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# Implementation Plan for the TMDL for Atrazine in Aquilla Reservoir

For Segment 1254



Prepared by the:  
TSSWCB TMDL Team and  
TNRCC Strategic Assessment Division, TMDL Team  
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# Implementation Plan for the TMDL for Atrazine in Aquilla Reservoir



## Introduction

In keeping with the State of Texas' commitment to restore and maintain water quality in impaired water bodies, the Texas Natural Resource Conservation Commission (TNRCC or Commission) and Texas State Soil and Water Conservation Board (TSSWCB) recognized from the inception of the Total Maximum Daily Load (TMDL) program that implementation plans would need to be established following the development of each TMDL.

The TMDL is a technical analysis that:

- (1) determines the maximum loadings of the pollutant a water body can receive and still both attain and maintain its water quality standards, and
- (2) allocates this allowable loading to point and non-point source categories in the watershed.

An implementation plan is developed based on the TMDL. An implementation plan is a detailed description of regulatory and voluntary management measures that are intended to achieve the pollutant reductions specified by the TMDL, and a schedule under which the commission anticipates how the TMDL implementation will proceed. The plan is a flexible tool that governmental and non-governmental agencies involved in TMDL implementation will use to guide their program management. Actual implementation will be accomplished by the participating entities through rule, order, guidance, or other appropriate formal or informal actions.

The implementation plan contained herein will provide the following components:

- (1) a description of control actions and management measures<sup>1</sup> that generally will be implemented to achieve the water quality target;
- (2) legal authority under which the participating agencies may require implementation of the control actions;
- (3) a schedule for implementing activities to achieve TMDL objectives;
- (4) a follow-up surface water quality monitoring plan to determine the effectiveness of the control actions and management measures undertaken;
- (5) a statement explaining why TNRCC has concluded that the implementation of voluntary management measures will achieve the load allocations for nonpoint sources; and
- (6) identification of measurable outcomes TNRCC will review to determine whether the implementation plan has been properly executed and whether

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<sup>1</sup> Control actions refer to regulatory pollutant reduction strategies, e.g., TDA actions concerning the use of pesticides. Management measures refer to non-point source pollutant reduction strategies, e.g., voluntary best management practices.

water quality standards are being achieved.

This implementation plan is designed to achieve the reductions in atrazine concentrations in finished drinking water for Aquilla Reservoir in Hill County, Texas, as defined in the Commission-adopted TMDL. In addition, this plan establishes accountability among local, regional, and state organizations and agencies that have responsibility for mitigating water pollution. These organizations include the TNRCC, the TSSWCB, the Texas Department of Agriculture (TDA), the Hill County-Blackland Soil and Water Conservation District, and the Aquilla Water Supply District.

This implementation plan was prepared by:

- the TMDL Team, TSSWCB
- the TMDL Team in the Strategic Assessment Division of the Office of Environmental Policy, Analysis, and Assessment, TNRCC
- the Hill County-Blackland Soil and Water Conservation District
- the informal, multi-agency group called the Surface Water Protection Committee has produced a draft document dealing with surface water management strategy and this document was consulted during the preparation of this implementation plan.

Technical assistance was provided by:

- the Texas Agricultural Experiment Station
- the Texas Cooperative Extension (formerly Texas Agriculture Extension Service)
- Syngenta (formerly Novartis)

The implementation plan outlined below was approved by the TSSWCB on January 17, 2002 and the TNRCC on January 18, 2002. Upon Commission adoption, this implementation plan will be combined with the TMDL to establish the overall Watershed Action Plan (WAP) for the Aquilla Reservoir watershed. A WAP provides local, regional, and state organizations a comprehensive strategy for restoring and maintaining water quality in an impaired water body. The WAP will be implemented through the TNRCC's and TSSWCB's continuing coordinated planning process.

## **Summary of TMDL**

Aquilla Reservoir has been determined by the TNRCC to have the following uses: public water supply, fish consumption, contact recreation, and aquatic life. Aquilla Reservoir was listed on the State of Texas 1998 Federal Clean Water Act, Section 303(d) List for failure to support the public water supply use. As outlined in 30 TAC Section 290.104(c)(1), the TNRCC has established a maximum contamination level (MCL) of 0.003 mg/l for atrazine in treated drinking water. For surface water systems, compliance with the MCL is based on a running annual average from quarterly sampling using EPA certified laboratories and methods for drinking water.

