Reconnaissance Phase
Draft

Tar Creek and Lower Spring River Watershed Management Plan

August 2004

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Purpose

The purpose of this document is to provide details of initial (reconnaissance phase) development of the Tar Creek and Lower Spring River Watershed Management Plan (Watershed Management Plan).

The Watershed Management Plan provides an assessment of the Tar Creek and Lower Spring River watersheds, including problems affecting residents, and identifies appropriate corrective actions. The Watershed Management Plan is based on input from the public and other stakeholders, existing technical information, and professional judgment. Additional information is required to verify the accuracy of numerous professional assumptions made during reconnaissance phase activities to continually refine the Watershed Management Plan.

The reconnaissance phase activities also provide an initial response to some of the recommended tasks documented in the May 2003 Memorandum of Understanding (MOU) between the U.S. Environmental Protection Agency (EPA), the U.S. Department of Interior, and the U.S. Department of the Army through the U.S. Army Corps of Engineers (collectively the "Federal Agencies"). The purpose of the MOU is to facilitate cooperation among Federal agencies in order to work toward a more holistic response to the risks posed at and adjacent to the Tar Creek Superfund Site in Oklahoma.

The Planning Process Used to Develop the Watershed Management Plan

There are significant Ongoing Activities to address watershed problems.

The strategy used during the planning process was to begin and identify short and long-term Additional Activities that would complement Ongoing Activities. The Ongoing and Additional Activities would collectively result in a comprehensive solution to high priority watershed problems.

Planning guidance[1] for the U.S. Army Corps of Engineers states: "alternative plans shall not be limited to those the Corps of Engineers could implement directly under current authorities. Plans that could be implemented under the authorities of other Federal agencies, State and local entities, and non-government interests should also be considered."

Recognizing the importance of Ongoing Activities, the strategy adopted during the reconnaissance phase was to begin to identify short and long-term Additional Activities that would complement Ongoing Activities. The Ongoing and Additional Activities would collectively result in a comprehensive solution to high priority watershed problems.

[1] Engineering Regulation 1105-2-100, Planning Guidance Notebook, 22 April 2000

The U.S. Army Corps of Engineers worked with stakeholders and interest groups to begin the six-step planning process that consists of: 1) identifying problems and opportunities; 2) inventorying and forecasting conditions; 3) formulating alternative plans; 4) evaluating alternative plans; 5) comparing alternative plans; and 6) selecting a plan. The reconnaissance phase development of the Watershed Management Plan primarily addressed steps one through three. Additional data and information are required to complete steps four through six. It may be necessary to repeat some steps as more information is acquired during future planning and design activities. This iterative process helps assure that comprehensive solutions are realized.

Geographic Area of Consideration and Watershed Problems

The area of consideration includes the Tar Creek and Lower Spring River watersheds in Ottawa County, Oklahoma.

Stakeholders may want to include additional areas of interests in the future development of the Watershed Management Plan.

High priority problems in the watersheds include:

- Health effects
- Subsidence
- Mine shafts
- Chat use
- Drainage and flooding
- Water quality
- Native American concerns
- Natural resource damages

Abandoned mine-related watershed problems occur in the former Tri-State Mining District of Oklahoma, Kansas, and Missouri (Figure 1). The primary area of focus of the Watershed Management Plan is the Tar Creek and Lower Spring River watersheds in Ottawa County, Oklahoma (Figure 2).

Oklahoma communities in the area include Picher, Cardin, Miami, North Miami, Commerce, and Quapaw. Area Tribal Governments include Cherokee, Eastern Shawnee, Miami, Modoc, Ottawa, Peoria, Quapaw, Seneca-Cayuga, Shawnee, and Wyandotte Nations.

Previous studies indicate downstream mining related impacts in the Lower Neosho River watershed. Southeast Kansas and southwest Missouri also have abandoned mine lands with similar watershed problems that may have downstream impacts in Oklahoma. A comprehensive Watershed Management Plan would include those areas in the future.

The watersheds are honeycombed with underground mine workings, pits, shafts (open, closed, and collapsed), mine tailings, waste piles, and tailing ponds. Subsidence problems associated with abandoned underground mines either existed during mining or have developed since the cessation of mining. The potential for future subsidence is also a concern.

Information on mining history, physiography, topography, land ownership, geologic setting, hydrology, and underground mine workings in the area of consideration was initially developed by the Oklahoma Geological Survey and is provided in Appendix A. This reference was used extensively to help gain an initial understanding and appreciation of the significance and extent of the underground mine workings.

