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# Implementation Plan for Arroyo Colorado and Donna Reservoir and Canal Legacy Pollutant TMDLs

For Segments 2202 and 2202A

Prepared by the:
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TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

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# Implementation Plan for Arroyo Colorado and Donna Reservoir and Canal Legacy Pollutant TMDLs

## Introduction

In keeping with the Texas commitment to restore and maintain water quality in impaired water bodies, the Texas Natural Resource Conservation Commission (TNRCC) recognized from the inception of the total maximum daily load (TMDL) program that implementation plans would need to be established for each TMDL developed.

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.

Based on the TMDL, an implementation plan is then developed. An implementation plan is a detailed description of regulatory and voluntary management measures that are intended to achieve the pollutant reductions identified in the TMDL, and a schedule under which the commission anticipates 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 by rule, order, guidance, or other appropriate formal or informal action.

The implementation plan contained herein will provide the following components:

(1) a description of control actions and management measures[1] 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) development of 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 as to why TNRCC has concluded that the implementation of voluntary management measures will achieve the load allocations for nonpoint sources; and

[1] Control actions refer to point source pollutant reduction strategies, generally TPDES permits. Management measures refer to nonpoint source pollutant reduction strategies, generally voluntary best management practices.

(6) identification of measurable outcomes TNRCC will review to determine whether the implementation plan has been properly executed and whether water quality standards are being achieved.

This implementation plan is designed to guide the achievement of reductions in legacy pollutant concentrations in fish tissue in the Arroyo Colorado Above Tidal and the Donna Reservoir and Main Canal in Cameron and Hidalgo Counties, as defined in the adopted TMDLs.

This implementation plan was prepared by:

- the TMDL Team in the Strategic Assessment Division of the Office of Environmental Policy, Analysis, and Assessment of the TNRCC, and
- the Region 4 Office of the Field Operations Division of the Office of Compliance and Enforcement of the TNRCC.

Technical assistance was provided by:

- the Seafood Safety Division of the Texas Department of Health, and
- the U.S. Geological Survey.

This implementation plan was approved by the TNRCC on September 14, 2001. This implementation plan, combined with the TMDL, establishes a Watershed Action Plan (WAP). A WAP provides local, regional, and state organizations a comprehensive strategy for restoring and maintaining water quality in an impaired water body. TNRCC has primary responsibility for ensuring that water quality standards are restored and maintained in impaired water bodies.

# Summary of TMDLs

The water bodies addressed by the TMDL document (*Four Total Maximum Daily Loads for Legacy Pollutants in the Arroyo Colorado Above Tidal and the Donna Reservoir and Canal System*, TNRCC 2000) are the Arroyo Colorado Above Tidal and the Donna Reservoir and Main Canal in the Lower Rio Grande Valley of Texas (Figure 1). These water bodies were included on the State of Texas §303(d) list as a result of the issuance of fish consumption advisories and a fish consumption ban by the Texas Department of Health (TDH) following determinations of unacceptable human health risk due to elevated concentrations of one or more legacy pollutants in fish tissue (Table 1; see TDH 2001a). Legacy pollutant is a collective term used to describe substances whose uses have been banned or severely restricted by the U.S. Environmental Protection Agency (EPA). Because of their slow rate of decomposition, these substances frequently remain at elevated levels in the environment for many years after their widespread use has ended.

The Arroyo Colorado watershed (Figure 1) is an intensively farmed area (TAES 2000). The extensive use of pesticides on surrounding cropland probably accounts for a substantial portion of the fish tissue contaminant residues in the Arroyo Colorado, as all three pesticides of concern were used extensively for control of agricultural insects.

FIGURE 1. Arroyo Colorado watershed and location of impaired water bodies.
Arroyo Colorado Above Tidal (Segment 2202) and the Donna Reservoir and Main Canal (Segment 2202A).

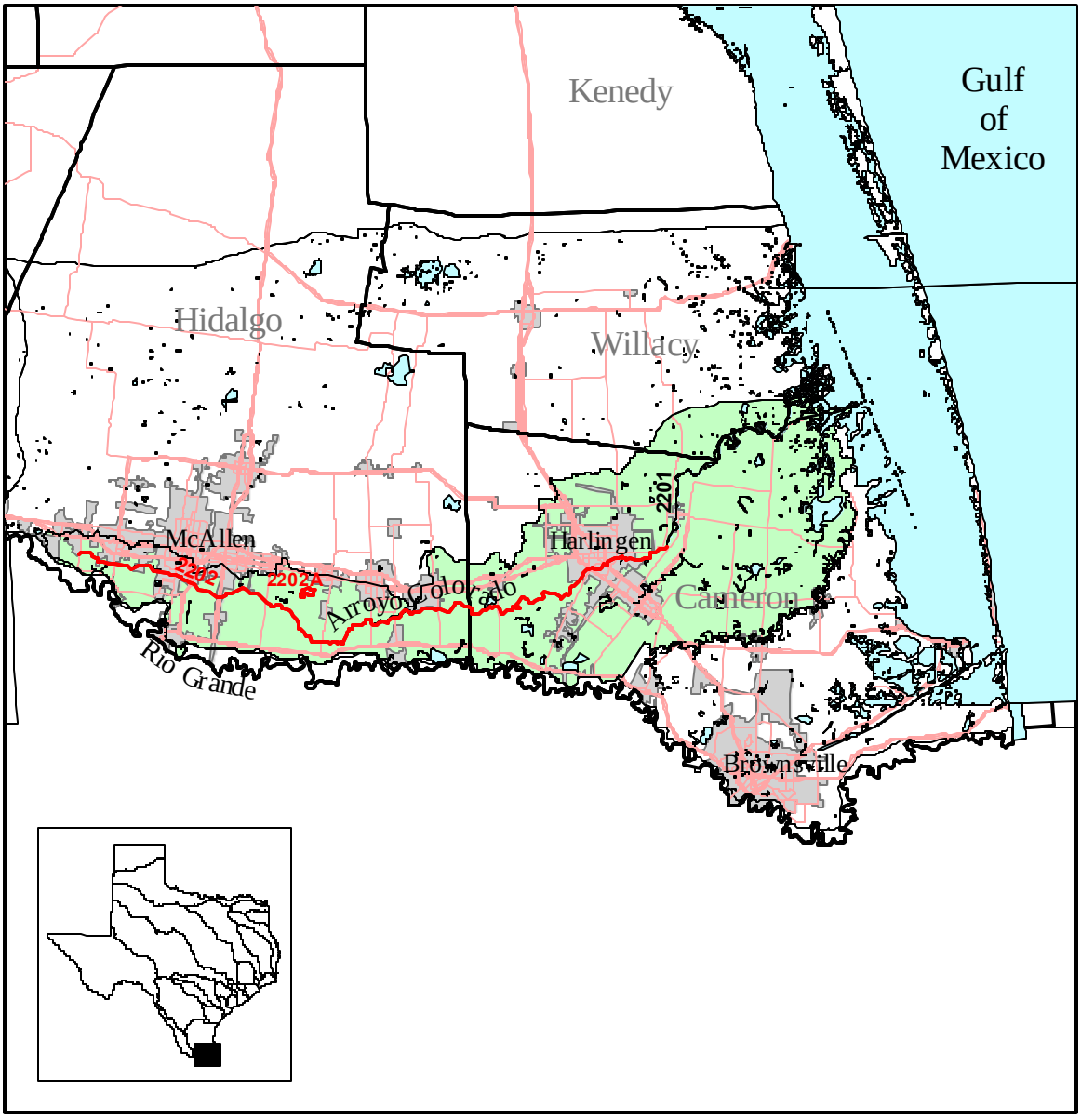


TABLE 1. Lower Rio Grande Valley water bodies listed on the 303(d) list due to legacy pollutant concentrations in fish tissue resulting in the issuance of a fish consumption ban or advisory by the Texas Department of Health, and endpoint targets necessary to meet the fish consumption use.