Aquilla Reservoir was originally assessed as not supporting its designated use as a public drinking water supply when samples of finished drinking water from Aquilla Water Supply

District, I.D. 1090068, violated the MCL for atrazine. The running annual average for the second quarter of 1997 through the first quarter of 1998 was 0.004 mg/L. After the MCL violation, the TNRCC listed Aquilla Reservoir on the 1998 303(d) list as impaired for atrazine, and assigned the reservoir a high priority for TMDL development. In accordance with the Texas Surface Water Quality Standards [30 TAC Section 307.6(d)(8)], the endpoint of the TMDL is a running annual average atrazine concentration of 0.003 mg/l, which is the numeric equivalent of the drinking water MCL. The running annual average is based on monthly sampling of ambient water from the reservoir.

The Aquilla Reservoir watershed drains approximately 255 square miles or 163,000 acres. Approximately 47 percent of the watershed is pastureland; approximately 17 percent of the watershed is brushy or open rangeland; approximately 29 percent of the watershed is used for row crops; approximately 1 percent is wetlands; and approximately 6 percent of the acres are commercial, industrial, transportation, residential, and urban.<sup>2</sup> Identification of primary sources of atrazine runoff is a function of the subwatershed's proportion of cropland and soil type. Land use coverage analysis indicates large percentages of cropland in the subwatersheds of Hackberry Creek, Jack's Branch, and Aquilla Creek. Moderate cropland acreage is found in the Two Mile Creek and Little Aquilla Creek subwatersheds. Two Mile Creek subwatershed cropland is used primarily for cotton production and has no atrazine use. Very little cropland exists in the Upper Aquilla Creek subwatershed. The majority of the residential land use is within Hillsboro, Texas, and is located in the subwatershed of Pecan Creek, which is a secondary tributary of Hackberry Creek. Based on this information, known soil properties and proximity, one may assume the majority of atrazine loading occurs in Aquilla Creek, Hackberry Creek, and Jack's Branch subwatersheds.

This TMDL has an implicit margin of safety embodied in the endpoint identification. By defining the endpoint in the same units as the impairment, concentration in mg/L at a geographic point within the drinking water source, the TMDL assures that successfully meeting the endpoint will also eliminate the impairment.

Responsibility for reducing pollutant loading to the extent that the concentration target will be met can be allocated. All atrazine loading originates from non-point sources associated with human activities. There are no natural background sources. There are no point source discharges and none are anticipated in the future. Therefore, none of the responsibility for reducing or controlling atrazine loading is allocated to the waste load allocation (WLA) and all of the responsibility is allocated to the load allocation (LA). Units of percent can be used to quantify the standard TMDL equation:

$$\begin{array}{rccccccc} \underline{LA} & & + & & \underline{WLA} & & = & \underline{TMDL} \\ 100\% & & + & & 0\% & & = & 100\% \end{array}$$

This equation describes both the allocation of allowable loading and the allocation of responsibility for reducing loading to the extent necessary to achieve the endpoint. There is minimal utility in attempting to define a precise target for loading when concentration is the important and controlling factor. However, using the data set resulting in the 1998 MCL

violation, albeit limited, suggests that a load reduction of approximately 25 percent would have resulted in attainment of the standard.

## Control Actions and Management Measures

Due to the aggressive leadership of individuals living within the atrazine-impaired area, much implementation was done prior to the completion of a TMDL implementation plan. Management measures to reduce the atrazine concentration in treated drinking water began immediately after the MCL violation in 1998. The Aquilla Water Supply District began additional treatment to remove atrazine by installing a powder-activated carbon hopper at the water treatment plant in 1999. This system came at a cost of \$434,169. All subsequent samples in the finished drinking water have shown atrazine concentrations at less than 50 percent of the MCL.

