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18 July 2016

Mr. Rafael Casanova, P.G.
Task Order Monitor
U.S. Environmental Protection Agency (EPA) Region 6
1445 Ross Avenue, Suite 1200
Dallas, Texas 75202-2733

RE: Feasibility Study Report, Revision 01
Donna Reservoir and Canal System
Remedial Investigation/Feasibility Study
EPA Region 6 Remedial Action Contract 2
Contract: EP-W-06-004
Task Order: 0082-RICO-06NS

Dear Mr. Casanova:

EA Engineering, Science, and Technology, Inc., PBC (EA) is submitting the Feasibility Study Report, Revision 01 for the above-referenced Task Order. Three hard copies and three electronic copies on compact disc (CD) are enclosed with this letter. Four hard copies and four electronic copies on CD will be sent to the Texas Commission on Environmental Quality (TCEQ). One hard copy and two electronic copies on CD will be sent to the U.S. Fish and Wildlife Service (USFWS). In addition, an electronic copy will be uploaded to the SharePoint site.

If you have any questions regarding this submittal, please call me at (510) 545-4138.

Sincerely,

Sheena Styger, P.G.
Project Manager

Enclosure

cc: Michael Pheeny, EPA Contracting Officer (letter only)
Rena McClurg, EPA Project Officer (letter only)
Anna Lund, TCEQ (3 hard copies, 3 electronic copies on CD)
Richard Seiler, TCEQ (1 hard copy, 1 electronic copy on CD)
Barry Forsythe, USFWS (1 hard copy, 1 electronic copy on CD)
Clare Lee, USFWS (1 electronic copy on CD)
Tim Startz, EA Program Manager (letter only via email)
File

500022797

TRANSMITTAL OF DOCUMENTS FOR ACCEPTANCE BY EPA		DATE: **18 July 2016**	TRANSMITTAL NO.: **0000027**
TO: **Mr. Rafael Casanova** **U.S. Environmental Protection Agency (EPA) Region 6**		FROM: **Ms. Sheena Styger** **EA Engineering, Science, and Technology, Inc., PBC**	
SUBTASK NO.	DELIVERABLE	NO. OF COPIES	
12	Feasibility Study Report, Revision 01 Donna Reservoir and Canal System Remedial Investigation/Feasibility Study	EPA - 3 hard copies and 3 electronic copies on compact disc TCEQ - 4 hard copies and 4 electronic copies on compact disc USFWS - 1 hard copy and 2 electronic copies on compact disc	
ACCEPTANCE ACTION			
DOCUMENTS FOUND ACCEPTABLE (LIST BY SUBTASK NO.)		NAME/TITLE/SIGNATURE OF REVIEWER DATE	

Feasibility Study Report

Remedial Investigation/Feasibility Study

Donna Reservoir and Canal System
Donna, Hidalgo County, Texas
EPA Identification No. TX0000605363

Remedial Action Contract 2 Full Service
Contract: EP-W-06-004
Task Order: 0082-RICO-06NS

Prepared for
U.S. Environmental Protection Agency
Region 6
1445 Ross Avenue
Dallas, Texas 75202-2733

Prepared by
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July 2016
Revision: 01
EA Project No. 14342.82

EXECUTIVE SUMMARY

The U.S. Environmental Protection Agency (EPA) authorized EA Engineering, Science, and Technology, Inc., PBC (EA) to conduct Remedial Investigation and Feasibility Study activities at the Donna Reservoir and Canal System (DRCS) site in Donna, Hidalgo County, Texas under Remedial Action Contract Number EP-W-06-004, Task Order 0082-RICO-06NS. This report presents the Feasibility Study. The purpose of the Feasibility Study is to develop and evaluate remedial alternatives that are appropriate to site-specific conditions, protective of human health and the environment, and comply with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). This report will support remedy selection in the Record of Decision.

CONCEPTUAL SITE MODEL

The DRCS includes a system of irrigation canals and reservoirs containing sediment and fish with elevated concentrations of polychlorinated biphenyls (PCBs). PCBs—specifically Aroclor-1254—were initially identified at the site when a tissue sample was reported with 399 milligrams per kilogram (mg/kg) of PCBs from a fish reportedly caught in the DRCS in 1994 (EPA 1994). After the identification of contaminated fish in the canal system, the Texas Department of Health issued Aquatic Life Order Number 9 that declared the DRCS a prohibited area for harvesting all species of aquatic life (Texas Department of Health 1994). In March 2008, the site was listed on the National Priorities List due to PCB contamination in sediment and fish (EPA 2008).

The Remedial Investigation determined sediment with elevated levels of PCBs is located in the Lower West Main Canal Unlined, downgradient of the siphon exit. The highest observed concentration of total PCB Aroclors in sediment was 11 mg/kg, which was reported entirely as Aroclor-1254, and the highest observed concentration of total PCB congeners in sediment was 6.1 mg/kg. The majority of samples for PCB congener analyses were collocated with those collected for PCB Aroclor analyses and samples with detectable concentrations of total PCB congeners tend to be collocated with detectable concentrations of PCB Aroclors. Sediment concentrations of PCBs as Aroclors and total PCB congeners decrease with distance in the Lower West Main Canal Unlined from the siphon exit to results reported below detection levels.

Fish with detectable levels of Aroclor-1254 or Aroclor-1260 were collected from all segments of the canals and reservoirs sampled (i.e., Main Canal, Lower West Main Canal, West Reservoir); the maximum detected concentration of total PCB Aroclors was 8.1 mg/kg in a fillet sample of smallmouth buffalo, a bottom feeder, from the Lower West Main Canal Unlined near the exit of the siphon. The maximum detected concentration of total PCB congeners in fish tissue was 150 mg/kg, also in a fillet sample of smallmouth buffalo caught in the Lower West Main Canal Unlined in a downgradient portion of the canal.

Maximum detected PCB congener concentrations observed in fish were approximately 25 times higher than those observed in sediment (150 mg/kg in fish to 6.1 mg/kg in sediment). Maximum detected PCB Aroclor concentrations observed in fish were similar to those observed in sediment

(8.1 mg/kg in fish to 11 mg/kg in sediment). Average detected PCB congener concentrations observed in fish were approximately 20 times higher than those observed in average detected sediment concentrations (7.2 mg/kg in fish to 0.41 mg/kg in sediment). Average detected PCB Aroclor concentrations observed in fish were approximately 3 times higher than those observed in average detected sediment concentrations (0.6 mg/kg in fish to 0.24 mg/kg in sediment). Therefore, it was concluded that PCBs are bioaccumulating in fish. Passive sampler data indicate that fish may receive PCBs from the water column directly or from prey or sediment they ingest, although the largest known PCB source at the site directly accessible to fish is sediment in the canal system.

The source of PCB contamination was determined to be the inverted siphon based on an evaluation of data collected during the Remedial Investigation. The geophysical survey provided targets for further investigation by the scientific divers in the Lower West Main Canal Unlined during the Remedial Investigation. The scientific divers found no indication of PCB-laden objects in the canal, which eliminated a possible source in the Lower West Main Canal Unlined. Surface water samples collected from within the siphon and passive samples collected downgradient of the siphon indicated that a continuing source of PCB contamination exists at the site. The remotely operated vehicle inspection of the siphon indicated that no foreign objects (e.g., transformer, drum) are located inside the siphon. The hydraulics of the siphon indicated that the majority of the time, a positive pressure is exerted from the inside of the siphon. This means that water is forced out of cracks or leaking joints in the siphon and the chances of contamination leaking into the siphon are low. Therefore, by deduction, the primary source of PCBs is located within the inverted siphon and is not a foreign object (e.g., transformer). It is possible that siphon construction or repair materials (e.g., caulking or sealant materials) are the primary source of contamination at the site. PCBs were domestically manufactured from 1929 to 1979 and used for a variety of purposes (EPA 2016a). Records for the construction of the siphon could not be located and samples from siphon materials (e.g., caulk, concrete, or sealant) were not collected during the Remedial Investigation because of technical challenges, health and safety concerns, and high cost. Therefore, the exact materials that serve as the primary source of contamination of PCBs at the site is unknown.

