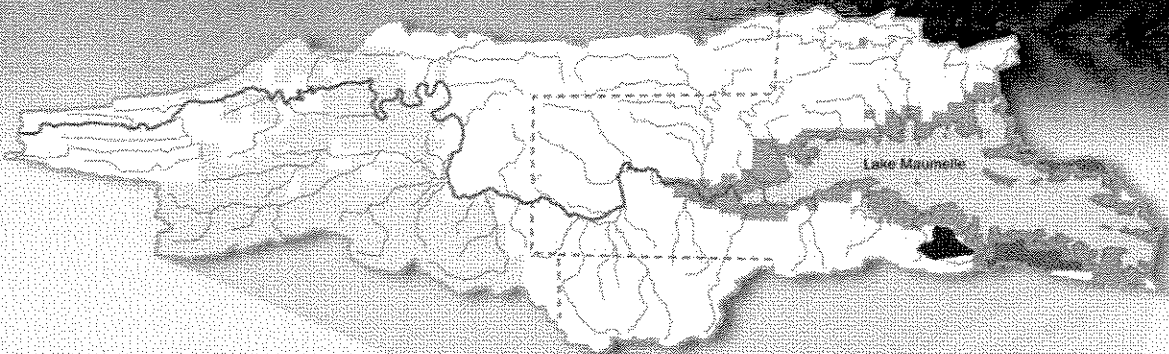


EXHIBIT F6

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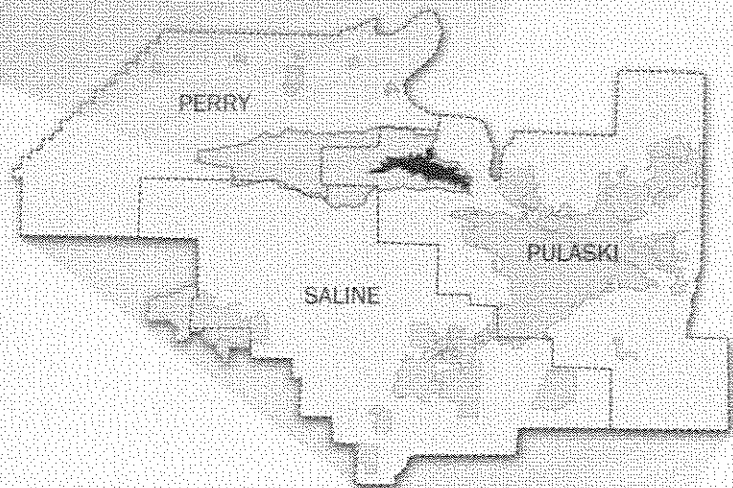
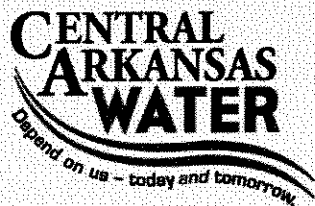
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Lake Maumelle Watershed Management Plan

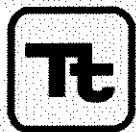


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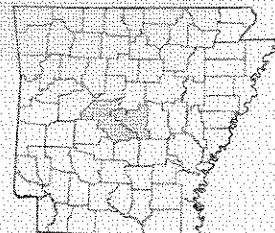
**Board of Commissioners
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The Lake Maumelle Watershed Management Plan was unanimously adopted by the Central Arkansas Water (CAW) Board of Commissioners on February 23, 2007. Between June 2005 and the time of adoption, many individuals contributed their time, energy, and expertise to the development of the Lake Maumelle Watershed Management Plan. Deserving special credit are members of the CAW Board of Commissioners and staff, the Policy Advisory Council and Technical Advisory Council (see names on pages ii–iv). We would also like to recognize all of the Tetra Tech staff that supported Plan development.

*Trevor Clements and Kimberly Brewer, A.I.C.P. – Co-Facilitators and Lead Planners
Tetra Tech, Inc.*



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Ms. Jane Dickey, Commissioner	Central Arkansas Water Board of Commissioners	Alternate
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Arkansas Department of Health
Arkansas Forestry Commission
Arkansas Natural Resources Commission
Audubon Arkansas

Central Arkansas Water

Deltic Timber Corporation
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Metropolitan Council of Local Governments
Pulaski County Department of Planning and
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U.S. Geological Survey
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University of Arkansas for Medical Sciences

Special thanks also goes to Professor Richard Ducker of the University of North Carolina School of Government and Mr. Craig Benedict, Director of Planning, Orange County NC, for the valuable assistance they provided.

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EXECUTIVE SUMMARY

Introduction and Background

Central Arkansas Water (CAW) owns and operates Lake Maumelle as one of two principle water supplies for 15 cities and communities in the region. Currently serving approximately 388,000 people, CAW estimates that it will serve over 575,000 people by the year 2050.

Lake Maumelle was built in the late 1950s at an estimated cost of \$34 million in today's (year 2006) dollars. However, today it would cost far more to replace this high quality water supply. Although its sole construction purpose was to provide water supply, Lake Maumelle has also become a place for recreation (sailing and fishing), a sanctuary for wildlife and waterfowl, and a place of serenity for the community.

The Lake Maumelle Watershed comprises all the land and stream tributaries that drain into the lake. It covers approximately 137 square miles (88,000 acres) and includes portions of Perry, Saline, and Pulaski counties, as well as the City of Little Rock's Extraterritorial Jurisdiction. Land use changes are expected in each of these jurisdictions over time, with up to 46,500 acres (53 percent of watershed) potentially developable. These potential changes have raised concerns about the protection of Lake Maumelle and the health and safety of those drinking its water.

A Task Group for Watershed Management was convened by CAW in 2004. The general charge to the Task Group was to review the existing watershed plan for Lake Maumelle and to make recommendations on the plan to the CAW Board of Commissioners. One of the Task Group's key findings was that the current CAW watershed plan does not adequately address the scientific, social, political, recreational, aesthetic, and economic factors influencing land use decision-making in the Lake Maumelle basin. A corresponding recommendation was for CAW to contract with an expert watershed management and planning consulting firm to assist in developing and implementing a comprehensive, scientifically-based watershed management plan that addresses these factors adequately.

In response to the Task Group recommendation, in 2005 CAW selected Tetra Tech, Inc. to conduct a watershed study and develop a comprehensive watershed management plan. Work began in June 2005, and this plan constitutes the culmination of effort between Tetra Tech, CAW, stakeholders, and state and local resource agencies and institutions. CAW invited community groups to appoint representatives to a 22-member Policy Advisory Council (PAC) which would help guide development of the plan. A panel of technical resource advisors—called the Technical Advisory Council—was also convened to provide input on and review of technical issues throughout the planning process. Multiple public meetings were held at four different times during the plan development process to share information and provide opportunity for anyone interested to participate.

In October, 2005, the Policy Advisory Council adopted Goals and Objectives for the Lake Maumelle Watershed Management Plan (see table on next page), with

CAW estimates that it will serve over 575,000 customers by the year 2050.

This plan constitutes the culmination of effort between Tetra Tech, CAW, stakeholders, and state and local resource agencies and institutions.

Lake Maumelle Watershed Management Plan

the overarching goals being to maintain a high quality drinking water supply and provide equitable sharing of costs and benefits for protecting the lake.

Next, Tetra Tech, with review and comment from the Technical Advisory Council, recommended water quality indicators and associated numeric targets for assessing compliance with the goals and objectives. The targets—which will maintain a high quality drinking water supply—were endorsed by the PAC.

Adopted Lake Maumelle Watershed Management Plan Goals and Objectives

Overarching Goals of the Watershed Management Plan • Maintain long-term, abundant supply of high quality drinking water for present needs and continuing growth of the community. • Provide an equitable sharing of costs and benefits for protecting Lake Maumelle.	
Objectives	
Minimize risks to public health from: • toxic spills • pesticide/herbicide runoff • bacteria/pathogens from failing septic/community systems and animal wastes • toxins from blue-green algae	(most important)
Minimize impacts on watershed property owners and residents including: • use restrictions • cost of BMPs	(most/more important)
Minimize water supply taste, odor, and color problems associated with: • algae • iron and manganese • turbidity	(more important)
Minimize impact on the water supply intake and water treatment facility operations such as: • intake/filter clogging • excess chemical additive requirements • increased operation and maintenance (O&M)	(more important)
Minimize rate increases from: • increased treatment cost • increased O&M • land acquisition/buffer easements	(more important)
Minimize loss of reservoir water supply storage capacity from sedimentation.	(important)
Minimize risk of impairment to tributary streams in the watershed for stream and lake protection from: • channel instability (erosion, sedimentation, scour) • pollution from runoff (sediment, nutrients, pesticides/herbicides, pathogens)	(important)
Allow limited recreation that reflects environmentally sound stewardship of the lake for: • fishing • sailing • boating • access (picnicking, hiking, visiting)	(important)
Meet other community values including: • Be economically competitive • Provide a strong tax base for communities in the region and minimize tax increases • Be administratively feasible	(important)

Study Findings

The study first analyzed, “*What happens if no further management action is taken (i.e. we do nothing)?*” This Baseline Analysis compared existing conditions to predicted future conditions, then compared future conditions to the water quality targets to help guide management plan development. Key findings of the Baseline Analysis include:

- Existing conditions in Lake Maumelle are very good, but the ability to maintain good quality is potentially threatened.
- Future water quality conditions are not predicted to meet the lake water quality targets under the build-out scenarios:
 - Chlorophyll a is an indicator of algae. The targets for mid- and lower lake are set to prevent nuisance algae blooms that can emit toxins, foul treatment equipment, and cause taste and odor problems. Expected future conditions under existing management regulations and policies far exceed the established targets.
 - Total organic carbon (TOC) is an indicator of the concentration of complex organic molecules in the watershed, derived from both natural and human sources. TOC must be kept below the target threshold in the water supply to prevent disinfection byproducts (toxic and cancer-causing substances) from reaching levels that threaten public health. Existing conditions provide a margin of safety from the threshold level. Future conditions without additional management are expected to exceed the threshold posing a significant threat to public health.
 - Secchi Depth is a measure of water clarity and is closely related to turbidity. EPA requires drinking water suppliers to maintain low turbidity in finished water to ensure adequate removal of disease-causing organisms, such as fecal coliform, cryptosporidium, or giardia. If the raw water supply in Lake Maumelle is too turbid (cloudy), it is harder to treat and this condition increases health risks to public water users. Predicted future Secchi Depth conditions do not meet the target, indicating an unacceptable threat to public health.
 - Increased population and traffic are also expected to increase the risk of spills of toxic substances that could enter the raw water supply and threaten public health, water supply operations, and recreation.

What needs to be managed to meet the water quality targets?

Based on detailed analysis and discussion with the Technical Advisory Council members, the following areas should receive the greatest attention by the management plan:

- New Development (runoff from development after construction is completed; wastewater; runoff during land disturbance or construction)
- Improvement and Maintenance of Existing Roads
- Spill Containment
- Forestry Practices
- Lake Management

Existing conditions in Lake Maumelle are very good, but the ability to maintain good quality is potentially threatened.

Future water quality conditions are not predicted to meet the lake water quality targets under build-out scenarios.

Management emphasis should be placed on controlling pollution from new development in the watershed.

No single management option can meet all of the objectives; therefore a combination of methods and actions are needed.

- Livestock Management
- Good Household Practices
- Land Acquisition

Emphasis should be placed on controlling sediment, phosphorus, TOC and pathogen loading from the watershed. The largest potential sources by far are expected from new development and the associated wastewater from those new residents.

Management Plan Recommendations

No single management option can meet all of the objectives; therefore a combination of methods and actions are needed. This Watershed Management Plan (the Plan) recommends actions in each of the areas listed above. Since the largest threat to the lake is from the conversion of forest to new housing development and the associated wastewater, a key focus of the Plan is managing the impacts from new development. Modifications to local regulations will be needed to address this threat.

Recommended Changes to Local Regulations

The Plan recommends that local Watershed Protection Ordinances or Subdivision Ordinances be adopted to carry out the management recommendations for new development, as well as local Sedimentation and Erosion Control Ordinances for land disturbance activities in the watershed. The Plan recommends three management areas in the watershed, with the requirements for undisturbed open space and impervious area in the developments becoming more strict as you move from the upper watershed area to areas closer to the lake and intake area. Pollution caps have been established for new development in each management area to ensure that water quality targets are met. As part of this Plan, the CAW Board voted to continue its policy of no development in Critical Area A and to acquire such land for conservation.

All of the development options in the Plan were designed to meet the site-scale pollution caps and the lake water quality targets, and fall under two general approaches. The first approach is Conservation Design which relies on site design and landscape to meet the pollution caps. At a minimum, it requires 5-acre lots on the low slope areas and 10-acre lots on the high slope areas for new residential development. A cluster design option is recommended which allows the lot size to vary, but overall the average lot size must remain 5 acres on low slopes and 10 acres on high slopes, when averaging in the undisturbed open space. The cluster design option generally allows less impervious area because less road and street area is needed to serve the same number of houses. The cluster design also does a better job of meeting the pollution caps than the fixed large lot because of the reduced impervious area and increased amount of undisturbed area for the development.

The second management approach is Performance Standards allowing use of engineered stormwater best management practices (BMPs) to meet water quality targets. Before this approach can be used, pilot projects must be performed to determine the effectiveness of BMPs in soils and slopes similar to the Lake Maumelle Watershed. The pilot studies must also address the effectiveness of BMPs

used during the land disturbance and construction phases. Once initiated, it is estimated that the pilot studies will take approximately four years to complete.

In essence, the Plan allows for the traditional large lot development that has occurred in the past in the watershed, and for a new pattern of development—called cluster development—that is more environmentally sensitive. The main difference between the recommended development and what has occurred in the past is the requirement for paving of roads and driveways. Unpaved roads and driveways are a major source of loading of sediment and other pollutants. The study found that the upfront cost for paving is up to 4 percent more than that of using gravel. However, the long-term maintenance cost for paving is much lower than gravel—resulting in lower overall costs to the landowner. Numerous studies have shown that the conservation type design called for in this plan can actually raise the value of the land and houses due to the premium people are willing to pay for guaranteed open space.

Another key recommendation in the Plan is for the State to prohibit any direct surface discharges of wastewater in the watershed. To strengthen this prohibition, the Plan recommends that local ordinances allow cluster development only under the condition that non-discharging wastewater systems be used.

Finally, the Plan provides flexibility to address concerns of current watershed residents. The Plan recommends that local ordinances provide exemptions to existing landowners to create additions to their existing homes and businesses and to create small subdivisions that would not have to comply with the Plan. In order to provide these exemptions and still meet water quality targets, CAW will need to acquire 1,500 acres of conservation land in the watershed.

Does the Plan Meet the Goals?

When you consider conservation land currently owned by CAW and the U.S. Forest Service, the 1,500 acres that CAW would acquire to offset the landowner exemptions, and the proposed conservation area in new developments (i.e., the minimum undisturbed open space requirements and very steep slope conservation area), *at buildout, this plan would result in:*

- Conservation of 49,800 acres or 65 percent of the land in the watershed.
- A total estimated 6,380 houses assuming the Conservation Design approach is used. Note: If the Performance Standards approach is used, the total houses in the watershed would increase more. The level of increase would depend on the development designs used which in turn would depend on the non-discharging wastewater systems allowed. For example, the drip irrigation technology, which is linked to the capacity of the soils, would likely increase the number of houses by 1,000 compared to the Conservation Design approach. Pumping wastewater out of the watershed would allow substantially more houses to be built, thereby increasing pollutant sources and risk to water quality from system failures.
- A total increase of 2,690 acres of imperviousness for houses, commercial areas, and institutions, or 3 percent imperviousness for the entire watershed and 5 percent when including existing imperviousness.

The Plan provides flexibility to address concerns of current watershed property owners.

At buildout, this Plan would achieve the Lake Maumelle water quality targets and a high quality water supply for the region.

- The remaining 30 percent of the land in the watershed covered with grass and meadow.
- Achievement of the Lake Maumelle water quality targets and high quality drinking water supply for the region.

This Watershed Management Plan has a strong foundation in land conservation, and wise land management, while still accommodating development for landowners. It meets the goal of maintaining a high quality drinking water supply and balancing the burdens and benefits of protection.

Success will require action beyond Plan adoption by Central Arkansas Water.

Plan Adoption and Implementation

The Central Arkansas Water Board adopted the Watershed Management Plan in February 2007, and then began initial implementation steps for the Plan. However, success will require action beyond Plan adoption by Central Arkansas Water. Local governments with jurisdiction of lands in the watershed will need to adopt ordinances to support the Plan and help implement it. CAW has pledged to fund a Watershed Administrator who would work with local governments to enforce such ordinances.

The Plan also provides recommendations for how CAW, local governments, resource agencies, non-governmental organizations, and other interested parties can work together to coordinate on plan implementation and ongoing adaptive management. Specifically, the Plan recommends the formation of a Lake Maumelle Stewardship Council to meet this need. It also recommends that CAW continue to monitor and assess water quality in the stream tributaries and lake to determine if water quality targets are being met and if problem sources exist. Such an adaptive approach will provide for long-term protection for Lake Maumelle, allowing for management to be responsive to the dynamics of the watershed. CAW has pledged to fund the hiring of a new Watershed Stewardship Coordinator to support the work of the Council, and to fund long-term water quality monitoring and assessment.

An implementation strategy for this Plan is under development. CAW, ratepayers, and other stakeholders should expect that implementation of the Watershed Management Plan will be an ongoing, evolving process for many years to come.

1 INTRODUCTION

1.1 The Call for a Comprehensive, Scientifically-Based Watershed Plan

Meeting Central Arkansas' Water Supply Needs

Lake Maumelle is a vital resource for Central Arkansas, providing water supply to meet 60 percent of the demand for 15 cities and communities in the region (Figure 1). Currently (year 2006) serving approximately 388,000 people, Central Arkansas Water (CAW) estimates that its ratepayer base will increase to over 575,000 people by the year 2050. Built in the late 1950s at an estimated cost of \$34 million in year 2006 dollars, it would cost far more to replace this high quality water supply source. Although its sole construction purpose was to provide water supply, Lake Maumelle has also become a place for recreation (sailing and fishing), a sanctuary for wildlife and waterfowl, and a place of serenity for the community. Truly the lake is a community asset worth protecting.

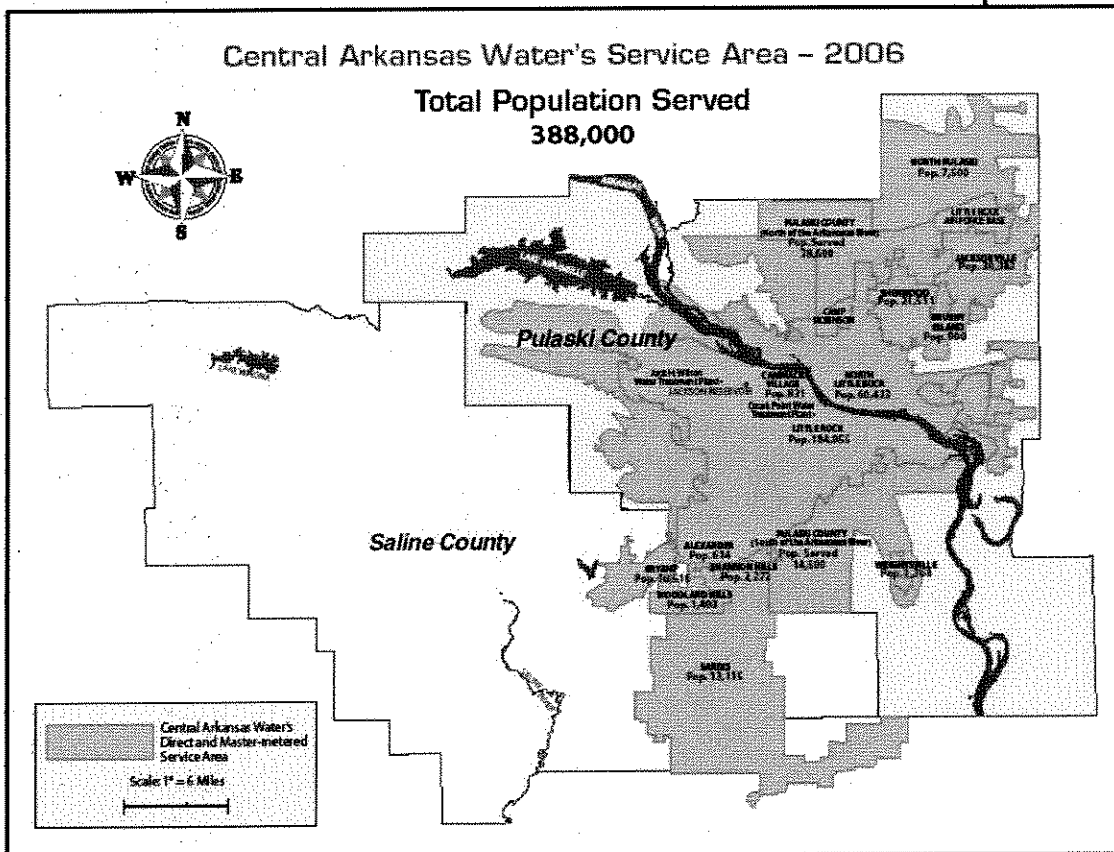


Figure 1. Central Arkansas Water's Service District as of 2006

High quality water and lower treatment costs are highly correlated to the amount of forest cover and natural area within a water supply's watershed.

Land Conservation Has Protected Lake Maumelle Water Quality

Lake Maumelle has served its purpose well by providing very high quality water. Data collected by the Arkansas Department of Environmental Quality and the U.S Geological Survey demonstrate that Lake Maumelle is not only one of the cleanest water supply lakes in Arkansas, but also across the Southeastern United States. One of the primary reasons for its high quality is that the land surrounding and draining to the lake (called its watershed) has largely remained free from development (Figure 2). Approximately 90 percent of the land in the watershed is maintained in forest cover, and another 7 to 8 percent is in open meadow or pasture. Only 2 to 3 percent is in developed road or residential and commercial use. A study by the Trust for Public Land (2004) has shown that high quality water and lower treatment cost are highly correlated to the amount of forest cover and natural area within a water supply's watershed.

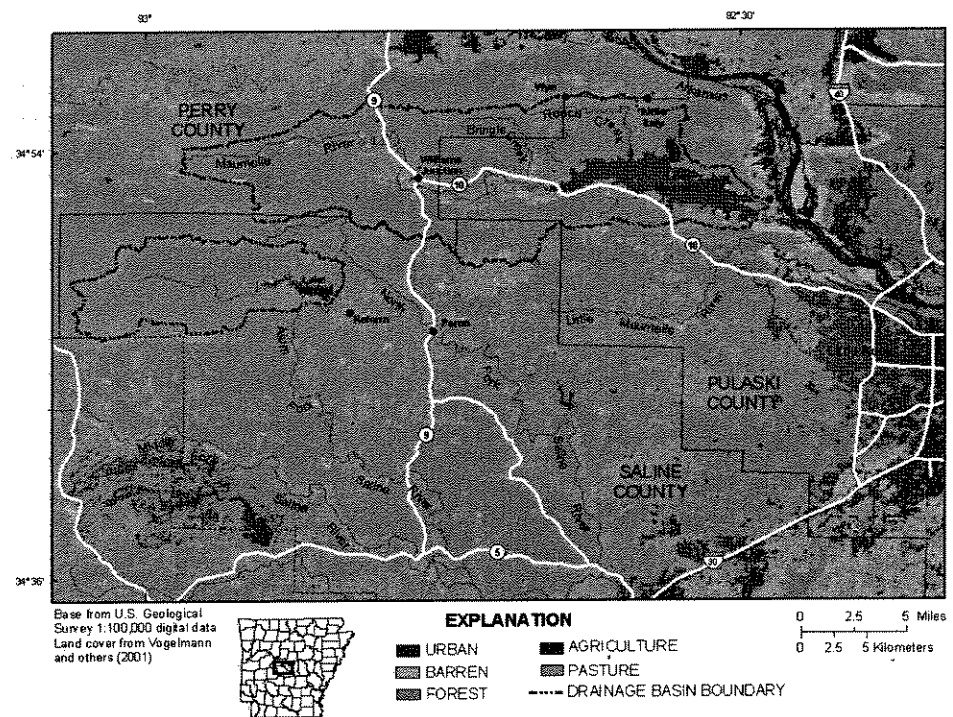


Figure 2. Land Use for the Lake Maumelle Watershed and Surrounding Area

The Potential Threat to Lake Maumelle Water Quality

If land use in the Lake Maumelle watershed were to stay as it is today, Lake Maumelle would likely maintain its very high quality without requiring any additional management. However, we live in an ever changing world, and the Lake Maumelle watershed is not immune to change. Portions of Pulaski, Perry, and Saline counties as well as a small portion of the City of Little Rock Extraterritorial Jurisdiction make up the watershed (see Figure 3 – Vicinity Map for the Lake Maumelle Watershed). Land use changes are expected in each of these jurisdictions over time. Based on review of ownership and geographic features, an estimated 46,500 acres out of 88,000 acres (53 percent) in the watershed is potentially developable.

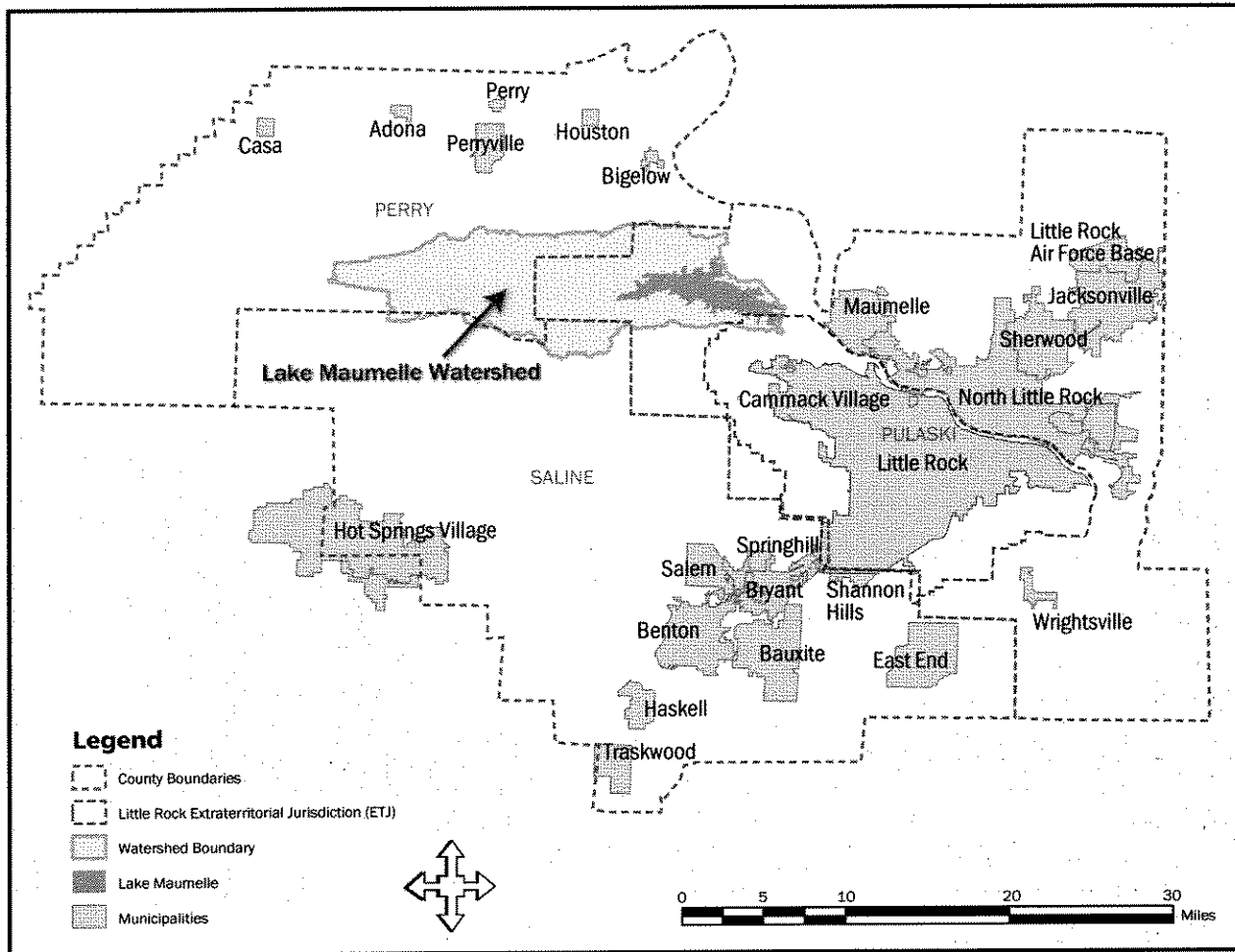


Figure 3. Vicinity Map for the Lake Maumelle Watershed

The proximity to Little Rock and access to and through the watershed along Arkansas Highway 10 add to the current land development pressure, particularly in the eastern portion of the watershed. Recently proposed development projects in the watershed are indicators that a higher rate of development nearer Little Rock is beginning to take place. As the proposed developments have come under review, concerns have arisen about the protection of Lake Maumelle and the potential future threat to the health and safety of those drinking its water.

CAW Task Group Calls for Comprehensive Management Plan

A Task Group for Watershed Management was convened by CAW in 2004 to further address concerns. The Task Group was comprised of governmental and nongovernmental organizations representing state and local interests. The general charge to the Task Group was to review the existing watershed plan for Lake Maumelle and to make recommendations on the plan to the CAW Board of Commissioners.

