, metal-rich waters began to discharge into Tar Creek and its tributaries. The first documented discharge of mine drainage was at a location near southeast Commerce, Oklahoma, denoted by the Oklahoma Water Resources Board as Site 14.

Figure 1-1. Commerce/Mayer Ranch, Commerce, Ottawa County, Oklahoma.
Map created with ESRI ArcView software using Microsoft Bing maps.

2. REMEDIAL ACTION AND TECHNOLOGIES

Through a competitive bidding process, a design/build engineering contract was awarded to CH2M-Hill using funds provided by the U.S. Environmental Protection Agency and U.S. Geological Survey. The intent of this project was to develop engineering plans and specifications for the design and construction of the passive treatment system, build the system, and provide as-built construction documents. Engineering design, based on the conceptual designs and taking into account on-site conditions, was undertaken as an iterative process between the design firm, the University of Oklahoma, and EPA. To accommodate site constraints, multiple adjustments were made to the system layout. Most notable of these included the configuration of the system as two parallel flow paths to allow estimation of variance in performance and to perform maintenance, consolidation of the layout into a more compact “footprint” area to comply with construction requirements adjacent to an existing utility corridor, and minimize impacts to adjacent landowners, thereby creating a flatter hydraulic profile. Rotosonic overdrilling of both mine drainage seeps was completed 18 months prior to passive treatment system construction, thus providing hydraulic control and allowing additional investigations to further quantify flow rates and variability.

Design and construction tasks included capture and control of the two known artesian mine drainage discharges, diversion of storm-water flows from a 470-ha upgradient watershed, implementation of all passive treatment process units including water conveyance structures, and provision of as-built documents. Design performance was estimated using inflow concentrations of 192 mg/L (Iron) Fe, 11 mg/L Zn, 17 µg/L (Cadmium) Cd and 60 µ/L Pb, and Fe removal rate of 20 grams per square meter per day with target Fe effluent of 1 mg/L and assuming net alkaline conditions, a discharge rate of 1000 L/minute, available site area of approximately 3.6 ha, and treatment area of 2 ha.

Construction began in July 2008 and was completed in late November 2008. Issues requiring resolution during construction and startup included the incorporation of a third seep (Seep D) into the inflow oxidation pond, removal of debris and existing iron oxide muck, delays throughout the course of construction caused by a record rainfall during the summer and related site water management issues, and changes in organic substrate requirements. The third seep was isolated as a distinct inflow into the first process unit and did not result in inflow discharge rates or mass loadings substantially different from initial designs. Based on additional laboratory work, the vertical-flow bioreactors received a mixture of 45% spent mushroom compost, 45% hardwood chips, and 10% manufactured limestone sand in the organic substrate layer. The total cost of design and construction totaled $1,196,000.

The completed system (Figure 2-1) includes 10 distinct process units with a single initial oxidation pond (cell 1) followed by parallel surface-flow aerobic wetlands/ponds (cells 2N and 2S), vertical-flow bioreactors (cells 3N and 3S), reaeration ponds (Cells 4N and 4S) and horizontal flow limestone beds (Cells 5N and 5S), and a single polishing pond/wetland (Cell 6). Mine water was diverted into the passive treatment system for the first time on December 2, 2008.

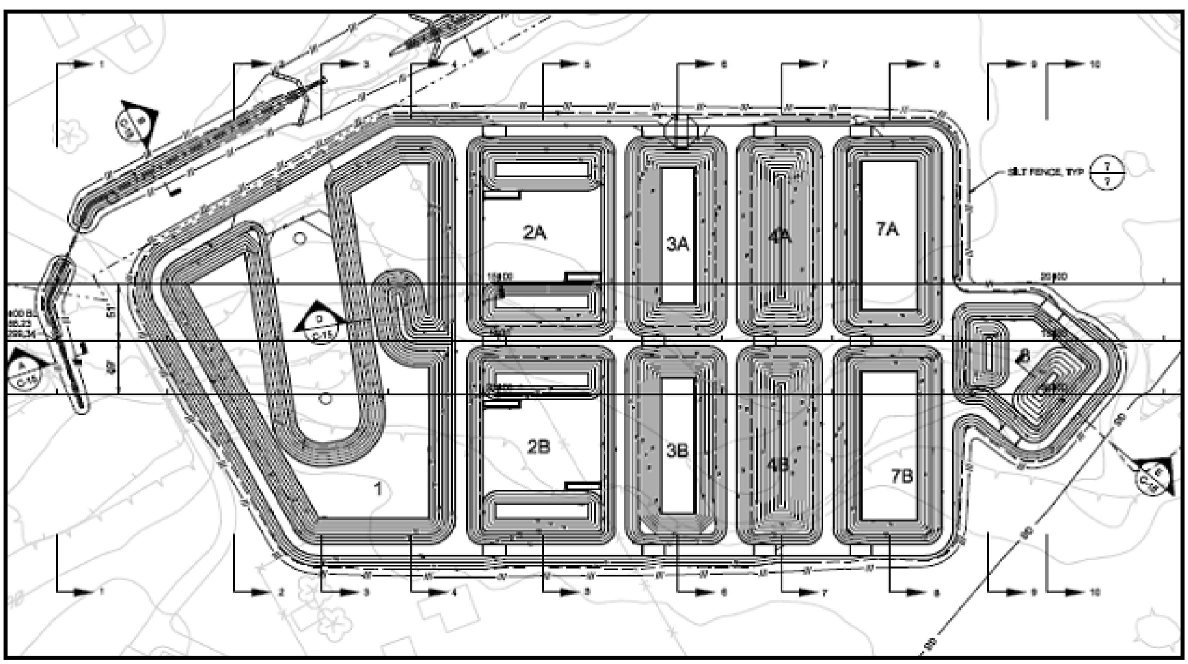

Figure 2-1. Completed remedial system.

3. PERFORMANCE

Based on an extensive field data collection effort, laboratory and field experiments, and a cooperative effort between academia, the private sector, and government, the first full-scale passive treatment system in the Tri-State Mining District was designed and constructed. This system represents a start-of-the-art ecological engineering field research site. Although only recently placed into operation, it is anticipated that this site will provide data contributing to the enhancement of future passive treatment system designs.

4. COSTS

The cost of design and construction totaled $1,196,000.

5. REGULATORY CHALLENGES

The Tar Creek site was proposed for the Comprehensive Environmental Response, Compensation and Liability Act (Superfund) NPL in 1981 and received final listing in 1983. Nearby are the Cherokee County Superfund Site (Kansas), and the Oronogo-Duenweg Mining Belt, and Newton County Mines Superfund Sites in Missouri.

6. STAKEHOLDER CHALLENGES

There were no significant public or stakeholder issues associated with the project.

7. OTHER CHALLENGES AND LESSONS LEARNED

No information was included with the case study.

8. REFERENCES

Nairn, R. W., T. Beisel, R. C. Thomas, J. A. LaBar, K. A. Strevett, D. Fuller, W. Strosnider, W. J. Andrews, J. Bays, and R. C. Knox. 2009. "Challenges in Design and Construction of a Large Multi-Cell Passive Treatment System for Ferruginous Lead-Zinc Mine Waters," pp. 871–92 in *Proceedings, Joint Conference of American Society of Mining and Reclamation 26th Annual Conference and 11th Billings Land Reclamation Symposium*, Billings, Mont.