Figure 1. Tar Creek and Spring River Watershed

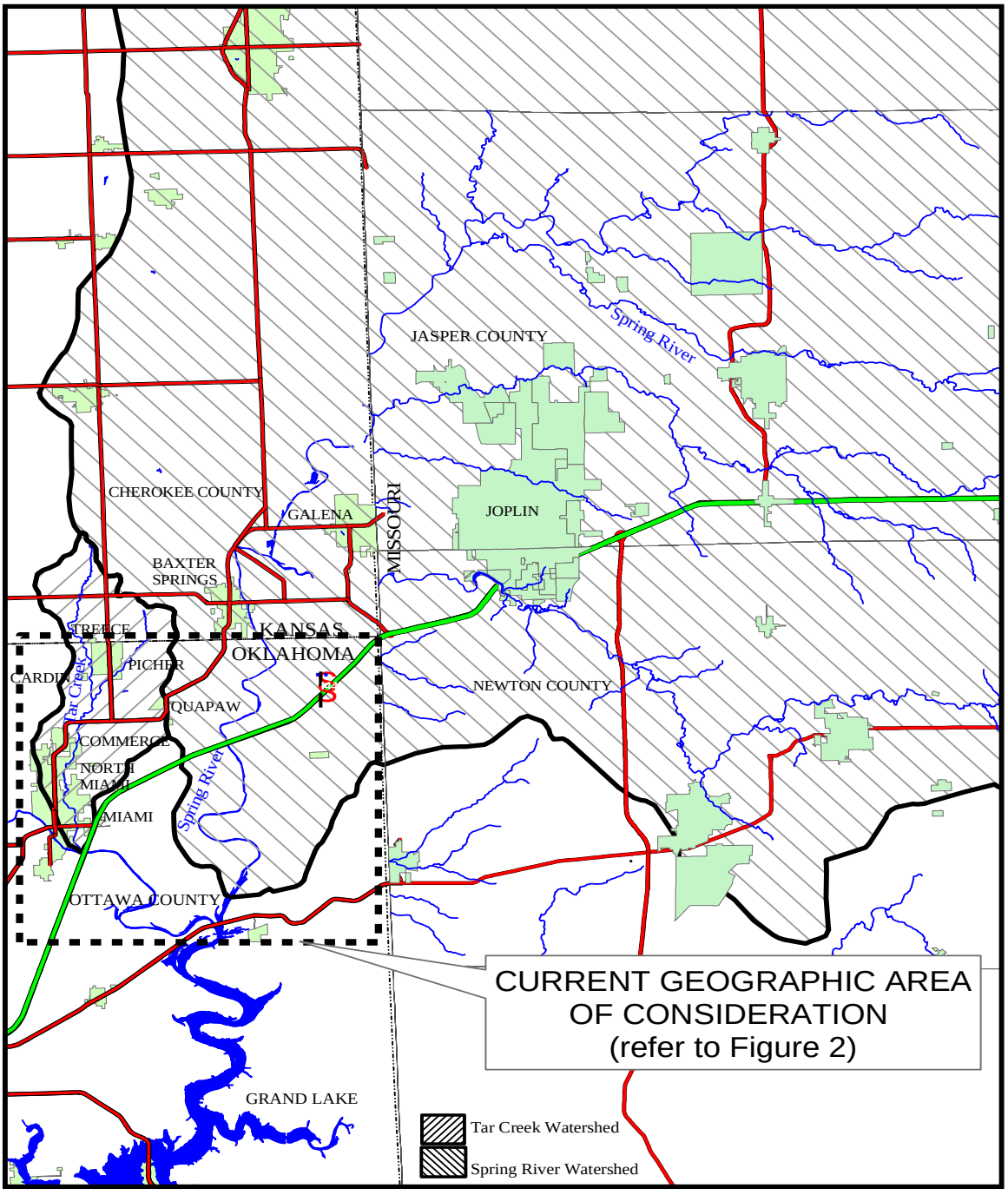
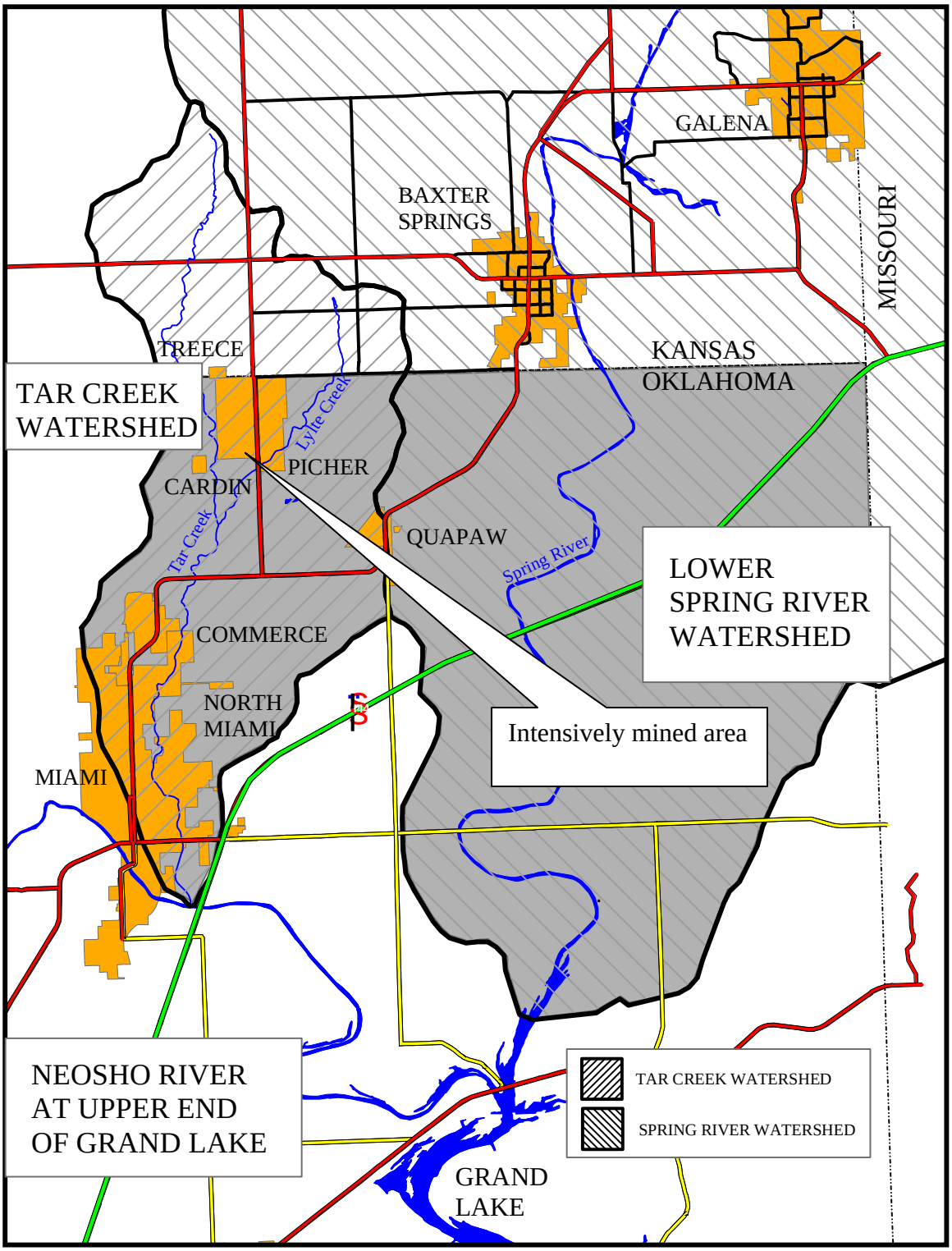
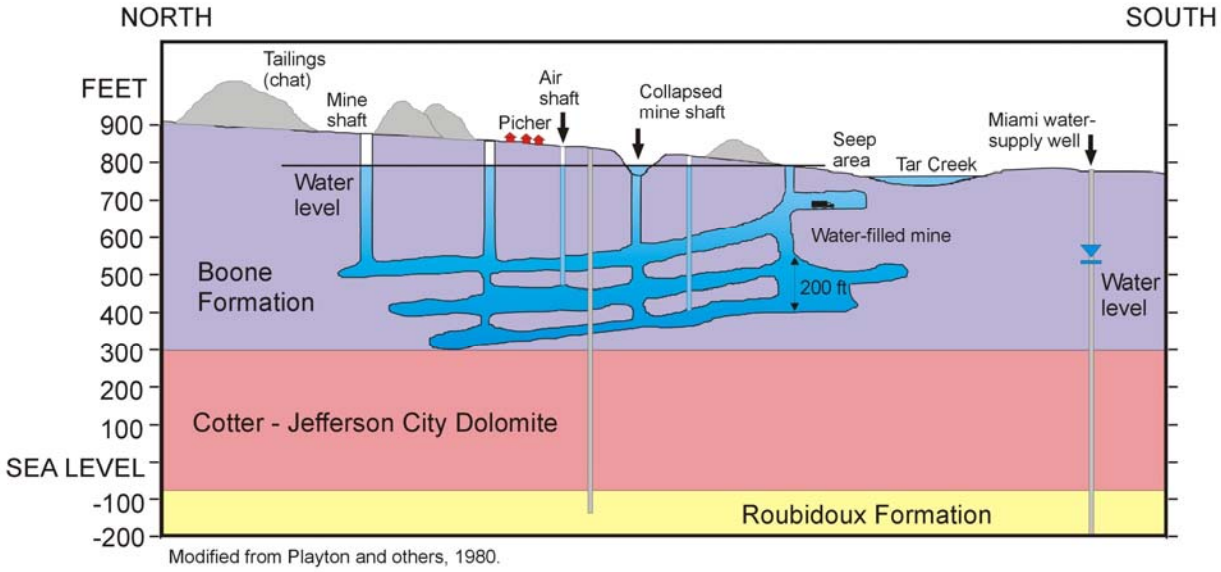


Figure 2. Tar Creek and Lower Spring River Watershed, Oklahoma



The primary sources of ecosystem degradation are the release of residual metal sulfides seeping from abandoned mine workings and mill tailings that were left uncovered and unstabilized. Upon exposure to the atmosphere, these sulfides mobilize as dissolved compounds, increasing acidity. The resulting metal-laden acidic waters, referred to as acid mine drainage (AMD), contaminate groundwater in the Boone formation and fill mine shafts and can lead to subsidence. When the waters surface through man-made and natural openings in the ground, they combine with metal-laden runoff and contaminate rivers, creeks, and lakes. Figure 3 illustrates the interaction of surface and underground watershed problems.

Figure 3. Interactions of Surface and Underground Watershed Problems[2]



The Tar Creek and Lower Spring River watersheds have a myriad of water-resource related problems. However, the high priority problems addressed in development of the Watershed Management Plan include the following:

- health effects
- subsidence
- mine shafts
- chat use
- drainage and flooding
- water quality
- Native American concerns
- natural resource damages

[2] Playton, S.J., Davis, R.E., and McClafin, R.G., 1980, Chemical quality of water in abandoned zinc mines in northeastern Oklahoma and southeastern Kansas: Oklahoma Geological Survey Circular 82, 49 p.

Information on these high priority watershed problems was developed by eight subcommittees as part of the October 2000 Governor Keating's Tar Creek Superfund Task Force Report and is provided in Appendix B. Information from the various subcommittee reports was used to help formulate the Watershed Management Plan.

Watershed Management Plan Components

Additional Activities and Ongoing Activities by the State of Oklahoma, the Environmental Protection Agency, the Department of Interior, Tribes, and local interest groups would collectively result in a comprehensive solution to high priority watershed problems.