PCBs enter the canal system by leaching into surface water during flow through the inverted siphon. PCBs are hydrophobic and adhere to particles in the surface water and sediment. The rapid decrease in surface water velocity as water exits the siphon results in deposition of particulates that have adsorbed PCBs, resulting in a gradient of decreasing PCB sediment concentrations with distance from the siphon exit. Over time, fish and other aquatic organisms bioaccumulate and biomagnify PCBs.

HUMAN HEALTH RISK ASSESSMENT

The Human Health Risk Assessment identified potential concerns for human health from the consumption of fish within the DRCS. The Human Health Risk Assessment results reveal that if no remedial actions or other means of control are taken for the consumption of fish from the DRCS, then there is a potential for an increased probability of cancer for child, adolescent, and adult recreational users and adult subsistence fishers above the EPA acceptable risk range and a

potential for systemic effects. Direct contact with other potentially affected media (i.e., soil, surface water, and sediment) does not reveal unacceptable human health concerns, which includes consumption of plants from the surrounding agricultural fields and consumption of drinking water from the DRCS. Based on the results of this analysis, Aroclor-1254, Aroclor-1260, and PCB congeners for the consumption of fish have been retained as the only site-related human health chemicals of concern (COCs).

ECOLOGICAL RISK ASSESSMENT

The Ecological Risk Assessment identified potential risks for ecological receptors from media at the site. Chemicals of potential concern initially identified during the Ecological Risk Assessment were further evaluated using information regarding spatial extent, magnitude of exceedance, and fate and transport information to determine if further action was required to mitigate potential ecological risks (EA 2016c). Based on the results of this analysis, PCBs have been retained as the only site-related ecological COC because of potential risks to small piscivorous birds, piscivorous mammals, benthic invertebrates, and the following threatened and endangered species: interior least tern, reddish egret, Coues' rice rat, false spike mussel, Salina mucket, and Texas hornshell.

MEDIA AND CHEMICALS OF CONCERN

Media of concern at the site include fish tissue, sediment, and benthos tissue. Addressing sediment contamination at the site will reduce concentrations in fish and benthos tissue, and thus will reduce the risks to human and ecological receptors.

Aroclor-1254, Aroclor-1260, and total PCB congeners were identified as COCs for human health receptors (recreational users and subsistence fishers) from ingestion of fish tissue.

PCBs (including total PCB congeners, and/or total PCB Aroclors, and/or Aroclor-1254) were identified as COCs for small piscivorous birds, piscivorous mammals, and the threatened and endangered species, interior least tern and reddish egret from ingestion of fish tissue.

PCBs (including total PCB congeners, and/or total PCB Aroclors, and/or Aroclor-1254, and/or Aroclor-1242, and/or Aroclor-1260) were identified as COCs for benthic invertebrates and the threatened and endangered species, Coues' rice rat, false spike mussel, Salina mucket, and Texas hornshell from ingestion of sediment.

PCBs (including total PCB congeners, and/or total PCB Aroclors, and/or Aroclor-1254, and/or Aroclor-1242, and/or Aroclor-1260) were identified as COCs for the threatened and endangered species Coues' rice rat from ingestion of benthos or sediment via ingestion of benthos.

SITE SPECIFIC HUMAN HEALTH PRELIMINARY REMEDIATION GOALS

Risk results from the Human Health Risk Assessment were reviewed to determine remediation goals for the site. Aroclor-1254, Aroclor-1260, and total PCB congeners were identified as COCs for recreational users and subsistence fishers from ingestion of fish tissue. Determination of a fish tissue remediation goal is based upon both the PCB cancer slope factors and the exposure parameters presented for each receptor in the Human Health Risk Assessment (EA 2016b). Cancer slope factors for both the Aroclors and total PCB congeners were assumed a "high risk" PCB at 2.0 per mg/kg-day. Non-cancer reference doses are only set forth for Aroclor-1254. This reference dose is typically not used as a surrogate for other Aroclors or PCB congeners. The primary source of PCBs at the site that result in fish PCB body burdens are found in the sediment, which are taken up through the food web into fish. In order to derive a sediment preliminary remediation goal protective of human receptors site-specific bioaccumulation factors were derived. The site-specific bioaccumulation factor for fish fillets is 9.54 mg/kg wet weight organism/mg/kg dry weight sediment.

The table below presents both the fish tissue remediation goals and sediment remediation goals for recreational users.

Potential Sediment Preliminary Remediation Goals Based on Fish Consumption at DRCS

Chemical of Concern	Receptor	Potential Fish Remediation Goal (mg/kg)	Potential Sediment Remediation Goal (mg/kg)
Recreational Users			
Aroclor-1254 Aroclor-1260 Total PCB Congeners	Cancer Risk 10^{-4} (Adult Recreational)	0.41	0.043
Aroclor-1254 Aroclor-1260 Total PCB Congeners	Cancer Risk 10^{-5} (Adult Recreational)	0.041	0.004
Aroclor-1254	Non-Cancer HI=1 (Child Recreational)	0.031	0.003
Subsistence Fishers			
Aroclor-1254 Aroclor-1260 Total PCB Congeners	Cancer Risk 10^{-4}	0.096	0.010
Aroclor-1254 Aroclor-1260 Total PCB Congeners	Cancer Risk 10^{-5}	0.010	0.001
Aroclor-1254	Non-Cancer HI=1	0.011	0.001

Note:
The most conservative recreational user was used to calculate potential remediation goals.
HI – hazard index
mg/kg – milligrams per kilogram
PCB – polychlorinated biphenyl

SITE SPECIFIC ECOLOGICAL PRELIMINARY REMEDIATION GOALS

The Ecological Risk Assessment evaluated risk on the basis of exposure groupings, however, a single set of preliminary remediation goals was developed to ensure consistency in risk management actions applicable across the entire site. The Ecological Risk Assessment determined benthic invertebrates, small piscivorous birds, piscivorous mammals, and threatened and endangered species (interior least tern, reddish egret, Coues' rice rat, false spike mussel, Salina mucket, and Texas hornshell) represented the most sensitive receptors evaluated for effects from PCBs. Therefore, preliminary remediation goal development focuses on these receptors. Risk-based thresholds of effect were developed for use as risk-based preliminary remediation goals for sediment. Background was not considered because PCBs are anthropogenic and were detected in very few samples upstream of the siphon.

A summary of potential preliminary remediation goals for ecological receptors is provided in the table below.

Potential Ecological Preliminary Remediation Goals

Chemical of Concern	Receptor	Potential Sediment Remediation Goal (mg/kg)	Note
Total PCBs	Small Piscivorous Birds General Population	0.483	NOAEL-LOAEL midpoint. Intended for application as a reach-wide average.
Total PCBs	Piscivorous Mammals General Population	0.071	NOAEL-LOAEL midpoint. Intended for application as a reach-wide average.
Total PCBs	Benthic Invertebrates General Population	0.68	Probable Effect Concentration. Intended for application on a point-by-point basis or as an average across small areas.
Total PCBs	Interior Least Tern	0.088	NOAEL. Intended for application on a point-by-point basis.
Total PCBs	Reddish Egret	0.088	NOAEL. Intended for application on a point-by-point basis.
Total PCBs	Coues' Rice Rat	0.023	NOAEL. Intended for application on a point-by-point basis, applicable to the reservoir only.
Total PCBs	False Spike Mussel, Salina Mucket, Texas Hornshell	0.06	Threshold Effects Concentration. Intended for application on a point-by-point basis or as an average across small areas.