| Segment | Fish Tissue Contaminants | TDH Action | Endpoint Targets |
|---|---|---|---|
| 2202 - Arroyo Colorado above Tidal (Arroyo Colorado upstream of the Port of Harlingen, including Llano Grande Lake and the Main Floodway) | Chlordane<br>DDE<br>Toxaphene | Consumption advisories issued in 06/1993 and 11/1993* | additive cancer risk $\leq 2.33 \times 10^{-4}$<br>cumulative noncarcinogenic hazard index $\leq 1$ |
| 2202A - Donna Reservoir and Main Canal | PCBs | Consumption ban issued in 04/1994 | $\leq$ 0.05 mg/kg total PCBs in fish tissue for adults<br>$\leq$ 0.02 mg/kg total PCBs in fish tissue for children |
| All water bodies | --- | --- | Removal of fish consumption bans and advisories |

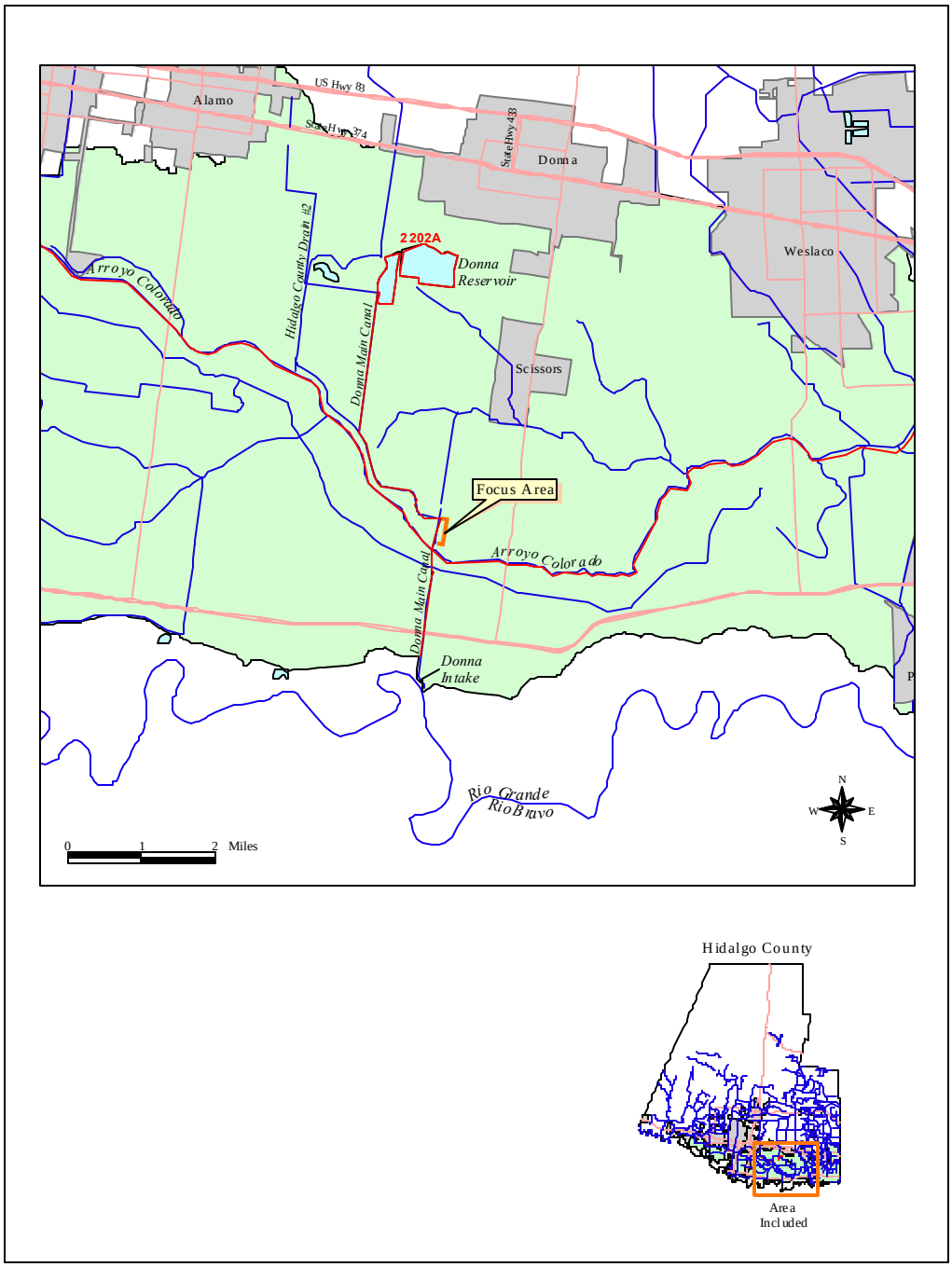
*Updates to 1980 consumption advisory issued for portions of the Arroyo Colorado.

Storm water runoff was mostly associated with agricultural land uses until 20-30 years ago, when urbanization and associated population increase began to occur in the region (Chapman *et al.* 1998). Erosion as a result of more recent urban development along the Arroyo Colorado may have contributed contaminants attached to the previously agricultural source soils. Other potential sources included municipal wastewater treatment plants that received washings from fruit and vegetable processing facilities (see Davis 1984) and three area Superfund sites contaminated with pesticides.

Donna Reservoir is a 400-acre impoundment located southwest of the City of Donna in southeast Hidalgo County, within the Arroyo Colorado watershed (see Figure 2). Water for the Donna Reservoir is pumped from the Rio Grande, through a seven mile elevated earthen Main Canal, to the reservoir, which is used for water supply and irrigation storage by the City of Donna and surrounding areas. The area around the reservoir and canal is primarily irrigated crops and pastureland, with scattered residences (Webster *et al.* 1998). Extensive investigations have been conducted into the polychlorinated biphenyl (PCB) contamination in the Donna Reservoir and Canal (Webster *et al.* 1998, 1999; *USGS Final Progress Memorandum: Investigation of PCBs on Suspended Sediment in Donna Canal, Texas, 15 December 2000*). These evaluations have narrowed the PCB source to within a 75-meter section of the canal. Follow-up investigation by the TNRCC Remediation Division is currently focused on this area (see Figure 2).

Because of the particular nature of these TMDLs, the TNRCC modified the typical load allocation approach of more conventional TMDLs, which typically limit the amount of a pollutant that can be added to an impaired water body. Because legacy pollutants are already restricted, and no significant additional loading is expected, the TMDLs do not specifically attempt to quantify allowable loads for these contaminants. The allowable load is based on acceptable, risk-based fish tissue concentrations.

FIGURE 2. Donna Reservoir and Main Canal (adapted from Webster *et al.* 1998). Focus area for PCB investigation in Main Canal is indicated.



EPA (1997) guidance and TDH assumptions concerning risk levels, consumer body weight, and fish consumption rates were used to develop endpoint targets for tissue contaminant levels that result in an acceptable risk level. The endpoint target of these TMDLs is the reduction of fish tissue contaminant concentrations to levels that constitute an acceptable risk to fish consumers, allowing TDH to remove the restrictions on fish consumption (Table 1). The ultimate endpoint goal for the affected water bodies is the complete removal of the fish consumption ban and advisories.

# Control Actions and Management Measures

Gradual declines in environmental legacy pollutant concentrations occur as a result of natural attenuation processes. Legacy pollutants in these water bodies are considered background sources that reflect the site-specific application histories and loss rates. Any continuing sources of pollutant loadings occur from nonpoint source runoff, leaching, or erosion of sinks that may exist within the watersheds. Residual PCB contamination from a site near the Donna Canal is likely to remain a continuing source until site investigation and remediation is completed. No authorized point source discharges of these pollutants are allowed by law.