Additional Activities would complement Ongoing Activities and address remaining high priority problems:

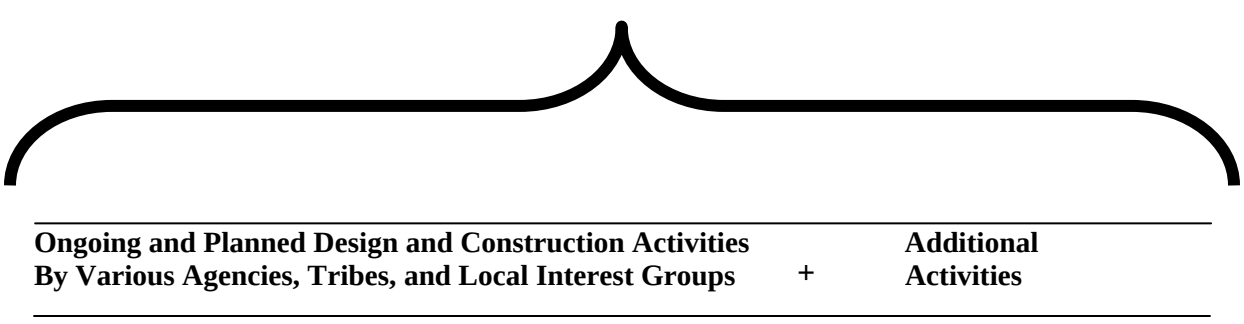
- Mine hazards
- Impacted stream corridors and flooding at Picher-Cardin
- Mine drainage
- Flooding at Miami

A significant amount of meaningful work that is essential to implementation of a holistic solution is currently underway and being accomplished by State of Oklahoma agencies and universities, the U.S. Environmental Protection Agency (EPA), the Department of Interior, Tribes, communities, and other local interests groups.

Recognizing the importance of the Ongoing Activities, the strategy adopted during the reconnaissance phase was to begin to identify short- and long-term Additional Activities that would complement Ongoing Activities. The Ongoing and Additional Activities would collectively result in a comprehensive solution to high priority problems. A graphic diagram that summarizes the planning, design, and construction activities of the Watershed Management Plan is shown in Figure 4.

Discussion on the Ongoing Activities and partnerships of communities, Tribes, and local interest groups begin on page 18. The following paragraphs summarize Ongoing Activities by the State of Oklahoma, the U.S. Environmental Protection Agency, and the U.S. Department of Interior.

Figure 4. Tar Creek and Lower Spring River - Watershed Management Plan Components



Oklahoma Plan for Tar Creek Activities

The current Oklahoma Plan for Tar Creek, provided in Appendix C, was developed by the State of Oklahoma through the cooperation of political, academic, and Tribal leaders. The plan focuses on four objectives that consist of improving surface water quality, reducing exposure to lead dust, reducing the number of mine hazards, and land reclamation at selected locations. Pre- and post-construction monitoring activities will be implemented to verify that project goals and objectives are achieved. The Oklahoma Plan for Tar Creek primarily addresses the perimeter lands outside the intensively mined areas but also includes projects at selected sites in the Picher/Cardin area where mining was extensive. The Oklahoma Plan for Tar Creek will be completed over the next 5 years at an estimated cost of approximately $45 million.

U.S. Environmental Protection Agency (EPA) Activities

The EPA Region VI has completed and Ongoing Activities in the Tar Creek and Lower Spring River watersheds in Oklahoma.

The EPA recently initiated activities, designated as Operable Unit 4, to identify alternatives to clean up chat piles, chat bases, millponds, and contaminated transition areas in the Oklahoma portion of the Tar Creek and Lower Spring River watersheds. A cost estimate and schedule for the Operable Unit 4 cleanup is currently being developed by the EPA and will be available at a later date. Alternatives that are being considered include but are not limited to:

- No Action (may include monitoring)
- Mine waste removal by excavation and hauling of mine and mill residues and smelter waste to an off-site landfill for disposal
- Surficial source removal by excavation and hauling of mine and mill residues and smelter waste (such as subsidence areas, mine shafts, and/or underground mine workings) to on-site locations for disposal
- Beneficial commercial reuse of mine and mill residues and smelter waste for road building in concrete and encapsulation in polymers for decorative items such as shingles
- Removal of high metal concentrations by washing the mine and mill residues and treating the wash water
- Restoration of former mine and mill residues and smelter wastes in place
- Containment and stabilization of mine and mill residues and smelter wastes
- Treatment of mine and mill residues and smelter waste
- Phytoremediation
- Passive Treatment Systems
- Institutional Controls

Sub-aqueous mine waste disposal is being considered by the EPA. A potential pilot project at the Tar Creek Superfund Site and potential remedial scale project at the Cherokee County, Kansas, Superfund Site in the Spring River watershed could demonstrate significant utility for future Operable Unit 4 cleanup activities in Oklahoma. Additional summary information on completed, ongoing, and planned EPA Region VI activities is provided in Appendix D.

U.S. Department of Interior Activities

The Bureau of Indian Affairs (BIA) is focusing on the sale of marketable chat owned by Native Americans and working with other Federal and State agencies in the implementation of various projects. The U.S. Fish and Wildlife Service is providing technical reviews for the EPA, participating as a co-trustee on the Natural Resources Damage Assessment Team (40 CFR Part 11), and working with agencies to help identify environmentally sustainable solutions to address high priority problems. The U.S. Geological Survey is working on several projects, such as a hydrogeologic model and data collection efforts, to support the Ongoing Activities of various agencies.

Potential Additional Activities[3]

The Additional Activities component of the Watershed Management Plan would address the following high priority problems identified by the public, local communities, the State of Oklahoma, Tribes, Federal agencies, and Congressional interests that are beyond the scope of the current Ongoing Activities discussed above:

- Mine hazards, including potential subsidence in populated areas and major road corridors, open and/or poorly sealed mine shafts, and open boreholes
- Stream corridors with impacted ecosystems and corridors subject to flooding in the Picher – Cardin area
- Acid mine drainage along the southern edge of the intensively mined areas in the vicinity of the Tar Creek and Lytle Creek confluence
- Flooding at Miami

A summary of the Additional Activities and their general locations are shown in Figures 5 and 6.

In addition, it is important to note, activities by the Agency for Toxic Substances and Disease Registry (ATSDR)[4]; human health and ecological assessments being performed by the EPA; Tribal risk assessments; and natural resource damage assessments (40 CFR Part 11) being performed by Oklahoma, Kansas and Missouri will provide health-related information to help define appropriate construction and material handling techniques.

[3] The Additional Activities were identified based on public, stakeholder, and Congressional interest input; existing information; and professional judgment. The candidate alternatives identified in the reconnaissance phase Watershed Management Plan will need to undergo additional screening level development and evaluation and comparison with other alternatives during potential follow-on plan formulation activities. It is envisioned that cost-effectiveness and incremental cost analysis techniques, similar to the techniques used by the U.S. Army Corps of Engineers for ecosystem restoration projects, could potentially be used to help identify final efficient solutions.

[4] The 2004 ATSDR Report to Congress and other pertinent information will be included in Appendix F when it becomes available.

Figure 5. Tar Creek Watershed Additional Activities

TAR CREEK WATERSHED

Additional Actitives

Additional Activities; when integrated with On-going Activities by the State of Oklahoma, Environmental Protection Agency, Department of Interior, Tribes and other local interest groups; would result in a comprehensive solution to high-priority watershed problems.

(1) MINE HAZARDS

If analysis indicates the potential for subsidence is a serious threat then evaluate and compare various alternatives to determine cost effective solutions. Prioritize and seal mine shafts and boreholes.

(2) IMPACTED STREAM CORRIDORS

(i.e. flooding at Picher and Cardin /degraded ecosystem)

Conduct a geomorphology assessment of the Tar Creek watershed. North of Highway 69 conduct a coordinated Agency effort within a defined floodplain to seal mine-shafts, remove mine waste, construct acid-mine drainage barriers, and re-construct and vegetate the defined floodplain. South of Highway 69 remove contaminated sediment, if required, and install various structural and non-structural measures to assure a stable channel morphology. This activity would be synchronized with resolving the mine drainage problems in the vicinity of the Tar Creek and Lytle Creek confluence and the Mayer Ranch site at Commerce.