Agricultural producers have also made a conscious effort to reduce the potential for atrazine discharge in runoff. Many producers are now using BMPs such as pesticide incorporation, banded application, conservation tillage, and crop residue management. Some producers have planted field borders or filter strips around their fields. Producers generally seek cost-share assistance for the more costly conservation practices, such as building terraces, waterways and grade stabilization structures. The Hill County-Blackland Soil and Water Conservation District and the NRCS provide technical assistance for implementing such practices as well as guidance and educational information. *(To contact these entities, call the local NRCS office in Hillsboro at (254) 582-7471.)* Cost-share assistance is available through federally funded programs such as the Environmental Quality Incentives Program (EQIP) and the TSSWCB Clean Water Act, Section 319(h)-*Aquilla TMDL Implementation Project*. One hundred and six applications for EQIP were made within the Aquilla-Hackberry watershed in 1999. Thirty-one of those applications were funded. In 2000, 84 applications were made and 20 were funded, and in 2001, 35 applications were made and 8 were funded. Approximately 100 acres of waterways, 202,000 feet of terraces, and 18 grade stabilization structures have been constructed since the 1998 violation. In addition to EQIP, 32 applications have been made for the Aquilla 319(h) project funding. Participation in other conservation programs, such as the Conservation Reserve Program (CRP) and the Wetlands Reserve Program (WRP) has also increased. Three hundred acres of cropland have been converted to wetland areas through the CRP and WRP programs since 1998.

Local stakeholders prepared a survey, which was administered to 40 agricultural producers within the watershed. The purpose of the survey was to document atrazine management practices within the Aquilla Reservoir watershed. Results will be compared to surveys administered in 2001 and 2002 to gauge the degree to which BMPs are implemented. The survey results from the 1999-production year show significant BMP adoption rates.

A project is currently being conducted to analyze on-farm economic impacts of atrazine remediation practices and policies on farms, ranches, and communities in the Aquilla Reservoir watershed. This project will focus specifically on (1) analyzing representative

farm profitability and financial viability implications of implementing alternative BMPs and (2) assessing the relative effectiveness of alternative BMPs on reducing atrazine losses. Farm economic impacts, both short-run and long-term, of atrazine remediation require predicting crop and forage yields associated with alternative remediation practices. Yields will be simulated with the APEX (Agricultural Policy/Environmental eXtender) model (Williams 1994). Simulated variations in crop and forage yields of alternative BMPs are directly related to farm finances. Yield variations impact the financial risk or probability of encountering bankruptcy. Conclusions can be drawn from these economic projections. If increased costs of crop production are insignificant and atrazine remediation is accomplished, the likelihood will be high for a successful and widespread adoption of a particular BMP.

State agency management measures to reduce nonpoint source atrazine loading also began immediately after the MCL violation. The TSSWCB and TNRCC, through an EPA Section 319(h) grant, contracted with the Texas Agricultural Experiment Station (TAES) and Texas Cooperative Extension (TCE) to launch an extensive public education campaign and water sampling effort. TAEX provided education, demonstration and training programs utilizing proven technologies in the area of water quality to assist residents of Hill County interested in environmental stewardship. TAES monitored water quality throughout the project period to evaluate effects of BMP implementation. Five sites equipped with Instrumentation Specialty Company (ISCO) water samplers were established in the Aquilla watershed to monitor areas that were potential nonpoint sources of atrazine. Data obtained was used to determine herbicide loads for each storm water runoff event monitored (Dozier, 2001). Data results indicated that 99.97% of the atrazine load originated from agricultural non-point sources while 0.03% of the atrazine load originated from urban non-point sources. The project, which was completed in December of 2000, dramatically affected the BMP adoption rate by agricultural producers.

In addition to current management measures, the TSSWCB, TDA, and TNRCC will implement various activities that are triggered by certain water quality benchmarks, as described in the implementation schedule section of this document. If the running annual average continues to exceed the atrazine MCL during various benchmark years, TSSWCB and TDA will implement a series of new management procedures. The TNRCC will continue to monitor the reservoir on a monthly basis until the running annual average is below the MCL for two consecutive years. TNRCC atrazine monitoring will then shift to quarterly sampling within the reservoir. The TSSWCB coordinates and carries out an extensive BMP implementation program through the use of CWA Section 319(h) funds. The Water Quality Management Plan (WQMP) Program is available for producers in those areas within the state where critical soil and water conservation needs are known to exist. Funds are available for implementing soil and water conservation plans developed jointly by the landowner/operator and local soil and water conservation districts, and certified by the TSSWCB.