One of the Task Group's key findings was that the current CAW watershed plan does not adequately address the scientific, social, political, recreational, aesthetic, and economic factors influencing land-use decision-making in the Lake Maumelle

To develop this Plan, Tetra Tech worked with CAW and stakeholders to integrate public priorities, science, engineering, accountability, and feasibility.

basin. A corresponding recommendation was for CAW to contract with an expert watershed management and planning consulting firm to assist in developing and implementing a comprehensive, scientifically-based watershed management plan that addresses these factors adequately.

In response to the Task Group recommendation, CAW selected Tetra Tech Inc. through a competitive and publicly open qualifications review process to provide neutral, professional consulting services in conducting a watershed study and developing a watershed management plan. Work began in June 2005, and this plan constitutes the culmination of effort between Tetra Tech, CAW, stakeholders, and state and local resource agencies and institutions.

1.2 The Approach For Watershed Study and Management Plan Development

To develop the plan, Tetra Tech worked with CAW and stakeholders to employ a multi-faceted approach integrating the public, science and engineering, accountability methods, and feasibility evaluation.

Public Participation

The Task Group report recognized that a comprehensive watershed management plan requires participation, “buy-in,” and long-term involvement from both public and private interests in the watershed to sustain recreational, aesthetic, and water quality values in Lake Maumelle. Development of this plan included several types of public participation:

- **Policy Advisory Council (PAC)** – This council was formed to provide input and make recommendations throughout development of the management plan. Membership is comprised of 22 representative groups or organizations in the CAW service area and in the Lake Maumelle Watershed that have a stake or interest in the Watershed Management Plan (Table 1). Regular monthly meetings were held for the full Council, and several subcommittees of members met more frequently as needed to work on specific issues.

Table 1. Organizations and Constituencies Represented in the Policy Advisory Council (number of primary representatives)

Community	
League of Women Voters of Pulaski County (1)	Property Owners
Citizens Protecting Maumelle Watershed (1)	Deltic Timber Corporation (1)
Little Rock Chamber of Commerce (1)	Water Association (1)
North Little Rock Chamber of Commerce (1)	U.S. Forest Service (1)
	Small landowner in northern portion of watershed (1)
	Small landowner in western portion of watershed (1)
Rate Payers	Environmental
Little Rock (1)	Audubon Arkansas (1)
North Little Rock (1)	Sierra Club (1)
Master-metered Customers (1)	
Elected Officials	Recreationists
Little Rock (1)	Grande Maumelle Sailing Club (1)
North Little Rock (1)	Fisherman (1)
Pulaski County (1)	
Perry County (1)	
CAW Board (1)	Realtors (1)

- **Technical Advisory Council (TAC)** – A panel of technical resource advisors was also convened to provide input on and review of technical issues throughout the planning process (Table 2). TAC members advised on matters such as selection of indicators for quantitatively and qualitatively evaluating whether management options met the adopted goals and objectives, selection of watershed and lake models, assumptions for management alternatives, technical considerations in evaluating management alternatives, and administrative means for implementing the Plan.
- **Public Meetings** – Multiple public meetings were held at four different times during the plan development process to share information and provide opportunity for anyone interested to participate. Topics ranged from communicating the goals and objectives for a watershed plan to obtaining input on specific management recommendations.
- **Web and Library Information Distribution** – Throughout the process, CAW provided public access to materials produced by Tetra Tech including slide presentations, Council meeting summaries, reports, memos, and supplemental documentation. Much of the information was accessible on the CAW website and at selected public library locations.

Table 2. Technical Advisory Council Member Organizations

Arkansas Department of Environmental Quality	City of Little Rock Planning
Arkansas Department of Health and Human Services	Metroplan Council of Local Governments
Arkansas Forestry Commission	Pulaski County Government Planning
Arkansas Natural Resources Commission	University of Arkansas at Little Rock
Audubon Arkansas	University of Arkansas for Medical Sciences
Central Arkansas Water	U.S. Forest Service
Deltic Timber Corporation	U.S. Geological Survey

Science and Engineering

The water quality of Lake Maumelle is affected most by what happens on the land and in the streams draining to the lake. To be capable of predicting how lake water quality would respond to various management alternatives, watershed and lake models were developed (Tetra Tech, Inc., 2006a). Additionally, the Tetra Tech Site Evaluation Tool (SET) was set up specifically for application to the Lake Maumelle watershed, providing means to evaluate the effect of different development designs and management options on site-scale pollutant loading rates (e.g., pounds of pollutant per acre of land per year) from the land.

The modeling tools were used in several ways to support the management planning process. A baseline analysis was performed to compare existing watershed and lake conditions to two potential future build-out scenarios (i.e., if developable land were developed under existing regulations, policies, and practices). The baseline analysis provided a scientific basis for establishing the bigger threats to water quality and the magnitude of the potential impacts to lake water quality if a comprehensive plan is not adopted and implemented (Tetra Tech, Inc., 2006b).

The models also provided the basis for determining maximum allowable pollutant loads to the lake. Using water quality targets adopted by the PAC, Tetra Tech applied the watershed and lake models to establish acceptable annual average

Modeling provided a quantitative means to evaluating the water quality goals and objectives.

loading rates that would meet the in-lake targets. This information provided the scientific basis for establishing load allocations and performance standards for new development, which will be discussed in further detail in the plan.

The SET applications were used to screen and evaluate different land cover and development designs to determine which types could achieve the allowable loading rates. This led to establishing the minimum levels of open space required and maximum amount of imperviousness allowable for minimum lot sizes on low or high sloped areas throughout the watershed.

The modeling framework was also used to evaluate relative travel time to the water supply intake under certain critical conditions. This application provides a scientific basis for establishing management zones based on relative risk.

Accountability Methods and Feasibility Evaluation

Although science and engineering are very important to supporting the watershed management plan, there are other factors that must be considered too such as community support, available resources and administrative capacity, and cost. Goals and objectives were adopted, and indicators (quantitative and qualitative measures) were established to evaluate how well various management alternatives meet the goals and objectives. The modeling framework provided a quantitative means to evaluating the water quality goals and objectives. Labor and cost estimates provided quantitative means for evaluating plan administration and implementation factors. Additionally, Tetra Tech worked with local governments, resource agencies, and other stakeholders to qualitatively evaluate political and economic feasibility of various options.

This approach – which integrates science, engineering and public participation – makes the decisions on recommended management alternatives accountable to the plan's goals and objectives.

1.3 Carrying Out The Project Phases

Tetra Tech organized the watershed planning tasks into four phases as listed in Table 3 and described in the sections below.

Table 3. Tetra Tech Watershed Plan Development Phases

Watershed Planning Phase	Schedule
1. Project Organization & Preliminary Planning	June 2005 – October 2005
2. Tool Development & Baseline Analysis	November 2005 – March 2006
3. Management Plan Development	April 2006 – November 2006
4. Plan Adoption & Implementation	December 2006 or ASAP thereafter

Phase 1 – Project Organization and Preliminary Planning

Forming Policy and Technical Councils

The purpose of the first phase was to create a strong information foundation upon which to organize and guide the remaining project phases. Tetra Tech assisted CAW in establishing Policy and Technical Advisory Councils as the primary basis for coordinating stakeholder participation. Protocols were developed for council operations and a diverse set of stakeholder and technical organizations

The Policy Advisory Council adopted goals and objectives to guide the Plan.

and institutions were contacted to nominate members or staff to represent them in the councils. Council membership was endorsed by the CAW Board of Commissioners.

Setting Goals and Objectives

Tetra Tech compiled and briefly reviewed existing studies and information to develop a preliminary understanding of watershed and lake conditions, and issues that would need to be addressed by the Watershed Management Plan. Based on the review, watershed management goals and objectives were drafted and subsequently refined and adopted by the Lake Maumelle Watershed Policy Advisory Council (PAC). The goals and objectives (Table 4) are a critical part of the watershed management plan providing the basis for determining what issues need

Table 4. Adopted Lake Maumelle Watershed Management Plan Goals and Objectives

Overarching Goals of the Watershed Management Plan	
- Maintain long-term, abundant supply of high quality drinking water for present needs and continuing growth of the community. - Provide an equitable sharing of costs and benefits for protecting Lake Maumelle.	
Objectives	
Minimize risks to public health from: - toxic spills - pesticide/herbicide runoff - bacteria/pathogens from failing septic/community systems and animal wastes - toxins from blue-green algae	(most important)
Minimize impacts on watershed property owners and residents including: - use restrictions - cost of BMPs	(most/more important)
Minimize water supply taste, odor, and color problems associated with: - algae - iron and manganese - turbidity	(more important)
Minimize impact on the water supply intake and water treatment facility operations such as: - intake/filter clogging - excess chemical additive requirements - increased operation and maintenance (O&M)	(more important)
Minimize rate increases from: - increased treatment cost - increased O&M - land acquisition/buffer easements	(more important)
Minimize loss of reservoir water supply storage capacity from sedimentation.	(important)
Minimize risk of impairment to tributary streams in the watershed for stream and lake protection from: - channel instability (erosion, sedimentation, scour) - pollution from runoff (sediment, nutrients, pesticides/herbicides, pathogens)	(important)
Allow limited recreation that reflects environmentally sound stewardship of the lake for: - fishing - sailing - boating - access (picnicking, hiking, visiting)	(important)
Meet other community values including: - Be economically competitive - Provide a strong tax base for communities in the region and minimize tax increases - Be administratively feasible	(important)

Water quality targets establish "Here's what we want lake conditions to be decades from now."

The Policy Advisory Council endorsed water quality targets for Lake Maumelle which would maintain a high quality drinking water supply.

to be managed and how they should be addressed. As such, they were shared with the public in meetings held in December 2005 for watershed property owners and CAW ratepayers.

Establishing Water Quality Targets

Tetra Tech, with review and comment from the TAC, recommended water quality indicators and associated numeric targets for assessing compliance with the goals and objectives. Recommendations reflected research, federal guidance and regulatory requirements, and discussion with treatment plant operating staff and TAC members. The final targets endorsed by the PAC are shown in Table 5.

Selecting Appropriate Assessment Tools

Tetra Tech completed phase one by working with the Technical Advisory Council (TAC) to select technical methods for studying and evaluating watershed management options in the context of the goals and objectives. The tools needed to be able to predict the quantitative indicators such that they could be compared to the water quality targets under different management scenarios. Based on the time and resources available, and given the primary threats and concerns, it was decided to focus model development and analysis on post-construction impacts. Construction impacts were determined to be of smaller scale, more localized (i.e., depending on where construction was occurring at a point in time), and temporary.

Table 5. Lake Maumelle Water Quality Targets

INDICATOR: Chlorophyll a		
Location: Mid-Lake	Target: 3.5 µg/L summer median	Existing: 2.8 µg/L summer median
Location: Lower Lake	Target: 3.0 µg/L summer median	Existing: 2.8 µg/L summer median
Explanation: Welch and Jacoby (2004), renowned limnologists, indicate that the boundary between oligotrophy and mesotrophy occurs at 3.5 µg/L. To protect the water supply to maintain oligotrophic conditions in the lower lake, it is recommended that a target of 3.5 µg/L chlorophyll a be applied at the mid-lake evaluation point, and that 3.0 µg/L be used as a safety factor at the lower lake evaluation point near the water supply intake. The summer growing season is defined as May through September.		
INDICATOR: Total Organic Carbon (TOC)		
Location: Lower Lake (Intake area)	Target: As close to existing concentrations as possible and not to exceed 3.1 mg/L	Existing: 2.4 mg/L annual median
Explanation: New disinfection byproducts regulations under the Safe Drinking Water Act require that Central Arkansas Water keep its annual running average (calculated quarterly) concentration of TOC under 2 mg/L in the finished drinking water. The CAW treatment system conservatively removes 35 percent of TOC from the raw water intake concentrations. Back-calculating from the finished target to the intake using the 35 percent removal rate produces an approximate target at the intake of 3.1 mg/L. Between August 1999 and January 2006, Arkansas Department of Health quarterly monitoring data indicated raw water concentrations ranged from 1.72 to 3.75 mg/L with a median of 2.65 mg/L. During that time frame, the highest finished water TOC concentration was 1.93 mg/L. Because the existing levels are close to the 3.1 mg/L boundary, the recommended target is to remain as close to existing levels as possible. The model-predicted annual median for existing conditions is 2.4 mg/L at the lower lake evaluation point (January 1997–September 2004 simulation). Since future evaluations will be done using the model, the 2.4 mg/L value will be used as the desired target for scenario performance comparisons.		

Table 5. Lake Maumelle Water Quality Targets (*continued*)

INDICATOR: Turbidity (use modeled Secchi depth as surrogate)		
Location: Lower Lake (Intake area)	Target: ≥ 2.6 m (8.5 ft) annual median Secchi Depth	Existing: 2.8 m (9.2 ft) annual median Secchi Depth
Explanation: The Enhanced Surface Water Treatment Rule requires that turbidity in finished filtered water be ≤ 0.3 nephelometric turbidity units (NTU). The intent of the Enhanced Surface Water Treatment Rule is to reduce the risk of specific microbial pathogens such as <i>Cryptosporidium</i>. Current raw water turbidity ranges from 1 to 5 NTU, with an average of 2.6 NTU over the past 15 years (personal communication, Gary Hum, March 2006, CAW). Increases in turbidity result in increased treatment cost (e.g., estimated increase in alum dosage = 30 percent to treat water with 9 NTU, per Gary Hum) and increased risk of other contaminants. The lake model does not directly estimate turbidity, but does predict Secchi depth which can be used as a surrogate for turbidity. The empirical relationship between Secchi depth and turbidity for the USGS data is relatively strong ($0.77 r^2$). Establishing a target of ≤ 0.2 m Secchi depth reduction in annual median should maintain turbidity levels within 1 NTU of existing levels.		

INDICATOR: Fecal Coliform Bacteria		
Location: Lower Lake (Intake area)	Target: < one order of magnitude increase from existing annual median concentration (interpreted as < 0.065 #/100ml)	Existing: 0.0065 #/100ml annual median
Explanation: The concentrations of fecal coliform bacteria being predicted for the future are not in and of themselves considered to be a threat. However, fecal coliform is being used as a surrogate indicator for the potential increase of other microbial pathogens such as <i>Cryptosporidium</i> and <i>Giardia</i>. These pathogens are likely present in minute amounts under current conditions, but have not been detected in CAW sampling. Health authorities typically examine risk in terms of the orders of magnitude of reduction in pathogen concentration between sources and water supply lines. By keeping the fecal coliform bacteria indicator concentration changes for future scenarios below one order of magnitude (factor of 10), the increase in risk of other microbial pathogens should also be minimized.		

The basic watershed modeling tool selected was the USEPA-supported Hydrologic Simulation Program-FORTRAN (HSPF) model (Bicknell et al., 2001), which provides a representation of hydrology and pollutant load and transport throughout the watershed. HSPF links activities on the land surface to responses in the streams and lake, and addresses hydrologic regime, sediment loading, and nutrient concentration/loading. It also was selected because it can be used to assess the effects of future development and the use of traditional (structural engineering devices) and non-traditional (e.g., conservation planning and low impact development) best management practices (BMPs) on pollutant loading to the lake.

The primary lake modeling tool selected was the U.S. Army Corps of Engineers CE-QUAL-W2 model (Cole and Wells, 2005), which provides a representation of hydrodynamics, mass transport, and chemical-biological interactions in the lake. The CE-QUAL-W2 model represents the lake as a laterally averaged longitudinal-vertical two dimensional system, which means it can allow for water quality differences from upstream to downstream, but cannot account for small scale lateral (side-to-side) transport processes. Several management questions require a more detailed understanding of localized three-dimensional variability in water quality. To support these analyses, a supplemental three-dimensional hydrodynamic model was developed based on the USEPA-supported Environmental Fluid Dynamics Code (EFDC) (Hamrick, 1992) to simulate higher resolution hydrodynamic and

Modeling tools were selected for their ability to quantitatively predict indicators that could be compared to water quality targets under different management scenarios.

transport process in the lake. The two selected lake models together could be used to assess effects of future development on lake water quality (Tetra Tech, 2005).

Phase 2 – Tool Development and Baseline Analysis

Model Development

During the second phase of the project, watershed and lake models were set up using detailed information on physical and hydrologic features. The models were then calibrated and validated using separate multi-year data sets collected by the U.S. Geological Survey (USGS). Model setup, calibration, and validation processes received extensive quality assurance and quality control review, and modeling documentation was provided to members of the TAC for review and comment (Tetra Tech, 2006a).

Other tools to support watershed management planning were also developed during this phase, including cost evaluation tools and a version of Tetra Tech's Site Evaluation Tool (SET) for analyzing the impacts of alternative development designs on pollutant loading from the land.

Baseline Analysis and Findings

The first application of the modeling framework was to conduct the baseline analysis (Tetra Tech, 2006b). The purpose of the baseline analysis was to compare existing conditions to predicted future conditions to guide management plan development. Based on discussions with local planners, engineers, realtors and the TAC, Tetra Tech established two potential future build-out scenarios for the watershed. These build-out scenarios were to represent reasonable projections of worst-case conditions for the Lake. The time horizon for build-out was projected to be approximately 30 years for areas surrounding the Lake, and 50 to 100 years for the rest of the watershed. The main difference between the two build-out scenarios was that one scenario predicted higher housing densities in the eastern portion of the watershed surrounding the lake and closest to the Little Rock metropolitan area. However, the results for both future scenarios were the same as follows:

What happens if no further management action is taken (i.e. we do nothing)?

Although existing conditions in Lake Maumelle are very good, future water quality conditions are not predicted to meet the targets under either build-out scenario.

Excessive levels of sediment, phosphorus and nitrogen, and total organic carbon (TOC) loading from future land use changes and new sources (e.g., new development, livestock) are expected to cause lake conditions to change significantly, potentially threatening public health, water supply facility operations, and recreation (Figure 4).

Without additional management, there is increased risk of disease-causing organisms, such as cryptosporidium oocysts (potentially deadly parasites), living in the water supply and threatening public health (Figure 5).

Increased population and traffic is also expected to increase the risk of spills of toxic substances that could enter the raw water supply and threaten public health, water supply operations, and recreation (Figure 6).

Although existing conditions in Lake Maumelle are very good, future water quality conditions are not predicted to meet the targets under either build-out scenario if no further management action is taken.

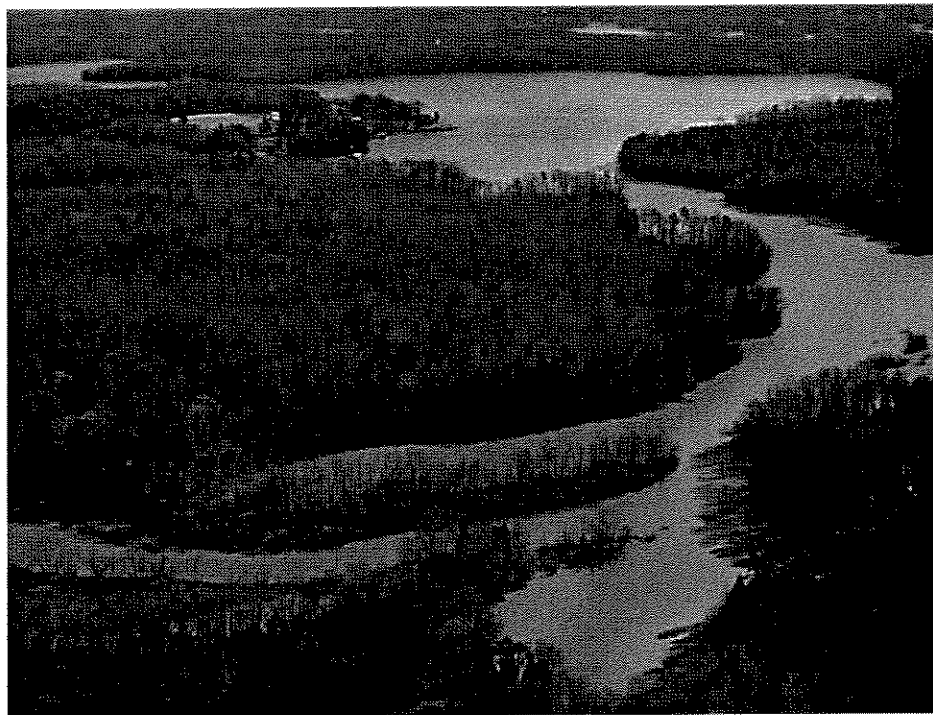


Figure 4. Polluted Runoff from Land Under Development in Another Watershed

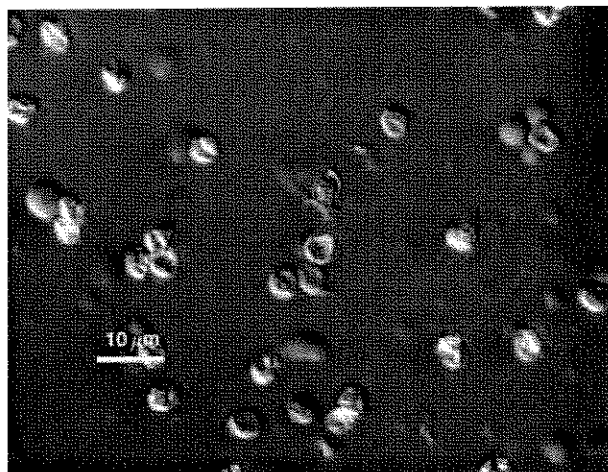


Figure 5. *Cryptosporidium* Oocysts Under the Microscope



Figure 6. Container Truck Accident

Without a new management plan, water quality and public health would be threatened by future excessive levels of sediment, phosphorus, nitrogen, carbon, disease-causing organisms and the increased risk of toxic spills.

The figures on this page represent examples of threats to water quality that this Plan should avoid or mitigate.

How bad would water quality conditions get and what are the biggest threats?

Model predictions indicate that big impacts are likely:

Chlorophyll *a*

Chlorophyll *a* is an indicator of algae. The targets for mid- and lower lake are set to prevent nuisance algae blooms that can emit toxins, foul treatment equipment, and cause taste and odor problems. Expected future conditions under existing management regulations and policies far exceed the established targets (see Figure 7 and Figure 8).

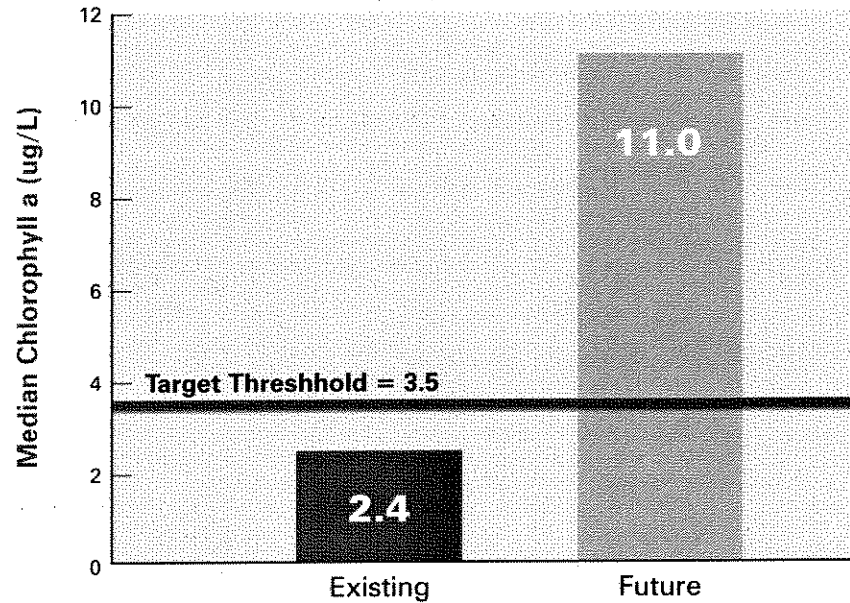


Figure 7. Predicted Chlorophyll *a* at Mid Lake

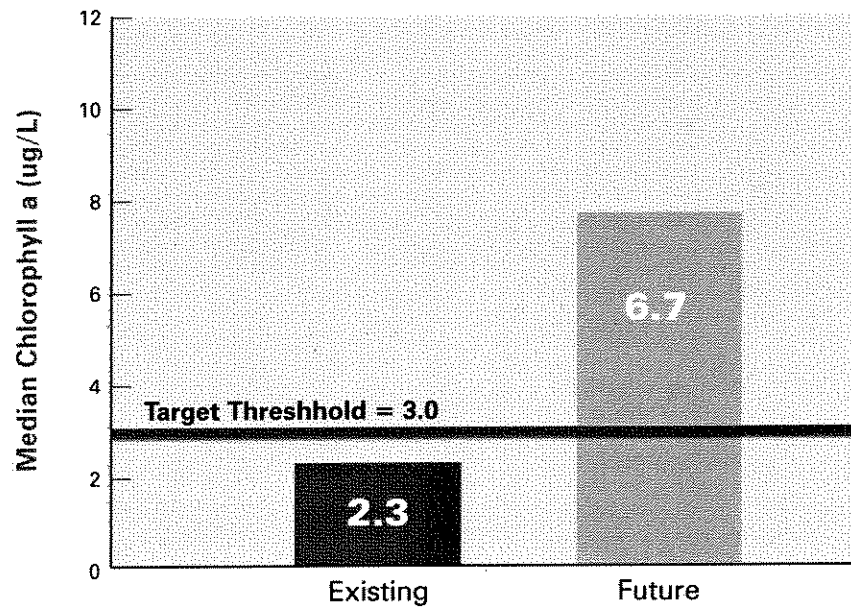


Figure 8. Predicted Chlorophyll *a* at Lower Lake

Total Organic Carbon (TOC)

TOC is an indicator of the concentration of complex organic materials in the watershed derived from both natural and human sources. TOC must be kept below the target threshold in the water supply to prevent disinfection byproducts (toxic and cancer-causing substances) from reaching levels that threaten public health. Existing conditions provide a margin of safety from the threshold level. Future conditions without additional management are expected to exceed the threshold providing a significant threat to public health (Figure 9).

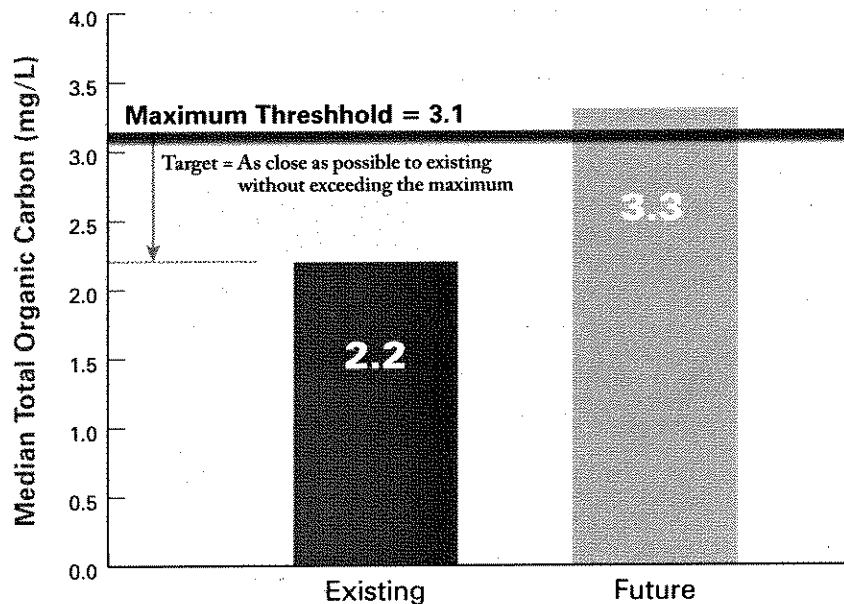


Figure 9. Predicted TOC at Lower Lake

Secchi Depth

Secchi Depth is a measure of water clarity and is closely related to turbidity. If the raw water supply in Lake Maumelle is too turbid (cloudy), it is harder to treat and this condition increases health risks to public water users. EPA requires drinking water suppliers to maintain low turbidity in finished water to ensure adequate removal of disease-causing organisms such as *Giardia*, *Cryptosporidium*, and fecal coliform bacteria. Predicted future conditions do not meet the target, indicating an unacceptable threat to public health (Figure 10).

What needs to be managed to meet the water quality targets?

Based on detailed analysis and discussion with the Technical Advisory Council members, the following areas should receive the greatest attention by the management plan:

- New Development (post construction impacts; wastewater; construction activity impacts, other public health threats)
- Improvement and Maintenance of Existing Roads and Utility Rights-of-Way
- Spill Containment

The management plan should focus on controlling impacts from new development and associated increases in population.

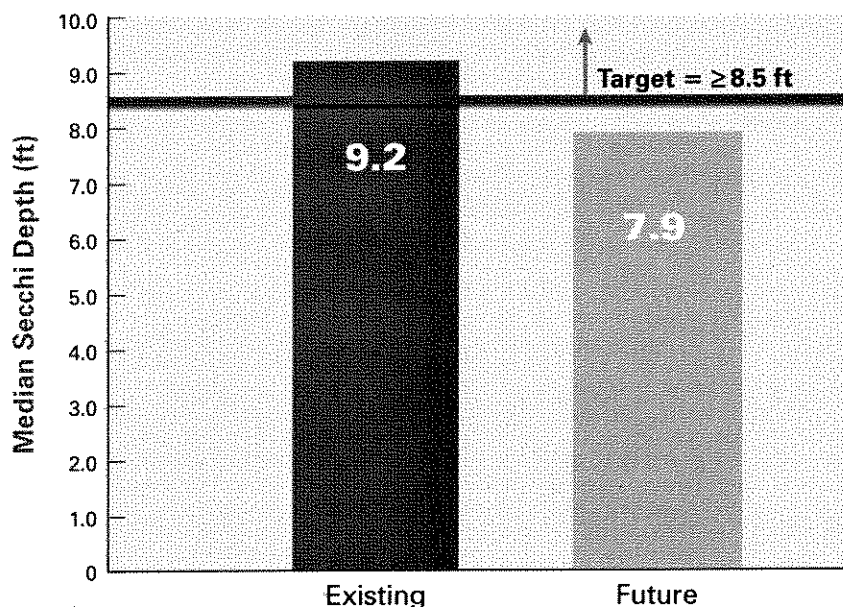


Figure 10. Predicted Median Secchi Depth at Lower Lake

- Forestry Practices
- Livestock Management Practices
- Good Household Practices
- Land Acquisition

Emphasis should be placed on controlling sediment, phosphorus, TOC and pathogen loading from the watershed. The largest potential sources by far are expected from new development and the associated wastewater from those new residents.