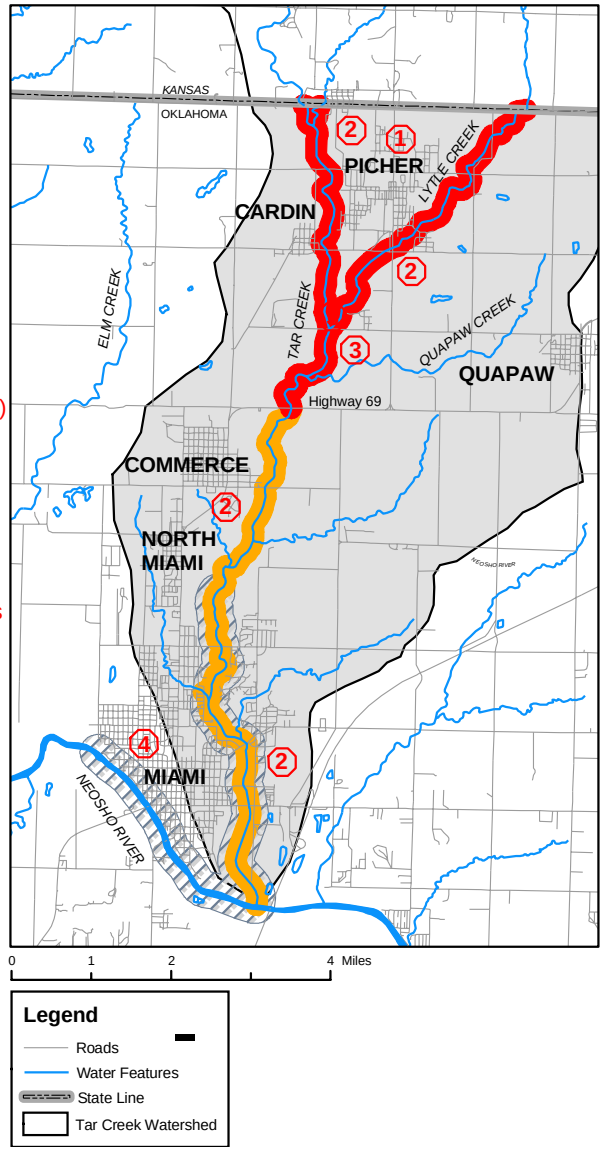
(3) MINE DRAINAGE

(along the southern edge of the intensively mined area)

Reduced acid mine drainage using groundwater and/or surface water control techniques and treat residual acid-mine drainage using a variety of passive and/or active techniques.

(4) FLOODING AT MIAMI

Reduce flooding using structural (levee, improved channel, detention) and/or non-structural (buy-out flood-prone properties) methods.



Moderately to Severely Impacted Stream Geomorphology within the Intensively Mined Area North of Highway 69

Transition Area

Impacted Stream Geomorphology South of Highway 69

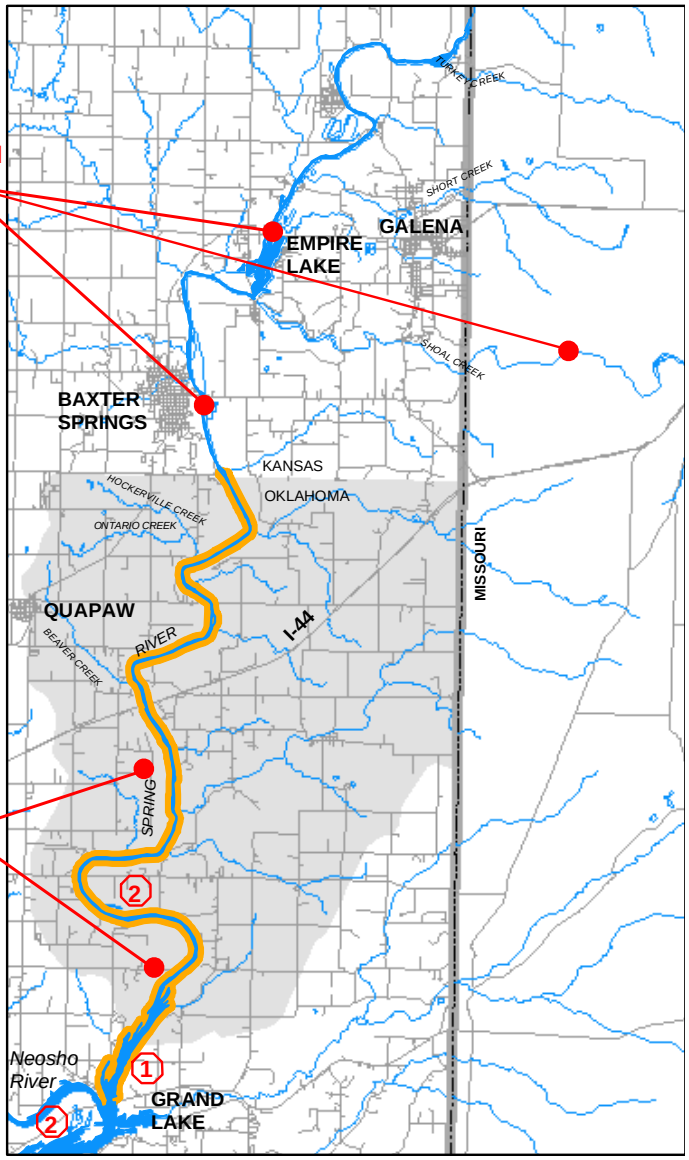
Urban Flooding at Miami

Figure 6. Lower Spring River Watershed Additional Activities

LOWER SPRING RIVER WATERSHED

A concern in Kansas and Missouri is contaminated sediments in the Spring River Watershed. Contingent on approvals, this problem could be addressed in future development of the Watershed Management Plan.

A concern in Oklahoma is downstream impacts to the Neosho River Watershed, which includes Grand Lake and the Lower Spring River Watershed.



Additional Activities

1. Obtain a depositional history of metal loading to the Lower Neosho River Watershed.

2. Determine the current loading and monitor future loading of metals from the Spring and Neosho Rivers during the cleanup of the Picher-Cardin area

   Once the impacts are determined, additional measures would be considered at a later date.

Mine Hazards

Mines in the Tar Creek and Lower Spring River watershed cover 2,540 acres of land and have been abandoned for at least 35 years. The mines vary in depth from 90 to 350 feet from the surface. Much of the area was mined on multiple levels with some mining voids reaching 125 feet in height from floor to ceiling, increasing the potential risk to populated areas and transportation corridors for collapse. There are 65 existing major collapsed areas in the watersheds between 100 and 650 feet in length.

The Oklahoma Plan for Tar Creek (Appendix C, page 26) documents the following mine hazard strategy: Work will begin west and south of Commerce, Oklahoma, where thirty mines shafts, ten subsidence features, and pockets of undermining exist. The undermined areas in Commerce and Picher/Cardin will be mapped to include more information about the subsurface. This map will be useful to others in the evaluation of subsidence potential. Work will then proceed to perimeter areas.

Potential Subsidence Areas

Using the mapping developed as part of the Oklahoma Plan for Tar Creek, the initial Additional Activity would be to assemble a team of Federal and State experts and review future land use options in the watersheds and identify high priority areas to be assessed. High priority areas include, but are not limited to, highly populated areas, major road corridors, and school bus routes. Using existing information; new technology, such as Interferometric Synthetic Aperature Radar (InSAR) data from the U.S. Geological Survey; and geophysics, conduct a risk assessment to help determine the relative risk of potential subsidence in high priority areas.

If analysis indicates the potential for subsidence is a serious concern, then various alternative solutions could be evaluated and compared to identify cost-effective solutions for consideration. Social affects and impacts are part of the evaluation process. Types of alternative solutions to address high-risk potential subsidence in populated areas include structural and non-structural measures. Structural alternatives are physical modifications designed to reduce the occurrence of potential subsidence events. Examples of structural alternatives include geotextile soil nets, pneumatic stowing, hydraulic flushing, grouting, grout bags, reverse roof bolting, dynamic compaction, and backfilling.

Non-structural alternatives reduce the impacts of subsidence independent of the occurrence of subsidence events. The October 2000 Governor Keating's Tar Creek Superfund Task Force (Subsidence Subcommittee) identified special building codes, city/county planning, and voluntary relocation as being viable non-structural alternatives for consideration. Additionally, many residents in the Picher-Cardin area have expressed an interest in considering voluntary relocation as an alternative because of the enormity of safety and health concerns in their communities.