Under Chapter 201, Subchapter I of the Texas Agriculture Code, the TSSWCB has the authority to revise WQMPs and offer secondary cost share payments, if approved by the State

Board. The implementation of WQMPs will be the primary management measure used by the agency to abate nonpoint source atrazine loading. The TSSWCB will also carry out an extensive monitoring program as described in the Monitoring Strategy section of this document.

Pesticide law enforcement and regulation shall be the primary management measures used by TDA to abate atrazine nonpoint source pollution. Any violation of the pesticide label restrictions may be reported to TDA by calling (800) 835-5832. Callers may file a formal complaint or anonymously report a misuse.

If the running annual average for atrazine exceeds the MCL by January of 2005, the TDA shall increase enforcement measures to encourage producer compliance with the atrazine label. If the running annual average for atrazine continues to exceed the MCL by January of 2009, TDA shall initiate regulatory procedures to reclassify atrazine as a state-limited use pesticide. If the running annual average for atrazine continues to exceed the MCL by January of 2011, the TDA shall assume the responsibility of regulating atrazine use as a state-limited use pesticide. If atrazine continues to exceed the MCL by January of 2014, TDA will initiate procedures to cancel the product's registration for use in the Aquilla Reservoir watershed.

The TSSWCB, TNRCC, TDA, and TCE will continue the BMP educational outreach efforts throughout the TMDL implementation schedule by utilizing Continuing Education Unit (CEU) meetings. These meetings facilitate education and coordination between producers and state agencies. To contact these entities: *call TDA at (800) 835-5832 or TCE at (254) 582-4022.*

Once the TMDL is complete, the Source Water Assessment & Protection (SWAP) Program will be encouraging continued protection activities and community involvement in watershed protection. The SWAP program will build on the success of the TMDL process and broaden the recommended BMP list to include structural and non-structural BMPs that will address other potential concerns that were not a focus of the TMDL. These protection activities will be on-going and will be voluntarily driven by local participants.

## **Legal Authority**

### **TSSWCB**

The TSSWCB administers and carries out Texas' soil and water conservation law and coordinates Texas' Soil and Water Conservation Programs with the soil and water conservation districts (SWCDs). The TSSWCB is the lead agency in Texas for the management of agricultural and silvicultural nonpoint source pollution, as designated under Title 7, Chapter 201, § 201.026 of the Texas Agriculture Code and Title 1, Subtitle D, Chapter 26, §26.1311 of the Texas Water Code. In addition, The TSSWCB coordinates and administers all programs for abating agricultural or silvicultural nonpoint source pollution, as stated under Title 1, Subtitle D, Chapter 26, §26.0136(a) of the Texas Water Code. In an area that the TSSWCB identifies as having the potential to develop water quality problems



due to agricultural or silvicultural nonpoint source pollution, the TSSWCB is responsible for establishing a water quality management plan (WQMP) certification program that provides, through individual SWCDs, for the development, supervision, and monitoring of individual WQMPs for agricultural and silvicultural lands. Each plan must be developed, maintained, and implemented under rules and criteria adopted by the TSSWCB and comply with state water quality standards established by the TNRCC. A certified WQMP has the same legal standing as a permit issued under the TPDES, as stated under Title 1, Subtitle D, Chapter 26, §26.121.

## **TNRCC**

The TNRCC's authority to protect water quality in the State of Texas is specified in the Texas Water Code. General Powers and duties are provided by the provisions of Title 2, Subtitle A, Chapter 5, Subchapter D. Responsibilities and authorizations pertaining specifically to water quality protection are contained within Title 2, Subtitle D, Chapter 26. The TNRCC has established MCLs for organic contaminants in 30 TAC 290.107.

Texas statutory provisions require the commission to establish the level of quality to be maintained in, and to control the quality of, water in the state (Texas Water Code (TWC) §26.011). Texas fulfills its obligations under Section 303(d) of the Clean Water Act to list impaired segments and create TMDLs through functions assigned by the legislature to TNRCC. The §303(d) list is prepared by TNRCC as part of its monitoring, planning and assessment duties (TWC §26.0135).

TMDLs are part of the state water quality management plans that TNRCC is charged by statute to prepare (TWC §26.036). As the state environmental regulatory body, the Commission has primary responsibility for implementation of water quality management functions within the State (TWC §26.0136 and §26.127). The Executive Director of the TNRCC must prepare and develop, and the Commission must approve, a comprehensive plan for control of water quality in the state (TWC §26.012). The list of impaired segments and resulting TMDLs are tools for water quality planning.