Note:
LOAEL – lowest observed adverse effect level
mg/kg – milligrams per kilogram (dry weight)
NOAEL – no observed adverse effect level
Total PCBs – Either the sum of polychlorinated biphenyls (PCBs) as Aroclors or the sum of individual PCB congeners.

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Section 121(d) of CERCLA and National Oil and Hazardous Substances Pollution Contingency Plan (NCP) Section 300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate federal and state requirements, standards, criteria, and limitations which are collectively referred to as "ARARs," unless such ARARs are waived under CERCLA Section 121(d)(4).

Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal, state, or local environmental laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal, state, or local environmental laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well-suited to the particular site. To be considered (TBC) criteria are non-promulgated, non-enforceable guidelines, or criteria that may be useful for developing a remedial action or that are necessary for evaluating what is protective to human health and/or the environment.

ARARs and TBC information are generally identified with reference to media and COCs. Media of concern at the site include fish tissue, sediment, and benthos tissue. Site COCs are PCBs. The only chemical specific ARAR that exists regarding the concentration of PCBs in edible fish, is the U.S. Food and Drug Administration's tolerance level for total PCBs in the edible portion of fish and shellfish, which is 2 mg/kg. There are no chemical specific ARARs for sediment or benthos tissue. The Texas Risk Reduction Program sediment protective concentration levels should be considered (2.33 mg/kg for non-carcinogenic and 5.48 mg/kg for 10^{-5} carcinogenic risk). However, these direct human contact protective concentration levels cannot be assumed to be protective of uptake to fish/shellfish tissue and thus not protective of human exposures through the consumption of contaminated fish/shellfish.

Location specific ARARs and TBCs relating to the geographical position of the site include: the National Historical Preservation Act, Executive Order 11988 (Floodplains Management), the Endangered Species Act of 1973, Texas Parks and Wildlife Department Endangered Species, the Migratory Bird Act, and U.S. International Boundary and Water Commission (IBWC) requirements. These ARARs either require evaluation of potential effects of remedial actions (as in the case of Floodplains Management and the Endangered Species Act), or require coordination with other agencies prior to making site improvements (as in the case of the IBWC).

There are a number of ARARs that will apply if remedial action is taken, these ARARs or TBCs are considered action specific. Included in this category is the Clean Water Act which will apply if a remedial action includes treatment of water following dewatering sediment, discharging to a waterway, or discharge of dredged or fill materials into water of the U.S. Disposal requirements

including applicable or relevant parts of Toxic Substances Control Act, Resource Conservation and Recovery Act, and Texas Administrative Code may apply.

REMEDIAL ACTION OBJECTIVES

Based on information relating to types of contaminants, environmental media of concern, and potential exposure pathways, Remedial Action Objectives (RAOs) were formed to aid in the development and screening of remedial alternatives. Final RAOs and remediation goals will be documented in the Record of Decision. Proposed RAOs are as follows:

- Reduce the long-term human health cancer risks and the non-cancer hazards from human consumption of DRCS fish contaminated with PCBs by reducing exposure to elevated concentrations of PCBs in sediment downstream from the source (i.e., the siphon) and mitigating the transport pathway from the siphon into the DRCS.

- Reduce the short-term human health cancer risks and the non-cancer hazards from human consumption of DRCS fish contaminated with PCBs.

- Reduce the risks to ecological receptors (i.e., small piscivorous birds, piscivorous mammals, benthic invertebrates, and threatened/endangered species) from exposure to PCBs in sediment.

The summary of potential quantitative preliminary remediation goals that can be selected from in order to achieve the RAOs are presented in the table below, in order of decreasing concentrations for each media of concern.

Summary of Potential Preliminary Remediation Goals

Chemical of Concern	Preliminary Remediation Goal	Basis for Preliminary Remediation Goal
Fish Tissue (mg/kg)		
Total PCBs	2	U.S. Food and Drug Administration Tolerance Level
Total PCBs	0.41	Human Health Calculated Risk-Based Value, Recreational User Cancer Risk 10^{-4}
Total PCBs	0.096	Human Health Calculated Risk-Based Value, Subsistence Fisher Cancer Risk 10^{-4}
Total PCBs	0.041	Human Health Calculated Risk-Based Value, Recreational User Cancer Risk 10^{-5}
Total PCBs	0.031	Human Health Calculated Risk-Based Value, Recreational User Aroclor-1254 Non-Cancer HI=1
Total PCBs	0.011	Human Health Calculated Risk-Based Value, Subsistence Fisher Aroclor-1254 Non-Cancer HI=1
Total PCBs	0.010	Human Health Calculated Risk-Based Value, Subsistence Fisher Cancer Risk 10^{-5}
Sediment (mg/kg)		
Total PCBs	0.68	Benthic Invertebrate Probable Effect Concentration (general population)
Total PCBs	0.483	Small Piscivorous Birds NOAEL-LOAEL Midpoint (general population)
Total PCBs	0.088	Small and Large Piscivorous Birds NOAEL (T&E species)
Total PCBs	0.071	Small Piscivorous Mammal NOAEL-LOAEL Midpoint (general population)
Total PCBs	0.06	Benthic Invertebrate Threshold Effect Concentration (T&E species)
Total PCBs	0.043	Human Health Calculated Risk-Based Value, Recreational User Cancer Risk 10^{-4}
Total PCBs	0.023[a]	Small Piscivorous Mammal NOAEL (T&E species)
Total PCBs	0.010	Human Health Calculated Risk-Based Value, Subsistence Fisher Cancer Risk 10^{-4}
Total PCBs	0.004	Human Health Calculated Risk-Based Value, Recreational User Cancer Risk 10^{-5}
Total PCBs	0.003	Human Health Calculated Risk-Based Value, Recreational User Aroclor-1254 Non-Cancer HI=1
Total PCBs	0.001	Human Health Calculated Risk-Based Value, Subsistence Fisher Cancer Risk 10^{-5} and Aroclor-1254 Non-Cancer HI=1

Note:
[a] Goal applicable to reservoir only based on evaluation of habitat as discussed in Section 2.3.3, note reservoir concentrations do not exceed 0.023 mg/kg and thus already meet this goal.
HI – hazard index
LOAEL – lowest observed adverse effect level
mg/kg – milligram per kilogram
NOAEL – no observed adverse effect level
T&E – threatened and endangered
Total PCBs – Either the sum of polychlorinated biphenyls (PCBs) as Aroclors or the sum of individual PCB congeners.

The calculated human health sediment preliminary remediation goals are based on exposure to PCBs through consumption of fish. Because fish are mobile throughout the canal and reservoir system, it is necessary to remediate sediment downgradient of the source (the siphon) at concentrations greater than the selected preliminary remediation goal in order to achieve the human health RAO. All of the possible human health risk-based goals for PCBs in sediment will result in protection of all ecological receptors of concern, including threatened and endangered species from any of the ecological exposure areas.

An analysis of the PCB concentrations in sediment across the reservoir and canal system, assuming removal of the sediment locations that exceed a preliminary remediation goal of 0.043 mg/kg, results in an overall 95 percent upper confidence level of 0.00276 mg/kg total

PCBs in the remaining sediment that theoretically would result in fish tissue concentrations at a 10^{-5} recreational fisher cancer risk level or a Aroclor-1254 non-cancer hazard index (HI) of 1.

IDENTIFICATION AND SCREENING OF GENERAL RESPONSE ACTIONS AND TECHNOLOGIES

General response actions (GRAs) and remedial technologies were identified and evaluated for media of interest at the site in accordance with EPA Guidance (EPA 1988). The media of interest include:

- **Siphon** – Applies to the concrete pipe buried underground between the Main Canal and Lower West Main Canal Unlined, which is approximately 1,600 feet in length and moves canal water under the Arroyo Colorado and its floodplain. The siphon is the primary source of PCBs at the site (EA 2016a).