Available evidence suggests that legacy pollutants are generally declining in the fish tissue of the affected water bodies, and recent samples indicate some pollutants may already be less than their endpoint target concentrations (TNRCC 2000; TDH 2001b; see Reasonable Assurance of Success section of this document). Continuing natural attenuation is expected via degradation and metabolism of the contaminants, burial of contaminated sediment through natural sedimentation in Donna Reservoir, and scouring and redistribution of sediments in the Arroyo Colorado.

Although contaminant tissue levels are expected to continue to decline through natural attenuation processes, investigations are underway to address any remaining pollutant loads to these water bodies. Suspended sediment sampling in the Donna Reservoir and Canal has isolated the PCB source to within a 75-meter reach of the canal (*USGS Final Progress Memorandum: Investigation of PCBs on Suspended Sediment in Donna Canal, Texas, 15 December 2000*). Follow-up investigation and remediation of the source area is being managed by the TNRCC Remediation Division. Initial sampling was conducted in March 2001:

- Sediment samples were collected at several locations in the Donna Canal, beginning just downstream from the Rio Grande pump station, downstream to the exit from the siphon under the Arroyo Colorado.
- Subsurface soil samples were collected at three foot intervals to an approximate depth of 18 feet, along an 80-foot section of the east bank of the canal below the siphon exit (see Figure 2).
- Surface water and suspended sediment samples were collected at various intervals along the canal.

- Water samples were collected in Donna Reservoir at the water treatment plant intakes for the City of Donna and the North Alamo Water Supply Corporation.

Analytical results were received in late May 2001, and evaluation of the data is currently in progress. Subsequent sampling and remediation activities will be planned following completion of this evaluation.

Evaluation and monitoring activities are continuing at three pesticide-contaminated Superfund sites in the Arroyo Colorado watershed, with oversight by the TNRCC Remediation Division (see <www.tnrcc.state.tx.us/permitting/remed/superfund/>):

- The Munoz Borrow Pits site is located just south of U.S. Highway 83, on the east side of State Highway 1016 in Mission in Hidalgo County. Contaminated soil was excavated and removed in mid-1997. The site was removed from the Superfund registry in September 1998. Groundwater monitoring to confirm natural attenuation of contaminants began in June 2000 and is ongoing.
- The Hayes-Sammons Warehouse site is located on Miller Avenue and East Eighth Street in downtown Mission in Hidalgo County. Demolition and off-site disposal of the warehouses, excavation and off-site disposal of approximately 1700 cubic yards of contaminated soil, and backfilling and grading of the excavated areas occurred in June-October 1998. The site was proposed for deletion from the Superfund registry; however, further evaluation resulted in a decision to conduct additional soil sampling. Samples were collected in April 2000. Evaluation of that data has resulted in development of a plan to conduct sampling in residential yards near the site. Subsequent activities at the site will be based on the evaluation of this data. The site remains on the Superfund registry at this time.
- The Niagara Chemical site is located west of the intersection of Commerce Street and Adams Avenue near downtown Harlingen in Cameron County. Remedial action was performed in August 1997 through April 1998. The final Administrative Order for the site requires ten years of groundwater monitoring to confirm natural attenuation of contaminants. Groundwater monitoring began in June 1998. The third year of monitoring was completed in September 2000. The site remains on the Superfund registry at this time.

Monitoring and remediation activities will continue at each Superfund site until acceptable levels of all contaminants (legacy and non-legacy) are achieved, and TNRCC approves the final disposition of each site allowing removal from the Superfund registry.

The TNRCC and local authorities in the Arroyo Colorado watershed will further evaluate the need for, and effectiveness of, various mitigation and remediation options, including site-specific natural attenuation, based on the results of the various monitoring efforts described in the Monitoring Plan section of this document. Decisions concerning the need for and implementation of any additional control actions or management measures, including selected

Best Management Practices (BMPs), will be further developed as the results of the various ongoing studies are known (see Implementation Schedule section of this document).

# Legal Authority

### *TNRCC*

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 the 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 Pollutant 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. This includes discharges of waste from industry and municipal treatment works, and discharges of storm water associated with industrial activities, construction sites, and municipal separate storm sewer systems (MS4s).

No point source wastewater permits currently authorize the discharge of any legacy pollutant into any of the water bodies addressed by these TMDLs. Any necessary regulatory action concerning the discharge of legacy pollutants will be addressed through storm water requirements:

- TNRCC assumed jurisdiction and administration of the EPA Multi-Sector Storm Water General Permit for industrial activities on September 29, 2000. TNRCC is in the process of renewing that permit as TPDES General Permit No. TXRO5000.

- Discharges of storm water associated with construction projects covering five acres or more are currently regulated by EPA under the Phase I Construction Storm Water General Permit. TNRCC will assume jurisdiction and administration of the construction permit by July 7, 2003, and will develop a state permit for renewal.
- Discharges of storm water associated with construction projects one to five acres in size, or smaller than one acre if designated, will be regulated under Phase II of the storm water program. Phase II rules were published by EPA on December 8, 1999, and became effective on December 22, 1999. TNRCC must issue a Phase II Construction General Permit by December 9, 2002. Phase II construction sites must begin obtaining permit coverage within 90 days of permit issuance.

- Discharges of storm water associated with MS4s in cities and counties with populations greater than 100,000 are currently regulated by individual MS4 permits issued by EPA under Phase I of the storm water program. TNRCC will assume jurisdiction upon expiration of each MS4 permit; however, there are currently no individual MS4 permits within the affected watershed.
- Cities and counties with populations less than 100,000 will be regulated under the Phase II storm water rules. TNRCC must designate additional small MS4s, and must issue a Phase II MS4 permit by December 9, 2002. Small MS4s must obtain permit coverage within 90 days of permit issuance. Phase II MS4s will be required to identify BMPs, along with associated measurable goals and implementation schedules, for efforts such as the identification and elimination of illicit discharges, construction site runoff control, and post-construction storm water management in new development and redevelopment areas.

The TNRCC has the regulatory authority to oversee the cleanup of sites contaminated with industrial and municipal hazardous and solid wastes. In general, remediation and closures at industrial solid and hazardous waste facilities must comply with the requirements of 30 TAC Chapter 335, which contains the Risk Reduction Standards, the state cleanup regulations that became effective in June 1993. Remediation and closures initially reported on or after May 1, 2000 must comply with the Texas Risk Reduction Program (TRRP) rules in 30 TAC Chapter 350. Legal authority for the Superfund program is contained within the Texas Health and Safety Code (§361.181 and §361.402). Three area Superfund sites are still being evaluated or monitored.

### *Other State Agencies*

The Texas Department of Agriculture (TDA) regulates the agricultural application of pesticides, as directed by Chapter 76 of the Texas Agriculture Code. Non-agricultural application of pesticides is regulated by the Structural Pest Control Board of Texas, as per the Structural Pest Control Act.

# Implementation Schedule

Several monitoring and evaluation projects are planned or underway as part of this implementation plan (see Table 2). The TDH recently completed a Health Consultation that contains a consumption risk assessment of fish tissue data collected from the Arroyo Colorado in Fall 1998 (TDH 2001b). This assessment has resulted in the issuance of a modified consumption advisory for the Arroyo Colorado, which make changes in the contaminants of concern and reduces the advisory coverage to a single fish species (see Reasonable Assurance of Success section of this document).