Texas Surface Water Quality Standards are contained in Title 30, Chapter 307 of the Texas Administrative Code (30 TAC Chapter 307). TNRCC procedures for implementing these standards are described in *Implementation of the Texas Natural Resource Conservation Commission Standards Via Permitting* (RG-194, August 1995).

The TNRCC received delegation of the NPDES program from EPA on September 14, 1998, and is authorized to implement the Texas Pollution Discharge Elimination System (TPDES), the regulatory program to control discharges of pollutants to surface waters. The TPDES program covers all permitting, surveillance and inspection, public assistance, and enforcement regulatory processes associated with waste discharges into or adjacent to any water in the state.

## **TDA**

The Texas Department of Agriculture is the State's lead regulatory agency for agricultural pesticide regulation. Texas Pesticide and Herbicide Law grants TDA the authority to enforce

the provisions of the law pertaining to the registration, distribution, and use of all agricultural pesticides. Through its Pesticide Division, TDA is responsible for licensing all agricultural pesticide applicators and the labeling, storage, sales, usage, and disposal of all pesticides. TDA also cooperates with other state agencies that have statutory pesticide responsibilities, such as the TNRCC, the Structural Pest Control Board, and the Texas Department of Health (TDH). TDA is also responsible for the enforcement of federal pesticide laws under a cooperative agreement with EPA.

TDA may designate a pesticide as a state-limited use pesticide if TDA determines that when used as directed or in accordance with widespread and commonly recognized practices, the pesticide requires additional restrictions to prevent unreasonable risk to humans or the environment. The department shall formally request an opinion regarding the impact on water quality from the TNRCC during the department's consideration of atrazine's inclusion on the current list of state-limited use pesticides. This designation will take the economic, social, and environmental costs of the pesticide's use into account. TDA shall conduct at least five regional hearings throughout the state before adoption of amendments to the state-limited use list. Section 76.003(e) of the Texas Agriculture Code authorizes TDA to regulate the time and conditions of use of a state-limited-use pesticide and requires that it be purchased or used only with the permission of TDA. The pesticide shall be under direct supervision of TDA in specific areas under certain conditions or in specified quantities and concentrations.

TDA is authorized to deny or cancel a registration under several conditions. It may be cancelled if the use of the pesticide has demonstrated uncontrollable adverse environmental effects. It may also be cancelled if the use of the pesticide is detrimental to the environment where detriment outweighs the benefits derived from its use. If properly used, the pesticide may be cancelled if proven detrimental to vegetation (excluding weeds), to domestic animals, or to public health and safety. A pesticide label change leading to a regional cancellation may be pursued through negotiations with EPA and the registrant. Should this option fail, TDA may call a hearing for the presentation of evidence, and then make a determination on cancellation under the provisions of Section 76.046(c) of the Texas Agriculture Code.

## **Schedule for Implementation - A Phased Approach**

The TMDL technical analysis indicates that 100 percent of the atrazine pollutants in the watershed are derived from nonpoint sources. Although the types of nonpoint sources are known, there is very limited data available on the effectiveness of existing and/or potential management measures available to address the sources. Furthermore, there are also limited financial resources available to stakeholders to address nonpoint sources. For these reasons, a phased approach has been selected for this implementation plan.

A phased approach provides assurances in the implementation process by incorporating measures in time-steps so that monitoring data may be evaluated to verify expected load reductions and determine the effectiveness of best management practices. A TMDL under

the phased approach includes a schedule for the installation and evaluation of management measures, data collection, the assessment for water quality standards attainment, and, if needed, additional management measures. The next phase of management practices shall be implemented if monitoring determines that the measures implemented under a phase are not sufficient to achieve water quality standards. The implementation plan of management measures for Aquilla Reservoir will be scheduled into five separate phases. Phase I of the implementation plan began in 2000 with the initiation of technical and financial assistance by TSSWCB. If the running annual average stays below the MCL for two consecutive years during Phase I, the implementation plan will be completed and the TMDL will end. Phase II will begin in January 2005, upon determination that Phase I BMPs have not effectively improved water quality sufficient to achieve a running annual average below the MCL. If the running annual average stays below the MCL for two consecutive years during Phase II, the implementation plan status will revert to Phase I status. Phase III will begin in January 2009 upon determination that Phase II BMPs have not effectively improved water quality sufficient to achieve a running annual average below the MCL. Phase IV will begin in January 2011 upon determination that Phase III BMPs have not effectively improved water quality sufficient to achieve a running annual average below the MCL. Phase V will begin in January 2014 upon determination that Phase IV BMPs have not effectively improved water quality sufficient to achieve a running annual average below the MCL.