- **Sediment** – Applies to the impacted sediment in the canals and reservoir located downstream of the siphon exit and reservoir. Potential preliminary remediation goals of 0.043 and 0.004 mg/kg of total PCBs in sediment were evaluated.

The GRAs and remedial technologies for media of interest were identified and screened for effectiveness, implementability, and cost before being developed into remedial alternatives. GRAs may include no action, institutional controls, containment, removal, treatment, disposal, monitoring, or a combination thereof (EPA 1988).

As required by the NCP (40 Code of Federal Regulations Section 300.430 [e][6]), the selected remedial alternatives must include the a no action alternative to be used as the baseline alternative against which the effectiveness of all other remedial alternatives are judged. In addition to no action, institutional and engineering controls were evaluated. Institutional controls are non-engineered instruments such as administrative and legal controls that help minimize the potential for human exposure to contamination and protect the integrity of a remedy by limiting land or resource use. Engineering controls are instruments such as fencing or signage that are used to limit access to contaminated areas or areas that may pose a physical hazard.

The GRAs evaluated for the siphon include containment and replacement. The GRAs evaluated for sediment include monitored natural recovery, containment, treatment, removal, and replacement. From the list of GRAs potentially applicable, the following were retained for development into alternatives because they were considered effective, implementable, and cost effective relative to the other GRAs under consideration, or required by the NCP: containment of the siphon, replacement of the siphon, monitored natural recovery of sediment, containment of sediment, and removal of sediment. Technologies associated with the retained GRAs include using a physical barrier in the siphon (e.g., slipline), construction of a new siphon, relying on un-enhanced natural processes for sediment in the reservoir, using an engineered barrier for sediment in the reservoir, and dredging and disposal of canal and/or reservoir sediment.

DEVELOPMENT AND ANALYSIS OF REMEDIAL ALTERNATIVES

Remedial alternatives were developed using the GRAs and technologies retained following the screening process. Remedial alternative components were developed based on the media that they are designed to treat. In order to remediate the primary source of PCBs at the site, two remedial alternative components were developed for the siphon: Component SI-A: Sliplining of the Siphon and Component SI-B: Replacing Siphon. In order to remediate impacted sediment downstream of the siphon, three remedial alternative components were developed for two sets of potential preliminary remediation goals:

- Component SE-A: Canal Dredging - Preliminary remediation goals of 0.031 mg/kg PCBs in fish tissue and 0.043 mg/kg PCBs in sediment.

- Component SE-B: Canal Dredging and Reservoir Monitored Natural Recovery - Preliminary remediation goals of 0.041 mg/kg PCBs in fish tissue and 0.004 mg/kg PCBs in sediment, corresponding to a 10^{-5} cancer risk level. Alternatively, preliminary remediation goals of 0.031 mg/kg PCBs in fish tissue and 0.003 mg/kg PCBs in sediment, corresponding to a Hazard Index of 1, could also be selected for this remedy component. Choosing these goals will not result in a change to the area subject to remediation or the assumptions made in the Feasibility Study cost estimate.

- Component SE-C: Canal Dredging, Reservoir Dredging, and Reservoir Capping - Preliminary remediation goals 0.041 mg/kg PCBs in fish tissue and 0.004 mg/kg PCBs in sediment, corresponding to a 10^{-5} cancer risk level. Alternatively, preliminary remediation goals of 0.031 mg/kg PCBs in fish tissue and 0.003 mg/kg PCBs in sediment, corresponding to a Hazard Index of 1, could also be selected for this remedy component. Choosing these goals will not result in a change to the area subject to remediation or the assumptions made in the Feasibility Study cost estimate.

Eight remedial alternatives were assembled using the remedial alternative components listed above, institutional and engineering controls, and community involvement. The eight remedial alternatives are as follows:

Alternative 1: No Further Action
Alternative 2: Limited Action
Alternative 3: Slipline Siphon, Canal Dredging, and Fish Removals
Alternative 4: Slipline Siphon, Canal Dredging, and Reservoir Monitored Natural Recovery
Alternative 5: Slipline Siphon, Canal Dredging, and Reservoir Dredging with Sand Layer
Alternative 6: Replace Siphon, Canal Dredging, and Fish Removals
Alternative 7: Replace Siphon, Canal Dredging, and Reservoir Monitored Natural Recovery
Alternative 8: Replace Siphon, Canal Dredging, and Reservoir Dredging with Sand Layer.

Four out of the eight remedial alternatives were retained after they were screened for effectiveness, implementability, and cost (Alternatives 1, 2, 3, and 6). Summaries of the retained alternatives, approximate costs, and discussion of the seven criteria used to evaluated alternatives

are provided in the tables below. Nine criteria are used to evaluate remedial alternatives, the first two criteria are considered threshold criteria and must be met for an alternative to be a viable option. The next five criteria are considered the primary balancing criteria. The final two criteria (state and community acceptance) are to be evaluated by EPA following receipt of feedback from the State and community. The nine criteria that are used to evaluate alternatives are listed below:

- Overall protection of human health and the environment
- Compliance with ARARs
- Long-term effectiveness and permanence
- Reduction in toxicity, mobility, or volume through treatment
- Short-term effectiveness
- Implementability
- Cost
- State acceptance (will be evaluated EPA following receipt of comments)
- Community acceptance (will be evaluated EPA following receipt of comments).

Alternative 1: No Further Action			
Component	**Cost**	**Details**	**Timeframe**
Not Applicable	$0	Not Applicable	Not Applicable
As required by the National Contingency Plan (40 Code of Federal Regulations Section 300.430 [e][6]), the selected remedial alternatives must include the a no action alternative to be used as the baseline alternative against which the effectiveness of all other remedial alternatives are judged.			

Evaluation Criteria	**Details**
Overall Protection of Human Health and the Environment	Is not protective of human health or the environment. Will not meet remedial active objectives.
Compliance with ARARs	Will not meet ARARs. The U.S. Food and Drug Administration tolerance level for total PCBs in the edible portion of fish and shellfish is 2 mg/kg and is an ARAR.
Long-Term Effectiveness and Permanence	Does not provide long-term effectiveness or permanence.
Reduction of Toxicity, Mobility, or Volume through Treatment	Does not reduce toxicity, mobility, or volume of contamination.
Short-Term Effectiveness	No short-term risk associated with this alternative.
Implementability	Not Applicable.

Note:
ARAR - Applicable or Relevant and Appropriate Requirement
mg/kg – milligrams per kilogram
PCBs – polychlorinated biphenyls

Alternative 2: Limited Action			
Component	**Cost [1]**	**Details**	**Timeframe**
Engineering Controls	$8,000 [2]	Placement of approximately 20 signs throughout the Donna Canal and Reservoir System. Signs will be used to inform the community regarding hazards of consuming fish from the canal and reservoir and of the aquatic life ban.	Not Applicable
Community Involvement	$1,630,000 [3]	Implement a public outreach program that will educate the community on the potential health risks associated with consuming fish from the Donna Canal and Reservoir System. Community involvement details will be specified in the Remedial Design.	30 years
Institutional Controls	$0	Aquatic Life Order Number 9	Until fish tissue goals have been reached
	$0	Land-use restriction in the form of a deed notice, details to be specified in the design.	As long as the existing siphon remains
Total Cost	**$1,640,000 [3]**		

Evaluation Criteria	**Details**
Overall Protection of Human Health and the Environment	Engineering controls in the form of signs and community involvement would only warn the public of the dangers of fish consumption. Low overall protection to human health. This alternative does not address protection to the environment and will not meet the ecological remedial action objective.
Compliance with ARARs	Is anticipated to meet ARARs assuming community involvement, engineering controls, and aquatic life ban are effective.
Long-Term Effectiveness and Permanence	Does not provide long-term effectiveness. The siphon would continue to release contamination to sediment. Ecological receptors would bioaccumulate the contaminants.
Reduction of Toxicity, Mobility, or Volume through Treatment	Does not provide reduction in toxicity, mobility, or volume of contamination through treatment.
Short-Term Effectiveness	Low short term risk.
Implementability	Highly implementable as no construction is required.