Refer to Appendix E (Mine Hazards) for additional information on structural and non-structural alternatives and other recent activities regarding voluntary relocation.

Mine Shafts and Boreholes[5]
It is estimated that there are over 1,320 mine shafts, thousands of drill holes, and other related mine openings in the Tar Creek and Lower Spring River watersheds. Many of the openings are closed, but the stability and ability to prevent infiltration to the underground mine workings need to be verified. Many of the remaining open mine shafts are extremely dangerous, could cause future subsidence events, and provide conduits for surface water to mine workings interaction, which aggravate conditions for contaminated mine seeps.

The initial Additional Activity will locate, geo-reference, and develop a prioritized mine shaft closure and sealing plan for remaining mine shafts not addressed by the Oklahoma Plan for Tar Creek. This information would be integrated with the Oklahoma Plan for Tar Creek into a comprehensive closure program. Items that will be considered when prioritizing the closing and sealing of mine shafts include, but are not limited to, human exposure, location in relation to streambeds and floodplains (refer to discussion on stream corridors below), ability to convey water back to the underground mine workings, and physical condition. Appropriate closure and sealing methods would be selected based on site characteristics. Potential closure methods include backfill, concrete cap, concrete plug, wedge, polyurethane foam plug, and hollow core plug. The final step would be to close the prioritized mine shafts using the appropriate method and plug open drill holes.

Stream Corridors
The Tar Creek drainage area has been greatly disturbed by 70 years of mining activity that has resulted in a watershed system of poorly draining tributaries and creeks that are commonly bank full of water during non-flood periods. New channels were developed in response to the creation of chat piles, tailing ponds, dikes, railroad tracks, and roads. Once maintenance of these human works ceased, natural processes further disrupted the alterations, and additional intermittent stream channels developed. Often such development was influenced by the subsidence of mines and the collapse of mine shafts. Infiltration of surface water into open mine shafts and boreholes further contributes to environmental degradation by enhancing the fluctuations of water in the mine workings which results in chemical reactions, acid mine drainage, and the filling of underground mine working which can activate surface seeps that impact surface water quality. Without reconstruction of floodplain corridors in the intensively mined area and improvement of geomorphology characteristics downstream of the intensively mined area, the Tar Creek watershed will continue to function as it presently does with frequent flooding in the area and heavy metals continuing to move downstream to the Neosho River. Stream corridor restoration upstream of Miami could improve the drainage at the Tar Creek upper basin and improve the riparian corridor ecosystem in the entire watershed. The first activity is to conduct a geomorphology assessment of the watershed to help identify a channel restoration plan.

Tar Creek and Lytle Creek North of Highway 69
Consideration should be given to utilizing a coordinated approach to restore the Tar Creek and Lytle Creek floodplain corridor north of Highway 69 to reduce flooding and improve the ecosystem. Working with Federal and State agencies, the recommended interactive process for

[5] Additional information on the concept strategy to address mine shafts and boreholes is in Appendix E (Mine Hazards) and the Governor Keating's Tar Creek Superfund Task Force Mine Shafts Subcommittee report at www.deq.state.ok.us/lpdnew/tarcreek/index.html.

consideration is to implement the following coordinated actions within the 100-year floodplain and buffer zone[6]:

- Seal mine shafts (exposed and buried) and collapsed areas to reduce surface water runoff into mine workings and stabilize ground conditions.
- Remove and dispose of mining waste, including sediments as required.
- Construct temporary and/or permanent barriers, as required, to preclude acid-mine drainage from adjacent areas into the buffer zone. Temporary barriers would be removed following completion of the cleanup of remaining chat piles, chat bases, millponds, and transition areas outside the buffer zone.
- Re-construct and vegetate the floodplain and buffer zone corridor to reduce flooding and restore aquatic and riparian habitat functions.

Prior to initiating steam corridor restoration along Tar Creek south of the Tar Creek and Lytle Creek confluence, the mine drainage problems in this area will need to be resolved (refer to the discussion on mine drainage below).

Tar Creek South of Highway 69
Contingent on the results of the geomorphology assessment, the anticipated action for the Tar Creek channel downstream of Highway 69 is to remove contaminated sediment, as required, and install energy-dissipating structures, if needed, to assure stable channel morphology. Prior to initiating stream corridor restoration along Tar Creek south of Commerce, the mine drainage problems at the Mayer Ranch site will need to be resolved. The mine drainage problem at the Mayer Ranch site is being addressed by Oklahoma University as part of the Oklahoma Plan for Tar Creek.

Additional information on the stream corridor strategy and preliminary costs is provided in Appendix E (Impacted Stream Corridors).

Mine Drainage Along the Southern Edge of the Mine Workings in the Vicinity of the Tar Creek and Lytle Creek Confluence
Acid mine drainage (AMD) is an active ongoing process in the Tar Creek and Lower Spring River watersheds. The primary sources of AMD include the following:

- Sources that emanate from the surface waste and tailings materials due to shallow groundwater and surface water runoff
- Sources that contribute seepage from the flooded underground mine workings.

There are three primary components, from a hydrologic perspective, that control flow at major mine seeps coming from the underground mine workings. They include:

- Surface water recharge infiltrating from shafts, boreholes, collapse and subsidence features; surface drainage flow into these features; and surface drainage through the base of chat piles or tailings over these features and back into the underground mine workings.

[6] Using guidance provided by 30 CFR Part 817, the buffer zone is defined here as a distance of at least 100 feet beyond the FEMA established 100-year floodplain of the watercourse under consideration.

- Drainage of stored mine water to the land surface from the flooded underground workings once they reach the "full" spill point elevation which varies from below 792 feet to 798 feet (generally below the 800-foot elevation contour). Major seep locations include the Mayer Ranch near Commerce, the Tar-Lytle creeks in the Tar Creek Watershed confluence, and Beaver Creek in the Spring River Watershed. The known seeps located at the Mayer Ranch and Beaver Creek are being addressed by the Oklahoma Plan for Tar Creek.
- Surface discharge near the major seep locations associated with Tar, Lytle, and Beaver creeks plus other locations not yet identified, such as from buried shafts and well bores, collapse and subsidence features, and shallow perched groundwater base, flow from mining waste and milling piles.

All three source components that control flow must be addressed to remedy the discharge at the Tar Creek–Lytle Creek confluence. The use of reactive barriers and passive treatment features is a potential alternative to address mine drainage.

A combination of technologies consisting of flow reduction features and treatment options would also be considered to address the AMD. The estimated cost for this alternative will vary depending on the final combination of flow control and treatment features. The evaluation of this alternative would involve a balancing consideration between flow reducing cost plus any treatment cost (which reduces if flow reduces). The design of flow reduction features will be directly influenced by decisions made by the EPA regarding chat, chat bases, millponds, and transition areas. Additional information on technologies to address AMD is provided in Appendix E (Mine Drainage).

Flooding at Miami

Flooding at Miami occurs with relative frequency along Tar Creek and infrequently along the Neosho River. The March 1989 Miami, Oklahoma, and Vicinity Reconnaissance Report documented 15 economically feasible structural solutions; however, areas of development prone to flooding may be eligible for the buyout program administered by the Federal Emergency Management Agency. Structural alternatives evaluated included 14 levee plans and one 25-year flood control reservoir. Current costs (August 2004) for potentially viable alternatives evaluated in the 1989 reconnaissance study range from about $1,500,000 to $29,000,000 for various levels of flood protection. In January 2002, a Reconnaissance Report was completed that recommends proceeding with a Corps of Engineers cost-shared feasibility study that would address flooding in Miami. The cost of a feasibility study would be determined based a scope of work developed by the Corps of Engineers and a local sponsor.

Section 449 of the Water Resources Development Act of 2000 also addresses flooding problems at Miami and directed the Corps to evaluate backwater effects specifically due to flood control operations on land around Grand Lake. Copies of the reconnaissance study report and the preliminary analysis of backwater effects are provided in Appendix E (Flooding at Miami, Oklahoma).

Special Considerations

Mining-related problems in Kansas and Missouri are relevant to a holistic approach to watershed problems in Oklahoma.