TABLE 2. Implementation schedule for monitoring and remediation activities and the evaluation of potential management measures.

| ENTITY | ACTIVITY | IMPLEMENTATION SCHEDULE |
|---|---|---|
| Texas Department of Health (TDH) | Risk assessment of Fall 1998 fish tissue data from the Arroyo Colorado | Completed in April 2001 (TDH 2001b); revised consumption advisory issued in June 2001 |
| U.S. Geological Survey (USGS) | Collection and analysis of sediment core from Llano Grande Lake | Spring 2001 |
| Texas Natural Resource Conservation Commission (TNRCC) | (1) Remediation of the Munoz Borrow Pits Superfund site | (1) Remediation completed in mid-1997; deleted from Superfund registry in September 1998; follow-up groundwater monitoring began in June 2000 |
| | (2) Remediation of the Hayes-Sammons Warehouse Superfund site | (2) Remediation conducted June-October 1998; additional soil sampling to be conducted at nearby residences |
| | (3) Remediation of the Niagara Chemical Superfund site | (3) Remediation conducted August 1997-April 1998; ten years of groundwater monitoring required by final Administrative Order began in June 1998 |
| | (4) Remediation of Donna Canal PCB source | (4) Initial sampling conducted in March 2001 - evaluation of results is in progress; additional sampling and remediation will be planned following evaluation of the initial data |
| | (5) Evaluation of results of activities conducted by USGS and TDH; Coordination and planning with TDH and local authorities for any additional monitoring and/or BMP implementation; See Table 3 for details | (5) Following completion of all scheduled activities and receipt of all resulting data - probably mid to late 2002; Interim meetings and evaluations will be conducted as appropriate; See Table 3 for details |

Tissue monitoring will continue until the consumption restrictions are lifted for all fish species. Natural attenuation processes are expected to continue for the remaining contaminants of concern. Because the natural attenuation of legacy pollutants occurs gradually, collection and analysis of fish tissue from both the Arroyo Colorado and the Donna Reservoir and Canal on a five-year cycle beginning in 2005 should be adequate to track continuing contaminant declines and allow for periodic reassessment of consumption risk by TDH. Tissue sampling will be performed by TDH, or by another entity through an arrangement with TDH. Sampling will continue on this schedule until endpoint targets have been reached and the consumption restrictions removed. Follow-up sampling will be conducted approximately five years later to verify that tissue contaminants remain at acceptable levels. TDH may choose to conduct additional monitoring in any of the water bodies at any time.

The U.S. Geological Survey (USGS), through an interagency agreement with EPA Region 6 (Dallas), will conduct a sediment core project in the Llano Grande Lake portion of the Arroyo Colorado to examine current sediment contaminant levels and historical trends in the occurrence of legacy pollutants (see *Historical Trends in Legacy Pollutants in the Arroyo Colorado as Recorded in Bottom Sediments in the Llano Grande, FY2001 Project Proposal - P.C. Van Metre, September 7, 2000*). A sediment core will be collected in Spring 2001. Analytical results are expected within approximately two months, with data evaluation complete by late Summer 2001.

Continuing evaluation and monitoring are in progress at three pesticide-contaminated Superfund sites in the Arroyo Colorado watershed. Monitoring and remediation activities will continue at each site until acceptable levels of all contaminants are achieved, and TNRCC approves the final disposition of each site allowing removal from the Superfund registry. All activities are being managed through the Superfund program in the TNRCC Remediation Division:

- Munoz Borrow Pits in Mission – During the late 1950s, the property owner accepted several dump truck loads of soil contaminated with pesticides, including DDT. The contaminated soil was excavated and removed in mid-1997, and the site was removed from the Superfund registry in September 1998. Groundwater monitoring to confirm the natural attenuation of contaminants began in June 2000 and is ongoing.
- Hayes-Sammons Warehouse in downtown Mission – Demolition and off-site disposal of the warehouses, excavation and off-site disposal of approximately 1700 cubic yards of contaminated soil, and backfilling and grading of the excavated areas occurred in June-October 1998. The site was proposed for deletion from the Superfund registry; however, further evaluation resulted in a decision to conduct additional soil sampling. Those additional samples were collected in April 2000. Evaluation of that data has resulted in development of a plan to conduct sampling in residential yards near the site. Subsequent activities at the site will be based on the evaluation of this data. The site remains on the Superfund registry at this time.
- Niagara Chemical near downtown Harlingen – Remedial action was performed in August 1997 through April 1998. The final Administrative Order for the site requires ten

years of groundwater monitoring to confirm natural attenuation of contaminants. Groundwater monitoring began in June 1998. The third year of monitoring was completed in September 2000. The site remains on the Superfund registry at this time.

Follow-up investigation into the PCB source to the Donna Canal is also being conducted through the TNRCC Remediation Division. The extent of contamination and the necessary remediation will be determined by those efforts. Initial soil, bed sediment, suspended sediment, and water samples were collected in March 2001. Analytical results were received in late May 2001, and the data are currently being evaluated. Additional sampling and subsequent remediation will be planned following completion of the evaluation of the initial data.

TNRCC and local authorities in the Arroyo Colorado watershed will further evaluate the need for, and effectiveness of, the various mitigation and remediation options, including site-specific natural attenuation, based on the results of the various monitoring efforts and the evaluation of remediation activities along the Donna Canal (Table 3). Timetables for additional monitoring and/or the implementation of any BMPs, and estimates of the time necessary for restoration of the fish consumption uses, will be further developed as results of these ongoing efforts are known. The following subsections outline a general approach (summarized in Table 3) to possible subsequent actions that will depend upon results of the efforts described above.

### *Historical Loading Trends*

Numerous studies have documented the long-term persistence of organochlorine pesticides and their degradation products in soil. Pesticide residue concentrations in soils can span several orders of magnitude, and are a reflection of application history and loss rates (Lichtenstein *et al.* 1971; Harner *et al.* 1999). Degradation rates of organochlorine residues are highly variable, and soil half-lives of as much as 20 to 35 years have been reported (Nash and Woolson 1967; Dimond and Owen 1996; Mattina *et al.* 1999).

The release of pollutants from undisturbed soils is not generally a major problem. Mattina *et al.* (1999) examined an experimental site 38 years after chlordane application, and found vertical and horizontal movement to be minimal. Bennett *et al.* (1974) observed little lateral movement of chlordane and dieldrin residues 21 years after application, except in areas that had experienced erosion. The primary method of transport of legacy pollutants into aquatic systems is by erosion of soil and attached contaminants (Munn and Gruber 1997), which settle into the sediments.

Contaminants present in sediment degrade slowly, and may be present for long periods of time (Oliver *et al.* 1989; Rhee *et al.* 1993; Sokol *et al.* 1998; EPA 1999). Van Metre *et al*. (1998) analyzed sediment core samples from 11 reservoirs, and determined mean

TABLE 3. Evaluation outline for any subsequent actions found to be necessary based on the results of ongoing monitoring and related studies.
Any subsequent activities will be coordinated by TNRCC and local authorities. See text for additional details.

| ACTIVITY | RESULTS | SUBSEQUENT ACTION |
|---|---|---|
| (1) Fish tissue contaminant concentrations (TDH) | (a) Removal of consumption ban or advisory by TDH due to reduction of tissue contaminant concentrations | (a) No action necessary other than follow-up tissue sampling five years after removal of the ban |
| | (b) Consumption restriction remains in effect, but trend in reduction of tissue contaminant concentrations is evident | (b) (i) Continue tissue monitoring every five years to verify continuing contaminant reductions<br>(ii) Conduct follow-up tissue monitoring five years after endpoint target is achieved and ban is removed |
| | (c) No evidence of reduction in tissue contaminant concentrations based on samples collected in 2000-2005 | (c) (i) Continue addressing pollutant sources and monitoring fish tissue<br>(ii) Reevaluate TMDL time frames and need for additional approaches |
| (2) Historical pollutant trends determined from Llano Grande Lake sediment cores (USGS/EPA) | (a) No substantial recent input - any existing pollutants in deeper layers of sediment | (a) Evaluate within framework of USGS conclusions - no additional action is likely to be necessary |
| | (b) Pollutant concentration and depth in core suggest recent or continuing input | (b) Evaluate within framework of USGS conclusions and activities in progress at Superfund sites to identify current source(s); Evaluate potential BMPs, additional remediation needs, and additional source investigation needs |
| (3) (a) Evaluation and remediation of Superfund sites (TNRCC) | (a) (i) Completion of remediation and implementation of any follow-up monitoring<br>(ii) Investigations indicate additional contaminant sources associated with a site, or contaminant problems are detected by follow-up monitoring | (a) (i) No additional action necessary - continue any required monitoring<br>(ii) Additional investigation and remediation efforts will continue until final TNRCC approval |
| (b) Evaluation and remediation of Donna Canal PCB source (TNRCC) | (b) (i) Completion of investigation and all remediation activities<br>(ii) Ongoing investigations indicate additional contaminant sources associated with the site | (b)(i) No additional action necessary - continue any required monitoring<br>(ii) Additional investigation and remediation efforts will continue until final TNRCC approval |

sediment half-lives of 7.7 to 17 years for chlordane, 13 ± 5.8 years for total DDT, and 9.5 ± 2.2 years for PCBs. Contaminant levels in lake sediment cores have shown good agreement with production and usage histories of the parent compounds, with peak concentrations appearing at the times of peak use (Ricci *et al.* 1983; Oliver *et al.* 1989; Van Metre and Callender 1997; Van Metre *et al.* 1998; Ging *et al.* 1999). Although residues can continue to persist in the deeper parts of sediment cores, burial by more recently deposited sediments may result in effective removal of the contaminants from bioavailability to aquatic life (Ricci *et al.* 1983).