Note:
[1] Costs and total are rounded
[2] Capital Cost
[3] Net Present Value (7 percent discount)
ARAR - Applicable or Relevant and Appropriate Requirement

Alternative 3: Slipline Siphon, Canal Dredging, and Fish Removals			
Component	**Cost [1]**	**Details**	**Timeframe**
Remedy Component SI-A			
Slipline Siphon	$3,800,000 [2]	Install an engineered barrier in the siphon using a fiberglass slipline.	2 months
Post Remediation Site Monitoring – Sediment	$450,000 [3]	Sample sediment downstream of the siphon for PCB congeners.	Annually for 5 years post construction
Remedy Component SE-A			
Dredging of Canal Sediment with Off-Site Disposal	$7,600,000 [2]	Excavate canal sediment above 0.043 mg/kg total PCBs and transport to an off-site disposal facility.	5 months
Fish Removal	$3,000,000 [3]	Remove fish from the canal and reservoir system using electrofishing and other fish removal methods.	Annually for 5 years post construction
Post Remediation Site Monitoring	$410,000 [3]	Sample fish tissue for PCBs as Aroclors.	Annually for 5 years and at years 7 and 9 post construction
	$150,000 [3]	Sample site-wide sediment for PCB congeners.	Once at 4 years post construction
Community Involvement and Engineering Controls	$140,000 [3]	Implement a public outreach program that will educate the community on the potential health risks associated with consuming fish from the site. Signs will be used to warn people at the site of risks.	10 years
Institutional Controls	$0	Aquatic Life Order Number 9	Until fish tissue goals have been reached
	$0	Land-use restriction to prevent disturbance of the siphon.	As long as the existing siphon remains
Total Cost	**$15,600,000 [3]**		

Evaluation Criteria	**Details**
Overall Protection of Human Health and the Environment	Removal of sediment above 0.043 mg/kg total PCBs will be protective of ecological receptors and will eventually reduce human health cancer risks from exposure to contaminated fish to below a calculated recreational fisher 10^{-5} cancer risk level and non-cancer hazard index of 1, and below a calculated subsistence fisher 10^{-4} cancer risk level. Subsistence fisher non-cancer hazards will be reduced. High overall protection of human health and the environment.
Compliance with ARARs	Is anticipated to meet ARARs.
Long-Term Effectiveness and Permanence	High long-term effectiveness and permanence.
Reduction of Toxicity, Mobility, or Volume through Treatment	The siphon slipline would reduce the mobility of source contamination and sediment dredging would reduce volume of contaminated material; however these methods are not considered treatment.
Short-Term Effectiveness	Short term risks are elevated by 7 months of construction activity.
Implementability	Implementable with time (fish tissue concentrations will take time to decrease following removal of the primary PCB source (the siphon) and a portion of the secondary PCB source (sediment).

Note:
[1] Costs and total are rounded
[2] Capital Cost
[3] Net Present Value (7 percent discount)
ARAR - Applicable or Relevant and Appropriate Requirement
mg/kg – milligrams per kilogram
PCB – polychlorinated biphenyl

Alternative 6: Replace Siphon, Canal Dredging, and Fish Removals			
Component	**Cost [1]**	**Details**	**Timeframe**
Remedy Component SI-B			
Replace Siphon	$8,100,000 [2]	Install new siphon adjacent to existing siphon. Fill existing siphon with grout and leave in place.	4 months
Remedy Component SE-A			
Dredging of Canal Sediment with Off-Site Disposal	$7,600,000 [2]	Excavate canal sediment above 0.043 mg/kg total PCBs and transport to an off-site disposal facility.	5 months
Fish Removal	$3,000,000 [3]	Remove fish from the canal and reservoir system using electrofishing and other fish removal methods.	Annually for 5 years post construction
Post Remediation Site Monitoring	$410,000 [3]	Sample fish tissue for PCBs as Aroclors.	Annually for 5 years and at years 7 and 9 post construction
	$150,000 [3]	Sample sediment site-wide for PCB congeners.	Once at 4 years post construction
Community Involvement and Engineering Controls	$140,000 [3]	Implement a public outreach program that will educate the community on the potential health risks associated with consuming fish from the site. Signs will be used to warn people at the site of risks.	10 years
Institutional Controls	$0	Aquatic Life Order Number 9	Until fish tissue goals have been reached
	$0	Land-use restriction to prevent disturbance of the existing siphon.	As long as the existing siphon remains
Total Cost	**$19,400,000 [3]**		
Evaluation Criteria	**Details**		
Overall Protection of Human Health and the Environment	Removal of sediment above 0.043 mg/kg total PCBs will be protective of ecological receptors and will eventually reduce human health cancer risks from exposure to contaminated fish to below a calculated recreational fisher 10^{-5} cancer risk level and non-cancer hazard index of 1, and below a calculated subsistence fisher 10-4 cancer risk level. Subsistence fisher non-cancer hazards will be reduced. High overall protection of human health and the environment.		
Compliance with ARARs	Is anticipated to meet ARARs.		
Long-Term Effectiveness and Permanence	High long-term effectiveness and permanence.		
Reduction of Toxicity, Mobility, or Volume through Treatment	The new siphon would reduce the mobility of source contamination and the sediment dredging would reduce volume of contaminated material, but these methods are not considered treatment.		
Short-Term Effectiveness	Short term risks are elevated by 9 months of construction activity.		
Implementability	Implementable with time (fish tissue concentrations will take time to decrease following removal of the primary PCB source (the siphon) and a portion of the secondary PCB source (sediment).		

Note:
[1] Costs and total are rounded
[2] Capital Cost
[3] Net Present Value (7 percent discount)
ARAR - Applicable or Relevant and Appropriate Requirement
PCB – polychlorinated biphenyl

COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

A comparative evaluation of the retained remedial alternatives was conducted for each of the evaluation criteria. The comparative analysis is summarized below.

Summary of the Comparative Analysis of Remedial Alternatives

Alternative 1 No Further Action	Alternative 2 Limited Action	Alternative 3 Slipline Siphon, Canal Dredging, and Fish Removals	Alternative 6 Replace Siphon, Canal Dredging, and Fish Removals
Estimated Sediment Volume Removed (cubic yards)			
0	0	20,000	20,000
Total PCBs Preliminary Remediation Goal in Fish Tissue (mg/kg)			
N/A	N/A	0.031	0.031
Total PCBs Preliminary Remediation Goal in Sediment (mg/kg)			
N/A	N/A	0.043	0.043
Overall Protection of Human Health and the Environment			
Low	Low	High	High
Compliance with Applicable or Relevant and Appropriate Requirements			
No	Yes	Yes	Yes
Long-Term Effectiveness and Permanence			
Low	Low	High	High
Reduction of Toxicity, Mobility, or Volume through Treatment			
No	No	Reduces mobility and volume	Reduces mobility and volume
Short-Term Effectiveness			
N/A	High	Moderate	Moderate
Implementability			
N/A	High	Moderate	Moderate
Cost			
$0	$1.6M	$15.6M	$19.4M

Note:
mg/kg - milligrams per kilogram
M – million
N/A – not applicable
PCB - polychlorinated biphenyl

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LIST OF ACRONYMS AND ABBREVIATIONS