Following are other pertinent topics that were brought up at public meetings, coordination meetings with stakeholders, and multi-agency technical team meetings.

Based on the interrelationships of mining-related water resource problems and activities that extend across state boundaries and to adjacent water bodies, stakeholders may want to consider other comprehensive strategies, discussed below, for future development of the Watershed Management Plan.

The National Environmental Policy Act is used as a planning tool to integrate environmental problems into policies and programs rather than individual projects.

Pertinent Upstream Watershed Issues in Kansas and Missouri

Some of the later reconnaissance phase multi-agency technical team meetings included participants from the States of Kansas and Missouri. Ongoing Activities in Kansas and Missouri are addressing mining-related problems similar to those being addressed in Oklahoma. There is significant information for Kansas and Missouri that could be included in the Watershed Management Plan at a later date. Since Oklahoma is downstream, those activities in Kansas and Missouri are relevant to helping resolve issues in Oklahoma so that recontamination does not occur.

Maps showing the locations of mined areas in Kansas and Missouri are shown in Figures 7 and 8. Additional information is available at the EPA Region VII website at www.epa.gov/region7/.

Lower Neosho River Watershed

A portion of the Lower Neosho River watershed, which includes Spring River and Grand Lake, is impacted, to some extent, from the mined areas upstream. Information from the March 1995 Diagnostic and Feasibility Study of Grand Lake O' the Cherokees documents the distribution of metals and nutrients in the water column and metals in the sediment. The July 2003 press release from the Oklahoma Department of Environmental Quality documents preliminary findings regarding lead and cadmium levels in bottom-feeding fish sampled at various locations in the Neosho River at the upper end of Grand Lake and the Lower Spring River. The 1995 study and 2003 press release are located in Appendix G.

A potential strategy to investigate the loading of mine waste to the lower Neosho River Watershed would include the following:

- Obtain a depositional history of metal loading to Grand and Hudson Lakes.
- Determine current loading and monitor future loading of metals from the Spring and Neosho rivers during cleanup of the Picher/Cardin area.

Once the impacts are determined, additional measures would be considered and implemented as required at a later date.

Figure 7. Abandoned Mine Lands in Kansas
(From EPA Region VII)

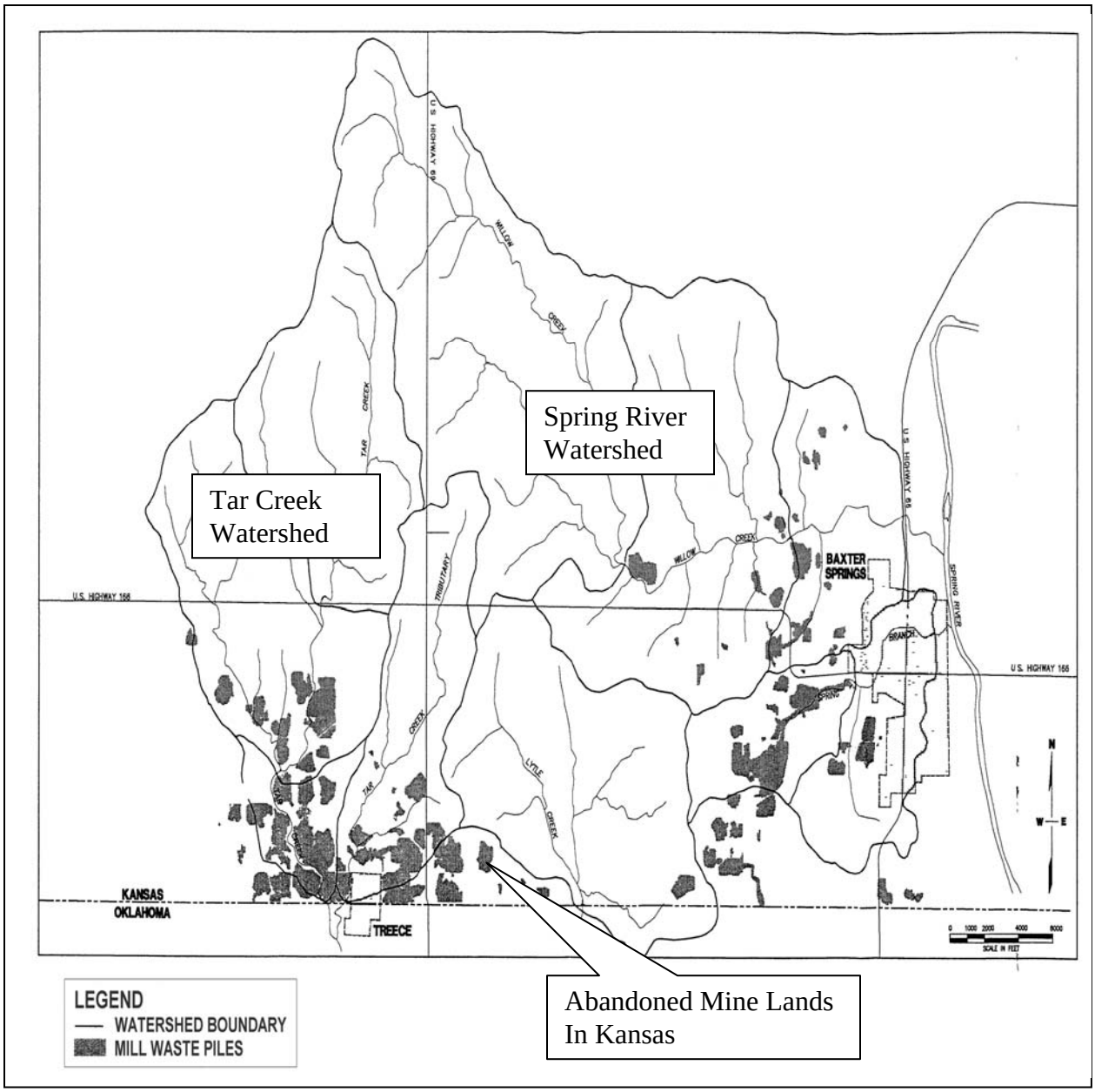
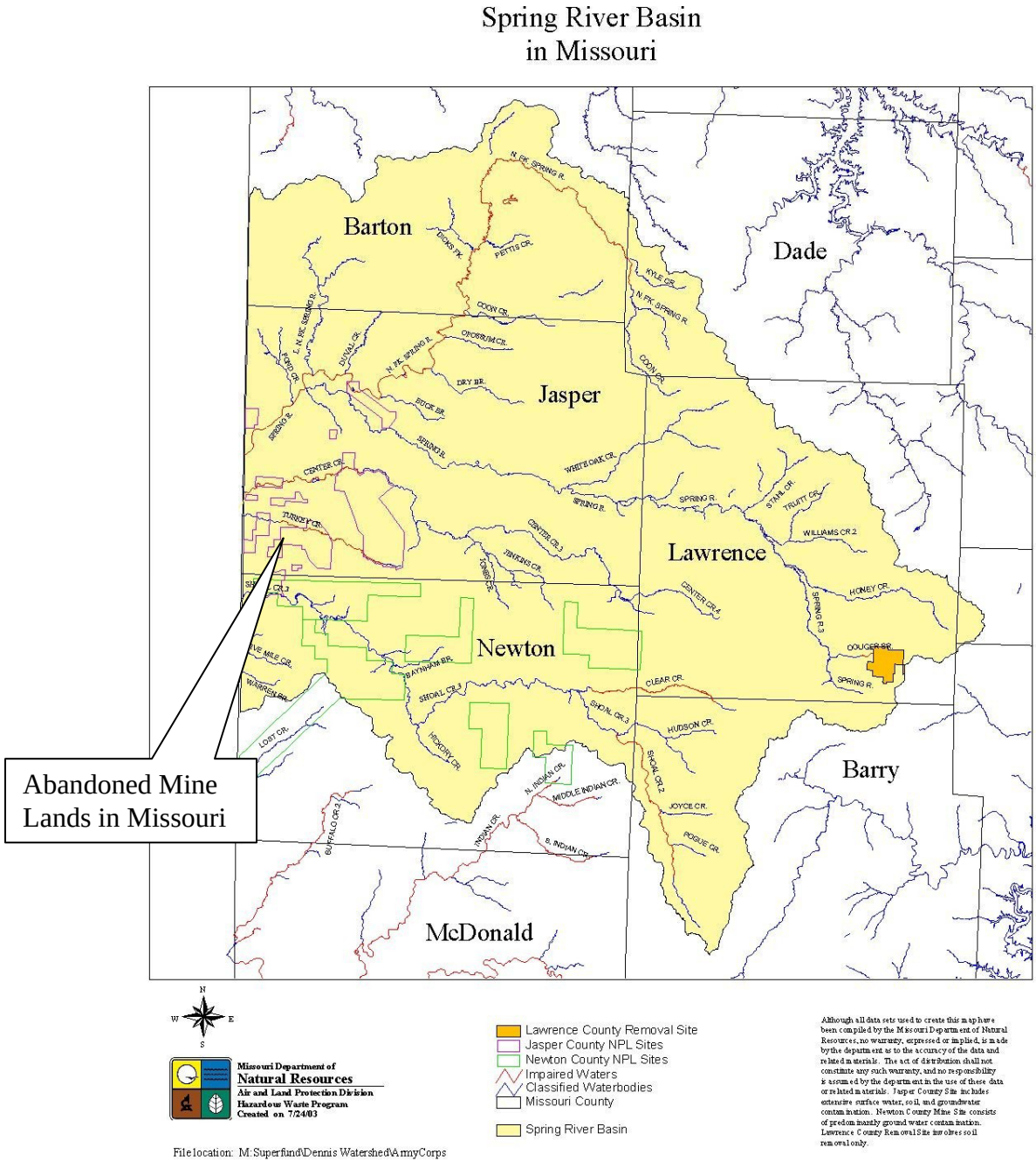