Phase 3 – Management Plan Development

Using the results of the baseline analysis, Tetra Tech worked with the TAC and PAC to identify and evaluate the most promising management methods for achieving the water quality targets while simultaneously meeting the other goals and objectives. This involved an iterative approach combining technical analysis with stakeholder review and input. Initial ideas were presented in February 2006 at public meetings held for watershed property owners and CAW ratepayers. Based on public feedback, conceptual ideas were turned into specific management alternatives for detailed evaluation.

Variations under two different management approaches were reviewed and assessed by Tetra Tech using its modeling and assessment tools, with review and comment by the TAC. Results were shared with PAC members and the public at several meetings held in July 2006, and input regarding preferences was obtained. Issues regarding some of the management provisions were discussed extensively with members of the PAC to refine recommendations and address concerns regarding implementation strategies for the proposed management plan. The CAW Board of Commissioners provided input on additional Plan refinements at

Based on the combined technical analysis and stakeholder input, Tetra Tech developed recommendations to meet the adopted goals and objectives.

their December 2006 meeting with Tetra Tech. Based on the combined technical analysis and stakeholder input for the management options under consideration, this Watershed Management Plan was developed to meet the adopted goals and water quality targets.

Phase 4 – Plan Adoption and Implementation

The Central Arkansas Water Board adopted the Watershed Management Plan in February 2007 and began initial implementation steps for the Plan. However, success will require action beyond Plan adoption by Central Arkansas Water. Local governments with jurisdiction of lands in the watershed must support the Plan and help implement it to ensure success.

The recommended Management Plan has many components, some of which require more resources and expertise to administer and carry out than others. An Implementation Strategy for the Plan is scheduled for completion in early Spring 2007. CAW, ratepayers, and other stakeholders should expect that implementation of the Watershed Management Plan will be an ongoing, evolving process for many years to come. The Plan provides recommendations for how CAW, local governments, resource agencies, non-governmental organizations, and other interested parties can work together to coordinate plan implementation and ongoing adaptive management. Such an adaptive approach will provide for long-term protection for Lake Maumelle, allowing for management to be responsive to the dynamics of the watershed.

*An adaptive approach
will provide for long-
term protection for Lake
Maumelle.*

2 PROPOSED MANAGEMENT STRATEGIES—OVERVIEW

2.1 Overarching Strategy for Protecting Lake Maumelle

The Lake Maumelle Watershed Management Plan has many components with an emphasis on managing new sources of pollutant loading throughout the watershed—especially from new development.

Early in the screening of management strategies, members of the Policy Advisory Council and the public stressed that all areas of the watershed should not be treated the same; more sensitive areas and those posing a greater risk to the drinking water supply—such as those closest to the lake and intake, and steeply sloped areas—should have stricter requirements.

Therefore, the overarching strategy for managing new development is to have three management areas: Critical Area A, closest to the intake, would have the most restrictive proposed requirements; Critical Area B, surrounding the lake but with a longer travel time to the lake and intake than Critical Area A, would have less stringent requirements than Critical Area A; the Upper Watershed Area would have the least restrictive requirements (see Figure 11 for the management area boundaries). Travel time to the lake and within-lake to the intake area shaped the boundaries for these areas. Under the conditions in Tetra Tech's modeling analysis, travel time to the intake ranged from 1 to 5 days within Critical Area A, 6 to 29 days in Critical Area B, and 30 to 37 days for the Upper Watershed Area.

Tetra Tech evaluated the total additional pollution that could be loaded into the lake from new development in the future while meeting the lake water quality targets. Based on the overarching strategy of increasing the level of protection as you get closer to the intake, Tetra Tech then developed site-scale pollution allocations for new development in each of the management areas. In other words, these pollution allocations represent the maximum amount of pollution that can run off each acre of new development (see Table 6).

Direct wastewater discharges from new development pose the most serious threat to Lake Maumelle. The watershed and lake analysis showed that if wastewater discharges are allowed, it will be impossible to meet lake water quality targets. The analysis also showed that “nonpoint source loading” or what washes off the rooftops, yards, driveways, streets, etc., requires 100 percent of the allowable load for new development. Therefore, the site-scale allocations shown in Table 6 do not include any allocation for wastewater discharges.

The overarching strategy is to have three management areas with more protective requirements closer to the lake and water supply intake.

Tetra Tech developed pollution caps for new development in each of the management areas.

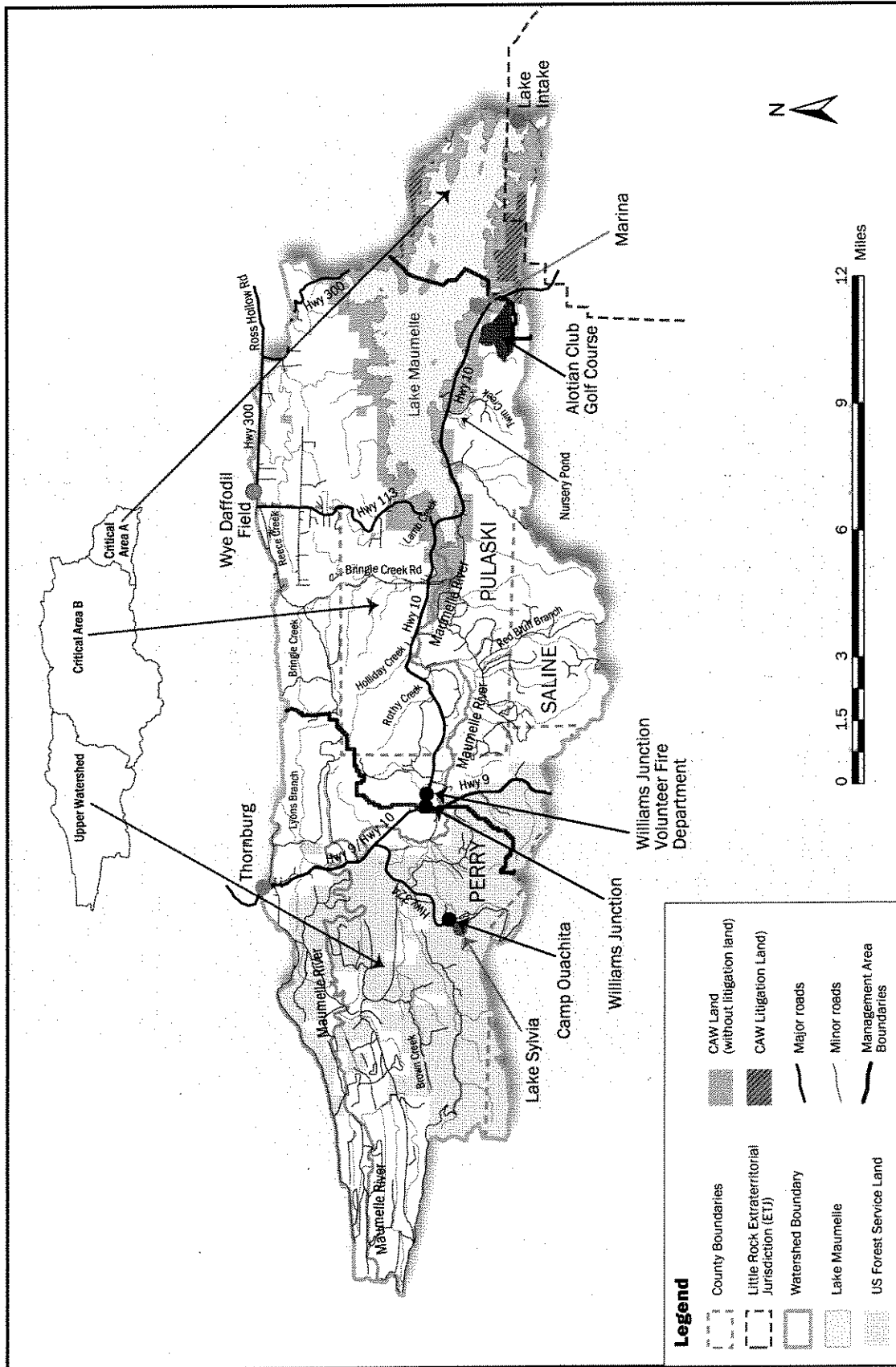


Figure 11. Management Area Boundaries

Table 6. Site-Scale Pollution Allocations for New Development

	Total Phosphorus (lb/ac/yr)	Total Suspended Solids (tons/ac/yr)	Total Organic Carbon (lb/ac/yr)
Critical Area A	0.20	0.080	36
Critical Area B	0.30	0.110	44
UWA	0.33	0.130	50

Tetra Tech then evaluated two approaches for managing new development to meet these onsite allocations: (1) Conservation Design – this approach relies on minimum requirements for open space and lot sizes, capping impervious area, and road surfacing, and (2) Performance Standards – this approach relies on minimum requirements for open space and allows for proven engineering practices to be used to meet caps on pollution runoff (called performance standards). Section 3 discusses what needs to be required under each approach to meet the loading limits and lake water quality targets.

A second feature of the overarching strategy is conserving and managing wisely steeply sloped areas. Because they are more sensitive to disturbance, high sloped areas have more restrictive development requirements than low sloped areas. Low slopes are considered to be those with 0 percent to 15 percent slope; high slope is considered to be 15 percent up to 25 percent slope; very high slope areas with 25 percent slope or greater are recommended for no development (see Figure 12).

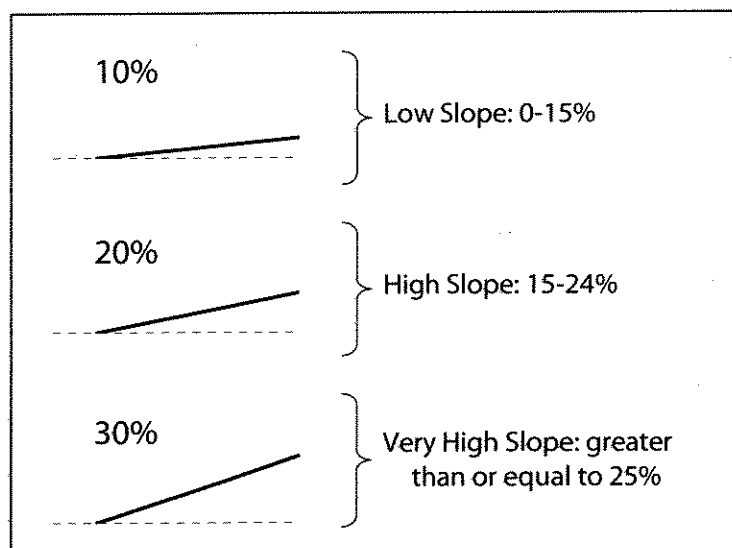


Figure 12. Definitions of Slope

A third feature of the strategy is accountability. It is important to limit the impacts throughout the development process—from land disturbance, to road building, to the creation of new residences and businesses. This Plan shows how to limit impacts to protect the lake through good management practices; importantly, it also recommends new regulations and enforcement mechanisms to require that such practices be used by landowners wishing to develop in the watershed.

A second feature of the overarching strategy is conserving and managing wisely steeply sloped areas.

A third feature of the strategy is accountability—including new regulations and enforcement mechanisms.

A final feature of the strategy is to monitor success and be adaptive.

Successful stewardship will depend on many agencies, community leaders, and landowners.

Recommendation:
CAW hire a Watershed Administrator to review development applications in the watershed, conduct site inspections, and work with local governments on development permit approval.

A fourth feature of the overarching strategy is to manage impacts not just from new development, but from other existing and potential sources of pollution, including forestry practices, lake recreation, livestock, and household chemicals. As shown in Section 2.2, there is much work to do, and sustained stewardship will require leadership and cooperation from many.

A final feature of the strategy is to monitor success and be adaptive. This Plan outlines a vision for the long-term, but also recommends actions and strategies for the short-term. An oversight body—a Watershed Stewardship Council—is recommended to provide for sustained coordination among the key stakeholders, to monitor success, and to adapt the Plan and ordinances as needed.

2.2 Key New Actions Recommended

Many existing watershed residents have been and continue to be good stewards of the land draining to Lake Maumelle by keeping much of their land in undisturbed forest and by using sustainable management practices. The major commercial forestry operations, Deltic and Weyerhaeuser, are participating in the Sustainable Forestry Initiative and the USFS uses good forest management practices. Central Arkansas Water has worked with the Marina and Sailing Club to use good stewardship practices. Sections 3-12 of this plan describe the many good stewardship practices already being used—and their *continued* use is strongly encouraged.

Tetra Tech has found where existing practices can and should be strengthened. Table 7 provides a snapshot of the *key new actions* recommended in Sections 3-12 of this Management Plan. It also shows who should take the lead in carrying out these new actions, and who needs to assist. As can be seen, there is much work to do, and successful stewardship will depend on many agencies, community leaders, and landowners.

2.3 Administration and Oversight

Regulatory Oversight

Key new actions recommended include adoption and administration of new local sedimentation and erosion control ordinances and new watershed protection ordinances. As a way to “start up” administration and oversight in the short term, this Plan recommends that CAW hire a Watershed Administrator to review development applications in the watershed and to conduct site inspections of new construction and building. Alternatively, CAW could contract with a local firm to provide these services. Having one Watershed Administrator would be more efficient and cost-effective than each local government hiring a staff person. This would provide one contact person to whom landowners and local governments could turn. This Plan recommends that, if possible, the Watershed Administrator have an office in the watershed where a portion of his or her time would be spent.

The Watershed Administrator (or contractor staff) would coordinate with the existing local government staff. The local staff would notify the Watershed Administrator that an applicant is interested in submitting an application for land disturbance and land development in the watershed. The Watershed Administrator would begin working with the applicant to review what is required; to review preliminary plans and final plans; and to make recommendations to the local planning commission. The Administrator would work with the existing local staff

Section 2 Proposed Management Strategies—Overview

Table 7. Key New Actions Recommended – Who Needs to be Involved (L = Leader; A = Assisting)

Key Actions	CAW	Local Governments	Stewardship Council	Metroplan	ADEQ/ADH	RME	USFS*/AFC	Bass and Sailing Clubs	Ag. Extension	Conservation Districts	Landowners	Land Trust	DOT	Utilities	USGS	UALR
Provide Coordination Oversight																
Form Stewardship Council	L	L		A												
Hire Stewardship Coordinator	A		L	L												
Manage Post-Construction Impacts																
Adopt Local Watershed Ordinances		L	A	A												
Hire Watershed Administrator to Enforce Ordinance	L	A														
Develop Landowners' Manual for Planning Development	A	A	A	A						L	A					
Develop Stewardship Plan for Open Space	L		L				A					A				
Request Preferential Tax Assessment for Conservation Easements	L	L	L	A						A	A	A				
Build Capacity for Performance Approach	A		A								L					A
- Conduct pilot projects	L															A
- Perform supplemental modeling studies	A	L	A								A					A
- Develop design manual	A	L	L													
- Create development review, inspection operation procedures	A	L														
- Train reviewers, inspectors	L	L														
- Hire/train staff as needed																
Manage Wastewater Impacts																
Prohibit Discharging Systems	A	A	A		L											
Form RME	A	L	A													
Use Non-discharging Systems		L			A	L					A					
Manage, Operate, and Own Non-discharging Systems						L					A					
Manage Construction Impacts																
Adopt Local Sedimentation and Erosion Ordinances		L	A	A	A					A						
Hire Watershed Administrator to Enforce Ordinances	L	A														
Develop Sedimentation and Erosion Control Manual	L	L	A							A						
Abate Public Health Threats																
Monitor Activities and Conditions in Watershed	L	L	L		A	A		A			A			A		
Monitor Proposed New Uses in the Watershed	L	L	L	A	A	A					A					
Improve and Maintain Existing Roads and Utility Rights-of-Way																
Develop Strategic Plan for Improving Roads and Utility Rights-of-Way in the Watershed	A	A	L				A				A		A	A		
Mitigate Hazardous Material Spills																
Monitor proposed new uses in the watershed	L	L	L	A	A	A					A					
Develop Strategic Plan for mitigating risks from transportation sources	A	L	L	L									A			
Maintain Good Forest Practices																
Encourage Better Use of Road BMPs	A		L	A			L				A					

Lake Maumelle Watershed Management Plan

Table 7. Key New Actions Recommended – Who Needs to be Involved (L = Leader; A = Assisting) (continued)

Key Actions	CAW	Local Governments	Stewardship Council	Metroplan	ADEQ/ADH	RME	USFS*/AFC	Bass and Sailing Clubs	Ag. Extension	Conservation Districts	Landowners	Land Trust	DOT	Utilities	USGS	UALR
Develop Enhanced Fire Management Plan	A		L				L				A					
Continue Good Lake Management Practices																
Improve Solid Waste Management	L							A								
Improve Hazardous Waste Management	L							A								
Encourage Good Livestock Management																
Reach Out to Existing and New Residents	A		L						L	A	A					
Explore CAW Cost-sharing for BMP Practices	L		A						A		A					
Encourage Citizen Stewardship																
Request Preferential Tax Assessment for Conservation Easements	L	L	L	A						A	A	A				
Develop Stewardship Plan for Open Space	L		A								A	A				
Develop Landowners Manual for Planning Development	A	A	A	A						L	A					
Educate on the Use of Good Household Practices	A		L							A	A					
CAW – Setting the Example																
Enhance Management of CAW Property	L							A				A		A		
Support Implementation of the Plan	L	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Land Acquisition																
CAW to Acquire 1,500 acres of Conservation Land	L										A					
Develop Stewardship Plan for Open Space	L		A								A	A				
Monitor Success																
Enhance Long-term Watershed and Lake Monitoring Program	L		L		A										A	A
Develop Overall Assessment Program Including Stewardship Report	A		L	A	A										A	A

*For national forest lands

Recommendation:

For consideration of appeals and variances to local ordinances, local governments should appoint a Watershed Review Board, staffed by the Watershed Administrator.

to schedule agenda items for the local planning commissions as needed. Planning commissions from each individual jurisdiction would review and make decisions on the development applications in the watershed.

This Plan recommends that the Watershed Administrator be housed by CAW and paid for by CAW ratepayers. Alternatively, the contractor staff would be paid for by CAW ratepayers.

In the short-term, it is recommended that local governments begin discussing possible ways to coordinate on development review, including the possibility of forming a joint planning commission for the purpose of reviewing development proposals in the Lake Maumelle Watershed, or a regional planning commission for Lake Maumelle Watershed (at Metroplan). Both of these types of commissions could be formed through interlocal agreement.

For consideration of appeals and variances to the local ordinances, local governments should appoint a Watershed Review Board. The Watershed Administrator would be staff to this Board. It is recommended that the Watershed Review Board include technical expertise and landowner representation.

Finally, for regulatory oversight of wastewater management, this Plan recommends that local governments establish or identify a “Responsible Management Entity” (RME) to own, operate, and maintain all new wastewater systems in the watershed. The RME could be an existing entity such as Little Rock Wastewater, or could be a new entity such as a sanitation district.

For regulatory oversight in the longer-term, the PAC has expressed interest in exploring creation of a regional watershed authority—or body that would provide unity and consistency in managing and enforcing the Lake Maumelle Watershed Management Plan. State enabling legislation would be required for such an authority with regulatory, administrative, and enforcement powers.

The PAC stressed that it is critical for *all local governments in the watershed* to:

- Be part of this exploration and discussion.
- Help determine the need for and feasibility of such an authority.
- Help design the authority structure, if created.
- Be governing members of the authority.

Finally, PAC members stressed that this exploration will take time, and that it is critical to take the time needed—all local governments working together—to establish the required support for a watershed management authority.

Non-Regulatory Oversight

The stewardship and management of the Lake Maumelle Watershed depends on the collective efforts of citizens, businesses, and governmental agencies. A Watershed Stewardship Council is recommended as a way to establish and support a strong partnership among those organizations which have significant authority or resources for managing the watershed. It is also intended to ensure meaningful public participation in the decision-making process.

Watershed management should be adaptive—a living process that responds to changing conditions, needs, and information. Instituting a Watershed Stewardship Council establishes an approach that can adapt to changing needs and will allow current and future challenges to be met in ways that are environmentally sound and fiscally responsible. It is an approach in which all stakeholders pool and coordinate their technical and financial resources to achieve water supply protection goals.

Potential goals this council could address include:

Monitor and Update Watershed Priorities

The Council must monitor water quality trends and watershed activities. Based on this information the Council should update management priorities and management strategies as needed.

Meet Localized Needs in Addition to Watershed-Wide Objectives

The Watershed Stewardship Council partners must recognize that the collective communities in the watershed have their own unique character and

Recommendation:

Form a Watershed Stewardship Council to establish strong partnerships and ensure meaningful public participation.

Instituting a Watershed Stewardship Council establishes an approach that can adapt to changing needs and allow current and future challenges to be met in ways that are environmentally sound and fiscally responsible.

This Plan recommends that the Watershed Stewardship Council include multiple coordinating forums to support stakeholder involvement.

resource concerns. At the same time, they must also recognize that they are part of a larger region—the Lake Maumelle Watershed. The Council must address local geographic issues and help meet watershed-wide objectives.

Build a Strong Watershed Management Partnership

Natural processes and human activities will change over time. Resource needs will change and will, at times, be in conflict. The Watershed Stewardship Council partners must provide a forum to bring together multiple interests, perspectives, and disciplines to reach agreement on how to best balance multiple objectives over time.

Improve the Information Base for Decision Making

An improved information base will require providing coordinated, targeted monitoring and systematic data management. In addition, the information should be presented clearly and effectively to citizens and decision makers.

Achieve Long-Term Sustainability

A key factor of the management approach must be long-term sustainability of watershed management, the regional economy and the watershed partnership.

Produce Rational and Achievable Management Strategies

The Watershed Stewardship Council must continually help create management strategies that are rational, consistent, efficient and realistic.

The Council could include multiple forums to support stakeholder involvement. For the purposes of the Watershed Stewardship Council, the term stakeholder covers a broad range of people and organizations, which can be grouped into two general categories:

- **government** – city, county, regional, state, and federal government agencies.
- **the public** – individual residents and landowners; schools; commercial and industrial establishments; agricultural, mining, and forestry operations; utilities; environmental, consumer, and community groups.

This Plan recommends that the Watershed Stewardship Council include multiple coordinating forums to support stakeholder involvement, providing an opportunity for everyone to participate according to the level of effort they want to contribute, and providing a known place to “plug in.”

Watershed Stewardship Council. The purpose of the Watershed Stewardship Council is to coordinate on policy and on resource allocations, to provide sustained leadership, to ensure that the partnership is strong, and that management is updated as needed. Members will brief and solicit input and action from their respective boards. This group should comprise lead staff and officials from partners that have significant authority and/or resources to manage the Lake Maumelle Watershed.

Management Tracking Committee. The purpose of the Management Tracking Committee is to track progress in implementation of the management plan, as well as assist in tracking water quality trends and watershed activities, and in developing a biennial Stewardship Report for the Watershed Stewardship Council. This Committee would include public, private, and nonprofit group representatives that are willing to assist in these watershed management tracking activities. Examples include the University of Arkansas at Little Rock, U.S.G.S.

Section 2 Proposed Management Strategies—Overview

Citizens to Protect Lake Maumelle, League of Women Voters, Chamber of Commerce, environmental groups such as Sierra Club and Audubon, Grande Maumelle Sailing Club, and Maumelle Bass Club.

Technical Advisory Committee. The TAC should include staff representatives from governmental agencies and select non-governmental organizations with technical expertise working on water resource management issues in the Lake Maumelle Watershed. The purpose of the Committee is to help carry out the activities of the Watershed Management Plan and to report recommendations to the Watershed Stewardship Council.

The Watershed Stewardship Council would not have regulatory authority. Rather, it would be a non-profit organization allowing interested parties to work together, carry out mutually beneficial projects, track progress, and make recommendations as needed.

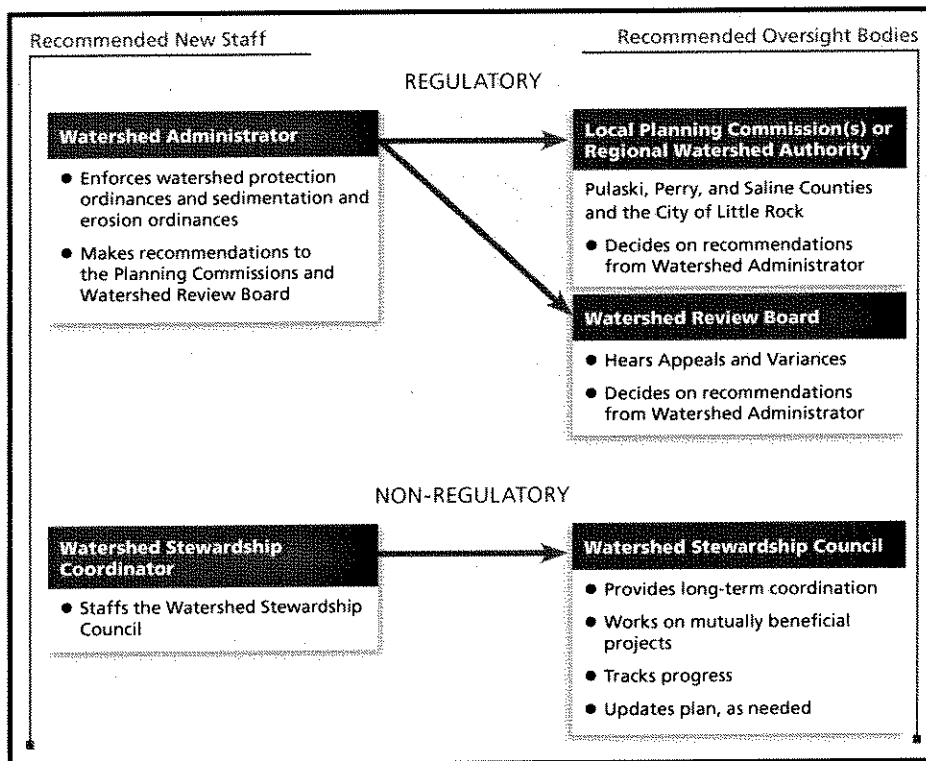
As a start-up for the Council, it is recommended that Central Arkansas Water provide funding to hire a Watershed Stewardship Coordinator who would support the work of the Council. Administrative offices and the Stewardship Coordinator could be housed at Metroplan. In the future, the work and staff of the Council could be partially funded through CAW ratepayers, grants and through contributions of its members.

Table 8 shows the Recommended Oversight Structure for the Plan. Two new staff are recommended: (1) a Watershed Administrator who enforces the local ordinances working with the planning commission(s) and Watershed Review Board, and (2) a Watershed Stewardship Coordinator who provides staff support

Recommendation:

CAW should provide funding for a Watershed Stewardship Coordinator to support the work of the Council

Table 8. Recommended Oversight Structure for the Plan



to the Watershed Stewardship Council in coordinating the long-term watershed management.

Key Short-term Implementation Actions for Administration and Oversight

Landowners may soon begin to request that CAW review development proposals and enter into a development agreement to implement the watershed management plan recommendations. Following are the key initial implementation steps that CAW needs to take in order to be able to review development proposals in the Lake Maumelle Watershed in the near term (e.g., development proposals submitted within the next 2 years) and to administer their provisions.

1. *Hire Watershed Administrator and Develop Procedures for Plan Review and Inspections.*
Timeline: March 2007 – December 2007.
2. *Develop model Erosion and Sedimentation Control Manual.*
Timeline: May 2007 – December 2007.

Following are key initial steps for general implementation of the watershed management plan. These constitute high priority actions for 2007.

1. *Complete Implementation Strategy.* Timeline: Draft by April 2007.
2. *Hire Watershed Administrator and Develop Procedures for Plan Review and Inspections.* Timeline: March – December 2007.
3. *Hire Stewardship Coordinator.* Timeline: March 2007 – June 2007.
4. *Form Stewardship Council.* Timeline: May 2007 – July 2007.
5. *Develop model watershed protection ordinance for local governments' consideration.* Timeline: February 2007 – July 2007.
6. *Develop model sedimentation and erosion control ordinance for local governments' consideration.* Timeline: February 2007 – July 2007.
7. *Develop model Erosion and Sedimentation Control Manual.*
Timeline: May 2007 – December 2007.
8. *Pursue wastewater discharge prohibition with ADEQ.*
Timeline: June – December 2007.
9. *Form Responsible Management Entity (RME) for new wastewater systems in the watershed.* Timeline: April 2007 – December 2008.
10. *Explore formation of Joint Planning Commission and/or Watershed Management Authority.* Timeline: July 2007 – December 2008.
11. *Develop Landowners' Manual for Planning Development.*
Timeline: July 2007 – December 2007.
12. *Develop strategic plan for mitigating hazardous material spill risks from transportation sources.* Timeline: January 2008 – tbd.
13. *Monitor Proposed New Uses in the Watershed.* Timeline: ongoing.

RECOMMENDED NEW REGULATIONS

- 3.1 Manage Post-construction Impacts
- 3.2 Development Agreements
- 3.3 Provide Exemptions to the Watershed Plan Requirements
- 3.4 Manage Wastewater Impacts
- 3.5 Control Sedimentation and Erosion During Construction Phase
- 3.6 Develop Design Guidelines and Maintenance Requirements for New Roads, Streets, and Driveways
- 3.7 Abate Public Health Threats

3 MANAGE IMPACTS FROM NEW DEVELOPMENT

Ninety-seven percent of the land in the Lake Maumelle Watershed is currently forest land or meadowland and undeveloped. Many landowners and residents have been good stewards of this land for generations—supporting the existing high quality of the lake.