Throughout the implementation process, general updates will be provided to the stakeholders in the basin on a biennial basis. If monitoring shows a two-year period without any MCL violations, during any stage of the implementation plan, the implementation plan shall move back into Phase I. However, if in subsequent years an additional violation of the running annual average occurs, based either on surface water or finished drinking water samples, the entire process will restart.

FIGURE 1. Phased Implementation Process

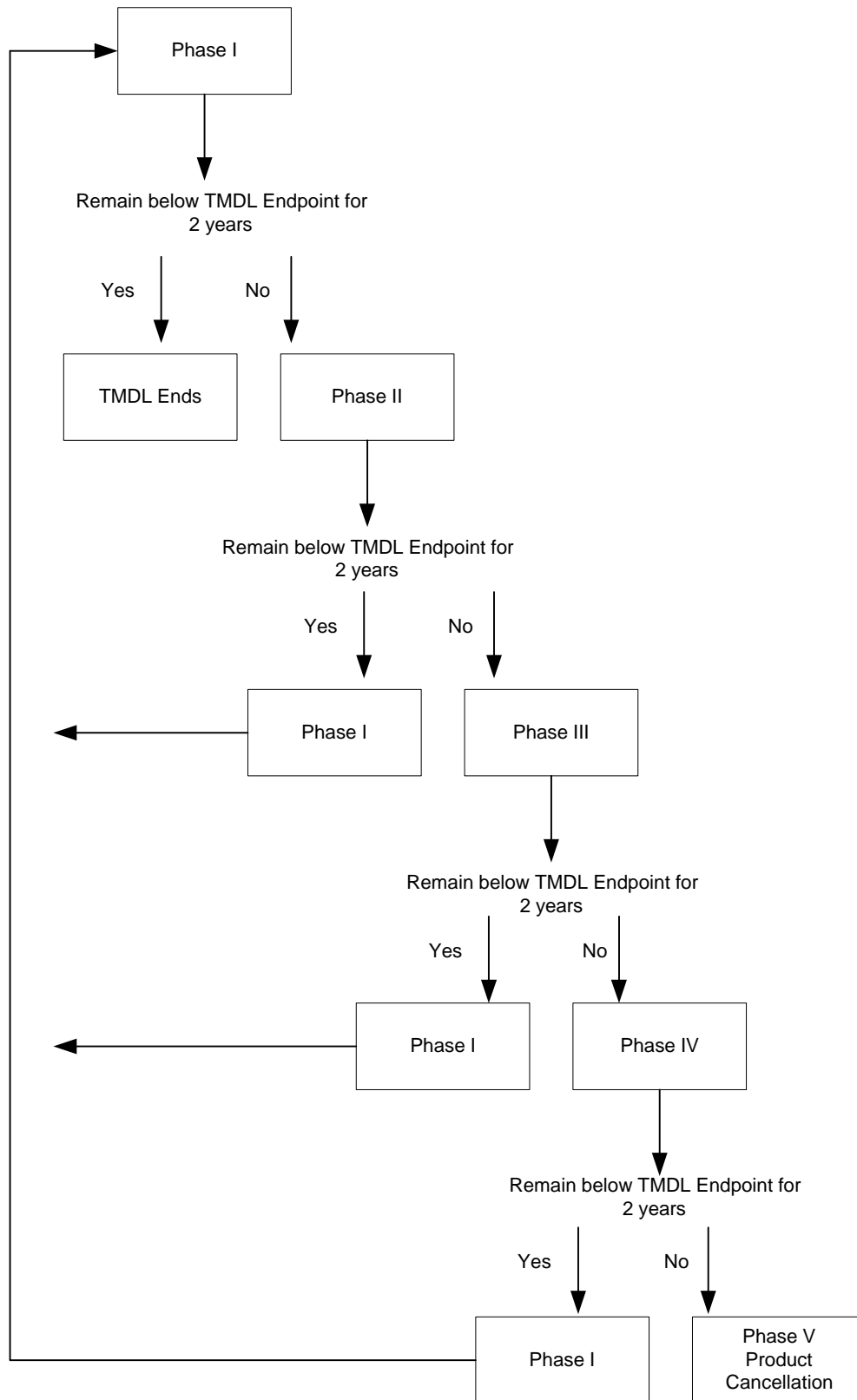


Table 1. Implementation Schedule

Entity	Activity	Schedule
<b>Phase I</b>		
		2000 - 2004
TSSWCB	319(h) -WQMP program	7/2000 thru 4/30/2002
TSSWCB	Tributary stormwater and sediment sampling	2001 thru 2004
TNRCC	Monthly atrazine sampling in reservoir	started 3/2001; ongoing
TDA	BMP effectiveness study (subject to available funding) Ongoing enforcement of label restrictions	May, 2001
TDA/TSSWCB/ TNRCC/ TAEX	Educational Outreach/ CEU Meetings	ongoing
<b>Phase II</b>		
		2005 - 2008
TSSWCB	WQMPs revised to include more extensive BMPs	2005-2008
TSSWCB	Request funding for secondary cost share payments	2005
TSSWCB/TAES/ TCE	Tributary stormwater and sediment sampling	ongoing
TNRCC	Monthly atrazine sampling in reservoir	ongoing
TDA	Intensified enforcement of label restrictions	2005-2008
TDA/TSSWCB/ TNRCC/ TAEX	Educational Outreach/ CEU Meetings	ongoing
<b>Phase III</b>		
		2009 - 2010
TSSWCB	WQMPs revised to include more extensive BMPs	2009-2010
	Tributary stormwater and sediment sampling	ongoing
TNRCC	Monthly atrazine sampling in reservoir	ongoing
TDA	Reclassify atrazine as a state-limited use pesticide	2009-2010
TDA/TSSWCB/ TNRCC/ TAEX	Educational Outreach/ CEU Meetings	ongoing
<b>Phase IV</b>		
		2011 - 2013
TNRCC	Monthly atrazine sampling in reservoir	2011-2013
TDA	Regulate atrazine as a state-limited use pesticide	2011
TDA/TSSWCB/ TNRCC/ TAEX	Educational Outreach/ CEU Meetings	ongoing
<b>Phase V</b>		