Figure 8. Abandoned Mine Lands in Missouri



National Environmental Policy Act (NEPA)[7]

The NEPA is used as a planning and guidance tool to integrate environmental concerns into policies and programs rather than individual projects. Future development of the Watershed Management Plan will continue to integrate all agency activities and focus maximum resources and efforts on solving the problems of the affected watersheds. As discussed above, Oklahoma, Kansas, and Missouri have similar mining-related watershed problems, and it is prudent to consider a comprehensive NEPA strategy, such as a program Environmental Impact Statement, for the "Former Tri-State Mining District." Additional information on a potential comprehensive NEPA strategy is provided in Appendix H.

Surface Water, Groundwater, and Chemistry

Of particular interest is the hydrogeology of the Tar Creek and Lower Spring River area. Without a rudimentary understanding of how surface water, groundwater, and water in the open mine workings interact, accurate engineering designs to address contaminated mine drainage, potential subsidence, and disposal of large amounts of mining waste will be extremely difficult to achieve and likely result in costly mistakes.

A three-dimensional model of the ground and surface water systems within the watersheds between the Spring and Neosho rivers is being developed by the U.S. Geological Survey. The model represents a synthesis of these complex flow systems that are integrally tied to the subsurface mine workings. A major benefit of the model is that it can be used to simulate the long-term hydrologic consequences of proposed remedial activities (such as the emplacement of chat within the subsurface mine workings) and is a cost-effective tool for evaluation of activities prior to implementation. The model will provide a basis to evaluate optimal pumping and dewatering strategies to control mine-water discharge and for development of subsequent transport models of the Tar Creek site.

Preliminary Conceptual Cost and Schedule

A preliminary cost estimate and schedule, shown in Figure 9, was developed to illustrate a conceptual program approach to address the high priority mining-related problems. Schedules are preliminary and contingent on approvals and funding. A key principle of the Watershed Management Plan is that changes and refinements are made as new information is developed. As future development of the Watershed Management Plan continues, it may be realized that some of the Additional Activities described above will not be necessary if the problem is addressed by an Ongoing Activity. On the other hand, it may be determined that in some cases there is a need for more Additional Activities.

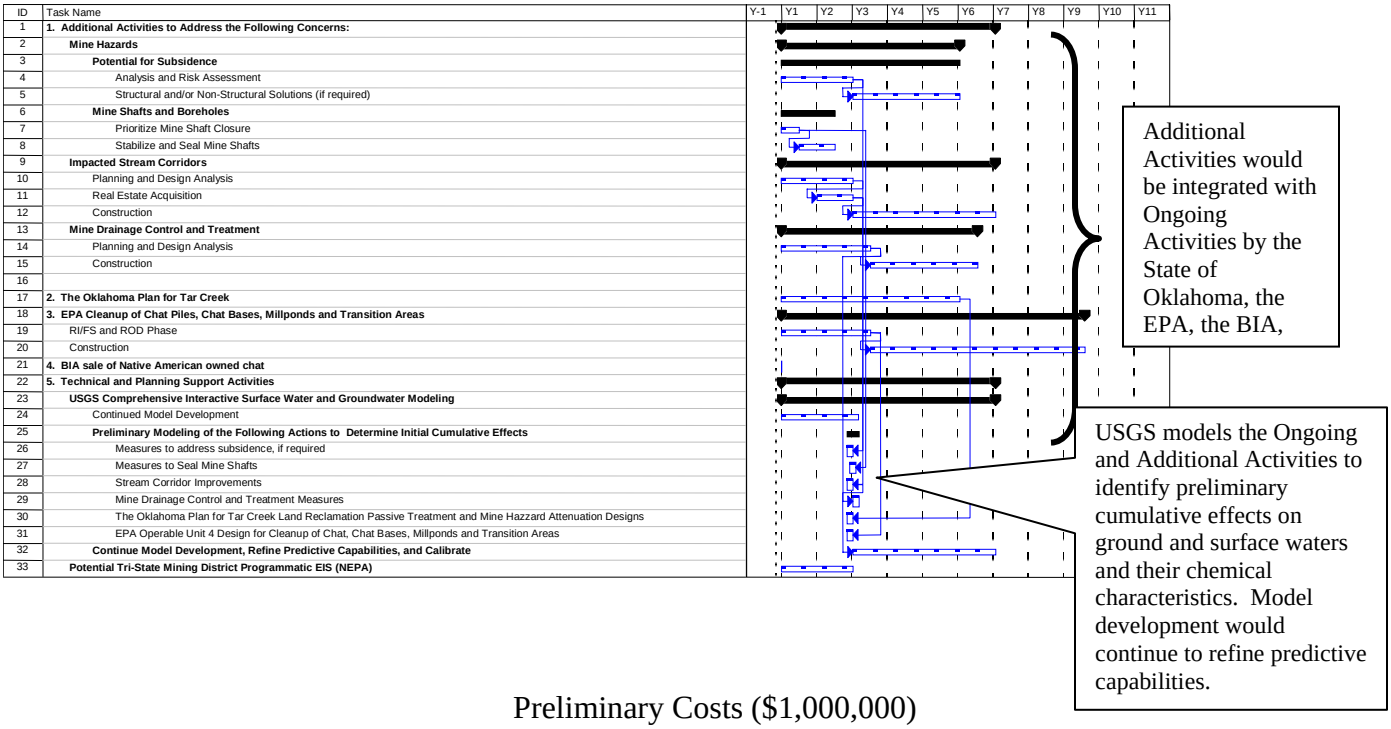
Watershed Partnerships

There are three distinct groups of individuals who participate in watershed partnerships:

- Those who are affected by, but not interested in, watershed management
- Those who are interested in, but not affected by, watershed management
- Those who are both affected and interested in watershed management

[7] Refer to Title 40 of the Code of Federal Regulations (CFR) parts 1508.5, 1508.16, and 1508.28

Figure 9. Preliminary Concept Implementation Schedule and Costs of Additional Activities



Preliminary Costs ($1,000,000)