Now there is a growing demand for new houses and roads in the watershed. As the land is converted from forest to residential development, the lake could be severely degraded if actions are not taken to require that good stewardship practices be followed during and after development. The following sections describe what is required to limit and manage the impacts from new development, including:

- Post-construction impacts (from residential and non-residential development).
- Wastewater impacts.
- Construction activity impacts (sedimentation and erosion).
- Roads and streets impacts (from improper design and maintenance).
- Other conditions posing public health threats.

3.1 Manage Post-construction Impacts

This section outlines the requirements for new development to manage post-construction impacts—essentially what is washing off the land, asphalt, and rooftops after construction has been completed and the land stabilized. The section is divided by Upper Watershed Area and Critical Area B which have similar requirements, then covers Critical Area A and decisions made by the CAW Board of Commissioners due to its sensitivity and proximity to the water supply intake. For each of these sections, the Plan discusses the Conservation Design Approach and the Performance Standards Approach, including what is required for each.

Before covering proposed requirements for managing post-construction impacts, it is important to define some key terms used and proposed general policies:

Impervious Area: Roads, streets, and driveways with paving or gravel material; houses, patios, outbuildings, and recreation facilities such as tennis courts that do not allow rain to infiltrate into the ground.

Undisturbed Open Space: Vegetated area that is left undisturbed during construction, and remains in natural vegetation. The Open Space location must be recorded at the Register of Deeds Office as “Undisturbed Open Space.” Future disturbance is prohibited except for the management activities and uses outlined in the following pages. If a development parcel was disturbed prior to development,

As land in the watershed is converted from forest to residential development, the lake could be severely degraded if good stewardship practices are not required during and after development.

Recommendation:

CAW and the Stewardship Council work with the legislature to allow local preferential tax assessment for land placed under conservation easement.

e.g., clear cut, graded, etc., and the required amount of vegetated area is not present onsite, then the required vegetated area would have to be reforested prior to development approval.

The undisturbed open space could be retained within private lots or may become common open space for the enjoyment of the development's future residents. Alternatively, the land or conservation easement on the land may be given to CAW or a land trust (such as the Trust for Public Lands) for ownership and management.

If a conservation easement is placed on undisturbed open space as part of a new development in the watershed or on any land in the watershed, the landowners may receive federal and state tax benefits. Some states also allow local governments to provide local preferential tax assessment for land placed under conservation easements (similar to preferential tax assignment for agriculture and forestry). At this time, the state of Arkansas tax code does not provide for such an allowance. This Plan recommends that CAW and the Stewardship Council work with the legislature to allow local preferential tax assessment for land placed under conservation easements.

Steep Slopes: Because their development impacts are greater, high sloped areas have more restrictive development requirements than low sloped areas. Low slopes are considered to be those with 0 percent to 15 percent slope; high slope is considered to be 15 percent up to 25 percent slope. Very high sloped areas, with 25 percent slope or greater, are considered "undevelopable" (i.e., recommended for no development). In its watershed analysis, Tetra Tech subtracted out the

Proposed Policy for Managing Undisturbed Open Space in the Watershed

Developers should be required to write Homeowners Agreements deed restrictions that specify how the open space will be managed. These restrictions would be approved by the Watershed Administrator. The following management activities could be allowed in the undisturbed open space:

- Thinning and brush removal using equipment that does not compact soil or damage tree roots. For example, bulldozers should not be used, but handheld equipment and small tractors equipped with a bush hog could be used.
- Prescribed burning conducted by forestry professionals according to Arkansas Forestry Commission guidelines and consistent with stewardship of the lake water quality. See Section 6 – Enhanced Fire Management Plan.
- Establishment of native understory grasses and other herbaceous species.
- Planting of annual rye grass where bare soil is exposed.

Management activities should focus on maintaining a diverse cover of trees that includes hardwoods. Thinning, brush removal, or prescribed burning could be allowed every three to five years.

The planting of vegetation may not be necessary since soils should contain substantial seed banks. Soil should be tested, and the county extension agent should be consulted for recommendations on encouraging establishment of grass and other herbaceous species.

Proposed Policy for the Uses of Undisturbed Open Space in New Development

Following are uses compatible with stewardship of the lake and maintaining the integrity of the water quality functions of the natural area and should be allowed in the dedicated open space areas:

- Hiking or walking trails
- Fishing
- Birding
- Hunting (as posted)
- Education

Other uses that maintain the integrity of the natural area, such as drip irrigation for non-discharging wastewater systems, may also be allowed. All Terrain Vehicle (ATV) use should not be allowed in the undisturbed open space.

undevelopable areas, including very steep slopes, and then applied new development requirements to developable land. In implementing the plan, the *minimum* undisturbed open space requirements should apply to the developable land to the maximum extent practicable.

Where very steep slopes constitute a large portion of a tract and an undue burden is caused the landowner, the applicant should request that some or all of the very steep slope area to be included in the minimum undisturbed open space. Note that only 10 percent of the privately owned developable land is in very steep slopes. A majority of that land is in a large tract in a remote area of the watershed in Saline County. If the Saline County area considered undevelopable due to steep slopes is subtracted, the remaining area with slopes greater than or equal to 25 percent represents only 6 percent of the privately owned land in the watershed. Generally, there should not be a problem adding this on to the minimum undisturbed open space requirements. The Watershed Administrator and the Planning Commission should consider such requests on a case-by-case basis, and allow the very steep slope areas to be used in the calculations to prevent undue hardship.

Proposed Policy for Identifying Undisturbed Open Space in New Development

Minimum undisturbed open space requirements are the *minimum* requirements; to the extent that the tract has slopes greater than or equal to 25 percent, the minimum open space requirements should be increased to the maximum extent practicable. In those cases where adding all of the very steep slopes to the undisturbed open space constitutes a very large portion of the development tract, renders the tract undevelopable, and/or causes an undue burden on the landowner, the Watershed Administrator and Planning Commission should allow the very steep slope areas to be used as part of the undisturbed area requirement.

Following is the general process for identifying the amount of area to preserve as undisturbed open space for a given tract of land:

1. Determine the area of land on the tract for each slope category: low slope (≤ 15 percent); high slope (> 15 percent and ≤ 25 percent); very high slope (> 25 percent).
2. Multiply the area for low sloped land by its undisturbed open space requirement (30 percent in Critical Area B or 15 percent in the Upper Watershed Area).
3. Multiply the area for high sloped land by its undisturbed open space requirement (50 percent in Critical Area B or 30 percent in the Upper Watershed Area).
4. Add the products of steps 2 (low sloped undisturbed open space area) and 3 (high sloped undisturbed open space area) to the area of land in very high slope. This is the amount of required undisturbed open space land for the tract.

[Note: If the area in very steep land constitutes a large portion of the tract, the landowner may request that a portion or all of the very steep slope area be counted in the minimum undisturbed open space. The Watershed Administrator would review the request and make a recommendation to the local planning commission or CAW Board of Commissioners for a final decision depending on whether the development falls under an ordinance jurisdiction or development agreement.]

The Watershed Stewardship Council and Watershed Administrator should track the extent to which developers are including very steep slope areas in the minimum undisturbed area requirement. If it appears that very steep slopes are not separated out "to the maximum extent practicable," (i.e., that this policy is being abused), then the Stewardship Council should seek an amendment to the Watershed Plan. Such an amendment could include a revision of the performance standards/pollution caps, a revision of the minimum undisturbed open space requirements, creation of a variance procedure regarding very steep slopes, or CAW acquisition of additional conservation area.

Local Watershed Protection Ordinances

A key action in implementing this Watershed Management Plan is local governments' adoption of watershed protection ordinances. This is what turns the recommendations for managing new development into actual requirements and laws that must be adhered to. While the ordinances must stipulate design requirements that the Plan identified as meeting the pollutant loading limits, just as importantly, the ordinances must stipulate meaningful remedies and penalties for non-compliance and must be backed by a watershed management program that includes frequent inspections during the development phases and strong enforcement actions.

This Plan recommends that local ordinance's remedies for non-compliance include but not be limited to:

- Withholding of Certificate of Occupancy.
- Disapproval of Subsequent Permits and Development Approvals.
- Threat of Stop Work Order and issuance of a Stop Work Order.
- Injunction.

Section 3 Manage Impacts from New Development—Recommended New Regulations

- Civil Penalties of \$5,000 per day (with each day of non-compliance begin a separate violation).
- Criminal Penalties.
- Restoration of areas affected by failure to comply.
- Correction as Public Health Nuisance, Cost as Lien.

Sections of 3.1 through 3.4 of this Plan describe what should be required as a part of watershed protection ordinances enacted by local governments in the watershed and as a part of development agreements between landowners and CAW as they relate to managing new development.

Section 3.5 describes what should be required as a part of a sedimentation and erosion control ordinance enacted by local governments. Similar sedimentation and erosion control activities should also be part of any development agreement.

Upper Watershed Area and Critical Area B

Conservation Design Approach

This Plan recommends that local governments adopt watershed protection ordinances or amend their existing subdivision ordinances to allow large lots and cluster designs. The requirements for the large lot and cluster development options are shown in Table 9. It is recommended that the ordinances including the requirements be adopted by December 2008.

Parcels greater than or equal to 5 acres could develop under the requirements for the Upper Watershed Area and Critical Area B. Figure 13 and Figure 14 show example developments for a 100-acre parcel using the fixed large lot and cluster design. These are examples for illustration only.

All of the options for the Upper Watershed Area and Critical Area B meet the site-scale pollution caps and the lake water quality targets. At a minimum, they require 5-acre lots on the low slope areas and 10-acre lots on the high slope areas. A cluster design option is recommended which allows the lot size to vary, but overall the average lot size must remain 5 acres on low slopes and 10 acres on high slopes, when averaging in the undisturbed open space. The cluster design option generally allows less impervious area because less road and street area is needed to serve the same number of houses. The cluster design also does a better job of meeting the pollution caps than the fixed large lot design because of the reduced impervious area and increased amount of undisturbed area.

If the state prohibits direct discharges of wastewater (see Section 3.3), Tetra Tech recommends that both options be allowed in the ordinances without condition.

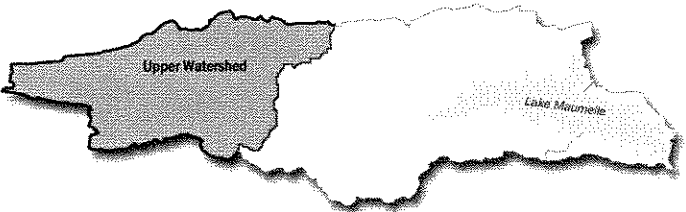
If the state does not prohibit direct discharges, this Plan recommends that the local ordinances allow the cluster option only under the condition that non-discharging wastewater systems are used. This is due to the fact that the cluster design option which allows smaller lots might encourage the use of package treatment plants that have direct wastewater discharges; therefore, the local ordinance would need to condition the use of the cluster design upon the use of non-discharging systems. The fixed large lot options, with minimum lot sizes of 5 acres and 10 acres for the low and high sloped areas, should have sufficient size to locate a non-discharging system such as a septic tank or capping fill system.

A Conservation Design approach manages new development through minimum requirements for open space and lot sizes, capping impervious area, and road surfacing.

Recommendation:
Local governments adopt watershed protection ordinances by December 2008 to allow large lot and cluster designs.

Lake Maumelle Watershed Management Plan

Table 9. Fixed Large Lot and Cluster Options

Upper Watershed Area					
					
1	2	3	4	5	6
Average Lot Slope	Minimum Road Surface	Minimum Driveway Surface	Minimum Undisturbed Area	Maximum % Imperv.	Minimum Lot Size (ac)
Low Slope					
Large Lot					
Low	Paved	Gravel	15%	8.25%	5
Cluster Development Option					
Low	Paved	Paved	15%	7.50%	5 (avg.)
High Slope					
Large Lot					
High	Paved	Gravel	30%	4.25%	10
Cluster Development Option					
High	Paved	Paved	30%	4.25%	10 (avg.)

Critical Area B					
					
1	2	3	4	5	6
Average Lot Slope	Minimum Road Surface	Minimum Driveway Surface	Minimum Undisturbed Area	Maximum % Imperv.	Minimum Lot Size (ac)
Low Slope					
Large Lot					
Low	Paved	Gravel	30%	8.00%	5
Cluster Development Option					
Low	Paved	Paved	30%	7.50%	5 (avg.)
High Slope					
Large Lot					
High	Paved	Gravel	50%	4.25%	10
Cluster Development Option					
High	Paved	Paved	50%	4.00%	10 (avg.)

Section 3 Manage Impacts from New Development—Recommended New Regulations

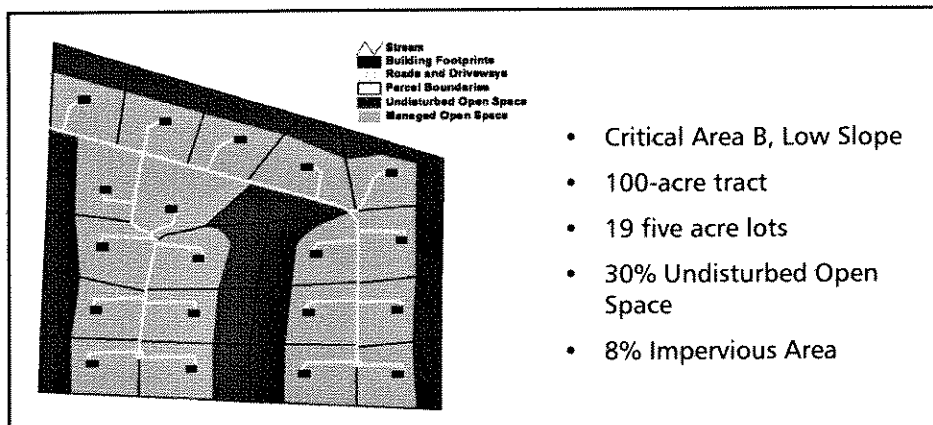


Figure 13. Fixed Large Lot Example

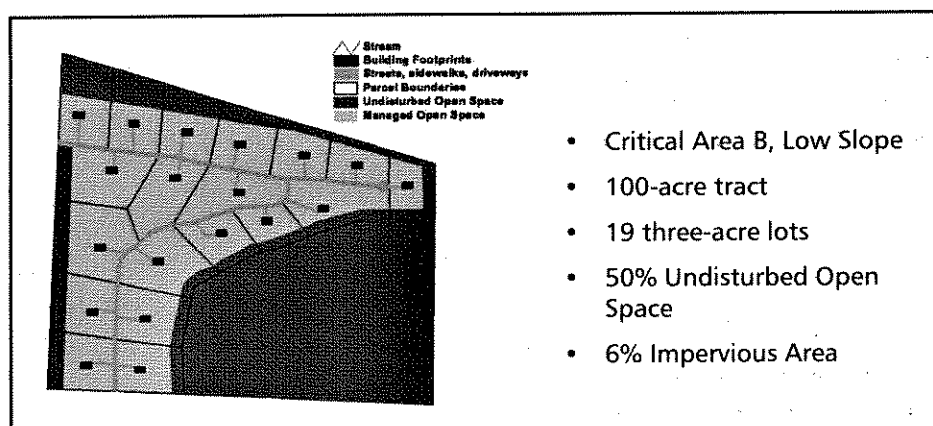


Figure 14. Cluster Design Example

Table 10 lists the options for new commercial and other non-residential development in the Upper Watershed Area and Critical Area B. Because there is no minimum lot size, Tetra Tech developed an undisturbed area to impervious area ratio that can be used to ensure that the pollution caps are met. Essentially, this ratio is the amount of undisturbed area required to offset total impervious area, which includes building sidewalks, patios, parking areas and any other impervious surfaces.

One might expect the Upper Watershed Area ratios to be lower than Critical Area B, given the more lenient pollution caps. However, the Upper Watershed Area has somewhat higher loading rates than Critical Area B, due mainly to

All of the options meet pollution caps and lake water quality targets.

Table 10. New Commercial and Non-Residential Options

Zone	Undisturbed Area to Impervious Area Ratio
Upper Watershed Area	
Low Slope	8.0
High Slope	10.2
Critical Area B	
Low Slope	7.9
High Slope	9.7

A Performance Standards approach manages new development through minimum requirements for open space and use of proven engineering practices to meet caps on pollution runoff (called performance standards).

Recommendation:
Before a Performance Standards approach can be used, pilot studies must be performed to prove effectiveness of BMPs during the post-construction phase of development on representative soils and slopes.

higher annual average rainfall. These differences in loading rates are magnified in the commercial analysis due to the high proportion of impervious surface, making the results comparable between the two zones.

When CAW and landowners wish to enter into a development agreement, CAW staff may use the Menu of Development Options found in Appendix A. The development agreement should stipulate no direct discharge of wastewater.

This Plan recommends these requirements for the Conservation Design Approach in the Upper Watershed Area and Critical Area B for the following reasons:

- The ordinance would be simple to understand for an average citizen/landowner.
- The ordinance would be feasible for local government staff to administer.
- The approach provides flexibility to the landowner, including the large lot development patterns seen historically in the watershed, and the cluster development option which reflects new development patterns seen in more recent development elsewhere.
- It allows the cluster development option which can provide more environmentally sound development design by avoiding sensitive areas, having less impervious area, and generating less pollutant loading.
- Requirements for paving roads and driveways not only reduces the sediment loading, but also cuts the long-term cost to the landowner. The study found that the upfront cost for paving is up to 4% higher than that of using gravel. However the long-term maintenance cost for paving is much lower – resulting in lower overall cost to the landowner.
- The requirements would help discourage the use of discharging wastewater systems. If the state does not implement a ban on direct discharges in the watershed, these options would provide more security on wastewater management and loading.
- The Menu—is more complex but allows more flexibility. The Menu could be used by CAW and landowners in negotiating development agreements. Parties to a development agreement would be able to understand the menu options.
- Numerous studies have shown that the types of conservation design required in these options raise the value of land and houses due to the premium people are willing to pay for guaranteed open spaces.

Performance Standards Approach

The second management approach for the Upper Watershed and Critical Area B is Performance Standards allowing engineered stormwater BMPs to meet water quality targets. Before this approach can be used, pilot projects must be performed to determine the effectiveness of BMPs in soils and slopes of the Lake Maumelle Watershed. Once initiated, it is estimated that the pilot studies will take approximately four years to complete. The Lake Maumelle Watershed Management Implementation Strategy will outline the requirements for the pilot studies. To make the studies as objective as possible, the criteria for success and failure will be

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clearly defined in the pilot project design prior to any construction or monitoring taking place. Central Arkansas Water will review the results of the pilot projects to determine if the criteria for success have been met. In the future, Central Arkansas Water may transfer these pilot project review responsibilities to the Stewardship Council.

Pilot projects may be conducted in the Upper Watershed Area and in Critical Area B, or outside of the watershed. If conducted within the watershed, a developer could use a pilot project as phase 1 of a proposed development project. Once the pilot project demonstrates that applicable performance standards can be met using the BMPs and/or overall development design being tested, those BMPs or site design may be used in future phases of development for the remainder of the property. Once proven successful, the development design or BMPs, whichever is tested, can be used to meet applicable performance standards for other proposed development in Critical Area B and the Upper Watershed Area.

If the pilot studies are conducted and show that BMPs can be used, and the performance approach is adopted, each development applicant must perform an engineering analysis to demonstrate compliance with onsite loading limits and undisturbed open space requirements. (Note: Alternatively, the applicant could show conformance with the requirements of the non-engineering approach.) Therefore, in the Performance Approach, local governments must have adequate capacity to review the applications, review the BMPs design, inspect BMP construction, and conduct follow-up inspections for BMPs. Such administrative capacity does not exist at this time, and must be built before the performance approach can be used.

The Performance Approach allows the most flexibility to the landowner in site design, including lot size, housing density, imperviousness, road improvements, and off-site land conservation. The pollution loading limits for the Upper Watershed Area and Critical Area B are shown in Table 11.

Table 11. Performance Standards for Upper Watershed Area and Critical Area B

	Total Phosphorus (lb/ac/yr)	Total Suspended Solids (tons/ac/yr)	Total Organic Carbon (lb/ac/yr)
Critical Area B	0.30	0.110	44
UWA	0.33	0.130	50

The overall requirements for the Performance Approach in Critical Area B and the Upper Watershed Area are as follows:

Performance Standards for Critical Area B:

- Adhere to Sedimentation and Erosion Control Manual (to be developed for Lake Maumelle Watershed) for land disturbance activities.
- Use non-discharging wastewater systems.
- Overall design to meet site-scale performance standards of 0.3 lb/ac/yr TP, 0.11 tons/ac/yr TSS, and 44 lb/ac/yr TOC.

Recommendation:

Build administration and enforcement capacity before the Performance Standards approach can be used.

- Minimum undisturbed open space of 30 percent on low sloped lots and 50 percent on high sloped lots.
 - Undisturbed open space defined by Plan as “vegetated area that is left undisturbed during construction, and remains in natural vegetation.” The location of the Open Space must be recorded at the Register of Deeds Office as “Undisturbed Open Space”. If a development parcel was disturbed prior to development, e.g., clear cut, graded, etc., and the required amount of vegetated area is not present onsite, then the required vegetated area would have to be reforested prior to development approval.
 - Low sloped lots are defined as having slopes between 0 and 15 percent; high sloped lots are defined as having slopes between 15 and 25 percent; and slopes greater than 25 percent are not recommended for development.

Performance Standards for Upper Watershed Area:

- Adhere to Sedimentation and Erosion Control Manual (to be developed for Lake Maumelle Watershed) for land disturbance activities.
- Use non-discharging wastewater systems.
- Overall design to meet site-scale performance standards of 0.33 lb/ac/yr TP, 0.13 tons/ac/yr TSS, and 50 lb/ac/yr TOC.
- Minimum undisturbed open space of 15 percent on low sloped lots and 30 percent on high sloped lots.
 - Undisturbed open space defined by Plan as “vegetated area that is left undisturbed during construction, and remains in natural vegetation.” The location of the Open Space must be recorded at the Register of Deeds Office as “Undisturbed Open Space”. If a development parcel was disturbed prior to development, e.g., clear cut, graded, etc., and the required amount of vegetated area is not present onsite, then the required vegetated area would have to be reforested prior to development approval.
 - Low sloped lots are defined as having slopes between 0 and 15 percent; high sloped lots are defined as having slopes between 15 and 25 percent; and slopes greater than 25 percent are not recommended for development.

To help meet the site-scale pollutant loading limit or performance standards, engineered stormwater BMPs are allowed, such as filter strips, bioretention cells, wet and dry ponds. Figure 15 shows how the filter strip can be used to capture sediment from streets and driveways to allow the use of gravel roads and driveways in new development. Only non-discharging wastewater systems are allowed.

If landowners wish to enter into a development agreement using the Performance Standards approach the above conditions must be met in such agreement. In addition, CAW and/or local governments must commit to providing adequate oversight, administration, and enforcement of the Performance Approach.

If pilot projects are successfully completed, but local governments do not adopt local ordinances that allow the Performance Standards approach, CAW will determine if it is in the best interest of implementing this management plan to

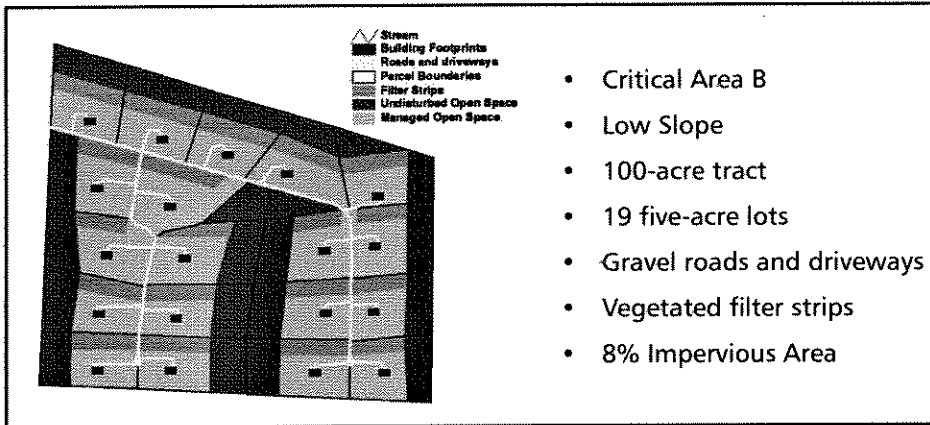


Figure 15. Large Lot Performance Approach Example Critical Area B

allow the Performance Standards approach in the development agreements, if it can develop legally binding agreements with strong consequences for non-compliance, and if it is willing to assume the responsibilities of oversight and enforcement.

Policy Regarding Development in Critical Area A

Critical Area A contains about 3,620 acres of land and is closest to the water supply intake. Although this represents only 4 percent of the Lake Maumelle watershed, its proximity to the water



supply intake, steep topography, erodible soils, high development potential, and quick pollutant travel time to the intake make it a very sensitive and vulnerable area for water supply protection. CAW's current policy has been to acquire all of Critical Area A and preserve it as a natural area.

No development and no activity in Critical Area A would pose the least risk to the water supply intake within that management area. CAW could purchase remaining private land in Critical Area A and apply this acquisition to the 1,500 acres that CAW will need to acquire to offset the land owner exemptions (see Section 3.2). Critical Area A meets the criteria that utilities commonly use to identify priority lands for acquisition (e.g., parcels close to a waterway or encompassing small streams, near an intake area, high development potential, with steep slopes or erodible soils, and with forest or other natural cover). CAW has already condemned about 90 percent of developable land in Critical Area A. Therefore, CAW could reasonably continue its policy of no development in Critical Area A as part of this Watershed Management Plan.

Another alternative is for CAW to allow very limited development in Critical Area A, requiring permanent conservation of 70 percent to 92 percent of the land and requiring very strict development standards on the remaining area (described in more detail below). If CAW allows development in Critical Area A, even under strict requirements, the risks to the intake area would be somewhat

increased. Therefore, such development should only be allowed if the following five conditions are met:

1. Overall risks to the lake and intake area are reduced. Through its representation on the PAC, Deltic Timber has indicated that if allowed to develop in Critical Area A, it would adhere to the Plan requirements not only in Critical Area A, but also on land that it owns in other parts of the watershed. In order to reduce overall risks to the lake and intake, both major landowners in Critical Area A must agree to follow the watershed plan requirements on all land they own in the watershed, and in the event they sell their property, must bind all future owners of their land to do the same. The two major landowners in Critical Area A own 41 percent of the developable land in the rest of the watershed, including 37 percent in Perry County, and almost all in Saline County. Given the uncertainty about adoption of local ordinances, such an agreement could help ensure implementation of the watershed plan in a majority of the watershed, while still preserving 70 percent to 92 percent of Critical Area A in conservation area.
2. Major landowners in Critical Area A must work with CAW to identify and obtain lands in other parts of the watershed that meet the land acquisition ranking criteria. The major landowners should sell or donate conservation easements to CAW to help meet the goal of acquiring 1,500 acres over the next decade, selling at least the amount of land as is currently condemned in Critical Area A.
3. Major landowners must conduct pilot studies to determine if and how Best Management Practices can be used in Critical Area A pursuant to the Performance Standards Approach. Such pilot studies must show that BMPs can be used effectively. A BMP design manual must be developed before a performance standards approach can be implemented. The pilot studies are anticipated to last four years.
4. If the pilot projects are unsuccessful, CAW should not be penalized by having to pay a higher price for land in four years. Major landowners and CAW should agree on a purchase price prior to initiation of the pilot projects.
5. Adequate administrative, regulatory, enforcement, and governance structures must be in place for the watershed. These structures comprise the recommendations in this section of the Management Plan, including local watershed protection ordinances, wastewater RME, and sedimentation and erosion control ordinances, or the equivalent protection through other ordinances and authorities.

Recommendation:

Consider Critical Area A in the context of the whole watershed. Consider overall risk reduction to the water supply, along with all of the adopted goals and objectives.

If these five conditions are met, CAW could reasonably include limited development of Critical Area A as a part of the Plan.

In summary, there are two types of risks that the Management Plan is addressing: risk to the lake and intake area due to annual loading of pollution from the whole watershed, and risk to the water supply due to annual or episodic pollution loading to the drinking water intake area. Both are very important to maintaining a high quality water supply. Tetra Tech recommended that CAW consider Critical Area A in the context of the whole watershed, and overall risk reduction to the water supply, and how well each alternative meets the adopted goals and objectives. Based on its deliberations, the CAW Board voted in December 2006

to continue its policy of no development in Critical Area A and to acquire such land for conservation.

Develop Landowners Manual

Knowing that this is a new way of development and that these concepts may be difficult at first to understand, it is recommended that a Landowners' Manual for Planning Development be created. This manual would be written to illustrate these requirements and recommended site design practices, including suggestions for where to locate undisturbed open-space, building locations, and on-site wastewater to minimize impacts to water quality.

Recommendation:

Create Landowners' Manual for Planning Development to illustrate site design requirements and provide guidance for minimizing impacts to water quality.

3.2 Development Agreements

This Management Plan will change in the future based on new conditions, needs, and information. Development proposals should be reviewed and approved in light of the management plan in effect at the time. Therefore, if there is remaining developable land that would fall under the conditions of a development agreement, such agreement must be revised to reflect the most recent management plan requirements.

3.3 Provide Exemptions to the Watershed Plan Requirements

Two types of exemptions are proposed for landowners in the Lake Maumelle Watershed. For each exemption, landowners would not be held to the watershed protection plan requirements and the related ordinance requirements. Below is a summary of each exemption.