Natural attenuation will continue to reduce contaminant concentrations, while ongoing sedimentation will continue to bury any remaining contaminated sediment. If historical trends determined from sediment cores indicate continuing contaminant input to the Arroyo Colorado, investigation will be necessary to identify the source. Suspended sediment sampling may be needed to isolate the source. If the USGS study indicates unexpectedly large concentrations, the need for dredging will also be considered.

### *Fish Tissue Contaminant Concentrations*

A large number of factors associated with fish physiology, environmental conditions, and the form of the contaminant have been found to influence contaminant elimination from fish tissue (see literature surveyed in TNRCC 2000). The time necessary for elimination is both long and variable. Half-lives for DDT, DDE, and PCBs in lake trout have been estimated at 9 to 10 years (see Borgmann and Whittle 1992; Van Metre *et al.* 1998). Long-term field studies have generally found that elimination rates are considerably longer than those measured in laboratory studies (de Boer *et al.* 1994; Delorme *et al.* 1999).

Additional tissue sampling may be the only step necessary to monitor progress towards the endpoint target of these TMDLs if the data indicate a clear trend in the reduction of tissue contamination. Recent assessment of fish tissue data collected in the Arroyo Colorado in 1998 (TDH 2001b) found that contaminant concentrations do not yet allow for complete removal of the consumption advisory; however, advisory coverage has been reduced to a single species, the smallmouth buffalo, and toxaphene is no longer listed as a contributor to consumption risk. It will be necessary to continue tissue monitoring until contaminant concentrations allow removal of the advisory.

Because the natural attenuation of legacy pollutants occurs gradually, collection and analysis of fish tissue from both the Arroyo Colorado and the Donna Reservoir and Canal on a five-year cycle beginning in 2005 should be adequate to track continuing declines and allow for periodic reassessment of consumption risk by TDH. Tissue sampling will be performed by TDH, or by another entity through an arrangement with TDH. Sampling will continue on this schedule until endpoint targets have been reached and the consumption restrictions removed. Follow-up sampling will be conducted approximately five years later to verify that tissue contaminants remain at acceptable levels. TDH may choose to conduct additional monitoring in any of the water bodies at any time.

Decreases in fish tissue concentrations of organochlorine insecticides and PCBs have been observed where no major additional inputs are occurring (see Moore and Ramamoorthy 1984; Brown *et al.* 1985; Bremle and Larsson 1998). Available fish tissue data from the Arroyo Colorado and the Donna Reservoir indicate that legacy pollutant concentrations in those water bodies are decreasing as a result of natural attenuation processes (see Reasonable Assurance of Success section of this document). A decrease is not as evident in the Donna Canal due to the presence of a PCB source. Natural attenuation in the canal is expected to proceed more quickly following remediation of that source. If tissue samples collected in 2005 indicate no reduction of contaminants in a water body, reevaluation of the TMDL approach will be required for that case.

### *Monitoring After Additional Action*

Subsequent remediation of source(s), implementation of BMPs, institutional controls, or other regulatory or enforcement activities will be dependent upon the nature of the source(s). Additional monitoring may be necessary to assess the adequacy of any of these additional efforts. TNRCC and local authorities will cooperate in planning this assessment monitoring when a decision is made to take a particular action in a designated location. This monitoring may include fish tissue and/or suspended sediment sampling. If ongoing investigations associated with the area Superfund sites indicate the need for additional remediation and/or monitoring, the necessary actions will be conducted within the context of the Superfund activities.

### *Restoration of Fish Consumption Use*

The results of current monitoring efforts, and any subsequent need to implement one or more additional activities, will likely affect any estimates of the time necessary for restoration of the fish consumption use to these water bodies. Given current knowledge of fish tissue chlordane concentrations and potential existing environmental reservoirs of legacy pollutants, restoration of the fish consumption use in these water bodies is expected within the next fifteen years. Findings of the ongoing monitoring efforts, and subsequent reassessments of tissue contaminant risk by TDH, may require revision of these estimates.

# Monitoring Plan

The TNRCC will continue a variety of efforts to determine if any current loading is occurring, and to verify decreasing pollutant loading and tissue concentration trends. The TNRCC will continue to cooperate with the TDH to monitor fish tissue in the impaired water bodies, in order to better define the extent and severity of the impairments, establish spatial and temporal trends in fish tissue contamination, and monitor the reduction of tissue concentrations to levels that allow removal of the fish consumption bans. Monitoring of fish tissue in the Arroyo Colorado and the Donna Reservoir and Canal will continue at five year intervals, beginning in 2005, until the endpoint targets are reached. TDH will reassess tissue contaminant levels after each sampling event. Fish tissue will be collected five years after removal of a fish consumption

advisory or ban to verify that tissue contaminants remain at acceptable levels. Additional fish tissue sampling will be coordinated with TDH. The TDH may also choose to conduct additional fish tissue monitoring in any of the water bodies at any time.

The USGS, through an interagency agreement with EPA Region 6 (Dallas), will collect a sediment core (Van Metre and Callender 1997; Van Metre *et al.* 1998; Ging *et al.* 1999) in the Llano Grande Lake portion of the Arroyo Colorado, located southwest of the City of Mercedes in southeast Hidalgo County (Figure 3). Llano Grande Lake is a long, shallow depression that acts as a large settling basin, collecting much of the upstream sediment load. The sediment core will be analyzed to determine current sediment contaminant levels, estimate any current loading of legacy pollutants, and determine historical trends in the occurrence of legacy pollutants (see *Historical Trends in Legacy Pollutants in the Arroyo Colorado as Recorded in Bottom Sediments in the Llano Grande, FY2001 Project Proposal - P.C. Van Metre, September 7, 2000*). Core collection is planned for Spring 2001. Analytical results are expected within approximately two months, with data evaluation complete by late Summer 2001.

The TNRCC and local authorities in the Arroyo Colorado watershed will further evaluate the need for additional monitoring activities based on the results of the ongoing studies (see also Implementation Schedule section of this document). The necessary extent of any additional monitoring will be further developed as the results of the USGS/EPA sediment core project are known, and as monitoring and remediation activities at the three Superfund sites and along the Donna Canal continue. Groundwater monitoring is currently in progress at two of the Superfund sites.

If sediment coring in Llano Grande Lake indicates continuing contaminant input, additional investigation will be needed to isolate and delineate the source area(s). Additional sampling will be planned and performed through a contract with USGS or another entity, with input and/or participation by local authorities. Additional monitoring may be necessary to assess the adequacy of any subsequent source remediation, BMP implementation, or regulatory activities that are undertaken. This monitoring may include fish tissue and/or suspended sediment sampling, and will be coordinated with the appropriate local authorities.