		2014 - 2016
TDA	Cancellation of atrazine product	2014-2016
TSSWCB/ TNRCC	Reevaluate TMDL	2016

## Monitoring Strategy

A follow-up monitoring plan will be conducted within the Aquilla Reservoir watershed throughout the implementation schedule. As previously mentioned, the TNRCC will monitor atrazine concentrations in Aquilla Reservoir on a monthly basis. The water quality target for standards compliance as well as the trigger for phase determination shall be based upon the running annual average atrazine concentration as determined by TNRCC's monthly sampling in the reservoir. Sampling frequency of the surface water will reduce to quarterly if the water body does not violate the atrazine TMDL endpoint after two years of monitoring. Samples are analyzed using the EPA's method 525.2 entitled "Determination of Organic Compounds in Drinking Water by Liquid-Solid Extraction and Capillary Column Gas Chromatography/ Mass Spectrometry."

Concentrations in finished drinking water shall also be used for standards compliance (in accordance with the established TNRCC methodology) as well as the trigger for phase determination. As in the case for surface water, exceedance of the MCL by the running annual average will be used.

Monitoring shall also be conducted to evaluate the effectiveness of BMPs. These include, but are not limited to: filter strips, buffer strips, banding herbicide applications, reducing atrazine rates applied, construction of sediment retention ponds, and the use of transgenic herbicide crop varieties. The TSSWCB and Hill County- Blackland SWCD will monitor the impact implementation has on reducing atrazine runoff within the watershed. They will monitor atrazine by collecting stormwater samples from the Aquilla watershed tributaries. Samples will be analyzed using the EPA's method 525.2 entitled "Determination of Organic Compounds in Drinking Water by Liquid-Solid Extraction and Capillary Column Gas Chromatography/ Mass Spectrometry."