Additions to Existing Houses, Businesses, and Institutions

The additions exemption would allow additions to existing residences, businesses, and other non-governmental institutions in the watershed. For existing residences, no ordinance limit is recommended. However, the study assumed that the additions would increase imperviousness on the parcel by less than 10,000 square feet. Exemptions for additions to existing non-residential structures (businesses and institutions) would be limited in the ordinance to 10,000 additional square feet of imperviousness; beyond that amount, the landowner must comply with the watershed protection requirements. Figure 16 illustrates this exemption for an existing residence.

Recommendation:

Allow additions to existing residences, businesses, and other non-governmental institutions in the watershed without requiring adherence to Plan provisions.

Who would get this exemption? All existing watershed residents with houses built and legal lots recorded prior to the effective date of the ordinance, and all existing businesses and institutions with legal lots recorded and structures built prior to the effective date of the ordinance would receive this exemption. The exemption would carry over to future owners of the existing houses, businesses, and institutions. It would apply to the existing residents, businesses, and institutions of the Upper Watershed Area, Critical Area B, and Critical Area A.

Small Subdivisions

The purpose of this exemption is to address legacy issues for longstanding landowners in the watershed. Legal counsel has recommended that "longstanding" be

Recommendation:

Allow up to five 3-acre lots (that are not subject to Plan requirements) for all landowners as of December 2000 in Critical Area B and the Upper Watershed Area.

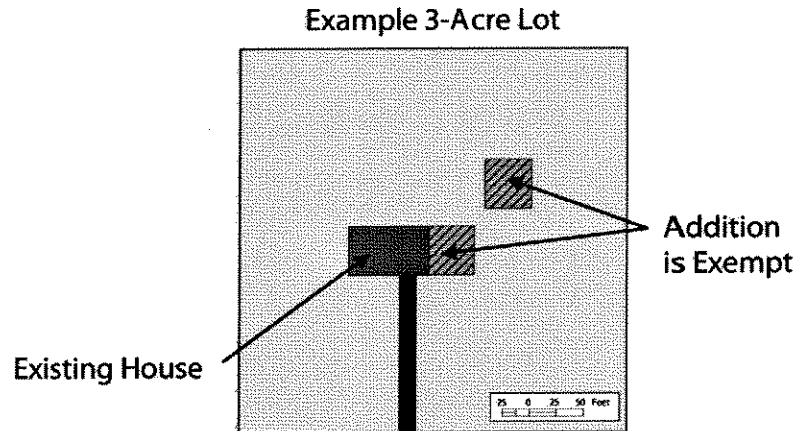


Figure 16. Exemption for Additions to Existing Houses

defined as 5 to 10 years. Therefore the subdivision exemption would allow up to five 3-acre lots for all landowners who have a legally recorded lot as of December 2000. These longstanding landowners could create a small subdivision of land which could be handed down to family members, sold, or developed without having to comply with the watershed protection requirements (except the wastewater requirements). The exemption would carry over to subsequent owners of the land. Additional land could be handed down or sold by these longstanding landowners, but those parcels would need to comply with the watershed protection requirements.

How would the subdivision exemption be applied? For non-governmental/CAW owners of record through December 2000 in Critical Area B and the Upper Watershed Area, up to five 3-acre lots would be exempted. The smallest lot that may be created is 3 acres (but parcels owned by a single landowner as of December 2000 may be recombined for the calculation). For example, if a landowner possesses 30 acres, he or she could create five 3-acre lots which would be exempted. The rest of the parent tract must comply with the watershed plan (Figure 17). A landowner who possesses 10 acres could create three 3 1/3-acre lots which would be exempted (Figure 18). If a landowner owns a total of six acres, two 3-acre lots could be created that would be exempted (Figure 19). This exemption does not apply to land in Critical Area A.

Offsetting the Exemptions

Allowing these exemptions increases pollutant loading over the amount needed to meet water quality targets in the lake. To offset the additional pollutant loading, Tetra Tech recommends that the CAW Board adopt a policy to purchase 1,500 acres of land in the watershed for conservation over the next 10 years (land that otherwise would have been developed in the future). Land could be acquired through multiple means, including but not limited to fee simple acquisition, purchase of conservation easements, or donation of land or easements.

This Plan recommends that CAW use rate payer funds as well as grants from state, federal, or non-profit organizations to acquire the land. Similar to other utilities, CAW can use the Watershed Plan as a basis for applying for grants.

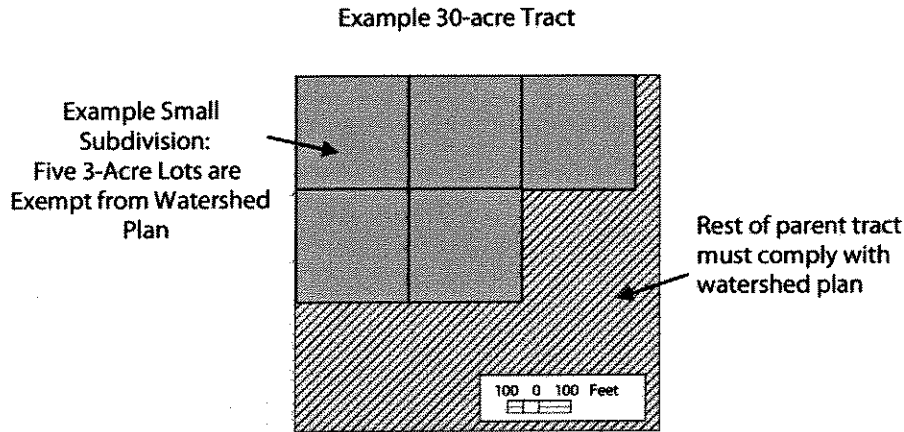


Figure 17. Subdivision Exemption – Example 30-Acre Tract

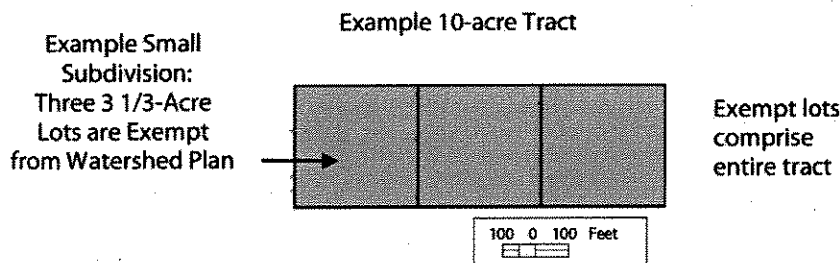


Figure 18. Subdivision Exemption – Example 10-Acre Tract

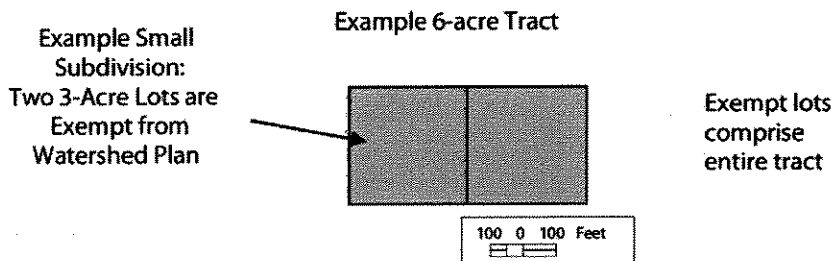


Figure 19. Subdivision Exemption – Example 6-Acre Tract

Recommendation:

To offset the exemptions, CAW should adopt a policy to purchase 1500 acres of land in the watershed over the next ten years.

3.4 Manage Wastewater Impacts

The watershed study's baseline analysis indicated that long-term, direct wastewater discharges pose the single most serious and dominant threat to Lake Maumelle, greatly increasing the likelihood of harmful algae blooms and significantly degrading the current high level of water quality. The watershed and lake analysis showed that allowing wastewater discharges and the associated phosphorus loading would make it impossible to achieve the lake water quality targets even assuming the lowest ADEQ permittable limit of 1 mg/L for a small community system. For example, allowing such discharges:

Direct wastewater discharges pose the most serious and dominant threat to Lake Maumelle.

Recommendation:

The state of Arkansas should adopt and enforce a standard of no direct wastewater discharge in the Lake Maumelle Watershed.

Recommendation:

Establish a Responsible Management Entity (RME) to own, operate and maintain new non-discharging wastewater treatment systems in the watershed.

- Exceeds total allowable load for 3-acre lots (without even considering non-point runoff from the lot).
- Represents 2/3 of total allowable phosphorus load for 5-acre lots.

This Plan determined in the watershed assessment that there are approximately 46,500 developable acres in the Lake Maumelle Watershed. This Plan recommends that local governments adopt ordinance provisions to mitigate the impacts from the new development that are capable of meeting water quality targets established for Lake Maumelle. Tetra Tech's analysis found that nonpoint source loading of nutrients from this new development would require 100 percent of allowable load. Therefore all of the nutrient loading must be allocated to development runoff rather than wastewater discharges associated with that development.

The watershed study determined that the pollution loading of any wastewater discharge into Lake Maumelle would negate the protection attained through managed land development within the watershed. The Lake Maumelle Policy Advisory Council voted unanimously to prohibit direct discharges of wastewater, and considers this action the foundation for this Watershed Management Plan. PAC members stressed the importance of communicating to others that without this prohibition the other management recommendations for new development would not achieve water quality targets.

Since the State of Arkansas has the authority for regulating wastewater discharges, this management plan calls for appropriate state agencies to adopt and enforce a standard of no direct wastewater discharges in the Lake Maumelle Watershed. This may be accomplished through amendment of the state's water quality plan or revision of the state's water quality standards. Until such a state prohibition is achieved, it is recommended that local ordinances and development agreements allow only development types and densities that would use onsite non-discharging systems (see below).

Create Responsible Management Entity

Any wastewater treatment technology adopted for use in the Lake Maumelle watershed will require regular, ongoing, and perpetual management, including appropriate planning and risk analyses, system design and installation, operation and maintenance attention, and removal of accumulated residuals from septic tanks and treatment facilities. Due to the poor results experienced by management programs that depend on homeowners to service their systems, it is strongly recommended that a professional management entity be identified or created to own, operate, and maintain, new wastewater treatment systems installed in the Lake Maumelle watershed. This is USEPA's recommended model for managing onsite wastewater systems in sensitive environmental areas.

This management entity would be responsible for planning, designing, overseeing installation, monitoring, and maintaining the treatment systems and equipment, and would operate much like any wastewater treatment utility in any urban area. The responsible management entity (RME) would work with state environmental and health agencies to ensure that treatment facilities were designed and operated to eliminate or minimize any risks to water quality in the lake, and would receive monthly or quarterly fees from the population served to cover all management program costs.

RME management duties could be assumed by an existing entity, such as the Little Rock Wastewater Utility (LRWU), or they could be provided by a new entity, such as a newly formed sanitation district, public corporation, multi-county district, or other legal entity established to provide wastewater management services. Homeowner associations have a poor track record in operating highly technical and mechanized wastewater treatment facilities: this option is not recommended.

Whatever RME is selected or created, it must have the technical, managerial, and financial capabilities to meet treatment performance goals and cover its operating costs in an effective, efficient, and responsible manner. A monthly fee is charged the homeowners to cover all operational and maintenance expenses for RMEs which own, operate, and manage the system. The monthly fee is typically about \$30. Finally, due to economies of scale and the desirability of standardized wastewater management practices throughout the watershed, it is recommended that a single RME be designated to handle services for the lake drainage area if possible. This will ensure a consistent approach across jurisdictions, maximize operational independence, and promote efficient, responsible service.

Rely on Non-Discharging Systems

There are a number of options for using non-discharging systems in the Lake Maumelle Watershed, both for individual homes on larger tracts and systems for cluster-type development. Non-discharging systems are defined as those not discharging wastewater directly to the surface of the land, into streams, or into the lake. Non-discharging systems include individual onsite or onsite cluster (community) systems that disperse wastewater within native or specially designed soil areas such as those described below. In some circumstances as approved by CAW and the RME (see below), non-discharging systems can include the collection and pumping of cluster system wastewater for discharge outside of the watershed.

Individual Onsite Systems

Alternative approaches are available for wastewater treatment and effluent dispersal sites that do not meet minimum requirements for soil depth, slopes, and dispersal system groundwater separation distances. In Arkansas, the most widely used alternative approaches include capping fill systems and mound systems. Both of these system types include septic tanks to receive raw wastewater from the served facility (i.e., residence or business), and sometimes pump tanks to provide dosing pressure to the capping fill or mounded effluent dispersal area. The capping fill is used to increase soil depth in the infiltration area, and involves clearing and scarifying the surface of the native soil and adding the appropriate depth of approved supplemental fill (e.g., 8-16 inches) across the effluent dispersal area as needed. Mounds are used when little native soil is available for incorporation into the effluent dispersal area, and a deeper infiltration area that can handle the full load of septic tank effluent is required. The mound consists of a layer of suitable sand fill, an absorption bed filled with aggregate, and a covering layer of topsoil. The topsoil layer for both capping fills and mounds should be at least 6 inches deep and serves as a growth medium for vegetation. Operation and maintenance for the septic tank for both systems includes pumping every 3 to 5 years. If either system includes a pump tank, maintenance includes annual or semiannual inspection of the pump, float switches, tank, and dosing chamber; and maintenance of vegetative cover (i.e., grass) over the infiltration area to prevent erosion.

There are a number of non-discharging system options for individual homes on larger tracts and cluster-type development.

Mound or capping fill systems are good options where traditional septic systems cannot be used and there is sufficiently low slope.

During the watershed assessment, Tetra Tech, CAW, and TAC members spoke with state Department of Health (DOH) and Department of Environmental Quality (DEQ) staff. The state's wastewater experts indicated that the capping fill systems do not pose a problem if properly installed, monitored, and maintained. The state has considerable experience with these type of systems and has observed good results. Since the mound systems are very similar to the capping fill, these systems should also not pose a problem if they are installed properly and maintained. These systems are a good option where traditional septic systems cannot be used but there are portions of the lot with low enough slope to establish capping fills or mound systems.

Cluster Systems

Cluster (community) systems typically serve fewer than a hundred homes, although they can serve more. Under this approach, septic tank effluent from each home is collected and routed to another site for further treatment and eventual release into the subsurface. Other designs where primary treatment occurs at the treatment site instead of at individual home septic tanks are also possible, but most designers prefer individual tanks due to a greater ability to detect problems that may affect biological treatment processes (e.g., dumping of toxic wastes into household drains). Collection and movement of effluent to the final treatment site can be accomplished by gravity flow or pumps. The offsite treatment facility resembles a downsized sewage plant, using similar technologies such as trickling (attached growth media) filters, aerobic lagoons, constructed wetlands, etc. Final dispersal of treated effluent is to the soil. An example of a cluster system is the use of a septic tank system plus an intermittent sand filter for treatment with dispersal through a subsurface leaching system or a drip irrigation system. Operation and maintenance for the treatment system includes monitoring influent and effluent, inspecting the dosing equipment and float switches, maintaining the filtration media surface (i.e., raking and replacing as needed), checking the discharge orifices for buildup or blockage, and flushing the distribution manifold periodically (in addition to septic tank maintenance).

During the watershed assessment, the state's wastewater experts indicated that drip irrigation technology is relatively new to Arkansas, even though it is used extensively elsewhere in the southeast. As of 2006, the state only has a couple of years experience with drip irrigation, but initial system applications appear to be working well. In the opinion of the state experts, drip irrigation remains a viable option for community systems if designed, installed, and maintained properly. One significant benefit of drip irrigation is the ability to introduce treated effluent high in the soil profile, where treatment of wastewater is enhanced due to higher soil oxygen levels, greater access to carbon for nitrogen reduction, and better likelihood of nutrient uptake by plants. It is recommended that the cluster systems (e.g., drip irrigation) technology be available for use in the Upper Watershed Area and Critical Area B.

During the development of this Plan, it was noted by some that there may be circumstances in Critical Area B and the Upper Watershed Area where pumping wastewater out of the watershed might be the most environmentally sound alternative. In general, Tetra Tech does not recommend the use of sewer and pump stations within the watershed other than for small collection systems that are located on the development property to support conservation-based cluster

The recommended strategy for cluster developments is to maintain smaller, disconnected wastewater systems so that—if failures do occur—impacts should be more localized and smaller in magnitude.

design. Larger volumes of wastewater pose a greater threat to water quality when systems fail due to events such as power outages, pipeline breaks, or sewer overflows due to wet weather stormwater infiltration. Therefore, the recommended strategy for cluster developments is to maintain smaller disconnected community systems so that—if failures do occur—impacts should be more localized and smaller in magnitude. In a few cases, these systems may be on property adjacent to the watershed boundary and pumping out of the watershed may be deemed appropriate by the RME and the Watershed Administrator.

The following general guidelines are provided to aid the Watershed Administrator and the RME in evaluating developments for pumping wastewater out of the watershed:

1. Land is immediately adjacent to the watershed boundary or the edge of the property is within one-quarter mile of the boundary. (Note: the intent is for there to be minimal length of pipe and a small number of pump stations to limit potential for system failures.)
2. Wastewater pumping volume should not exceed 95,000 gallons per day (amount associated with maximum of 300 homes).
3. Pipelines should not cross intermittent or perennial streams.

Application of these guidelines should be evaluated on a case-by-case basis; they are meant to provide clarification to the Watershed Administrator and RME on the intent of the Plan.

3.5 Control Sedimentation and Erosion During Construction Phase

Federal Phase II Stormwater Management regulations now require a stormwater control plan for any activity disturbing land of one acre or more (except agriculture and forestry operations). These construction sedimentation and erosion control requirements apply to all cities and counties in Arkansas. Where local sedimentation and erosion control programs are not in place to review and enforce stormwater/sedimentation control plans, state ADEQ staff is charged with carrying out these responsibilities. In 2006, ADEQ had 12 staff to cover the entire state. By comparison, counties with strong local programs in the US—knowing that site inspections and enforcement are the linchpin to success—may have four or five staff just to cover one county. Inadequate funding and staff at the state level can result in lack of knowledge about these requirements, low compliance rate, and site inspections on a complaint-only basis.

To help prevent runoff during construction such as shown in Figure 20, this Plan recommends that:

- Local governments with jurisdiction in the watershed develop local sedimentation and erosion ordinances for the watershed (or for their entire jurisdiction, with more protective requirements in the Lake Maumelle Watershed). The watershed sedimentation and erosion control program should go beyond the minimum state requirements.
- Local governments enter into a memorandum of understanding with CAW to carry out the ordinance requirements, including working with applicants in developing a sedimentation and erosion control plan, conducting final plan

Recommendation:

Local governments should develop sedimentation and erosion control ordinances that go beyond minimum state requirements.



Figure 20. Sediment Runoff During Construction: What Should Be Prevented

Recommendation:

CAW should work with local governments to build capacity for administering and enforcing the ordinances.

review and issuing the land disturbance permit, conducting site inspections, and enforcing permit and plan requirements.

- CAW fund a Watershed Administrator with responsibilities for carrying out such programs working with the local governments. A portion of the cost of the Watershed Administrator and any additional inspectors could be covered through a plan review fee and land disturbance permit fee.
- CAW support development of a local sedimentation and erosion control manual to provide guidance to applicants and staff regarding what is required, how to implement BMPs, and the penalties for non-compliance.

To address impacts from construction activities, it is recommended that any activity disturbing 10,000 square feet or more in Critical Area A and Critical Area B and 20,000 square feet or more in the Upper Watershed Area be required to develop and implement a sedimentation and erosion control plan. The sedimentation and erosion control site requirements for the watershed should include, but not be limited to:

- Revegetation requirements post-grading.
- Sedimentation and erosion control devices to retain all sediment within the boundaries of the tract.
- Ground cover to restrain erosion following the construction or development phase.
- Encouraging stream side management zones.
- Prohibiting the channeling of runoff directly into a waterbody. Must use swales or other systems to decrease the velocity of stormwater, increase infiltration, allow solids to settle and remove pollutants.

Section 3 Manage Impacts from New Development—Recommended New Regulations

- Limiting alteration of natural watercourses such as straightening, widening, or dredging.
- Limiting land disturbing activity on the site.
- Periodic inspections.

The site shown in Figure 21 shows how multiple BMPs are used to control sediment and erosion, including silt fences, temporary seeding above a drainage swale, and an intact vegetated buffer.

Even with protective requirements such as those listed above, research has shown that the key to a successful sedimentation and erosion control program is enforcement, including frequent site inspections and meaningful penalties for non-compliance. Strong local sedimentation and erosion control ordinances commonly have the following types of remedies for non-compliance:

- Threat of a stop work order and issuance of a stop work order.
- Power to revoke the land disturbance permit and require that the permit fee be paid again.
- Civil penalties of \$5,000 per day (with each day of non-compliance being a separate violation).
- Criminal penalties for willful violations.
- Injunctive relief.
- Restoration of areas affected by failure to comply.

The sedimentation and erosion control ordinances for the Lake Maumelle Watershed should stipulate that non-compliance results from:

- Not adhering to the sedimentation and erosion control plan developed for the site.
- Sediment washing off of the site despite adherence to the sedimentation and erosion control plan.

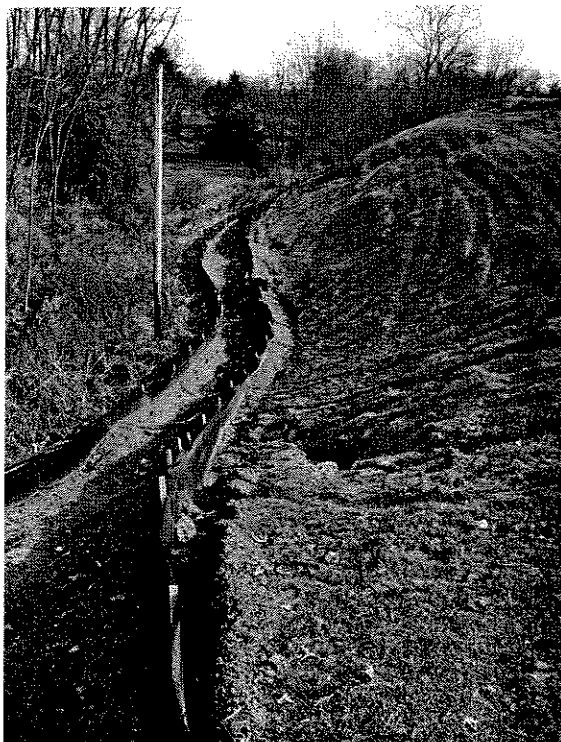


Figure 21. Sediment and Erosion Control Using Multiple BMPs

Research has shown that the key to a successful sedimentation and erosion control program is enforcement, including frequent site inspections and meaningful penalties for noncompliance.

Recommendation:

The Watershed Stewardship Council should take the lead in drafting design guidelines and maintenance requirements for new roads, streets, and driveways.

3.6 Develop Design Guidelines and Maintenance Requirements for New Roads, Streets, and Driveways

Roads, streets, and driveways constitute the major portion of impervious surfaces in a developed watershed. As such, they are responsible for the majority of the surface runoff that carries sediment and other pollutants into receiving waters.

Proper design of new roads, streets, and driveways can help mitigate impacts. Most of these new streets are expected to be in planned developments. For such streets, the Center for Watershed Protection has developed "better site design" guidelines that have an overall objective of reducing needless impervious cover while meeting community needs for safety, traffic flow, and parking. In the types of less dense development expected for the Maumelle watershed, such designs can also use grass swales to maximize pollutant removal and stormwater infiltration. The Center for Watershed Protection recommends the following general performance criteria:

1. Reduce total road length.
2. Design narrower local streets.
3. Limit rights-of-way.
4. Reduce number and size of cul-de-sacs.
5. Limit driveway lengths.
6. Design for safe pedestrian movement
7. Use open channel stormwater treatment.

Section 3.1 outlined the impervious surface limitations and performance standards to limit post-construction impacts. In order to meet these development standards, many applicants will likely use many of the design criteria listed above. However, these criteria can also be covered in design guidelines, which could be incorporated into county subdivision regulations.

Poor maintenance of privately owned roads can also be a major source of sediment and pollutant loading, particularly through failure of runoff conveyance structures. Maintenance requirements and maintenance covenants for privately owned roads should be included in the watershed protection ordinance or subdivision ordinance, and such ordinances should include a provision for ensuring compliance. Alternatively, the ordinance could require that all new roads be dedicated to the public for maintenance.

The Watershed Stewardship Council should take the lead in drafting the design guidelines and maintenance requirements, working in conjunction with the counties.

3.7 Abate Public Health Threats

The watershed protection ordinance should have a provision for the abatement of activities that pose a threat to water quality and the public health, safety and welfare. Such activities might include a landfill, inadequate onsite sewage systems, improper management of stormwater runoff, or any situation found to pose a threat to water quality.

Recommendation:

The Watershed protection ordinance should have a provision for the abatement of activities that threaten water quality or public health and safety.

Section 3 Manage Impacts from New Development—Recommended New Regulations

The Watershed Administrator should monitor activities within the watershed to identify activities or situations that may pose a threat to the quality of Lake Maumelle. The Administrator should report findings to the Watershed Review Board, and should consult other agencies as needed, to request recommendations. Where the Watershed Review Board finds a threat to water quality and the public health, the Board may use any appropriate action to restrain, correct, or abate the condition.

In addition, if uses are proposed in the watershed that pose a public health threat, CAW and/or local governments may need to use their powers of eminent domain to prevent such uses from occurring. Examples of these uses include hazardous waste storage facilities, large hazardous materials storage facilities, chemical manufacturers, industrial lagoons or pits, and large animal waste lagoons.

It is important to note that due to the good stewardship of current and past landowners, the watershed currently does not have an activity, such as described above, that poses a public health threat.

OTHER RECOMMENDED MANAGEMENT ACTIONS

- 4 Acquire Conservation Land
- 5 Mitigate Hazardous Material Spills
- 6 Improve and Maintain Existing Roads
- 7 Continue Good Lake Management Practices
- 8 CAW – Setting the Example

4 ACQUIRE CONSERVATION LAND

CAW currently owns a ¼ mile buffer around Lake Maumelle, comprising 7,200 acres (or 8,190 acres including land currently condemned and in litigation). This Plan calls for CAW to acquire an additional 1,500 acres over the next decade (by 2017). Land conservation emphasizes permanent preservation of land around water supply sources. Acquisition of conservation land is a key tool for watershed management, a tool used along with regulatory and non-regulatory techniques in a comprehensive watershed management plan. Communities sometimes invest in land conservation to reduce the risk of hazardous or toxic spills or leachate reaching the lake, reduce the risk of conventional pollutant runoff and emerging unregulated contaminants reaching the streams and lake, reduce treatment costs, and maintain consumer confidence in the drinking water supply. This section reviews more specifically why communities use land acquisition in watershed management, the types of land acquisition commonly employed, criteria used to target land for community investment, and how conservation forms the strong foundation for this Lake Maumelle Watershed Management Plan.

Recommendation:

CAW should acquire an additional 1500 acres of conservation land by 2017 to offset Plan exemptions for existing watershed owners.

4.1 Why Communities Use Land Acquisition in Watershed Management

In Protecting the Source, the Trust for Public Land (TPL) discusses why communities use land conservation as a key element in the multiple-barrier approach to drinking water protection. Highlighted below are the main reasons cited by TPL and communities with which they work.

Nonpoint Source Pollution – Development of formerly forested land or open space removes the filtering capacity of the land. Nonpoint source pollution includes runoff from developed land—from lawns, streets, and rural septic systems. It also includes runoff from undeveloped farms and forests. Preservation of land can reduce the annual loading to lakes of conventional pollutants such as nutrients, pathogens, and total suspended solids. To maximize filtering of nonpoint source pollution through a land acquisition program, most communities prioritize conservation of land adjacent to streams and lakes (Figure 22). Small streams, which can constitute up to 85 percent of total stream length in a watershed, are critical to maintaining water quality. These small streams collect most of the water and pollutants from the land, with minimal “new” pollutants entering the system over the banks of large rivers or reservoirs. Also, small streams (with an average flow of 37 cubic feet per second or less) have been shown to remove nitrogen at a rate of eight times that of larger streams.

Water Quantity – Development of open space reduces the storage capacity of the land and its ability to recharge groundwater and stream baseflow. Land conservation through acquisition or other means helps maintain water quantity and natural hydrology in the watershed.



Figure 22. CAW's Natural Buffer Around Lake Maumelle

Emerging Contaminants – Emerging contaminants are those that are either new to the environment or have only recently been identified as potential health threats. Emerging pathogens tend to be:

- Resistant to chlorination or disinfection.
- Resistant to antibiotics.
- Spread by animals and humans.
- Highly infectious.

Other emerging contaminants include metallic compounds, chemicals, and pharmaceuticals. Industries invent or put on the market new compounds daily, such as pesticides, chemicals for plastics, and pharmaceuticals. These chemicals can reach our water sources via septic systems, storm sewer overflows, and runoff from lawns and farms. A recent nationwide monitoring study designed by USGS found steroids and nonprescription drugs in over 80 percent of the 139 streams tested. Conventional treatment processes, such as clarification and filtration, remove many known and unidentified contaminants, yet they typically do not remove most pesticides or pharmaceuticals. Little is known about the toxicity of these substances in the drinking water source, or how treatment processes, such as disinfection, may alter the structure of the chemicals. Land conservation (through land acquisition or other means) can help reduce the risk of exposing the water source to potentially harmful levels of these contaminants.

Changing Standards – Since passage of the Safe Drinking Water Act, the U.S. Environmental Protection Agency (USEPA) has continued to identify compounds that potentially cause cancer or have other adverse health effects. For these, it has set maximum contaminant levels. While drinking water standards and treatment guidelines have been established for many chemicals, there are countless known, and as yet unknown, contaminants that need to be identified and studied. Many chemical compounds do not have standards, and current standards do not yet account for exposure to complex mixtures for long periods at low concentrations, or for seasonal spikes in concentrations. Land conservation, by introducing fewer and lesser amounts of substances into the waterways, may increase surety of meeting future standards.