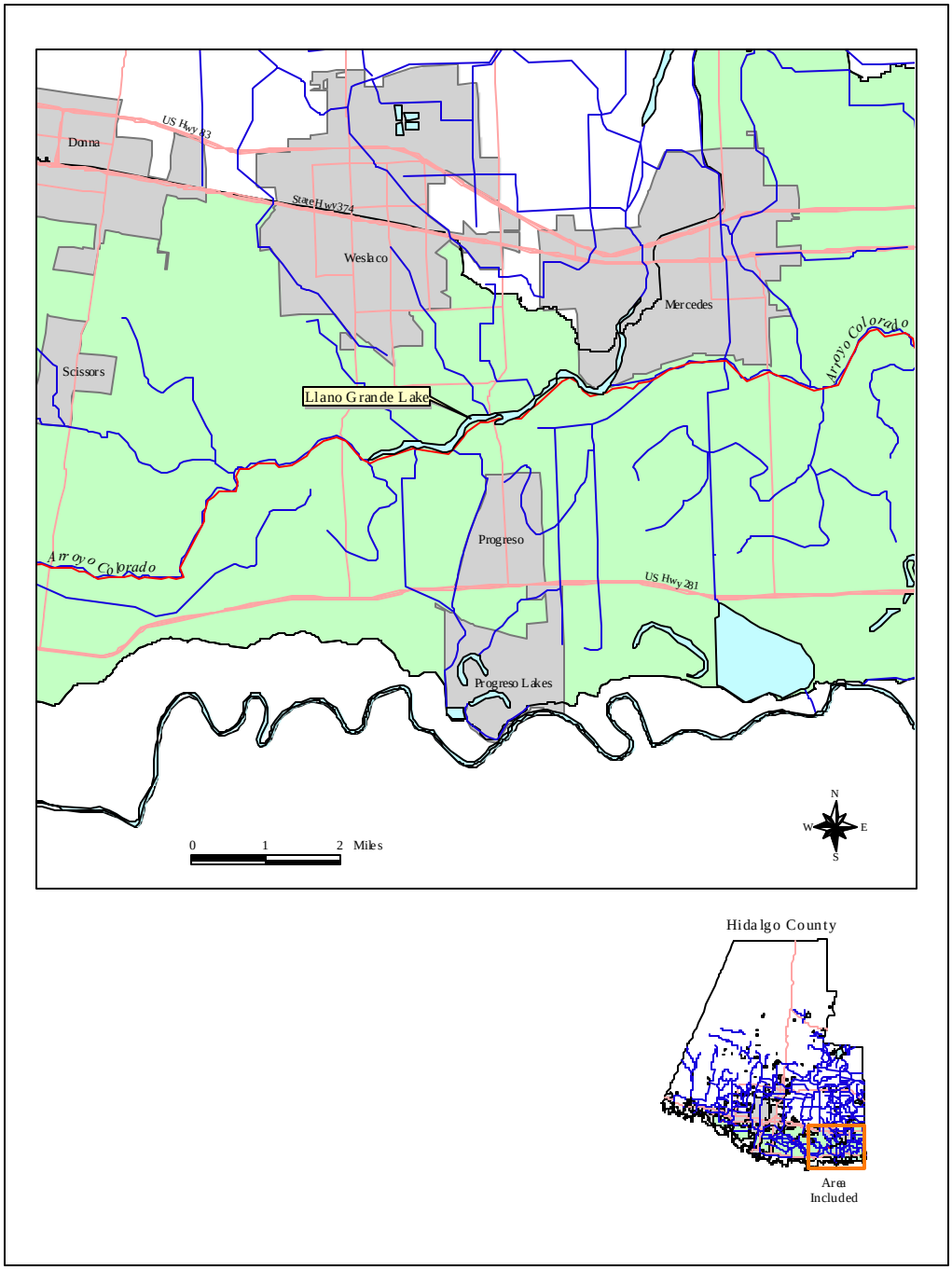



FIGURE 3. Location of Llano Grande Lake portion of the Arroyo Colorado.

# Reasonable Assurance of Success

Restrictions on the use of legacy pollutants generally have resulted in a slow but steady decline in environmental residues (Smith *et al.* 1988). Reconstructed contaminant trends in lake sediment cores have shown good agreement with production and usage histories of the parent compounds, with peak concentrations appearing at the times of peak use (Ricci *et al.* 1983; Oliver *et al.* 1989; Van Metre and Callender 1997; Van Metre *et al.* 1998; Ging *et al.* 1999). Higher concentrations generally appeared deeper in the cores, indicating that input and accumulation were decreasing with time. Although residues continue to persist in deeper parts of the cores, burial by more recently deposited sediments may result in effective removal of the contaminants from bioavailability to aquatic life (Ricci *et al.* 1983).

Decreases in fish and human tissue concentrations of organochlorine insecticides and PCBs have been observed where no major additional inputs are occurring (see Moore and Ramamoorthy 1984; Brown *et al.* 1985; Hovinga *et al.* 1992; Bremle and Larsson 1998; Schiff and Allen 2000). Reviews of tissue data collected from a variety of water bodies in northern Europe between 1967 and 1995 have found a significant decrease in organochlorine concentrations over time (Skåre *et al.* 1985; Bignert *et al.* 1998). Total DDT and PCB concentrations showed annual decreases of 6.2 to 12 percent and 3.6 to 13 percent, respectively over this time period.

Fish tissue concentrations of total DDT, chlordane, and toxaphene have declined across the U.S. since uses of these substances were discontinued (Schmitt *et al.* 1990; USGS 2000). The DDE component of total DDT has increased as a result of continued degradation. Total chlordane levels were stable, although a shift from the *cis*- to the *trans*- isomer between the mid-1970s and mid-1980s suggested a smaller influx of chlordane to the environment (Schmitt *et al.* 1990). Toxaphene tissue concentrations steadily increased nationwide through the 1970s before stabilizing, while the incidence of detection rose from 60 to 88 percent of sites (Schmitt *et al.* 1985). The incidence of toxaphene detection subsequently declined to 69 percent of sites by 1984, accompanied by a lower nationwide average tissue concentration and an overall downward trend in tissue levels (Schmitt *et al.* 1990).

Declining tissue concentrations of DDT, toxaphene, and PCBs have been reported in various locations and fish species in the Great Lakes (Glassmeyer *et al.* 1997; Scheider *et al.* 1998). Wszolek *et al.* (1979) found that DDE had decreased considerably from 1970 levels in a similar age group of fish. DDT concentrations in Lake Michigan and Lake Superior fish decreased steadily, to approximately 10 to 25 percent of 1969 levels by the late 1970s (see Bierman and Swain 1982). DDT and PCB concentrations in Lake Ontario spottail shiners in 1987 were significantly reduced from 1975 levels (Suns *et al.* 1991). Chlordane residues were near the detection limit in the shiner samples. A significant decline in toxaphene levels was observed in four of five Great Lakes fish species examined by Glassmeyer *et al.* (1997).

Total PCB concentrations in Lake Michigan fish declined, and then appeared to stabilize in the 1980s as a result of the large pools of PCBs that are being recycled in the environment (Stow *et al*. 1995). Modeling results indicate that PCBs in Lake Michigan salmonids will continue to decline very slowly over the next decade (Lamon *et al.* 1998). Lake Ontario lake trout PCB levels have been declining at a half-life of approximately ten years, although concentrations in two other species have not declined appreciably (see Borgmann and Whittle 1992). Less consistent trends in tissue PCB levels may be a reflection of the congener-specific nature of PCB metabolism and degradation. The pattern of decline in total PCBs may be dominated by declines in the less chlorinated congeners (Brown *et al.* 1985). In addition, strong oscillations in PCB levels influenced by food web interactions can be superimposed on a gradual decline (see Borgmann and Whittle 1992).