95UCL	95 percent upper confidence level
ARAR	Applicable or Relevant and Appropriate Requirement
AT_c	averaging time - cancer
BAF	bioaccumulation factor
BW	body weight
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
COC	chemical of concern
CR	fish ingestion rate
CRQL	contract required quantitation limit
CSF	cancer slope factor
DRCS	Donna Reservoir and Canal System
EA	EA Engineering, Science, and Technology, Inc., PBC
ED	exposure duration
EF	exposure frequency
EPA	U.S. Environmental Protection Agency
ERA	Ecological Risk Assessment
FS	Feasibility Study
GRA	general response action
GREM	Green Remediation Evaluation Matrix
HHRA	Human Health Risk Assessment
HI	hazard index
IBWC	International Boundary and Water Commission
kg	kilogram
LOAEL	lowest observed adverse effect level
LWMCU	Lower West Main Canal Unlined
mg/kg	milligram(s) per kilogram
MNR	Monitored Natural Recovery
NCP	National Oil and Hazardous Substances Pollution Contingency Plan

LIST OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

NFA	No Further Action
NOAEL	no observed adverse effect level
OSWER	Office of Solid Waste and Emergency Response
PCB	polychlorinated biphenyl
ppm	parts per million
PRG	preliminary remediation goal
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
SLERA	Screening Level Ecological Risk Assessment
T&E	threatened and endangered
TBC	To Be Considered
TCEQ	Texas Commission on Environmental Quality
TDSHS	Texas Department of State Health Services
TNRCC	Texas Natural Resource Conservation Commission
TRRP	Texas Risk Reduction Program

1. INTRODUCTION

EA Engineering, Science, and Technology, Inc., PBC (EA) has been authorized by the U.S. Environmental Protection Agency (EPA), under Remedial Action Contract Number EP-W-06-004, Task Order 0082-RICO-06NS, to conduct a combined Remedial Investigation (RI) and Feasibility Study (FS) at the Donna Reservoir and Canal System (DRCS) site. EA has prepared this *Feasibility Study Report* in accordance with: (1) specifications provided in the EPA Statement of Work, Revision 03, dated 17 April 2013 (EPA 2013); and (2) the EPA-approved EA Work Plan and Cost Estimate, Revision 03, dated 12 June 2013 (EA 2013).

The *Remedial Investigation Report* (EA 2016a), *Human Health Risk Assessment* (HHRA) (EA 2016b), and *Ecological Risk Assessment* (ERA) (EA 2016c), provided the basis for this *Feasibility Study Report*. The regulatory and guidance documents that were utilized in this evaluation included, but were not limited to, the following:

- National Oil and Hazardous Substance Pollution Contingency Plan (NCP), 40 Code of Federal Regulations (CFR) Part 300
- *Guidance for Conducting Remedial Investigation and Feasibility Studies under Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA), Office of Solid Waste and Emergency Response [OSWER] Directive 9355.3-01 (EPA 1988)
- *Guide to Developing and Documenting Cost Estimates During the Feasibility Study*, EPA 540-R-00-002, OSWER Directive 9355.0-75 (EPA 2000a)
- *Principles for Managing Contaminated Sediment Risks at Hazardous Waste Sites*, OSWER Directive 9285.6-08 (EPA 2002)
- *Contaminated Sediment Remediation Guidance for Hazardous Waste Sites*, EPA-540-R-05-012, OSWER Directive 9355.0-85 (EPA 2005).

This *Feasibility Study Report* has been divided into six sections. Section 1 provides site background information, a summary of results from the RI, and conclusions of the HHRA and ERA. Section 2 identifies chemicals of concern (COCs), potential remediation goals, applicable or relevant and appropriate requirements (ARARs), and remedial action objectives (RAOs). Section 3 discusses general response actions (GRAs) and associated technologies for each media of interest that will satisfy the RAOs. The GRAs and remedial technologies are then screened for effectiveness, implementability, and cost. Section 4 discusses technologies that were retained after screening (Section 3) and develops remedial alternatives. Section 5 provides a screening of the developed remedial alternatives. Section 6 provides a detailed analysis of remedial alternatives developed in Section 4 following protocols outlined in EPA's guidance (EPA 1988). Section 7 provides a comparative analysis of remedial alternatives developed in Section 4. Section 8 provides information regarding remedy performance. Section 9 includes a list of

references. Detailed cost estimates prepared for remedial alternatives discussed in Section 4 are included in Appendix A.

1.1 PURPOSE OF REPORT

This *Feasibility Study Report* will support remedy selection in the Record of Decision by developing and assessing potential remedial alternatives. Nine criteria are used to evaluate potential remedial alternatives for the Record of Decision. Seven of these nine criteria are employed in this FS:

- Overall protection of human health and the environment
- Compliance with applicable or relevant and appropriate requirements
- Long-term effectiveness and permanence
- Reduction in toxicity, mobility or volume through treatment
- Short-term effectiveness
- Implementability (technical and administrative)
- Cost.

The remaining two of the nine criteria are employed to evaluate remedial alternatives in the Record of Decision:

- State acceptance
- Community acceptance.

1.2 SITE BACKGROUND

The DRCS includes a system of canals and reservoirs containing sediment and fish with elevated concentrations of polychlorinated biphenyls (PCBs). PCBs in fish tissue are the primary risk driver for human health at the site. Access to the DRCS, from county and private roads, is not restricted. During several removal actions, the EPA placed signs (Engineering Controls) along the DRCS to warn the public of the contaminated fish. These signs have since been vandalized or removed and most are no longer present at the site. The Texas Department of Health implemented an Institutional Control in 1994 (Aquatic Life Order Number 9) that declared the DRCS a prohibited area for harvesting all species of aquatic life (Texas Department of Health 1994). At the time of the last site visit in April 2015, a single sign remained at the reservoir warning of a fine for possession of fish. The subsections below provide information regarding the site location, description, history, and previous investigations.

1.2.1 Site Location and Description

The site is located in south Texas near the United States border with Mexico and the Gulf of Mexico, southwest of the city of Donna (Figure 1-1). The DRCS is the dominant feature of the site and includes the 400-acre Donna Reservoir and a system of lateral canals and pipes that supply water to the City of Donna and the North Alamo Water Supply Plant No. 5, and irrigate the surrounding farmland. The system of irrigation canals, reservoirs, and pipes is owned and

operated by the Donna Irrigation District No. 1. The infrastructure of the Donna Irrigation District No. 1 extends north from the Rio Grande River approximately 17 miles with lateral canals that extend approximately 6 miles to the east and west. The canal system includes approximately 168 miles of lateral canals and pipelines (Texas Department of State Health Services [TDSHS] 2010).

The DRCS is a freshwater system fed from the Rio Grande River. The volume and velocity of the water entering the canal system, and thus the reservoir, can be controlled by the number of operational pumps. The canals and siphon have been designed to transport water at a maximum flow rate of 400 cubic feet per second, as measured at the Rio Grande River pumping station. The flow rate is variable throughout the year and directly corresponds to the agricultural and municipal demand; the flow rate usually varies between 40 to 300 cubic feet per second during the year. Variable pumping rates correspond to variable water levels in the canal system, ranging from a foot or less in some places during periods of low agricultural water demand (e.g., rainy cold seasons) to over 15 feet in others during periods of high agricultural water demands (e.g., dry summers).

Features of the site investigated during the RI are highlighted in purple on Figure 1-1, presented on Figure 1-2, and discussed in the following sections. Distances, depths, and dimensions discussed below are approximate.

1.2.1.1 Main Canal

The Main Canal starts at the Rio Grande Pump Station where water is pumped into the Main Canal from the Rio Grande River by a series of five diesel pumps one mile downstream from Reynosa, Tamaulipas, Mexico. The Main Canal conveys water in an unlined earthen channel 60 feet in width for 1.6 miles to a wooden weir that is located 150 feet from the entrance of the siphon. The majority of the Main Canal levees are elevated above the adjacent agricultural fields.