Increased Treatment Costs – A study of 27 water suppliers conducted by the American Water Works Association and the Trust for Public Land (TPL) found that the more forest cover in a watershed, the lower the treatment costs. According to the study:

- Approximately 50 to 55 percent of the variation in treatment costs can be explained by the percent of forest cover in the source area. (According to the study, the approximately 50 percent of the cost that can not be explained by percent forest cover is likely explained by varying treatment practices, size of the facility, and the location and intensity of development and row crops in the watershed).
- For every 10 percent increase in forest cover in the source area, treatment and chemical costs decrease approximately 20 percent, up to 60 percent for forest cover.

The study did not collect enough data on suppliers with over 65 percent forest cover to draw conclusions; however, the study conjectured that the treatment costs level off when forest cover is between 70 and 100 percent of the watershed area.

In a similar, more recent study, the TPL used GIS analysis to estimate the percent forest cover in the watersheds rather than relying on the utilities to provide estimates. In this study, which TPL believes is more accurate than the 2004 report, researchers found that for every 10 percent increase in forest cover, treatment and chemical costs decreased approximately 12 percent. This study is unpublished and TPL is seeking to increase its sample size.

Increased Capital Investment in New Treatment Technologies – Upgrading treatment systems can be very expensive. While new water quality regulations are often the final impetus for treatment upgrades, water suppliers with protected source waters are less likely to be forced to invest in major upgrades. USEPA's Final Long-Term 2 Enhanced Surface Water Treatment Rule (published January 5, 2006) requires less treatment for high quality waters.

Loss of Consumer Confidence – When water quality causes illness, or even taste, odor, and color problems, the public can quickly lose confidence in the safety of its water supply. Residents begin buying bottled water and household filtration systems. Local businesses that rely on clean water install their own filtration systems. In addition, studies have found that clean water is a primary factor in businesses deciding to locate to an area.

In summary, land acquisition is commonly part of a comprehensive watershed management plan. As indicated by the Trust for Public Land, communities invest in land conservation to help meet water quality goals or targets related to nonpoint source loading of pollutants, to reduce the risk of contamination from emerging contaminants, to help ensure compliance with future water quality standards, to manage water supply treatment and capital cost, and to maintain consumer confidence. Finally, some utilities invest in land conservation as a way to “invest in the watershed” and help address equity issues with landowners.

It is important to note that it would be cost-prohibitive to rely solely on land acquisition to protect Lake Maumelle, and far more expensive than relying on a combination of land management and land acquisition techniques.

4.2 Types of Land Acquisition

Communities rely on a range of land acquisition techniques; the following is a review of three commonly used approaches – donations, land purchases, and conservation easements.

Donations: Landowners are sometimes in the position to donate a piece of land (as part of a development project or an entire developable parcel) either to the local government, the utility, or a non-profit organization like a land trust. Often the entire value of the donation can be deducted over time from federal and/or state income taxes. In addition, real estate taxes, insurance, and maintenance costs can be avoided. While land donations can be attractive to the owner and to the local government, this approach cannot meet the needs of a coordinated land acquisition strategy. In a bequest donation, the landowner retains the ownership until death. In a donation with reserved life estate, the landowner donates during his or her lifetime, but has lifetime use of the property.

Outright (or Fee Simple) Land Purchases: Local governments or utilities may be committed to the acquisition of selected parcels deemed so significant to their future that they are willing to purchase them outright. The local government may choose to purchase the land at its market value or may negotiate a bargain sale with the landowner. With a bargain sale, the difference between fair market value and the reduced price may qualify for a deduction from state and/or federal income taxes.

Conservation Easements: An easement is a tool used by many local governments and land trusts to protect sensitive environmental resources at relatively little costs. An easement is a limited right to use or restrict land owned by someone else. Easements presume that various land rights may be sold separately. An easement can assist in protecting land from development by restricting all or a portion of the property to open space or limited development uses. Often, purchasing a conservation easement is more cost effective than purchasing land fee simple. Landowners who place conservation easements on their land may receive a federal or state tax benefits. In addition, it is recommended that CAW works with the state legislature to allow for local preferential tax assessment for conservation easements.

Other land acquisition techniques include:

Required conservation land in new development through watershed protection ordinances:

Land Exchange: This involves the exchange of land more suited to development for land with higher conservation value.

Eminent Domain: This is the right of the government to take private property for public purpose upon payment of just compensation to the property owner. This provides government with a tool to acquire properties if other acquisition techniques are unworkable.

It is important to note that it would likely be cost prohibitive to rely solely on a land acquisition program to meet the goals of a watershed management plan, and far more expensive than relying on a combination of land management and land acquisition techniques.

Recommendation:

CAW should work with the legislature to amend the state tax code to allow for local preferential tax assessment for conservation easements.

4.3 Criteria Used to Target Investment in Conservation Land

Communities and utilities are faced with the questions, “How much land do we need to buy to meet our source protection goals?” and “What land should receive the highest priority for conservation and acquisition?” The Management Plan answers the first question: CAW needs to acquire a minimum of 1,500 acres to in order to meet the water quality targets. In terms of ranking which land should be purchased, ranking systems vary by community but often include the following criteria: parcels close to a waterway or encompassing small streams, near an intake area, with steep slopes or erodible soils, and with forest or other natural cover. Some communities place higher priority on land that has more development potential.

CAW’s past policy was to purchase land in Zone 1 (similar to Critical Area A) around the intake due to its sensitivity, and to target this area as a no development zone. Its policy was to also acquire land within 300 ft. of critical streams as identified in the CAW Board Resolution 2003-10. As discussed in Section 3.1, CAW could continue to give high priority to these lands to meet the goal of acquiring 1,500 acres within 10 years. CAW can also work with other landowners willing to donate or sell land or easements in other developable portions of the watershed. The same types of ranking criteria listed above should be used in identifying the areas which should be donated or sold to CAW.

4.4 Conservation – Strong Foundation of the Lake Maumelle Watershed Management Plan

When you consider conservation land currently owned by CAW and the U.S. Forest Service, the 1,500 acres that CAW would acquire to offset the subdivision exemptions, and the minimum undisturbed open space requirements and very steep slope conservation area proposed for the watershed protection ordinances, at build-out, this plan would result in:

- Conservation of 49,800 acres or 65 percent of the land in the watershed.
- A total estimated 6,380 houses assuming the Conservation Design approach is used. Note: If the Performance Standards approach is used, the total houses in the watershed would increase more. The level of increase would depend on the development designs used which in turn would depend on the non-discharging wastewater systems allowed. For example, the drip irrigation technology, which is linked to the capacity of the soils, would likely increase the number of houses by 1,000 compared to the Conservation Design approach. Pumping wastewater out of the watershed would allow substantially more houses to be built.
- A total increase of 2,690 acres of imperviousness for houses, commercial areas, and institutions, or 3 percent imperviousness for the entire watershed (5 percent when including existing imperviousness).
- The remaining 30 percent of the land in the watershed covered with grass and meadow.
- Achievement of the Lake Maumelle water quality targets and a high quality drinking water supply for the region.

Lake Maumelle Watershed Management Plan

This Watershed Management Plan has a strong foundation in land conservation, and wise land management, while still accommodating development for landowners. A portion of the additional land conservation, approximately 1,500 acres, is to be achieved through CAW land acquisition.

5 MITIGATE HAZARDOUS MATERIAL SPILLS

It is important to minimize the risk of accidental discharges of hazardous material reaching the water supply. While such risks cannot be entirely eliminated, they can be reduced and managed.

Sources of hazardous material spills can first be divided into fixed and mobile (transportation) sources. Within each source type we can further distinguish events that pose major and minor risks. Major risks are those that have the potential to release large quantities of material of significant toxicity directly into watercourses; minor risks are those that result in small volume releases, releases that are unlikely to reach flowing water, or that involve material that has a low level of toxicity. The strategies for addressing major and minor risk sources are generally different.

5.1 Address Fixed Sources

In some watersheds there are major, high-risk fixed sources, such as chemical plants. The Maumelle watershed at present does not have major fixed sources, nor are industrial-type sources expected. However, because of the lack of zoning ordinances, there are not absolute prohibitions on the creation of such sources. Local governments and CAW will need to use other remedies and mechanisms to prevent such sources being built in the watershed (see Section 3.6 – Abate Public Health Threats).

One fixed source type involving significant volumes of hazardous material that is expected in the watershed is gas stations. However, when storage tanks for petroleum products are built to modern standards and regularly inspected, the probability of a large volume release is small. At minimum, the Watershed Administrator should ensure that adequate spill control plans are in place for such storage tanks as is required by federal and state laws.

Minor fixed sources involve small quantity releases (accidental or intentional) that may occur at residences, farms, and commercial properties in the watershed. For example, a homeowner might spill herbicides on a driveway, or dump paint or waste oil in a drainage ditch. The volumes of such releases tend to be extremely small relative to the dilution capacity of the lake, and a single event is of minor concern. However, the cumulative effect of many small releases throughout the watershed could result in problems for the water supply. The frequency and impact of such minor releases can be addressed in several ways:

- Landowner education (see Section 9 – Encourage Good Household Practices).
- Provision of convenient hazardous waste disposal options (CAW is exploring providing such a service in the watershed. See Section 10.2.).
- Disconnection of paved area drainage from streams.
- Contract for lawn maintenance that minimizes use of chemicals.

Recommendation:

The Watershed Administrator should ensure that adequate spill control plans are in place for hazardous material storage tanks in the watershed.

5.2 Address Mobile Sources

The risks from fixed sources of hazardous waste in the watershed are generally expected to be small. Transportation risks could potentially be of greater concern if large quantities of hazardous material are transported through the watershed.

Major transportation risks are generally associated with highways, railways, and pipelines. There are no active railways in the watershed. There is, however, a petroleum pipeline and several highways. In particular, Highway 10 crosses several embayments of Lake Maumelle. A catastrophic accident involving a chemical tanker truck on one of these bridges, although of low probability, could result in a major impact on the water supply.

To date, no analysis has been undertaken on the extent to which hazardous material transport occurs within the watershed. Such an analysis should be conducted by the Watershed Stewardship Council and Metroplan. If such transport is likely, under either present or future conditions, steps should be undertaken to mitigate such risk. There are three types of mitigation actions that could be considered.

Recommendation:

The Watershed Stewardship Council and Metroplan should conduct an analysis of hazardous material transport in the watershed and develop mitigation recommendations.

- Ensure that there is adequate emergency response capability (Figure 23) that can reach any spill site in a short amount of time with equipment to provide containment. HAZMAT response teams should be located near the watershed and provided with adequate training and equipment. There is also a need to ensure proper communication among police, fire departments, other emergency responders, Arkansas DOT, and CAW.
- Prohibit or limit hazardous material transport on highways that intersect perennial waterways in the Lake Maumelle watershed.
- Retrofit bridges and drainage ditches on bridge approaches to provide spill containment. This last option involves a high level of expense, so a cost-benefit analysis would need to be conducted to balance risk versus cost and prioritize those areas that present the greatest risk.



Figure 23. Ensuring Adequate Emergency Response Capability

The petroleum pipeline is also a potential major mobile source since the oil is transported via the pipeline. The Exxon-Mobile pipeline, recently reactivated, parallels the north shore of the lake in Critical Area B as well as a portion of the Maumelle River, intersects CAW property at various locations, and then crosses the Maumelle River in Critical Area B. CAW has worked with Exxon-Mobile to improve the safety system on the pipeline, which includes check valves that shut down flow in the event of a break in the line. An extra check valve has been installed at CAW's request. At least weekly, Exxon-Mobile conducts aerial surveys along the pipeline. CAW should continue to work with Exxon-Mobile to maintain or enhance the current level of management.

Even if long-range transport of large quantities of hazardous waste through the watershed is prohibited there will be potential minor transportation sources that

Section 5 Mitigate Hazardous Material Spills—Recommended Actions

cannot be wholly eliminated. Development will bring with it local deliveries of fuel oil, lawn care service trucks, exterminators, septage pumpers, and so on. Indeed, any internal combustion vehicle in the watershed is a potential source of toxic material spills in a traffic accident. Transportation spills of this type will generally be of small volume, and thus of lower risk.

- Ensure adequate emergency response capabilities, as outlined above for major sources.
- To the extent possible, design road drainage systems so that they divert water to pervious areas or route water through detention basins—both of which will lessen the potential transport to flowing waters and provide greater time for emergency response.

6 IMPROVE AND MAINTAIN EXISTING ROADS

Roads can be a major source of loading of sediment and associated pollutants through both direct and indirect means. Unpaved roads are a major direct source of sediment loading, including fine sediment that leads to elevated turbidity. Traffic continuously grinds the bed material of unpaved roads, resulting in a source of fine sediment that may be washed off or eroded by storms. Paving the road surface reduces direct erosion, but can still result in large sediment loads as runoff from paved roads generates high energy flows that can erode road margins and ditches. Scoles et al. (2001) report for the Alum Creek watershed that the average soil loss rate for unpaved roads was 73.2 tons per mile per year, while the load delivered to streams was 10 tons per mile per year. A separate WEPP model analysis reported by Alan Clingenpeel of the U.S. Forest Service (personal communication, December 2005) estimated annual average sediment delivery to streams for various types of unpaved roads ranging from 15.8 to 22.6 tons per mile per year in the Ouachita Mountains. Paved roads were estimated to yield 4.8 tons per mile per year, or about one quarter the rate of unpaved roads. As a result, a major portion of the existing sediment load to Lake Maumelle is derived from roads, and additional roads will be constructed as development occurs.

Minimizing the impacts of roads requires a number of actions that address road design, road surface, and road drainage. Loads from existing roads can be addressed by paving the surface and redesigning drainage to lessen impact. (As discussed in Section 3.5, new roads can be designed from the start to reduce impact.)

6.1 Develop Strategic Plan for Unpaved Roads in the Watershed

Unpaved roads are a major source of sediment load in the watershed, but not all road segments present equal risk. A flat unpaved road segment in good maintenance and drainage that diverts flow onto adjacent pervious areas may deliver very little sediment to streams; however, a road segment on a steep slope leading to a stream crossing and with poorly maintained drainage can yield enormous sediment loads.

Mitigation of the impact from existing unpaved roads can occur through paving and drainage improvements. Because this is expensive, it is important first to prioritize unpaved road segments as sediment sources. The first step is thus a visual inventory of existing unpaved road segments, with particular focus on points where the road drainage is connected to streams. (Segments should be defined by the road drainage network.) Roads that show visual signs of erosion and that have drainage connected directly to a stream should in general receive the highest priority. A road that experiences erosion, but where drainage ditches are routed through upland vegetation would have a lesser priority, while a road

Mitigation of the impact from existing unpaved roads can occur through paving and drainage improvements.

Recommendation:

CAW and the Watershed Stewardship Council should form a task force to set priorities and locate funding for road improvement projects.

segment with no evident signs of erosion and no direct drainage connection to streams would have the lowest priority.

Once a candidate list of "problem" road segments is identified, quantitative measurements of road surface/ditch condition and drainage patterns need to be obtained. The WEPP-Road program can then be used to develop a quantitative prioritization based on estimated sediment delivery. Results should be summarized both in terms of load per mile and load per segment, and priority assigned to those segments with the greatest total estimated loads. A scaling factor could be used to assign higher priority to roads that deliver sediment loads directly to tributaries within a short distance of the lake margin.

Personnel with both the U.S. Forest Service and the Arkansas Forestry Commission have considerable expertise in the assessment of unpaved roads. CAW should investigate whether contracting/funding mechanisms exist to involve these experts in the road prioritization. Otherwise, a variety of private consultants are available to provide these services.

The road segment prioritization project will identify those road segments that contribute or are at risk of contributing the greatest sediment load. High priority segments should then be evaluated for potential mitigation by paving and/or drainage improvements (or, alternatively, closure). In many cases, paving alone may not be a sufficient response, as paving may actually exacerbate erosion of poorly designed ditches. For some segments, drainage improvement may be more important than paving, but maximum load reductions will likely be obtained by a combination of the two.

WEPP-Road applications developed during the prioritization process can be used to evaluate potential load reductions and further rank projects based on cost-effectiveness.

CAW and the Watershed Stewardship Council should form a task force of interested parties to set priorities on which road segments should be improved, types of improvements needed, funding required, and funding sources.

7 CONTINUE GOOD LAKE MANAGEMENT PRACTICES

7.1 Continue Strong Regulation of Reservoir Uses Consistent with Stewardship of the Lake

Lake Maumelle is not only a drinking water supply source. The beautiful lake and watershed draw residents from Pulaski, Saline, and Perry counties to fish, sail, picnic, bird watch, and enjoy the stunning scenery (Figure 24 and Figure 25). It is also a regional and state tourist attraction, drawing visitors and school kids year round.

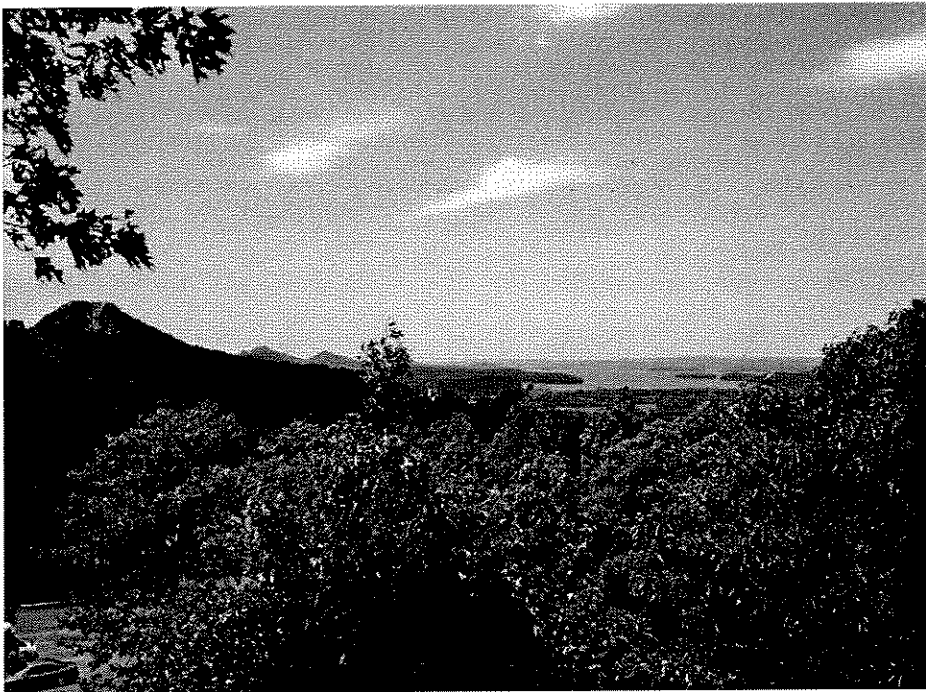


Figure 24. Lake Maumelle View from Pinnacle State Park

Although the CAW Board has provided for limited recreational use of the lake, the Board may curtail or entirely prohibit all authorized uses if it believes such action is necessary to protect the water supply. Therefore, a very important part of this Watershed Management Plan is the set of Rules and Regulations adopted by the CAW Board of Commissioners for the use of the reservoir. All persons using the Lake Area for recreational purposes must abide by the Rules and Regulations. CAW urges all persons using the Lake Area to cooperate with and abide by the Rules and Regulations so that CAW can continue the authorized recreational uses of this beautiful area.

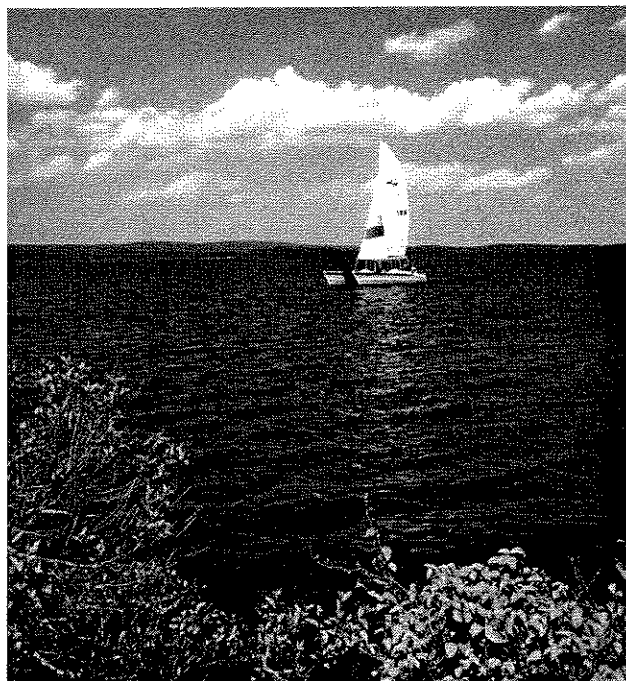


Figure 25. Sailing on Lake Maumelle

Recommendation:

CAW should continue strong regulation of reservoir uses, monitor lake activity as development occurs in the watershed, and adapt regulations as needed to ensure stewardship of the lake and protection of the drinking water supply.

Appendix B contains the full set of rules and regulations adopted by the Board. This Plan recommends the continued strong regulation of reservoir uses as reflected in the current rules, and encourages CAW to monitor lake activity as development occurs in the watershed, and modify the use regulations as needed to ensure stewardship of the lake and protection of the drinking water supply. Below are selected rules and regulations, adopted by the Board, that are especially important to maintaining Lake Maumelle's high quality water supply.

General

The Board may, without prosecution, suspend or revoke the privileges of a person whom it believes to be in violation of the rules. The Lake Wardens have authority to enforce the Rules and Regulations. The wardens and other law enforcement officers have authority to issue tickets and make arrests for violations of the rules.

To protect water quality, Lake Maumelle consists of two zones. The establishment of the zones and the map are parts of the official Rules and Regulations. Special and clearly visible markers and buoys distinguish the area of the restricted zone from the remainder of the lake (unrestricted area).

The unrestricted Lake Area is open to boating and fishing only during the hours of 6 a.m. to 8 p.m. November 1 through March 31 and 24 hours a day from April 1 through October 31.

No persons other than Water Utility personnel or law enforcement officers engaged in the performance of their duties may enter or exit the Lake Area other than at points of entry that the private dock operators have leased for this purpose, or at areas that the Water Utility has marked clearly as picnic facilities.

Selected Prohibited Activities (See Appendix B for complete list.)

- No person shall perform an act in the Lake Area that tends to pollute the waters of Lake Maumelle other than acts that are permitted by the Rules and Regulations.
- The Water Utility has provided appropriate receptacles for waste and prohibits lake patrons from depositing refuse, cans, trash, garbage, or human waste on lands or waters in the Lake Area, except in the receptacles that the Water Utility has provided for said purposes.
- The emptying of a toilet into the lake is prohibited.
- Cooking and the building or setting of fires in the Lake Area are prohibited, except in fireplaces that the Water Utility has established in picnic areas. Lake patrons may not smoke or build fires in the facilities during burn bans in effect by order of the Arkansas Forestry Commission or Pulaski County Judge.
- Swimming, bathing, wading, and the use of aquaplanes, surfboards, motorized surfboards, wind-powered surfboards, personal water craft, water skis, rafts, kayaks, or other similar devices or vehicles that the Rules and Regulations do not expressly permit are prohibited. Skin diving and aqua-lung sports are prohibited (Figure 26).
- No person willfully shall permit livestock in the Lake Area.

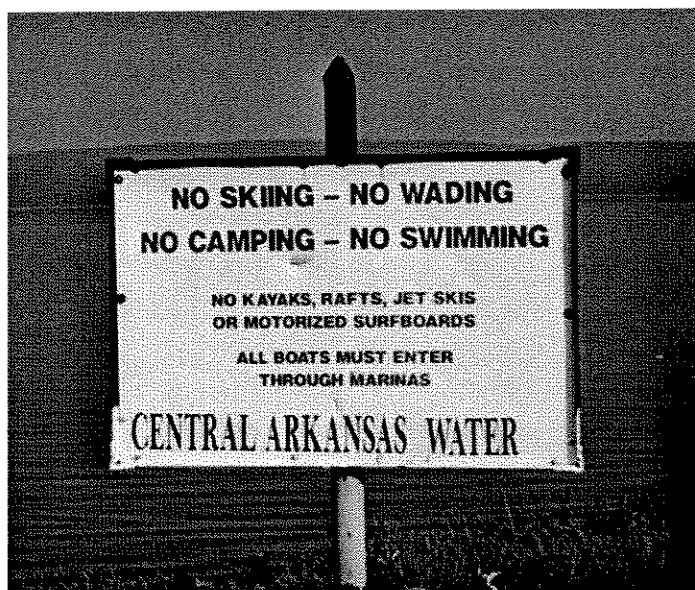


Figure 26. CAW Reservoir Use Regulations

Fishing (See Appendix B for complete list.)

- Fishing is prohibited in the restricted zone (Zone 1). Zone 2 is open to fishing activities (Figure 27). (Note: Zone 1 is similar to Critical Area A.)

Boating (See Appendix B for complete list.)

- In Zone 1 (restricted area), the Water Utility prohibits all boating activities, with the exception of boating activities by Lake Wardens, Water Utility,

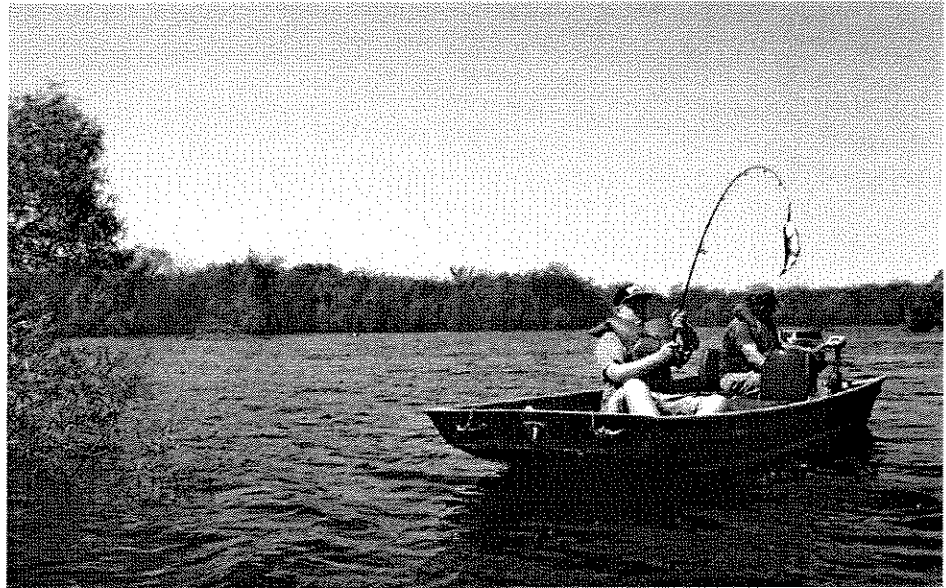


Figure 27. Fishing on Lake Maumelle

Arkansas Game & Fish Commission, and United States Geological Survey personnel, and law enforcement officers engaged in the performance of their duties. Zone 2 is open to boating activities.

- The lake and Lake Area are not open to boats with an unblocked through-the-hull toilet.
- A boat operator shall not launch or operate a boat on the lake without a prior thorough cleaning of the boat's interior and exterior.
- Lake patrons may place boats upon the Lake Area only at points of entry that the private dock operators have leased for said purpose or at the designated hand-launch area at Sleepy Hollow. Launching at Sleepy Hollow requires a valid launch permit.
- Boat owners/operators shall restrict their operation of boats with a primary motor of less than nine horsepower to the Lake Area west of the Arkansas Highway 10 Bridge. Sailboats are not subject to this rule.
- Lake patrons shall restrict canoeing to the Lake Area west of the Arkansas Highway 10 Bridge. Canoe launching is permissible at Sleepy Hollow and at the access west of the Arkansas Highway 10 Bridge; however, actual canoeing activity must remain west of the bridge.

Dock Operators

- Dock operators shall store and handle gasoline, oil, and other inflammable liquids in a manner satisfactory to the Water Utility and in compliance with all state and federal regulatory requirements.
- Dock operators shall be responsible for requiring that boat operators thoroughly clean the interior and exterior of all rented boats and private boats prior to launching or prior to leaving the dock area.

7.2 Continue Managing Boat Marina Operations

Two entities manage boat use on Lake Maumelle: the Grande Maumelle Sailing Club and Jolly Roger's Marina (Figure 28). CAW owns the land on these sites, and leases it to the respective parties. To date, monitoring of the lake indicates that the current level and types of boating activity are causing no water quality problems due to ongoing best management practices. It is recommended that CAW continue to work with the Sailing Club and Marina to sustain the current best management practices and to strengthen management in several areas, as noted below.

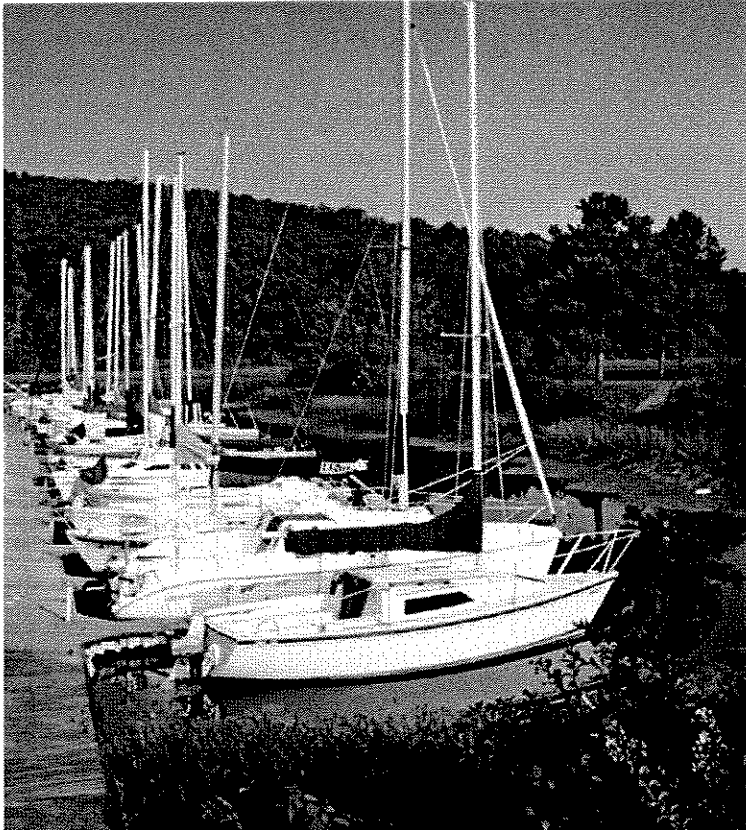


Figure 28. Lake Maumelle Boat Marina

Recommendation:

CAW should continue to work with the Sailing Club and Marina to strengthen and sustain best management practices.