Continuing decreases in environmental legacy pollutant levels are expected, although the necessary time frame is subject to debate. In addition to degradation and biotransformation of compounds, there may also be a shift towards the atmosphere in the overall partitioning of some organochlorines (see Jones and de Voogt 1999; Gevao *et al.* 2000). Although residues may continue to persist in deeper sediments, burial by more recently deposited sediments may result in effective removal of the contaminants from bioavailability to aquatic life (Bopp *et al.* 1982; Ricci *et al.* 1983). Contaminants can also become so strongly attached to sediment particles over time that bioavailability may decline as a result. Severe extraction procedures used during analysis may not always reflect actual availability to biota (see Jones and de Voogt 1999).

### *Arroyo Colorado*

Available fish tissue data from the Arroyo Colorado indicate that legacy pesticide concentrations are decreasing as a result of natural attenuation processes. Fish tissue data have been collected at several locations in Segment 2202 since the late 1970s, most often in the upper and lower end of Llano Grande Lake and near the Port of Harlingen at the downstream end of the segment. Species collections most often included one or more of the bottom-feeding common carp, smallmouth buffalo, blue catfish, and channel catfish, although a wide variety of game and nongame fish have been collected at various times.

Most of the earlier (1970s and early 1980s) tissue analyses were conducted on whole fish (see Dick 1982; White *et al.* 1983; Davis 1984, 1989). Residues of one or more pesticides were generally very high in these samples (up to 31.5 mg/kg for toxaphene and DDE). Whole-body tissue samples collected as part of a 1989 intensive survey exceeded the nationwide 85$^{th}$ percentile for chlordane and DDE at the lower end of Llano Grande Lake and near the Port of Harlingen (Davis 1989). Chlordane exceedences were highest near the Port of Harlingen, whereas DDE exceedences were highest in Llano Grande Lake. Chlordane also exceeded the nationwide 85$^{th}$ percentile in a blue catfish fillet sample collected at the Port of Harlingen. TNRCC (1994) reported that one of five fish collected in the Arroyo Colorado in 1992-1993 exceeded the TNRCC screening level (85$^{th}$ percentile of statewide values) for toxaphene. Fish fillet tissue data is available for eight years of the 1980-1998 time period in Llano Grande Lake, and for nine years at a site just upstream from the Port of Harlingen in Segment 2202

(Table 4). Sample sizes consisted of six to 14 individual fish and/or composites. The range of pesticide concentrations in fish from a given sample was often wide. In many cases, several fish had very low concentrations while others contained elevated levels. The mean was often influenced by elevated concentrations in one or two fish. Erratic concentrations near the Port of Harlingen may be a result of fish moving in and out of the site from downstream areas. Samples collected at this location included a wider variety of fish, including estuarine species, than the upstream locations.

TABLE 4. Mean and range of contaminant fish tissue (fillet) concentrations through time in Segment 2202. N = number of samples (individual fish and composites). nd = less than detection limit. Raw data were obtained from Davis (1984, 1989) and the Texas Department of Health (*Fish Tissue Sampling Data 1970-1997* and *Fish Tissue Sampling Data 1998-1999*).

| | | | CHLORDANE (mg/kg) | | DDE (mg/kg) | | TOXAPHENE (mg/kg) | |
|---|---|---|---|---|---|---|---|---|
| **SAMPLE LOCATION** | **DATE** | **N** | **MEAN** | **RANGE** | **MEAN** | **RANGE** | **MEAN** | **RANGE** |
| SE of Donna | 11/1998 | 9 | 0.203 | 0.015 - 0.610 | 1.26 | 0.074 - 3.3 | nd | nd |
| Llano Grande Lake | 07/1980 | 8 | 0.054 | nd - 0.110 | 3.38 | 0.052 - 6.90 | 1.7 | nd - 4.8 |
| | 07/1981 | 14 | 0.096 | nd - 0.748 | 2.22 | 0.077 - 8.91 | 1.14 | nd - 5.9 |
| | 05/1983 | 12 | 0.039 | nd - 0.157 | 1.47 | 0.013 - 5.10 | 0.94 | nd - 5.0 |
| | 08/1985 | 10 | 0.292 | nd - 0.930 | 1.63 | 0.13 - 4.7 | 1.16 | nd - 4.1 |
| | 07/1987 | 15 | 0.353 | nd - 1.4 | 1.42 | 0.02 - 5.1 | nd | nd |
| | 06/1989 | 7 | 0.158 | nd - 0.530 | 1.45 | 0.120 - 4.0 | nd | nd |
| | 06/1993 | 6 | nd | nd | 0.76 | 0.03 - 2.2 | nd | nd |
| | 11/1998 | 11 | 0.091 | nd - 0.420 | 0.66 | 0.044 - 4.2 | nd | nd |
| Port of Harlingen | 07/1980 | 7 | 0.102 | 0.014 - 0.220 | 2.06 | 0.17 - 7.9 | 2.98 | 0.22 - 9.1 |
| | 1981 | 12 | 0.15 | nd - 0.874 | 1.21 | nd - 4.92 | 1.25 | nd - 3.49 |
| | 05/1983 | 8 | 0.027 | nd - 0.048 | 1.05 | 0.052 - 2.3 | 1.08 | nd - 2.44 |
| | 08/1984 | 12 | nd | nd | 0.903 | 0.051 - 1.74 | nd | nd |
| | 06/1985 | 10 | 0.115 | nd - 0.500 | 1.34 | 0.040 - 3.33 | 0.214 | nd - 1.04 |
| | 03/1986 | 6 | nd | nd | 0.097 | nd - 0.301 | nd | nd |
| | 07/1987 | 7 | 0.544 | nd - 1.4 | 2.14 | 0.02 - 5.1 | nd | nd |
| | 05/1989 | 12 | 0.068 | nd - 0.200 | 0.423 | nd - 1.17 | nd | nd |
| | 10/1998 | 12 | 0.118 | 0.027 - 0.470 | 0.786 | 0.13 - 3.0 | nd | nd |

Toxaphene exhibits the clearest decreasing trend in tissue concentration in the Arroyo Colorado. Toxaphene levels have been less than the detection limit in all fish collected since 1987 in Llano Grande Lake, and since 1986 near the Port of Harlingen. Toxaphene was also less than the detection limit in all fish collected in the Arroyo southeast of the City of Donna in 1998. Toxaphene is not included among the contaminants listed in the most recent TDH risk assessment for the Arroyo Colorado (TDH 2001b; see below).

Chlordane concentrations were somewhat erratic in Llano Grande Lake through the 1980s, which is not unexpected given the continuing use of chlordane through much of that decade. The greatest mean and maximum chlordane concentrations were measured in 1987 in both Llano Grande Lake and the Port of Harlingen. Manufacture and domestic sale of chlordane ceased in 1987, and all remaining uses were banned as of April 1988. Tissue chlordane concentrations have subsequently declined in both locations (Table 4). Chlordane was detected in most of the fish collected in 1998; however, the mean and maximum concentrations were less than the target concentrations for acceptable carcinogenic and noncarcinogenic risk (TDH 2001b; see below and Table 4).

DDE concentrations have been the most erratic and the most resistant to decrease. This is not entirely unexpected given the widespread use of DDT and the resulting common occurrence of DDE as a pesticide residue (Schmitt *et al.* 1990; Kuehl *et al.* 1994). Mora (1996) found that DDE remained elevated in the eggs of four species of waterbirds nesting in the Lower Laguna Madre, which receives drainage from the Arroyo Colorado, but noted that the levels were much lower than those measured in the 1970s and early 1980s. This suggests that some progress is also occurring in the reduction of environmental DDE concentrations in the area. The mean DDE concentration in the 1998 fish tissue samples was less than the target concentrations for acceptable carcinogenic and noncarcinogenic risk, although the maximum DDE concentration exceeded the target values (TDH 2001b; see below and Table 4).

**Assessment of 1998 Fish Tissue Data**

The TDH recently completed an assessment of fish consumption risk using data collected in the Arroyo Colorado in Fall 1998 (TDH 2001b). The assessment compared average contaminant concentrations with acceptable health-based values for carcinogenic and noncarcinogenic effects. Concentrations of eleven organochlorine pesticides and pesticide degradation products (chlordane, DDT, DDD, DDE, dacthal, dieldrin, endrin, heptachlor, heptachlor epoxide, hexachlorobenzene, and lindane) with known carcinogenic and/or noncarcinogenic effects on the liver were detected in the tissue of the various fish. Toxaphene was not detected in any fish, and was not included on the list of contaminants.