1.2.1.2 Siphon

The inverted siphon, constructed around 1928, is a concrete structure with a 9-foot diameter circular opening that allows water to flow from the north end of the Main Canal under the Arroyo Colorado River and its floodplain to the southern end of the Lower West Main Canal Unlined. The inverted siphon loses approximately 25 feet in elevation from its entrance to its lowest point (underneath the Arroyo Colorado River) before rising back to an elevation only 1 or 2 feet lower than its entrance (Figure 1-3). The siphon is approximately 1,600 feet in length.

1.2.1.3 Lower West Main Canal Unlined

The Lower West Main Canal Unlined is an unlined earthen channel 50 feet in width that transfers water from the siphon exit north 2,000 feet, where the channel bends 90 degrees to the west and transfers water another 2 miles to the west-northwest. The length of the Lower West Main Canal Unlined is 2.2 miles from the exit of the siphon to the Lower West Main Canal

Lined. There is a wooden weir at the corner of the 90 degree bend that is used to regulate water flow from the Lower West Main Canal Unlined into the Lower East Main Canal. Water that is not allowed to flow into the Lower East Main Canal or is removed to irrigate adjacent agricultural fields, travels to the Lower West Main Canal Lined. The entire length of the Lower West Main Canal Unlined is elevated above the adjacent agricultural fields by 5 to 20 feet.

1.2.1.4 Lower East Main Canal

The Lower East Main Canal is a 1.8-mile concrete lined canal 20 feet in width that was constructed in the late 1950's to early 1960's. This canal is used to irrigate adjacent agricultural fields by gravity feed.

1.2.1.5 Lower West Main Canal Lined

The Lower West Main Canal Lined is a 1.7-mile concrete lined canal, 30 feet in width. Water from the Lower West Main Canal Unlined flows into this canal and then is either used to irrigate adjacent agricultural fields by gravity feed or flows into the reservoir system at the southwest corner of the West Reservoir.

1.2.1.6 Donna Reservoir

The Donna Reservoir system, referred to collectively as Reservoir No. 3, has an average depth of 5 feet, stores up to 1,200 acre-feet (390 million gallons) of water, and is made up of three major segments: the Northwest Reservoir, the West Reservoir, and the East Reservoir. The reservoir system is surrounded by earthen levees that slope outward to prevent surface water runoff from entering the system. The Donna Reservoir system is known by local residents as Donna Lake, Val Verde Lake, Laguna Val Verde, and Laguna El Gato.

Reservoir No. 3 Northwest Reservoir
The Northwest Reservoir was likely constructed during or shortly after the irrigation district was created in the late 1800's or early 1900's. After construction of the West Reservoir (discussed below), culverts were installed and the Northwest Reservoir has been used as an overflow.

Reservoir No. 3 Second Enlargement (West) Reservoir
The West Reservoir covers an area of 120 acres. Water flows into the West Reservoir from the Lower West Main Canal Lined. Re-lift Pumping Plant No. 3 uses electric drive pumps to lift water from the north side of the West Reservoir into the confluence of the Upper West Main Canal and the Cross Over Main Canal.

Reservoir No. 3 Third Enlargement (East) Reservoir
The East Reservoir covers an area of 240 acres. Water flows freely between the West Reservoir and the East Reservoir through two conduits beneath South Valley View Road, which divides the west and east reservoir segments.

1.2.1.7 Cross Over Main Canal

The Cross Over Main Canal is a concrete-lined canal 1.9 miles in length that transfers water from the West Reservoir to agricultural fields, the Donna Water Treatment Plant, and other adjacent canal segments. The Upper West Main Canal and the Cross Over Main Canal are connected by numerous lateral canals, one of which serves the North Alamo Water Supply Corporation Plant No. 5.

The remaining water that enters the DRCS and is not diverted for irrigation or drinking water supply by the City of Donna Water Treatment Plant (Section 1.2.1.11) or North Alamo Water Supply Corporation Plant (Section 1.2.1.12), flows to the Engleman Irrigation District (Zapata, personal communication, 2016).

1.2.1.8 Rio Grande River

The Rio Grande River is the main water resource for portions of northern Mexico and the Rio Grande Valley. The estimated productive area of the watershed of the Rio Grande Basin is 456,000 square kilometers (International Boundary and Water Commission [IBWC] 2006). The 2000 to 2011 average mean daily discharge of water in the Rio Grande River near Reynosa, Tamaulipas is 2,200 cubic feet per second, the minimum 42 cubic feet per second, and the maximum 42,000 cubic feet per second (IBWC 2015). The Donna Irrigation District, Rio Grande Pump Station located at the Rio Grande River, near the Donna – Rio Bravo International Bridge provides water to the Main Canal of the DRCS (Figure 1-2). The Donna Irrigation District has water pumping rights for approximately 96,000 acre-feet of water annually for agricultural irrigation and municipal use from the Rio Grande River (Border Environment Cooperation Commission 2004).

1.2.1.9 Arroyo Colorado River

The Arroyo Colorado River is an ancient distributary of the Rio Grande River. The Arroyo Colorado River serves as flood drainage for the Rio Grande River, drainage for agricultural irrigation, and municipality discharge for several communities before ending in the Laguna Madre. The water depth normally varies from 2 to 8 feet through the site, with the deepest section immediately down gradient from where the inverted siphon passes under the Arroyo Colorado River.

1.2.1.10 Arroyo Colorado Tributary

The Arroyo Colorado Tributary is a small ephemeral stream that parallels the west side of the siphon. The Arroyo Colorado Tributary flows from south to north for 0.25 miles where it enters the Arroyo Colorado River. The Arroyo Colorado Tributary drains agricultural and surface water runoff from the southern side of the Arroyo Colorado River flood plain and agricultural fields located to the southwest of the Main Canal (through a large diameter pipe with a gate valve under the south levee road).

1.2.1.11 City of Donna Water Treatment Plant

The City of Donna Water Treatment Plant is located 0.25 miles north of the East Reservoir (Figure 1-2). The water from the Cross Over Main Canal is pumped through the Donna Water Treatment Plant prior to distribution to consumers. Texas Commission on Environmental Quality (TCEQ) online data for the City of Donna, Public Water System ID: TX1080002, indicates the water system serves 15,000 people (TCEQ 2015a).

1.2.1.12 North Alamo Water Supply Corporation Plant No. 5

Water Treatment Plant No. 5 has a treatment capacity of 9.6 million gallons per day, a high service pump capacity of 11,000 gallons per minute, and 4.35 million gallons of storage capacity (North Alamo Water Supply Corporation 2015). TCEQ online data for the North Alamo Water Supply Corporation, which includes Water Treatment Plant No. 5 (Public Water System ID: TX1080029), indicates that the water system serves 127,824 people (TCEQ 2015b). Samples were not collected from the North Alamo Water Supply Corporation Plant No. 5 during the RI, this section is included for informational purposes only. The North Alamo Water Supply Corporation Plant No. 5 is not depicted on Figure 1-2 as it is located north of Highway 83 and is beyond the extent of this figure.

1.2.1.13 Irrigation Risers

Irrigation risers, also known as standpipes, are vertical concrete pipes used by the farmers for water outlet control into the surrounding agricultural fields for furrow or flood irrigation. The irrigation risers are connected to underground pipes leading to the canal system. Gate valves are used at the canal to regulate water flow to various fields scheduled for irrigation along the canal system. The height and size of irrigation risers vary depending on field elevation and size.

1.2.1.14 Ambient Soil

The Baird and Taormina Units of the Las Palomas Wildlife Management Area, Lower Rio Grande Valley were selected to serve as background reference areas (Figure 1-2). The units are located 4 miles north of the U.S. border with Mexico and 1.5 miles east of the Lower East Main Canal. These units were historically pastureland areas that have been converted to native brush areas currently used for wildlife habitat. These areas have designated dove hunting areas. Each of the units contained old growth trees and other vegetation not indicative of recent agricultural practices.