Protect the Shoreline and Streambank

Currently, both the Sailing Club and the Marina sites have stable shorelines with only a few areas that need to be improved. As conditions may change in the future, the sites should be evaluated periodically to determine the further need for stabilization measures. Vegetative stabilization is the preferred method of stabilization and should be used except where a serious erosion problem occurs. If structural methods are needed, methods should be chosen that incorporate revegetation. Wetland restoration near the shoreline can help reduce erosive wave energy and filter pollutants. Breakwaters should be properly designed and maintained to protect marina shorelines from wave energy. "No wake" markers and enforcement should be used near the shore to prevent boats from gaining excessive speed and creating high energy waves.

The Grande Maumelle Sailing Club has been applying several of the above strategies and has been successful in maintaining much of its shoreline in a natural, stabilized state. The club has two launching areas: a sandy beach for launching catamarans and a concrete launch for boats on trailers. The sandy beach erodes into the lake, and the club periodically replaces the sand by recapturing the eroded sand or by adding new sand. The club has minimized erosion from excessive current caused by fast-moving boats through the following methods. The catamaran launch is protected by a breakwater, and the club has posted “no wake” markers in the area to remind boaters to move slowly behind the breakwater. Club members have further reduced this erosion by laying carpet on the sand when launching boats. Aside from the areas used for the two boat launches, most of the remaining shoreline at the sailing club is protected by natural forest (see Figure 29).



Figure 29. Lake Maumelle Natural Shoreline

At the Marina, rip rap is currently being used to control erosion and stabilize the jetty. The remaining shoreline is in a natural condition and well-stabilized. Several concrete ramps exist on the site and should be monitored for excessive erosion, especially along the edges; however, this erosion is not likely to be significant. The marina has posted no-wake markers to remind boaters to move slowly behind the jetty.

CAW should continue to work with the sailing club and marina to prevent the introduction of *Hydrilla verticillata* or other aquatic invasive plants. One of CAW's rules and regulations is that boat operators must thoroughly clean the interior and exteriors of boats before they enter the lake. This rule reduces the risk of introducing an aquatic invasive. CAW should work with the sailing club and marina to increase enforcement of this rule and to further educate boaters on the problems associated with *Hydrilla*.

Recommendation:
CAW should work with the Sailing Club and Marina to strengthen efforts to prevent introduction of aquatic invasive plants to Lake Maumelle.

Manage Chemical Pollutants in Stormwater Runoff from Marina Operations Area

Stormwater runoff from the sailing club and marina is not expected to present a significant risk to lake water quality due to high dilution volume relative to source magnitude. However, good housekeeping and stormwater management should be used to minimize the toxins—such as paint dust and petroleum products—that are washed off of impervious surfaces during storm events. CAW should work with the board of Grande Maumelle Sailing Club and the operator of Jolly Roger's Marina to ensure continued good practices and encourage increased implementation of the following management measures. Boat repair and maintenance should be performed on concrete work pads that are located as far from the lake as possible. To further reduce pollutant loading, stormwater treatment BMPs could be constructed to treat stormwater runoff from the work and parking areas. Potential BMPs include grassed filter strips, grit/oil traps, or bioretention areas. Commercial entities should use vacuum sanders when removing paint from boat hulls. Hull maintenance areas, roads, driveways, and parking lots should be regularly swept or vacuumed.

The Grande Maumelle Sailing Club has plans to construct several concrete work areas in the back of their leased property, farthest from the lake. Improvements to hull maintenance areas are recommended for the marina as well. Currently, the work area at Jolly Roger's marina is located about 100 feet from the shoreline. CAW should work with the marina to add a work area to the back of the property (farthest from the lake), for large maintenance jobs. If a small work area is added, the reduced risk of contamination should outweigh impacts from forest disturbance. The marina parking lot has at least a 30-ft grass buffer along most of its perimeter, which helps to intercept and filter stormwater runoff. To further reduce pollutant loading from the parking lot, CAW could consider installing bioretention cells, grit/oil traps, or other treatment devices.

Solid and Fish Waste Management

The Grande Maumelle Sailing Club and Jolly Roger's Marina are currently handling solid and fish waste in a manner that protects Lake Maumelle water quality. Grande Maumelle Sailing Club currently uses a dumpster for its solid waste, and the dumpster is equipped with a closing top. The club's members do not fish, so fish waste management is not required. The marina also has a dumpster with a closing top, and several management practices are in place to minimize improper fish waste disposal. Fish cleaning is not allowed at the marina, and patrons are expected to clean fish and dispose of fish waste at home. The sailing club and marina should continue the above practices to maintain the current level of solid and fish waste management.

To further improve solids management on the site, the following practices should be used by both the sailing club and marina. Boaters should continue to avoid hull maintenance activities while boats are in water. In-water maintenance should be limited to activities, like propeller work and hull inspection, that do not generate solid waste. Trash receptacles should continue to be placed in convenient locations at both sites. Maintenance crews should regularly transfer trash to dumpsters so that receptacles do not overflow. Covered receptacles and dumpsters should be used to prevent tipping by heavy wind, tampering by wildlife, or

Recommendation:

Educational materials and training should be provided to Marina employees for the safe use, storage, and disposal of hazardous materials.

overflow during rain events. To discourage boaters from disposing of waste in the lake, managers could provide boaters with trash bags.

To prevent release of hazardous materials into the lake, marina and club managers should provide hazardous materials collection or educate patrons on the proper disposal of hazardous waste in the watershed. Typical hazardous waste on marina sites includes lead acid batteries and used oil filters. Hazardous materials should be stored in a covered location on an impervious surface, and these materials should be transported to either a recycling center or disposal facility for hazardous wastes.

Ensure the Proper Use, Storage, and Disposal of Hazardous Liquid Material and Cleaning Solutions

No significant liquid hazards are expected at the sailing club. The club does not have a fueling station, and only four motorized boats are owned by the club. Most boats used by the club members are non-motorized. Pressured water for washing boats is only available in the work areas, and non-toxic soap is typically used to wash boats. The sailing club should continue to maintain this level of management.

The marina is generally managing liquid hazards properly, but opportunities exist now and in the future for improved management of liquid hazards. The marina has a fueling station which is designed according to regulations for spill control, and the fueling station should continue to be maintained at these standards. In addition, the marina staff should keep hazardous materials—including but not limited to used batteries and petroleum products—on an impervious surface in the administration building or other covered structure, and properly dispose of such material.

Educational materials and programs should be used to promote safe storage and use of hazardous liquids. Employees should be trained in the proper handling and disposal of hazardous liquids so that they can act as role models and educate patrons on a daily basis. The facilities could provide products that help facilitate proper materials handling; for example, phosphate-free, non-toxic cleaners could be provided, or oil absorption pads could be provided at the marina's fueling station to help patrons reduce fuel drips during fueling.

Sewage Facility Management and Maintenance

The current level of sewage facility management protects the water quality of Lake Maumelle and CAW should work with the board of Grande Maumelle Sailing Club and the operator of Jolly Roger's Marina to ensure the continued practice of the following management measures. Discharge of sewage into Lake Maumelle is prohibited according to CAW's rules and regulations. Both the sailing club and the marina provide restrooms in a convenient location. At the marina, CAW recently installed a dual grinder pump station with audio and visual alarms in case of failure. A new septic system for the sailing club has been approved and will be installed in the near future.

Sewage facilities should continue to be regularly inspected and maintained at the marina and sailing club. Clean and dry restrooms should also be maintained to encourage use of the facilities. To further reduce fecal and sediment contamination, the feeding of birds, especially large water fowl, should be prohibited.

Section 7 Continue Good Lake Management Practices—Recommended Actions

Dump and pump out stations could be provided at low or no cost to discourage patrons from illegally dumping sewage. Since the marina does not currently have these facilities, CAW could work with the operator of Jolly Roger's Marina to install these facilities. The location of portable toilet dump stations near docks could help encourage use by patrons.

The Clean Vessel Act Pumpout Grant Program, administered by the U.S. Fish and Wildlife Service, provides grants for boater education as well as pumpout facilities installation. In the past, the State of Arkansas has received funding from this program for educational projects. Grants are awarded to state governments, and then states can sub-grant funds to public or private marinas. This funding source could be used to provide pumpout facilities for the marina or to educate marina patrons on the proper disposal of sewage.

8 CAW – SETTING THE EXAMPLE

8.1 General Management of CAW Property

Currently CAW owns 7,200 acres of land in the watershed or 8,190 acres if one includes the land currently condemned and in litigation (see Figure 11).

CAW manages its property to minimize pollutant loading and protect the water quality of Lake Maumelle. CAW should continue its current level of management and seek opportunities to further reduce pollutant loading in the future.

CAW owns and operates a pump station that is associated with the Lake Maumelle drinking water intake. The site includes a house, intake structure, boat shelter, parking area, and lawn (Figure 30). CAW currently limits the use of herbicides and fertilizers on this site. CAW has also designed the pump station generator and diesel fuel storage tanks so that if a failure occurs, berms will contain the spill and any fuel leakage will drain outside of the watershed. A secondary containment system is currently under review and is likely to be constructed in 2007. CAW is currently using a synthetic hydraulic oil that degrades in sunlight. CAW does not anticipate any future construction projects that will require major disturbance of the site; however, if construction does take place on CAW property, CAW will implement strict sedimentation and erosion control practices to protect the lake from sediment loading during construction.

Recommendation:

In managing its property, CAW should continue its current level of water quality protection measures and seek opportunities to further reduce pollutant loading in the future.



Figure 30. CAW Property Near the Intake Structure

CAW owns and operates several parks at which trash receptacles and portable toilets are provided. The trash receptacles at these locations are covered. Hand launch of boats is allowed at a park along the Maumelle River, upstream of the Highway 10 bridge. CAW should continue to provide these facilities and maintain the current level of management at these parks.

CAW has established a comprehensive list of rules and regulations for public recreational use of Lake Maumelle. Monitoring indicates that current rules and regulations are sufficient to protect lake water quality at the present level of recreational use. If boat traffic increases in the future and causes a significant increase in shoreline erosion, CAW could consider one of the following measures: 1) restricting boating permits; 2) setting a speed limit for boats; and 3) setting a maximum allowable horsepower for outboard motors.

As discussed in Section 5, Exxon-Mobile pipeline intersects CAW property and was recently reactivated. The safety system on the pipeline includes check valves that shut down flow in the event of a break in the line, thus minimizing the spill. An extra check valve has been installed at CAW's request. Exxon-Mobile conducts aerial surveys along the pipeline at least weekly. CAW should continue to work with Exxon-Mobile to maintain the current level of management. Additionally, CAW should work with Exxon-Mobile to examine methods used for maintenance of the pipeline easement to ensure maximum protection of water quality (i.e., types of pesticides, herbicides, fertilizers, and erosion and sedimentation controls used).

The majority of CAW's property is under natural forest cover. The lake and forested land area are policed by CAW's patrol staff. CAW has limited access to land north of the lake due to lack of roads. They have been using game cameras to record trespassers. Evidence exists of people bringing pets onto CAW property as well as ATV use. Trespassers are probably gaining access from adjacent properties, the Ouachita Trail, or the pipeline easement. An old roadway also exists on the site. To reduce impacts from trespassers, CAW should continue to use game cameras where effective, increase signage and fencing, and increase enforcement on the north side of the lake.

CAW currently does not manage its forested areas to reduce the risk of forest fire. CAW should work with the Arkansas Forestry Commission to implement forest fire prevention strategies, taking care to balance the risk of forest fire and sediment loading from prevention strategies. Section 6 – Maintain Good Forest Practices – discusses these strategies in more detail. It is also recommended that CAW work with a Land Trust to develop a Stewardship Plan for its conservation land. Such a Stewardship Plan could further reduce risk of forest fires.

The Arkansas Game and Fisheries Commission (AGFC) currently manages a fish nursery pond on CAW property. To protect the lake from eutrophication, AGFC does not use phosphorus-containing fertilizer. The U.S. Geological Survey regularly monitors the water quality of the pond and its impact on lake water quality. CAW should continue to work with AGFC and USGS to ensure that nutrient loads from the pond do not exceed the nutrient capacity of the lake.

CAW should also work with those maintaining the major power line easements to ensure maintenance practices that protect water quality (i.e., types of pesticides, herbicides, fertilizers, and erosion and sedimentation controls used).

8.2 CAW Supporting Implementation of the Management Plan

Central Arkansas Water is committed to the development of a comprehensive watershed management plan that protects the water quality of Lake Maumelle. In doing so, CAW will explore and financially support various approaches that are beneficial to preserving the water quality, as well as work with watershed property owners and other private and public entities in the watershed. Some of the approaches under consideration are:

- Funding for a Watershed Stewardship staff position.
- Funding for a Watershed Administrator staff position.
 - Cost for two positions estimated to be \$135,000 to \$185,000 including salary, fringe and overhead.
- Purchasing land to offset any watershed property owner exemptions.
 - Cost estimated to be \$7.5 million (in year 2006 dollars) assuming acquisition of land fee simple and through conservation easements for an average cost of \$5,000 per acre.
- Working with existing water systems in the watershed to provide supplemental water.
 - Cost to be determined.
- Working with existing watershed property owners to provide water service in accordance with existing policies.
 - Cost to be determined.
- Working with small property owners in the watershed to cost-share on agricultural best management practices.
 - Cost estimated to be \$10,000 per year.
- To collect household hazardous.
 - Cost estimated to be \$12,000 per year.
- Working with Perry County to fund a way to collect household hazardous waste for watershed property owners in Perry County.
 - Cost to be determined.
- Funding for training of existing volunteer fire department personnel within the watershed on response measures that go beyond existing procedures for hazardous waste spills.
 - Cost to be determined.
- Working with county governments on the best approach for plan implementation.
 - Cost of staff time covered by Watershed Stewardship and Administrator positions.

Recommendation:

CAW should demonstrate its commitment to watershed planning by ensuring adequate funding for plan administration and implementation, and by working with stakeholders to develop and implement watershed protection approaches.

Lake Maumelle Watershed Management Plan

- Continuing existing ambient water quality monitoring program and conducting special monitoring studies as needed.
 - Estimated cost \$400,000 per year.
- Working with county governments on a cost-sharing approach to pave certain critical roads.
 - Cost to be determined.
- Working with gas pipeline and powerline utility owners to ensure easement maintenance practices support water quality protection.
 - Cost to be determined.
- Working with landowners who wish to place a conservation easement on their land. Such landowners may receive federal and state tax benefits.
 - Cost to be determined.
- Working with the state legislature to provide local preferential tax assessment for conservation easements.
 - Cost to be determined.

CAW has evaluated the costs of implementing the plan in light of its programmed rate structure and has determined that these costs will pose no substantial rate increases to CAW customers (other than those increases already programmed). However, CAW will use the plan to apply for various grants available to assist in providing funds to support the above approaches.

VOLUNTARY STEWARDSHIP RECOMMENDATIONS

- 9 Maintain Good Forest Practices
- 10 Encourage Good Livestock Management
- 11 Encourage Good Household Practices

9 MAINTAIN GOOD FOREST PRACTICES

Forestry BMP implementation is voluntary in Arkansas, and the Arkansas Forestry Commission (AFC) conducts a BMP implementation survey every two years to monitor implementation. Using the AFC survey data, Tetra Tech found a 92 percent overall implementation rate for sites in the vicinity of the Lake Maumelle watershed in Perry and Pulaski counties. However, potential problems may exist when land is timbered in anticipation of sale or new development(s) and proper BMPs are not employed. Based on the survey results, on field work during the watershed assessment, and on concerns raised about potential fire hazards, the plan recommends:

- Maintaining current levels of BMP implementation in the watershed for harvesting and other non-road forestry BMPs.
- Encouraging better use of forest road BMPs.
- Developing an enhanced fire management plan for the watershed.

9.1 Encourage Continued Use of Good Harvest BMPs

There are strong incentives for timber companies and large timber producers to implement forestry BMPs because these practices reduce soil loss and maintain the productivity of forest stands. This incentive is particularly strong in the Lake Maumelle watershed where the topsoil layer is thin and highly erodible. The incentive to reduce soil loss coupled with the Arkansas Forestry Commission published and accessible guidance on BMPs for timber harvesting have contributed to the very high rate of BMP use for harvesting activities in the watershed. This plan recommends taking action to encourage the continued use of good harvest BMPs.

One of the major harvesting BMPs is the spreading of organic material called “logging slash,” which typically covers a site after harvesting (Figure 31). Another important harvesting and site preparation BMP is subsoiling, which creates small depressions that collect rainwater and suspended sediment (Figure 32). The AFC also recommends devices called “water bars” on skid trails and fire lines to direct runoff away from disturbed surfaces and allow sediment to settle in undisturbed areas. BMPs related to regeneration activities minimize disturbance and compaction of the soil by heavy equipment. Forestry BMPs include the planning of streamside management zones (SMZs) that reduce the degree of disturbance near streams, including minimizing stream crossings (Figure 33). AFC also emphasizes that planning is essential to successful BMP implementation. Proper BMP planning involves the identification of sensitive areas and the evaluation of site-specific conditions prior to the selection of forestry BMPs. Forestry practitioners should be trained in BMP implementation, and AFC recommends the use of technical assistance providers.

Proper BMP planning involves the identification of sensitive areas and the evaluation of site-specific conditions prior to the selection of forestry BMPs.



Figure 31. Forestry Harvesting BMP: Logging Slash



Figure 32. Forestry Harvesting BMP: Subsoiling

Another reason that high BMP implementation was measured in the watershed is that timber producers are participating in the Sustainable Forestry Initiative (SFI®). Companies who are SFI participants pledge to follow state forestry BMP guidelines and agree to pursue SFI third-party certification, which involves an audit of BMP implementation by an independent auditor. A key requirement of



Figure 33. Forestry BMP: Maintain Adequate Stream Buffers

The continued training of forestry professionals in BMP implementation is important to minimizing impacts from forestry practices.

SFI certification is employee training. The Arkansas Timber Producers Association maintains the Ark Pro Logger Training Program, which includes classes on BMPs. Implementation of forestry BMPs is a site specific process and requires the ability to choose BMPs based on unique erosion problems and other specific conditions encountered at each site. The continued training of forestry professionals in BMP implementation is an important component to minimizing impacts from forestry practices.

9.2 Encourage Better Use of Forest Road BMPs

The AFC survey and Tetra Tech's field reconnaissance did show that there is room for improvement in the use of forest road BMPs (Figure 34). Therefore this plan recommends increased implementation of forest road BMPs by landowners throughout the watershed, including small landowners and large landowners such as Deltic, Weyerhaeuser, and the U.S. Forest Service. Use of the following types of BMPs would reduce existing and future sediment loading to the lake:

- Broad-based Dips – A forestry BMP for roads in active use. Broad-based dips direct runoff away from the road surface while allowing normal vehicle travel over roads.
- Water Bars – A forestry BMP for inactive roads, firelines, and trails. Water bars direct runoff away from the road surface. Water bars can be easily damaged by vehicles and should not be used for active road drainage.
- Water Turnouts – A drainage ditch that drains runoff away from roads.
- Seeding and mulching or stabilization – Bare areas should be seeded and mulched or otherwise stabilized as soon as possible after disturbance.



Figure 34. Problem Forestry Road in Need of BMPs

- Application of Aggregate – Where needed, aggregate or other suitable material should be applied on the approaches to fords, bridges, and culvert crossings.
- When a forest road is retired, proper BMPs should be implemented to stabilize the retired roads and minimize future erosion. Water bars should be installed on retired roads according to AFC guidelines. Bare soil should be revegetated under soil and weather conditions that promote rapid establishment of plants. The retired roads should be inspected periodically to ensure that water bars are functioning properly and that vegetation has been successfully reestablished. Vehicular traffic should be blocked from the entrances and exits of retired roads using gating, large earthen berms, ditching, fencing, or other barricades.

The AFC should continue to publish and make accessible guidelines for forest road BMPs. The Arkansas Timber Producers Association should host more frequent Ark Pro Logger workshops in the watershed focused on the use of forest road BMPs. A more detailed survey of unpaved roads in the watershed would help determine where BMPs are most needed and what funding sources could be used to correct those problems. Outreach to small landowners should include promotion of the USDA Environmental Quality Incentives Program (EQIP). EQIP provides incentive payments and cost-shares for agricultural conservation practices, including forest road BMPs.

9.3 Develop Enhanced Fire Management Plan

A fire that destroys a whole stand of forest could substantially increase pollutant loading. Fire prevention strategies can help reduce this risk; however, prevention strategies can increase sediment loading from forest land. A balanced plan

Section 9 Maintain Good Forest Practices—Voluntary Stewardship Recommendations

is required to minimize the total impact on water quality, considering potential chronic impacts from prevention strategies and larger, acute impacts from forest fires. Professional foresters operating in the watershed currently use fire prevention strategies. This Plan recommends that an enhanced fire management plan be developed. This enhanced fire management plan should prescribe the timing and location of fire prevention and suppression strategies to minimize the impact to Lake Maumelle water quality.

The major forest fire prevention techniques are firelines, thinning, and prescribed burning. The enhanced fire management plan should focus on carefully planning the use of firelines and fire retardant, as these techniques could have an impact on water quality in the event of a large forest fire near Lake Maumelle. Fire retardant has a similar chemical composition to fertilizer and generally contains phosphorus, nitrogen, and potassium. The plan should identify where fire retardant can be dropped during a fire without risk of excessive nutrient loading to the lake. The use of fire retardant should remain as an option in case a fire is too severe to control without fire retardant. Fire prevention efforts should be focused in the near lake area so that the need for fire retardant is minimized.

The fire management plan should prescribe a program that works with developers to create firelines during development construction and ensures the maintenance of these firelines. The plan should also recommend the frequency and amount of thinning and prescribed burning that would help prevent forest fires in the watershed without a significant increase in sediment loading. Soil type and rock content should be considered when weighing the risks of fire and sediment loading. If a forested area has relatively rocky soil, more intensive fire management could be implemented; if an area has highly erodible soil, fire prevention strategies should be minimized to prevent excessive sediment loading.

Currently in the Maumelle watershed and throughout Arkansas, the timber sale inspection officer checks timber operation fire prevention strategies at the time of a timber sale. This practice should be continued to ensure that timber producers have the necessary equipment to prevent and suppress forest fires during timber operations.

The Arkansas Forestry Commission operates the FireWise program that educates communities on fire prevention techniques. FireWise education materials recommend the use of low risk building materials and landscaping strategies. This program facilitates the development and implementation of Community Wildfire Protection Plans (CWPPs). FireWise also offers a certification program for communities as an incentive for developing and implementing CWPPs. This program could help facilitate the planning of thinning, prescribed burning, and low impact fire lines in residential communities.

Development of the Enhanced Fire Management Plan should be led by the Lake Maumelle Stewardship Coordinator working closely with the AFC, the USFS, and CAW. If a Land Trust assists in developing a stewardship plan for conservation land in the watershed, the Trust should also participate in developing the Enhanced Fire Management Plan.

Recommendation:

Development of an Enhanced Fire Management Plan should be led by the Lake Maumelle Stewardship Coordinator working closely with state and federal forestry agencies, CAW, and any Land Trust involved in stewardship planning for conservation land in the watershed.

10 ENCOURAGE GOOD LIVESTOCK MANAGEMENT

In the future, different types of farming are expected in the watershed. There will likely be landowners with a few cattle or horses. There may be horse farms. Pastureland will be needed to support these livestock. Large-scale livestock operations are not encouraged, and proposal of such may be deemed a public health threat that could require actions by CAW to restrain, correct, or abate the operation (see Section 3.6). However, to encourage management of smaller livestock operations that provide for stewardship of the lake, the Agricultural Extension Agents and Lake Maumelle Stewardship Coordinator should reach out to landowners or provide assistance where needed.

The following practices are recommended to landowners who wish to be good stewards of the land and the lake. The measures are voluntary and are not to be included in local ordinances. CAW will assist landowners in finding funding to employ the following best management practices, including state, federal and CAW cost-sharing dollars.

10.1 Recommended Voluntary BMPs

The successful design of farm BMPs depends on careful attention to the specific needs of each site. Landowners should be encouraged to continuously evaluate the conditions on their property and work with agricultural extension agents who have expertise with the farm activities that they are managing.

The coordinator and agents could organize training workshops on BMPs, and inform landowners on how agricultural extension agents can work directly with them to implement site-specific management measures.

Outreach to small landowners should include promotion of the USDA Environmental Quality Incentives Program (EQIP). EQIP provides incentive payments and cost-shares for agricultural conservation practices. The following paragraphs describe the major recommended BMPs for livestock operations. When new development includes livestock operations, the local government and/or CAW should enter into an agreement with the landowner to implement the following management practices. In addition, CAW is exploring cost-sharing for needed BMPs for small landowners.

10.2 Livestock Best Management Practices

Livestock operations either consist of confinement or pasture systems. If a confined operation is greater than 1,000 animal units or is determined to threaten water quality, the operation requires a federal Concentrated Animal Feeding Operation (CAFO) permit. CAFOs are required to develop a nutrient management plan (NMP) as part of the CAFO permitting process. The CAFO NMP consists of manure management and disposal strategies that minimize the release

Voluntary Stewardship

Practices: Landowners are encouraged to continuously evaluate the conditions on their property and to seek assistance (including cost sharing) for implementation of site-specific best management practices.

of excess nutrients into surface and ground water. The CAFO NMPs are based on Natural Resources Conservation Service (NRCS) defined standards and technical expertise. Each nutrient management plan varies according to the type of operation and site-specific conditions. In the Lake Maumelle Watershed, even confined animal operations that do not require a CAFO permit should be encouraged to develop NMPs with assistance from agricultural extension agents.

In pasture related systems, management focuses on minimizing the amount of sediment and manure in runoff. Vegetation should be maintained on as much of the property as possible, and Heavy Use Areas (HUAs) should be managed to minimize runoff and erosion. HUAs include any land traveled enough by livestock, people, or machinery such that vegetation cannot be maintained.

A farm should be planned so that the livestock are given the proper amount of space. The landowner should coordinate with a USDA agricultural extension agent to determine the appropriate sizing of pastures, paddocks, barns, stalls, and feeding areas specific to site conditions and type of operation (see Figure 35).



Figure 35. Appropriate Sizing and Location of Stalls and Paddocks

Voluntary Stewardship

Practices: Pastures should be located at least 20 to 40 feet from streams, and vegetated buffer (preferably forest) should be maintained between pastures and streams.

Pastures should be located at least 20 to 40 feet from streams, and a vegetated buffer (preferably forest) should be maintained between pastures and streams (see Figure 36). Vegetated cover should be maintained on pastures at all times; this can be accomplished by fencing multiple pastures and rotating which pastures are used for grazing. Rotational grazing is also important to prevent manure from being concentrated in one location.

Barns, paddocks, feeding areas, and other HUAs should be located a minimum of 100 feet from streams. Since the land within the Lake Maumelle watershed is predominantly hilly or mountainous, it is important to site HUAs on the available level property. HUAs near barns should be located in the least sloped areas around the barn. All HUAs should be located on land that is properly drained (avoiding frequently wet and muddy areas), has less than 5 percent slope, and drains into a buffer area or vegetated filter strip. When accounting for these other factors, the preferred location for HUAs is on land that is more often in the sun (south, west, and east of buildings). HUAs should not be located above a septic system or leach



Figure 36. Forested Buffer Around Streams

field. Since farmland in Arkansas tends to become wet and muddy during the winter, landowners should consider stabilizing HUAs with geotextile, gravel, or concrete if the land cannot support animal use, especially if the muddy conditions persist for more than six months.

The farm facilities should be designed and constructed to minimize contamination of runoff from manure. Runoff from crop fields, hay fields, pastures, and roofs is considered relatively clean runoff and should be directed away from land containing manure. The drainage system should utilize roof gutters, water ditches, channels, waterways, and terraces to divert runoff away from land containing manure. Stalls, paddocks, feeding and watering areas, and manure storage facilities are among the areas where runoff should be minimized.

Livestock operations should maintain dry conditions on paddocks and feeding and watering areas by designing adequate drainage systems. To provide proper drainage, the farm owner may need to add two inches of sand to the surface or build a drain field under the surface, depending on drainage needs. Where runoff leaves these areas, grass filter strips should be installed to treat runoff. Installation of debris basins, filter fences, or other similar devices will provide additional treatment and help manure solids to settle out before runoff is treated by the vegetated filter strip.

To prevent contamination of surface and ground water by pathogens, nutrients, and sediment, manure should be properly collected, stored, and disposed. Manure should be regularly collected from HUAs, but the frequency of manure collection will depend on site-specific needs. Once collected, manure should be stored in a temporary storage facility until it can be properly disposed. The short-term manure storage facility should be located at least 100 feet from wells or surface water and should accommodate six months of manure production. For smaller farms, a temporary storage facility can consist of a high and dry location with a plastic cover. For larger farms, a more permanent storage facility with an impermeable floor is needed to protect water quality; protecting the pile from contact with rainwater will prevent delivery of nutrients and pathogens to streams.