Relatively small concentrations of contaminants were detected. The average concentration of each contaminant was less than the respective health-based values for acceptable carcinogenic and noncarcinogenic risk. However, the risk assessment was based on the cumulative effect of simultaneous exposure to all contaminants (TDH 2001b). The cumulative contaminant concentrations resulted in an unacceptable risk for both carcinogenic and noncarcinogenic

effects. The unacceptable risk was present when the diet was assumed to include a mixture of different fish species. Further evaluation found the risk to be acceptable when smallmouth buffalo were excluded from the diet.

The assessment concluded that long-term consumption of smallmouth buffalo poses an unacceptable risk due to the possibility of subtle adverse health effects from low-level simultaneous exposure to chlorinated pesticides (TDH 2001b). The assessment recommended that consumption of smallmouth buffalo be limited, but that there be no restriction on consumption of other fish species from the Arroyo Colorado. TDH issued a modified consumption advisory (ADV-19) on 4 June 2001, which states that persons should limit consumption of smallmouth buffalo to two meals per month, but that other species may be consumed without restriction.

The risk assessment of the 1998 data lends support to the continuing reduction of legacy pesticide concentrations in the Arroyo Colorado due to natural attenuation processes:

- Toxaphene is no longer contributing to the consumption risk.
- The average concentration of each contaminant is less than the individual health-based values for acceptable carcinogenic and noncarcinogenic risk. The current risk is due to cumulative exposure to several contaminants at low concentrations. Natural attenuation processes are expected to continue for all of the relevant contaminants.
- The new consumption advisory applies to a single fish species. Other species may be consumed without restriction.

### *Donna Reservoir and Canal*

Fish tissue data were collected in the Donna system in 1993, 1994, and 1997. The mean and range of tissue PCB concentrations for each sample date and location were examined using available fish fillet data, to see if any trends were apparent (Table 5).

Tissue concentrations in individual fish and composites from the Donna Main Canal were often quite variable. The eight carp collected in the canal in 1997 had PCB concentrations ranging from less than the detection limit to 20 mg/kg in a large carp. The largest tissue PCB levels in the main canal were observed from just south of the Arroyo Colorado through the bend north of U.S. Highway 281. Concentrations were generally lower in 1997 relative to 1993-94, although the 20 mg/kg concentration in one fish indicates that appreciable contamination remains, at least in older fish. Fish tissue PCB concentrations in the canal will continue to be affected by the presence of the PCB source until remediation of that site is complete.

Reservoir tissue concentrations were less variable, particularly in the 1994 and 1997 samples. A decline in tissue PCB concentrations is more apparent in the reservoir. There was a large decrease in mean and maximum PCB concentrations in Donna Reservoir between 1993 and 1994. The mean value in the reservoir was less than the detection limit in 1997.

TABLE 5. Mean and range of PCB fish tissue (fillet) concentrations through time in the Donna Reservoir and Main Canal (Segment 2202A). All PCB measurements greater than the detection limit were Aroclor 1254. N = number of samples (individual fish and composites). nd = less than detection limit. Raw data were obtained from Webster *et al.* (1998) and the Texas Department of Health (*Fish Tissue Sampling Data 1970-1997* and unpublished data).

| SAMPLE LOCATION | DATE | N | MEAN (mg/kg) | RANGE (mg/kg) |
|---|---|---|---|---|
| Main Canal, 0.25 mile north of Rio Grande pump station | 03/1994 | 5 | nd | nd |
| Main Canal, just south of Arroyo Colorado | 01/1994 | 5 | 3.8 | nd - 8.8 |
| Main Canal, at 90-degree bend north of US 281 | 05/1993 | 4 | 5.0 | 1.4 - 9.3 |
| Main Canal, at 90-degree bend north of US 281 | 01/1994 | 5 | 5.8 | 0.34 - 24 |
| Main Canal, 3.5 miles north of Rio Grande pump station | 03/1994 | 4 | nd | nd |
| Main Canal | 07/1997 | 8 | 2.7 | nd - 20 |
| Donna Reservoir | 05/1993 | 6 | 1.6 | nd - 9.6 |
| Donna Reservoir | 01/1994 | 10 | 0.026 | nd - 0.08 |
| Donna Reservoir | 07/1997 | 2 | nd | nd |

In 1999 and 2000, the USGS and the TNRCC conducted a series of high volume suspended sediment sampling events in the Donna Canal, and collected sediment core samples from the Donna Reservoir (*USGS Final Progress Memorandum: Investigation of PCBs on Suspended Sediment in Donna Canal, Texas, 15 December 2000*). The results yielded significant detections of PCBs in suspended sediment at specific sampling points in the canal. The PCBs in suspended sediment showed a decreasing trend in concentration in a downstream direction from the highest detectable PCB value. Through the combined use of sediment coring and suspended sediment analysis, the location of the source of PCBs in the Donna system was narrowed from within a total length of eight miles to within a 75-meter reach of the canal. No evidence of a historical release of PCBs to the reservoir was found. Additional investigation and remediation of the PCB source along the canal is being addressed through existing TNRCC programs (see the Control Actions and Management Measures and the Implementation Schedule sections of this document).

# Measurable Outcomes

The following outcomes will denote the attainment of various implementation steps:

(1) Completion of additional fish tissue sampling at five-year intervals
   (a) sampling events and laboratory analyses
   (b) reassessment of fish tissue risk by TDH

(2) Completion of Llano Grande Lake sediment core project
   (a) core sample collection and laboratory analyses
   (b) data analysis and reconstruction of historical trends

(3) Completion of remediation activities and any subsequent monitoring at the Hayes-Sammons Warehouse Superfund site, and removal of the site from the Superfund registry

(4) Completion of monitoring activities at the Niagara Chemical Superfund site, and removal of the site from the Superfund registry

(5) Completion of PCB investigation and remediation activities along the Donna Canal

(6) Completion of any additional sampling activities
   (a) planning/completion of sampling events and laboratory analyses
   (b) data analysis and evaluation of source areas

(7) Planning and implementation of any necessary BMPs and/or regulatory strategies.

The most significant outcome for determining the success of the TMDLs and the implementation plan will be the removal of the fish consumption bans and advisories by TDH. Interim outcomes that indicate progress towards this goal are:

- Continued reductions in fish tissue contaminant concentrations beyond those already observed,
- Reduction of fish tissue contaminant concentrations to a level that allows TDH to modify a consumption ban or advisory by removing some of the contaminants, shift to an advisory for certain groups at greater risk, or limit the advisory to specific fish species, and
- Reduction of fish tissue contaminant concentrations to levels that meet the endpoint target concentrations and acceptable risk levels, but where TDH has not yet removed the consumption ban or advisory.

As described in previous sections of this document, the most recent risk assessment for fish tissue from the Arroyo Colorado (TDH 2001b) no longer includes toxaphene as one of the

contaminants of concern. The remaining contaminants are present in concentrations less than the individual health-based values for acceptable carcinogenic and noncarcinogenic risk. The current risk is due to cumulative exposure to several contaminants at low concentrations. Natural attenuation processes are expected to continue reducing these contaminants. In addition, TDH has modified the consumption advisory for the Arroyo Colorado, reducing advisory coverage to a single fish species (smallmouth buffalo).

TDH has the authority and jurisdiction for the decision to issue or remove fish consumption restrictions. Subsequent risk assessments by TDH may result in no change to a restriction, removal of the ban or advisory, changes in the contaminants and/or fish species addressed, or a shift to an advisory for certain groups at greater risk. The ultimate endpoint goal for the affected water bodies is the protection of all groups and complete removal of the fish consumption bans and advisories.

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