Atrazine degrades from the soil primarily through microbial activity and chemical hydrolysis. The half-life of an herbicide is defined as the length of time required for half of an herbicide to dissipate from the soil. The average half-life of atrazine in topsoil under normal moist and warm conditions is 60 days, however, research at Blackland Research and Extension Center has shown that the half life in high pH-calcareous soils of the Blackland Prairies is closer to 40 days. Atrazine's half-life is generally longer (12 months or more) in subsurface soils or in water. The TSSWCB and Hill County-Blackland SWCD will monitor atrazine concentrations in sediment and soil samples to quantify the persistence of atrazine in the environment. They will collect soil samples at various BMP demonstration sites, and sediment samples will be collected in the tributaries and in the lake semi-annually. Sediment samples will be analyzed using the EPA's method 525.2, and soil samples will be analyzed by an immunoassay method. The immunoassay method will be used only as a screening tool to minimize expensive laboratory analysis. The TSSWCB monitoring project's QAPP will specify when and how immunoassay and EPA approved laboratory techniques will be used in the monitoring process.

## **Reasonable Assurance of Success**

Guidelines suggest that a TMDL implementation plan must include “reasonable assurances” that the NPS load allocations established in TMDLs (for waters impaired solely or primarily by NPSs) will in fact be achieved. These assurances may be non-regulatory and incentive-based, when consistent with applicable laws and programs. This implementation plan reasonably assures that Aquilla Reservoir will have an atrazine concentration lower than the MCL no later than 2016. It does this by extensive BMP implementation, increased regulation and enforcement of atrazine use, and the possible cancellation of the product’s registration.

## **Measurable Outcomes**

Verification that designated uses have been restored requires the measurement of applicable indicators to determine measures of success. Indicators generally fall into two major categories: programmatic indicators and environmental indicators. Environmental indicators can be subdivided into measures of environmental stressors or pollutants and measures of biological, ecological and human states of health. Programmatic and environmental monitoring activities represent important aspects of TMDL implementation, and both types of monitoring will be critical to assessing the implementation and effectiveness of activities that result in water quality improvements.

The measurable outcome of all phases shall be the attainment of the TMDL endpoint for atrazine within Aquilla Reservoir. The monitoring strategy contained within this implementation plan shall provide for monthly sampling in Aquilla Reservoir at one location. This is an environmental indicator that will be measured through the analysis of pollutant data collected by the TNRCC. An update on this measurable outcome will be provided to the stakeholders in the basin at CEU meetings.

The measurable outcome of Phase I shall be the successful completion of the TSSWCB Section 319(h) project. Twenty-five WQMPs will be installed within the watershed upon completion of the project. This is a programmatic indicator that will be measured by the completion and submission of a final report deliverable that is required in the 319(h) contract by May of 2002. An update on this measurable outcome will be provided to the stakeholders in the basin at CEU meetings.

The measurable outcome of Phase II shall be the intensified enforcement of label restrictions by TDA. Intensified enforcement will demonstrate whether a reclassification of atrazine may be necessary. If few label violations are found and the TMDL endpoint is not attained, reclassification (Phase III) may be necessary. This is a programmatic indicator that will be measured by the amount of field atrazine use assessments completed by the agency during 2005 to 2008. An update on this measurable outcome will be provided to the stakeholders in the basin at CEU meetings.

The measurable outcome of Phase III shall be the reclassification of atrazine to a “state-limited use” pesticide by TDA. This reclassification will allow for watershed-specific regulation, if needed. This is a programmatic indicator that will be measured by the completion and publication of a state-limited use regulation by 2010. An update on this measurable outcome will be provided to the stakeholders in the basin at CEU meetings.

The measurable outcome of Phase IV shall be to regulate atrazine as a state-limited use pesticide. This is a programmatic indicator that will be measured by the enforcement of the state-limited use regulation by TDA during the years 2011 through 2013.

The measurable outcome of Phase V shall be the cancellation of the atrazine product by the TDA. If this phase is ever reached, atrazine will be reclassified as a legacy pollutant by the TNRCC and the TMDL will be revisited. This is a programmatic indicator that will be measured by the cancellation of atrazine in 2016 by TDA. An update on this measurable outcome will be provided to the stakeholders in the basin at CEU meetings.

## References

Texas Natural Resource Conservation Commission and Texas State Soil and water Conservation Board 1999. Texas NPS Pollution Assessment Report and Management Program. SFR-68/99. October 1999.

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