Voluntary Stewardship

Practices: Livestock farm facilities should be designed and constructed to minimize contamination of runoff from manure.

For disposal, manure should be applied to fields either at a rate that crops will use the nutrients or with split applications during the growing season (at a recommended rate). If manure is not applied during the growing season or at a recommended rate, runoff could carry excess nutrients into surface water. Landowners should consult with an extension agent to determine the proper manure application rate for their particular site.

Like manure storage areas, composting facilities should be located on dry, flat, elevated land at least 100 feet from streams. The landowner should coordinate with a USDA agricultural extension agent to determine the appropriate design for a composting facility based on the amount of manure generated (see Figure 37).



Figure 37. Use of Composting Facilities

Landowners should work with an agricultural extension agent to properly design and locate watering facilities. The Arkansas Agricultural Extension recommends collecting rainwater from building roofs (with gutters feeding into cisterns) and using this water in the animal watering system to reduce runoff and conserve water use. The Extension does not have a formal recommendation regarding animal access to streams. However, allowing limited or no animal access to streams will provide the greatest water quality protection. Limited cattle access can be accomplished by fencing pasture along streams (with at least a 20-40 foot vegetated buffer) and constructing a narrow, fenced pathway to the stream. On properties where cattle need to cross streams to have access to pasture, stream crossings should be built so that cattle can travel across streams without degrading stream banks and contaminating streams with manure (Figure 38).

Horse farm owners should design riding facilities to minimize impacts on water quality. General recommendations for reducing the impacts of trail riding include constructing trails (instead of riding off-trail), properly maintaining trails, and using only constructed trails to prevent off-trail disturbance. Some horse farmers choose to build arenas to practice their preferred equestrian event. Much like paddocks, arenas should be designed so that the surfaces stay dry and well-drained. Drainage systems for arenas should be designed to minimize soil erosion both on the arena site and in downstream channels.

Voluntary Stewardship Practices: Allowing limited or no animal access to streams will provide the greatest water quality protection. Landowners should work with an agricultural extension agent to properly design and locate watering facilities.



Figure 38. Narrow Livestock Access to Stream

11 ENCOURAGE GOOD HOUSEHOLD PRACTICES

11.1 Good Household Practices

The Stewardship Coordinator should reach out to watershed residents to encourage the use of good household practices that relate to the following topics: household hazardous substances, landscaping and gardening, unpaved driveways, septic system maintenance, water conservation, pet waste disposal, and automobile maintenance. Since a phased approach is recommended, the Stewardship Coordinator should prioritize which practices could be best targeted. The following paragraphs summarize the major good household practices related to the above topics.

Residents should be encouraged to reduce the use of hazardous substances, find less toxic alternatives, and properly dispose of these substances (see Figure 39). The major good household practices relating to hazardous substances are:

- Purchase and use only the necessary amount.
- Purchase the least toxic or nontoxic alternative. (Note, the outreach program should list the alternatives that are available locally.)
- Dispose of substances through local hazardous waste disposal programs.

Lake Maumelle watershed residents in Pulaski County currently can dispose of hazardous waste at designated collection facilities of the Pulaski County Solid Waste Management District

(<http://www.pulaskiswdistrict.org/chemicals.htm>). These facilities accept household quantities of paint solvents; common household cleaners such as ammonia, bleach, disinfectants, strong cleansers (liquid and powder), degreasers, oven cleaners, spot removers, and drain cleaners; used oil, gasoline, and antifreeze; household, nickel-cadmium and car batteries; and pesticides, insecticides and herbicides. These facilities also accept electronic equipment, including computers, printers, televisions, VCRs, cell phones, rechargeable batteries, microwaves and one-time use cameras. This program is not available to Perry

Recommendation:

The Lake Maumelle Watershed Stewardship Coordinator should reach out to Watershed residents to encourage use of good household practices.



Figure 39. Use Household Hazardous Waste Drop Off Centers

and Saline County residents, however, CAW is exploring providing a household hazardous collection service to Perry County residents in the watershed.

The major good household practices that address the impacts of landscaping and gardening are:

- Revegetate or mulch erodible areas.
- Design landscaping with Low Impact Development (LID) practices to retain stormwater onsite.
- Select plants with low requirements for water, fertilizers, and pesticides.
- Minimize lawn and impervious areas, preserve existing trees and shrubs, and plant additional woody vegetation.
- Compost yard waste on site (grass clippings, leaves, etc.).
- Test soil to determine fertilization needs and calibrate applicators to dispense only the necessary amount.
- Use alternative fertilizers and pest controls (e.g., compost, use plants that discourage pests and attract beneficial insects).

The University of Arkansas Division of Agriculture Cooperative Extension Service (<http://www.arhomeandgarden.org/lawns/default.asp>) can provide information on the appropriate grasses for the Arkansas climate. Arkansas lies in the transition zone between climates suited for cool-season and warm-season grasses (UA Cooperative Extension Service, 2005). Therefore, it is important for residents to understand proper lawn care so that excessive use of lawn chemicals and irrigation can be prevented. The AR Cooperative Extension Service provides information on choosing appropriate grasses and how to maintain them.

The impacts of unpaved, residential driveways are similar to unpaved forestry roads, as discussed in an earlier section. Good household practices relating to unpaved driveways include:

- Reshape or regrade to cut out potholes and restore road crown.
- Add stone to areas with deep mud and improve drainage or reinforce road base with well-drained gravel or geotextile.
- If a road is too dry and vehicle travel creates airborne dust, rework stone into surface, topdress with good surface gravel, and stabilize with calcium chloride.
- Repair rills or gullies and prevent future road washouts by improving road drainage and stabilizing the soil.

If a driveway has not been constructed with the proper drainage design, homeowners could also hire a contractor to regrade the road and install the proper drainage controls. Although road regrading can be costly, properly designed driveways would require less maintenance.

The Watershed Stewardship Coordinator should reach out to households with septic systems built prior to the watershed plan, and encourage them to use good household measures relating to maintaining their septic systems. Note that houses built after the effective date of the plan would have wastewater systems owned,

Section 11 Encourage Good Household Practices—Voluntary Stewardship Recommendations

managed and maintained by an RME (see Section 3.3). These septic system practices include:

- Inspect system annually and empty system about every 3 to 5 years, depending on the tank size. (CAW could consider funding this maintenance of existing systems.)
- Refrain from trampling the ground or using heavy equipment above a septic system (to prevent collapse of pipes).
- Prevent septic system overflow by conserving water, not diverting storm drains or basement pumps into septic systems, and not disposing of trash through drains or toilets.

Outreach efforts on septic system maintenance should also emphasize the importance of water conservation. Water conservation strategies can reduce the risk of septic tank or sewer system overflows, and these strategies include:

- Use low-flow plumbing devices and water-saving appliances.
- Repair leaking faucets, toilets, and pumps.
- Use dishwashers and clothes washers only when fully loaded.
- Limit water use during car washing by using a bucket, only washing the car when needed, or washing the car at a commercial carwash where water is used efficiently and runoff is disposed of properly.

Additional water conservation strategies are available on EPA's Web site at <http://www.epa.gov/OW/you/chap3.html>.

Residents should be aware that using and maintaining automobiles and other equipment with internal combustion engines generates a significant amount of pollution. Residents can reduce the loading of toxic metals and petroleum byproducts released to surface water by cleaning up fluid spills, maintaining vehicles properly, and disposing of used oil and antifreeze at service stations and other recycling centers.

Recommendation:

The Watershed Stewardship Coordinator should reach out to households with septic systems built prior to the Plan to encourage and support proper system maintenance.

MAINTAINING AN ADAPTIVE APPROACH AND MONITORING SUCCESS

- 12.1 Assessment Tools Maintenance
- 12.2 Watershed and Lake Monitoring Program
- 12.3 Plan Performance Evaluation
- 12.4 Plan Updates

12 MAINTAINING AN ADAPTIVE APPROACH AND MONITORING SUCCESS

Land use in the Lake Maumelle watershed is expected to undergo significant changes in the next several decades, replacing forest with residential development in many areas. These land use changes have the potential to increase pollutant loads and degrade water quality in the lake. The Watershed Management Plan is designed to mitigate these risks and protect water quality, using predictions from water quality models and based on assumptions about future development patterns. The ability of the Plan to achieve objectives is unproven. Conditions in the lake and watershed must be monitored and assessed over time to ensure that the Plan is successful, as well as to show where adjustments to the Plan may be needed.

12.1 Assessment Tools Maintenance

CAW should develop and sustain a data management and assessment toolbox to use for tracking conditions in the watershed and lake, and to support analyses for performance evaluation and Plan updates.

One of the first steps will be to determine which selected conditions or parameters will be tracked to evaluate performance over time. Obvious choices include the water quality indicators for the adopted lake water quality targets (i.e., chlorophyll a, total organic carbon, Secchi depth, and fecal coliform bacteria). However, there are other water quality parameters that should be considered including phosphorus and nitrogen series, turbidity and total suspended solids, dissolved oxygen, pH, and more. Additionally, there are non-water quality indicators to consider including parameters such as land cover (with particular emphasis on impervious surfaces, forest, lawn, and pasture), development types and locations, wastewater system types and volumes and locations, and best management practices employed in the watershed. It will likely be difficult to track all parameters of interest, so the Watershed Stewardship Coordinator and Council will need to select a subset of indicators that can represent key performance areas to be tracked. It is recommended that the Council and Coordinator obtain strong input from the Technical Advisory Committee for this decision.

Once tracking parameters have been finalized, the Council and Coordinator will need to have adequate means to support monitoring and assessing those parameters. This will involve methods for collecting, storing and managing information for each parameter. It will also require maintaining and applying assessment tools including lake and watershed models and statistical analyses, which are needed to evaluate the status of the watershed and lake in relation to loading allocations and lake water quality targets. Monitoring data will provide reality checks at certain points in the watershed at discrete (i.e., monitored) times, but it cannot

Recommendation:

CAW should develop and sustain a data management and assessment toolbox to track conditions and support Plan performance evaluations.

Conditions in the lake and watershed must be monitored over time to ensure that the Plan is successful, and to show where adjustments to the Plan may be needed.

be collected continuously at all locations due to practical considerations including level of effort and cost. Thus, modeling tools help extrapolate information to provide continuous spatial and temporal coverage and allow for technically-sound comparison of summer and annual medians to targets that were developed using the models. Determining what questions should be answered in future reports to the Council will guide determination of what tools are needed to conduct the analyses, along with their respective data and resource requirements.

Responsibilities for collecting, managing, and analyzing the data should be established early on to make this a sustainable process. Resources should be invested in developing and maintaining a data management system to support assessment tool maintenance and application. Additionally, resources need to be provided for periodic model or other assessment tool update and application. These anticipated costs will need to be included in annual watershed management operating budgets.

12.2 Watershed and Lake Monitoring Program

CAW, under contract to USGS, has conducted continuous flow monitoring and regular ambient water quality monitoring in Lake Maumelle since 1989. CAW also monitors a variety of parameters in raw water withdrawn from the lake by the water treatment. These monitoring efforts have provided a wealth of information on the watershed and lake under existing conditions, and have enabled the development of calibrated watershed and lake response models.

It is essential that the existing monitoring efforts be continued so that any changes in watershed and lake water quality over time can be tracked and evaluated.

What should be monitored? As part of the Plan development, management objectives were associated with measurable indicators. Target values for key indicators were adopted by the PAC. Success of the Plan can thus be evaluated through these indicators, which must be tracked in future monitoring:

- **Chlorophyll *a* concentrations in the mid-lake and lower lake (intake) areas.** Chlorophyll *a* is used to measure algal growth in the lake. Targets for this indicator are defined as summer growing season (May – September) median concentrations. Samples should be collected at least monthly to evaluate the growing season medians.
- **Total organic carbon (TOC) concentrations in the intake area.** TOC concentrations must be kept low to prevent the formation of harmful disinfection byproducts in the water treatment system. The target is defined as an annual median concentration in the lower lake (intake area), requiring sampling at least monthly throughout the year. Additional information will be provided by CAW's regular analyses of TOC in raw water at the treatment plant.
- **Turbidity.** Maintaining low turbidity is essential to reduce the risk of microbial pathogens such as *Cryptosporidium* in finished water. The target is specified as an annual median in the lower lake (intake area), and is evaluated both in terms of direct turbidity measurements and Secchi depth (a field measurement of water clarity). Both parameters should be measured in the lake on at least a monthly basis throughout the year. In addition, CAW should continue to monitor turbidity in the raw water reaching the treatment plant.

- **Fecal coliform bacteria.** Concentrations of fecal coliform bacteria are another indicator of the presence of pathogens. The target is defined as an annual median concentration in the lower lake (intake area), requiring sampling throughout the year. (Health-based limits apply to individual values as well; however, the modeling results suggest that concentrations should remain many orders of magnitude below these critical values).

A long-term monitoring program should be established building on past monitoring in the watershed and lake. USGS has monitored flow and sampled water quality in Lake Maumelle and its watershed since 1989. Routine water quality samples are collected regularly in the Maumelle River at Williams Junction and at four lake sites along the main axis of the reservoir.

Water quality monitoring should be continued on a regular basis at each of these five sites to enable comparison of current and future water quality conditions. All laboratory and field parameters currently collected should be continued.

The existing ambient watershed monitoring station at Williams Junction is located relatively far up in the watershed. This is not believed to have caused a significant problem for evaluation of existing conditions that reflect sparse development and predominantly forest cover. However, in the future significant amounts of development may occur along Highway 10 between Williams Junction and the lake. It will then be important to measure water quality in the freeflowing part of the lower Maumelle River just above the lake. Tetra Tech therefore suggests that the existing storm event monitoring station on the Maumelle River near Wye should also be sampled as a regular ambient station. This effort should begin as soon as feasible to build up a monitoring record before significant land use changes commence in this part of the basin.

Streams entering Lake Maumelle other than the Maumelle River generally do not flow on a consistent basis, but may provide significant flows and pollutant loads during storm runoff events. During recent years, high-flow event samples have been collected at up to six sites in the watershed. This sampling network should be continued to the extent practicable to aid in evaluation of changes over time. As additional development occurs, it may be desirable to add or move monitoring stations to evaluate runoff from those areas.

Continuous flow gaging over long periods of time is essential to the evaluation of watershed pollutant loading, as well as hydrologic changes. USGS currently operates six flow or reservoir elevation gages in the watershed. Each of these gages should continue to be operated and maintained.

As land use and water quality conditions change, the need may arise for special studies to evaluate specific aspects of the watershed and lake. For instance, if chlorophyll *a* patterns begin to change, algal speciation studies and growth potential tests may be needed to evaluate implications. The need for such studies should be evaluated periodically.

One particular type of special study that may occur is pilot testing for BMPs to meet performance standards. Such studies would be intended to evaluate the sustainability of proposed BMPs and net loading rates for new developments, for both construction and post-construction phases. A detailed monitoring plan would be prepared prior to any such study.

Recommendation:

In addition to the ongoing USGS lake and watershed water quality monitoring, the long-term Lake Maumelle water quality monitoring program should include special studies periodically to support further planning and assessment.

All data collection efforts will be conducted under Quality Assurance Project Plans (QAPPs) that specify sample collection techniques, analytical methods, quality control measures, and remedial actions, among other things.

12.3 Plan Performance Evaluation

Results of monitoring and data collection need to be analyzed and fed back into the decision making process for adaptive management. This will occur in a variety of ways.

First, the entity collecting and reporting a particular type of data will evaluate raw data as they are acquired for any potential values that might require short-term operational intervention at the treatment plant (such as field measurements of high turbidity or observation of an intense algal bloom). Reporting requirements for such interim evaluations will be specified in the QAPP.

Data will then go through the quality assurance process, after which quality-assured (or flagged provisional) data will be made available electronically. Data will then go through the quality assurance process after which quality assured (or flagged provisional) data will be made available electronically. Those responsible for conducting the assessments will then draw on the databases to update or apply tools, analyze data statistically, etc. to perform assessments on the parameters and questions of interest. It is recommended that the Watershed Coordinator, every two years, develop reports of the previous two years' monitoring and modeling results as well as long-term trend summaries. These summaries should focus on the primary water quality indicators/targets and lake loading thresholds, using analyses of updated modeling and monitoring information.

This Plan recommends that the Coordinator provide the biennial summary reports to the Watershed Stewardship Council's Management Tracking Committee for input on evaluation of the Plan's success. The Committee could then make its recommendations on potential adaptive changes to the Plan in light of updated assessments. It is recommended that the Management Tracking Committee and Watershed Stewardship Coordinator, working together, develop a Watershed Stewardship Report biennially to present to the full Council and for public information regarding success of the Plan and recommended follow up management actions.

12.4 Plan Updates

The Watershed Management Plan should be routinely updated. It is recommended that the Watershed Management Plan be updated every 5 to 10 years, considering recommendations on Plan revisions from the Watershed Stewardship Coordinator and the Watershed Stewardship Council. Final action on the Plan update should be taken by the CAW Board.

Recommendation:

Periodic Stewardship Reports should include tracking progress in implementation of Plan recommendations, the effectiveness of actions taken, and modifications or adaptations needed to the Plan and its implementation mechanisms.

Recommendation:

The Watershed Management Plan should be updated every 5 to 10 years.

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APPENDIX A. MENU OPTIONS FOR THE UPPER WATERSHED AREA AND CRITICAL AREA B

Lake Maumelle Watershed Management Plan

Table A-1. Upper Watershed Area – Menu of Options for New Development

1	2	3	4	5	6	7	8
Ave Lot Slope	Min Road Surface	Min Driveway Surface	Min Undist Area	Max % Imperv	Min Lot Size (ac)	Pollutant Loading Limits	Acres Offsite Mitigation per 1 ac of Development
Low Slope							
<i>Non-cluster Development Options</i>							
Low	Gravel	Gravel	15%	9.00%	5	Does Not Meet	1.49
Low	Gravel	Gravel	70%	4.50%	10	Meets	0
Low	Paved	Gravel	15%	8.25%	5	Meets	0
Low	Paved	Gravel	30%	8.75%	5	Meets	0
Low	Paved	Gravel	50%	9.25%	5	Meets	0
Low	Paved	Paved	15%	9.50%	5	Meets	0
<i>Cluster Development Options</i>							
Low	Paved	Paved	15%	7.50%	5 (avg.)	Less than limit	0
Low	Paved	Paved	30%	8.00%	5 (avg.)	Less than limit	0
Low	Paved	Paved	50%	8.50%	5 (avg.)	Less than limit	0
High Slope							
<i>Non-cluster Development Options</i>							
High	Gravel	Gravel	30%	4.25%	10	Does Not Meet	0.37
High	Gravel	Gravel	50%	2.75%	20	Meets	0
High	Gravel	Gravel	80%	3.50%	15	Meets	0
High	Paved	Gravel	30%	4.25%	10	Meets	0
High	Paved	Gravel	50%	4.75%	10	Meets	0
High	Paved	Gravel	70%	5.25%	10	Meets	0
High	Paved	Paved	50%	4.75%	10	Meets	0
<i>Cluster Development Options</i>							
High	Paved	Paved	30%	4.25%	10 (avg.)	Meets	0
High	Paved	Paved	50%	4.75%	10 (avg.)	Less than limit	0
High	Paved	Paved	70%	5.25%	10 (avg.)	Less than limit	0

Appendix A. Menu Options for the Uppers Watershed Area and Critical Area B

Table A-2. Critical Area B – Menu of Options for New Development

1	2	3	4	5	6	7	8
Avg Lot Slope	Min Road Surface	Min Driveway Surface	Min Undist Area	Max % Imperv	Min Lot Size (ac)	Pollutant Loading Limits	Acres Offsite Mitigation per 1 ac of Development
Low Slope							
<i>Non-cluster Development Options</i>							
Low	Gravel	Gravel	30%	8.00%	5	Does Not Meet	1.21
Low	Gravel	Gravel	70%	4.25%	10	Meets	0
Low	Paved	Gravel	30%	8.00%	5	Meets	0
Low	Paved	Gravel	50%	8.75%	5	Meets	0
Low	Paved	Gravel	70%	9.50%	5	Meets	0
Low	Paved	Paved	30%	9.50%	5	Meets	0
<i>Cluster Development Options</i>							
Low	Paved	Paved	30%	7.50%	5 (avg.)	Less than limit	0
Low	Paved	Paved	50%	8.00%	5 (avg.)	Less than limit	0
Low	Paved	Paved	70%	8.50%	5 (avg.)	Less than limit	0
High Slope							
<i>Non-cluster Development Options</i>							
High	Gravel	Gravel	50%	4.25%	10	Does Not Meet	0.37
High	Gravel	Gravel	50%	2.50%	20	Meets	0
High	Gravel	Gravel	80%	3.50%	15	Meets	0
High	Paved	Gravel	50%	4.25%	10	Meets	0
High	Paved	Gravel	70%	5.00%	10	Meets	0
High	Paved	Paved	50%	4.75%	10	Meets	0
<i>Cluster Development Options</i>							
High	Paved	Paved	50%	4.00%	10 (avg.)	Meets	0
High	Paved	Paved	70%	4.75%	10 (avg.)	Less than limit	0

APPENDIX B. LAKE MAUMELLE RESERVOIR USE RULES AND REGULATIONS

Adopted by the Central Arkansas Water Board of Commissioners

The lake is available for limited recreational use. All persons using the Lake Area for recreational purposes must abide by the Rules and Regulations and all referenced rules, laws, etc., of the State of Arkansas and the federal government. The Board of Commissioners may curtail or entirely prohibit all authorized uses if it believes such action is necessary to protect the water supply. The Board urges all persons using the Lake Area to cooperate with and abide by the Rules and Regulations so that the Water Utility may continue the authorized recreational uses of this beautiful area.

Under State of Arkansas law, conviction for a violation of the Rules and Regulations carries a minimum fine of \$50 and a maximum fine of \$200, plus court costs.

General

The Board has adopted and established the following Rules and Regulations for the Lake Maumelle area. The Lake Area encompasses all property of Central Arkansas Water in Pulaski County, lying west of Pinnacle Mountain, and includes property that the Water Utility leases to other individuals and/or marina operators.

The Board extends the privileges of boating, fishing, and other permitted recreational uses on Lake Maumelle to all persons who comply with the Rules and Regulations. The Board may, without prosecution, suspend or revoke the privileges of a person whom it believes to be in violation of the rules. The Board may revoke or suspend the privileges of a person convicted of violating the Rules and Regulations or convicted of violating in the Lake Area applicable State of Arkansas rules or laws regarding public water supply reservoirs, boating, hunting, or fishing.

The Board, in accordance with State law, has designated certain Water Utility personnel as Lake Wardens. The Lake Wardens have authority to enforce the Rules and Regulations. The wardens and other law enforcement officers have authority to issue tickets and make arrests for violations of the rules, in accordance with Ark. Code Ann. 14-251-108; State boating laws; and the Arkansas State Board of Health's Rules and Regulations Pertaining to Public Water Systems.

To protect water quality, Lake Maumelle consists of two zones. The establishment of the zones and the map are parts of the official Rules and Regulations. Special and clearly visible markers and buoys distinguish the area of the restricted zone from the remainder of the lake (unrestricted area).

The unrestricted Lake Area is open to boating and fishing only during the hours of 6 a.m. to 8 p.m. November 1 through March 31 and 24 hours a day from April 1 through October 31.

No persons other than Water Utility personnel or law enforcement officers engaged in the performance of their duties may enter or exit the Lake Area other than at points of entry that the private dock operators have leased for this purpose or at areas that the Water Utility has marked clearly as picnic facilities.

Prohibited Activities

1. No person shall perform an act in the Lake Area that tends to pollute the waters of Lake Maumelle other than acts that are permitted by the Rules and Regulations.
2. The Water Utility has provided appropriate receptacles for waste and prohibits lake patrons from depositing refuse, cans, trash, garbage, or human waste on lands or waters in the Lake Area, except in the receptacles that the Water Utility has provided for said purposes.
3. The emptying of a toilet into the lake is prohibited.
4. Camping, hunting, and trapping are prohibited in the Lake Area.
5. Picnicking, except in picnic areas that the Water Utility has established and marked for such, is prohibited in the Lake Area.
6. Cooking and the building or setting of fires in the Lake Area are prohibited, except in fireplaces that the Water Utility has established in picnic areas. Lake patrons may not smoke or build fires in the facilities during burn bans in effect by order of the Arkansas Forestry Commission or Pulaski County Judge.
7. The introduction of materials for fish habitat enhancement in the lake and the presence of brush-cutting devices in a boat in the Lake Area or on the lake are prohibited.
8. Swimming, bathing, wading, and the use of aquaplanes, surfboards, motorized surfboards, wind-powered surfboards, personal water craft, water skis, rafts, kayaks, or other similar devices or vehicles that the Rules and Regulations do not expressly permit are prohibited.
9. Skin diving and aqua-lung sports are prohibited. A Lake Warden, upon request, may grant a special permit for the recovery of lost personal property.
10. The destruction, injury, defacement, or removal of signs, public property, vegetation, rocks, or minerals is prohibited.
11. The distribution, posting, or displaying of advertisements and private notices in the Lake Area without authorization from the Water Utility is prohibited.
12. The placement of buildings or structures in the Lake Area without Water Utility approval is prohibited.
13. A meeting of a political nature, as defined by the Board or Water Utility, is prohibited in the Lake Area and on the leased areas.
14. The landing of aircraft in the Lake Area is prohibited.

15. All pets in the Lake Area shall be on leash and shall not be allowed in the water.
16. No person willfully shall permit livestock in the Lake Area.
17. The possession of firearms and ammunition in the Lake Area by individuals other than law enforcement officers and Lake Wardens who have said authority is prohibited.
18. The use of fireworks in the Lake Area is prohibited.

Fishing

19. Fishing is prohibited in the restricted zone (Zone 1). Zone 2 is open to fishing activities.
20. Commercial fishing and fishing by trotline, seine, net, trap, gig, jug lines, yo-yo, or setline are prohibited in the lake.
21. Fishing from roads, bridges, or docks is prohibited. The Rules and Regulations permit fishing only from boats and designated bank fishing areas.
22. An activity that violates a law, rule, or regulation of the Arkansas Game & Fish Commission is prohibited in the Lake Area.

Boating

23. In Zone 1 (restricted area), the Water Utility prohibits all boating activities, with the exception of boating activities by Lake Wardens, Water Utility, Arkansas Game & Fish Commission, and United States Geological Survey personnel; and law enforcement officers engaged in the performance of their duties. Zone 2 is open to boating activities.
24. Owners/operators must equip and operate boats in accordance with State boating laws. The Lake Warden shall require the prompt removal of a boat that the Lake Warden deems unsafe for lake conditions or that is being operated in an unsafe manner.
25. No person shall operate a boat on the lake while intoxicated or under the influence of alcohol, as described in Ark. Code Ann. 5-76-102(a)(2); under the influence of a narcotic drug, barbiturate, or marijuana; or under a physical or mental disability that renders the person incapable of operating the boat safely under the prevailing circumstances and conditions.
26. The lake and Lake Area are not open to boats with an unblocked through-the-hull toilet.
27. Cooking on boats is prohibited.
28. A boat operator shall not launch or operate a boat on the lake without a prior thorough cleaning of the boat's interior and exterior. All boats are subject to inspection at all times. The Water Utility shall require the removal or prohibit the launching of a boat that fails to pass inspection.
29. No person under 16 years of age may operate a boat on the lake without the accompaniment of an adult. The Lake Warden may grant special permits for training on smaller boats.

30. The lake is not open to boats less than 14 feet in length. The Lake Warden may grant special permits for training on smaller boats.
31. Lake patrons may place boats upon the Lake Area only at points of entry that the private dock operators have leased for said purpose or at the designated hand-launch area at Sleepy Hollow. Launching at Sleepy Hollow requires a valid launch permit. The Water Utility may confiscate a boat or boat and motor, upon the determination that the operator has not entered the lake at a prescribed entry point. The owner may recover the boat only upon the payment of the Water Utility's applicable charge for taking, towing, and/or storing said boat.
32. Boat owners/operators shall restrict their operation of boats with a primary motor of less than nine horsepower to the Lake Area west of the Arkansas Highway 10 Bridge. Sail boats are not subject to this rule.
33. Lake patrons shall restrict canoeing to the Lake Area west of the Arkansas Highway 10 Bridge. Canoe launching is permissible at Sleepy Hollow and at the access west of the Arkansas Highway 10 Bridge; however, actual canoeing activity must remain west of the bridge.
34. When operating a boat on the lake during hours of darkness, the owner/operator must conform the boat's lighting to the specifications contained in the Arkansas Boating Laws, Title 27, as amended, and the regulations promulgated by the Arkansas Game & Fish Commission.

Dock Operators

35. Dock operators shall store and handle gasoline, oil, and other inflammable liquids in a manner satisfactory to the Water Utility and in compliance with all state and federal regulatory requirements.
36. Dock operators shall not permit a person, business, corporation, or a representative of such to engage in or solicit business on the leased area without prior authorization by the Water Utility.
37. All docks shall have the necessary boat haul-out mechanism.
38. Dock operators shall be responsible for requiring that boat operators thoroughly clean the interior and exterior of all rented boats and private boats prior to launching or prior to leaving the dock area.
39. Dock operators shall not permit the launching of a boat, private or rented, in an unsafe condition from their leased areas.
40. Dock operators shall not permit the launching of a boat, private or rented, from their leased areas by a person under the influence of alcohol, narcotic drug, barbiturate, or marijuana; or under a physical or mental disability that renders the person incapable of operating the boat safely under the prevailing circumstances and conditions.

The Board of Commissioners, Central Arkansas Water, adopted the revised Rules and Regulations herein for Lake Maumelle on October 10, 2002.