Additional Activities[8]	Y1	Y2	Y3	Y4	Y5	Y6	Total
Mine Hazards[9]	1.73	1.73	.08	.08	.08	.18	3.88
Stream Corridors[10]	1.22	5.10	5.10	5.10	5.10	5.10	26.72
Mine Drainage	1.53	1.53	9.55	16.32	21.42	19.79	70.14
NEPA and Project Management	.70	.55	.36	.36	.36	.36	2.69
Subtotal	5.18	8.91	15.09	21.86	26.96	25.43	103.43
Project Performance Monitoring	.05	.09	.15	.22	.27	.25	1.03
Adaptive Management Construction	.16	.27	.45	.66	.81	.76	3.11
Subtotal	5.39	9.27	15.69	22.74	28.04	26.44	107.57
Supervision and Admin. (8%)	.43	.74	1.26	1.82	2.24	2.12	8.61
Eng. During Construction (6.5%)	.35	.60	1.02	1.48	1.82	1.72	6.99
USGS Modeling and Monitoring	3.46	3.81	2.45	.81	.81	.53	11.87
Subtotal	9.63	14.42	20.42	26.85	32.91	30.81	135.04
Contingency (25%)	2.41	3.61	5.11	6.71	8.23	7.70	33.77
Total	12.04	18.03	25.53	33.56	41.14	38.51	168.81

[8] Preliminary estimates are shown in August 2004 dollars and do not include costs required for project life operation, maintenance, repair, and replacement. Preliminary costs do not include costs associated with Ongoing Activities.
[9] The preliminary cost estimate for mine hazards does not include the cost of alternatives, such as structural stabilization of mine workings, special building codes, city/county planning or voluntary relocation if required because of the potential for subsidence.
[10] The preliminary cost estimate for stream corridors does not include the cleanup of chat, chat bases, millponds, and transition areas. The cleanup of chat, chat bases, millponds, and transition areas would be addressed by the EPA's, Operable Unit 4 initiative.

The communities of Picher and Cardin are the most affected communities; however, Miami, North Miami, Commerce, Quapaw, Tribes, and other downstream interests recognize the importance of a watershed approach to solving problems. Individuals from these groups have knowledge and information that was used to help develop the Watershed Management Plan.

Local community outreach efforts, such as programs by the Ottawa County Health Department and the lead based paint abatement program by the Grand Gateway Economic Development Authority, are important partnership contributions to help address health problems.

The area Tribal governments of Cherokee, Eastern Shawnee, Miami, Modoc, Ottawa, Peoria, Quapaw, Seneca-Cayuga, Shawnee, and Wyandotte Nations are actively engaged in data collection, health-related studies, and education programs, and are providing technical expertise to State and Federal agencies.

Other groups, such as Local Environmental Action Demanded (LEAD) and Tribal Efforts Against Lead (TEAL), work with communities and Tribes on such items as education, training, and information sharing.

With these local resources of expertise and knowledge, watershed partnerships can bridge the capabilities, assets, and resources of multiple agencies, organizations, and individuals. Developing and implementing a Watershed Management Plan through a partnership creates local ownership and consensus for action. Information on ideas to encourage watershed partnerships is shown in Appendix I. Summary information on community, Tribal, and local interest groups activities and programs will be included in Appendix I at a later date.

Federal Agency Partnerships

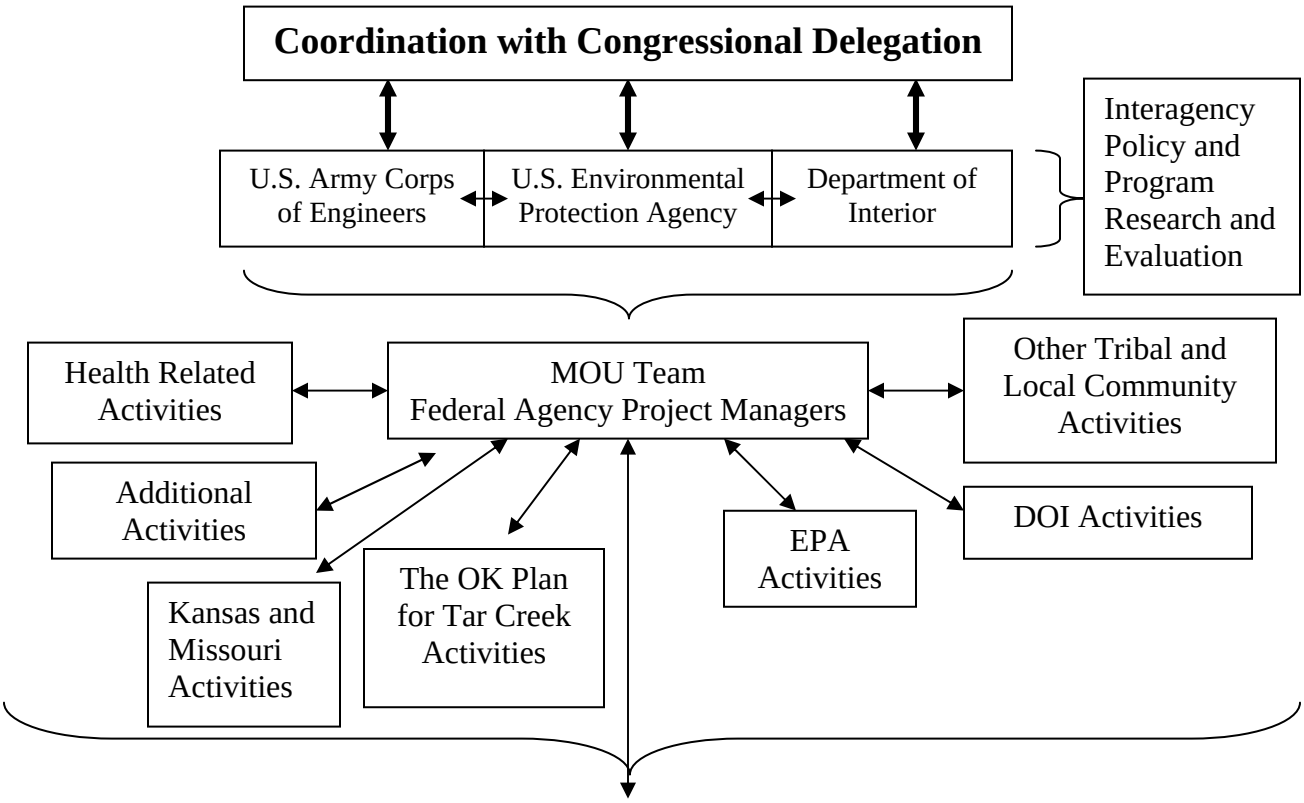
To effectively manage and efficiently implement the Watershed Management Plan activities, the three Memorandum of Understanding (MOU) Federal agencies have initiated efforts to coordinate between agencies, with stakeholders and Congressional interests. During reconnaissance phase development of the Watershed Management Plan, ideas from participants during Technical Team meetings helped develop a partnership organizational strategy for consideration. The potential strategy is graphically illustrated in Figure 10, and shows coordination as well as shared activities that could help keep costs down. Joint Agency Public Meetings and newsletters are examples of shared activities that have already been initiated.

Potential Federal Authorities to Implement Additional Activities

As previously defined, Additional Activities complement Ongoing Activities by the State of Oklahoma, the EPA, the Department of Interior, Tribes, and other local interest groups. The Ongoing and Additional Activities would collectively result in a comprehensive solution to high priority watershed problems. The Additional Activities would address similar problems that many of the current Federally authorized and funded Ongoing Activities address. Therefore, it is possible that existing Federal authorities, appropriately amended by Congress, could be utilized to implement many of the Additional Activities defined in the Watershed Management Plan. Consideration should be given to establishing an Interagency team to research and evaluate applicable Federal policies and programs.

New Congressional authorities may be required for special Additional Activities such as a "Former Tri-State Mining District" programmatic Environmental Impact Statement and other Additional Activities that may be identified at a later date based on new information.

Figure 10. Watershed Partnerships



- Geographical Information System Data Base and Mapping
- U.S. Geological Survey Surface and Groundwater Modeling
- Watershed Monitoring
- Long-Term Natural Resource Ecosystem Improvements (Oklahoma, Kansas, and Missouri)[11]
- Independent Technical Review/Value Engineering Team
- Public Meetings, Newsletters, and Watershed Partnership Development and Operation

[11] For an example of a potential natural resource area along the Neosho River upstream of Miami, that could be considered following appropriate future cleanup activities, refer to the December 1988 U.S. Fish and Wildlife Service Planning Aid Report for the Miami, OK and Vicinity reconnaissance study. The section of the Planning Aid Report that documents the potential natural resource area is included in Appendix E (Flooding at Miami, Oklahoma).