1.2.2 Previous Investigations

The following efforts were conducted and/or documented prior to the EPA RI/FS:

- Texas Natural Resource Conservation Commission [TNRCC] Routine Monitoring of the Lower Rio Grande Valley (TNRCC 1998)

- Lower Rio Grande Valley Environmental Study of 1992 (TNRCC 1998, 2001)
- 2001 Screening Site Inspection conducted by TNRCC Superfund Site Discovery and Assessment Program in coordination with EPA Region 6 (TNRCC 2001)
- U.S. Geological Survey Suspended Sediment Investigation (2002)
- TDSHS fish tissue collection (2007)
- TCEQ Feasibility Study (URS Corporation 2006)
- Agency for Toxic Substances and Disease Registry Public Health Assessment (TDSHS 2010).

In March 2008, the site was listed on the National Priorities List as a Superfund Site due to PCB contamination in sediment and fish (EPA 2008).

1.2.3 U.S. Environmental Protection Agency Removal Action

On 6 August 2008, an action memorandum was signed and approved by EPA Region 6 for the removal of contaminated fish from the site. Fish at the site were identified to have concentrations of PCBs as Aroclors above 2.0 parts per million (ppm), the tolerance level established by the U.S. Food and Drug Administration. Over the course of four removal actions conducted in 2008, 2009, and 2012, a total of 38,255 edible size fish were removed from DRCS.

1.3 REMEDIAL INVESTIGATION RESULTS

The purpose of the RI Report is to: (1) summarize site information and data; (2) identify potential source areas; (3) define the nature and extent of contamination; (4) evaluate contaminant migration pathways; and (5) present a summary of human health and ecological risks. These elements also form the conceptual site model, which is summarized below and forms the basis for the risk assessments.

The complete discussion of the nature and extent of contamination and additional site details are presented in the *Remedial Investigation Report, Remedial Investigation/Feasibility Study, Donna Reservoir and Canal System, Donna, Hidalgo County, Texas* (EA 2016a). This section provides a brief summary of information regarding PCBs, the conceptual site model, and uncertainty associated with the RI.

1.3.1 Polychlorinated Biphenyls

PCBs are man-made chlorinated hydrocarbons domestically manufactured from 1929 to 1979 (EPA 2016a). There are 209 possible isomers of PCBs known as congeners; each with a similar structure but different numbers of chlorine atoms and arranged in different configurations. Commercially, PCB congeners were mixed together to provide desired electrical or engineering

properties, commonly sold in the U.S. under the trade name Aroclor, although other trade names for PCBs exist. The manufacture of PCBs was discontinued in the U.S. in 1979 because of the compounds' toxicity and persistence in the environment (EPA 2016a). A variety of products and materials produced before the 1979 ban may contain PCBs (e.g., transformers, oil, caulking, plastics, etc.) (EPA 2016a).

PCBs are hydrophobic. Therefore, they tend to bind to sediment particles, organic matter in sediment, and fatty tissue in biota. As such, migration of soil, sediment, or aquatic life in surface water are potential routes of migration for PCBs.

EPA considers PCBs to be persistent organic pollutants; PCBs not only bioaccumulate, but the breakdown of individual congeners is a slow process. Half-lives for most congeners range from months to years (Agency for Toxic Substances and Disease Registry 2014), this process is not considered likely to contribute significantly to loss of these chemicals from the site.

1.3.2 Conceptual Site Model

The DRCS includes a system of canals, reservoirs, and adjacent waterways containing sediment and fish with elevated concentrations of PCBs. Sediment with elevated levels of PCBs is located in the Lower West Main Canal Unlined, downgradient of the siphon exit. The highest observed concentration of total PCB Aroclors in sediment is 11 milligrams per kilogram (mg/kg), which was reported entirely as Aroclor-1254, and the highest observed concentration of total PCB congeners in sediment is 6.1 mg/kg. The majority of samples for PCB congener analyses were collocated with those collected for PCB Aroclor analyses and samples with detectable concentrations of total PCB congeners tend to be collocated with detectable concentrations of PCB Aroclors. Sediment concentrations of PCBs as Aroclors and total PCB congeners decrease with distance in the Lower West Main Canal Unlined from the siphon exit to results reported below detection levels (Figures 1-4 through 1-17). Figures present human health direct contact and ecological screening criteria. The sediment screening criteria are not based on human consumption of fish.

Fish with detectable levels of Aroclor-1254 or Aroclor-1260 have been collected from all segments of the canals and reservoirs sampled (i.e., Main Canal, Lower West Main Canal, West Reservoir); the maximum detected concentration of total Aroclors is 8.1 mg/kg in a sample of smallmouth buffalo, a bottom feeder, from the Lower West Main Canal Unlined near the exit of the siphon (Figure 1-18, 2015 Area 3, BUF-153-F). The maximum detected concentration of total PCB congeners in fish tissue is 150 mg/kg, also in a smallmouth buffalo caught in the Lower West Main Canal Unlined in a downgradient portion of the canal (Figure 1-18, 2015 Area 4, BUF-170-F).

Maximum detected PCB congener concentrations observed in fish are approximately 25 times higher than those observed in sediment (150 mg/kg in fish to 6.1 mg/kg in sediment). Maximum detected PCB Aroclor concentrations observed in fish are similar to those observed in sediment (8.1 mg/kg in fish to 11 mg/kg in sediment). Average detected PCB congener concentrations observed in fish are approximately 20 times higher than those observed in average detected

sediment concentrations (7.2 mg/kg in fish to 0.41 mg/kg in sediment). Average detected PCB Aroclor concentrations observed in fish are approximately 3 times higher than those observed in average detected sediment concentrations (0.6 mg/kg in fish to 0.24 mg/kg in sediment). Therefore, it may be concluded that PCBs are bioaccumulating in fish. Passive sampler data from surface water indicate that fish may receive PCBs from the water column directly or from prey or sediment they ingest, although the largest known accessible source of PCBs at the site for fish is sediment in the canal system.

The source of PCB contamination has been determined to be the inverted siphon based on an evaluation of data collected during the RI. Sediment data collected during the RI initially suggested the following options for the source of PCB contamination:

1) Located between the siphon exit and 90 degree bend in the Lower West Main Canal Unlined in the area with the most elevated concentrations of PCBs in sediment

2) Located immediately upgradient of the siphon exit and downgradient of the Main Canal, in other words in the 160 feet concrete-lined section between the weir at the end of the Main Canal (where no sediment samples were collected) or inside the siphon (also where no sediment samples were collected)

3) Is no longer present at the site.

Land and water based geophysical surveys were conducted in the Lower West Main Canal Unlined to identify objects requiring assessment as potential sources of PCBs. These targets were investigated during a scientific diver survey. The scientific divers found no indication of PCB-laden objects in the canal, which eliminates a possible source in the Lower West Main Canal Unlined. Surface water samples collected from within the siphon and passive samples collected downgradient of the siphon indicate that a continuing source of PCB contamination exists at the site (Figures 1-19 through 1-21). The remotely operated vehicle underwater sonar and camera inspection of the siphon indicates that no foreign objects (e.g., transformer, drum) are located inside the siphon. The hydraulics of the siphon indicated that the majority of the time, a positive pressure is exerted from the inside of the siphon. This means that water is forced out of cracks or leaking joints in the siphon and the chances of contamination leaking into the siphon are low. Therefore, by deduction, the primary source of PCBs is located within the inverted siphon and is not a foreign object (e.g., transformer). It is possible that siphon construction or repair materials (e.g., caulking or sealant materials) are the primary source of contamination at the site. PCBs were domestically manufactured from 1929 to 1979 and used for a variety of purposes (EPA 2016a). Records for the construction of the siphon could not be located and samples from siphon materials (e.g., caulk, concrete, or sealant) were not collected during the RI because the siphon is in continuous use. Technical challenges, health and safety concerns, and high cost associated with a siphon in continuous use (always full of water), resulted in the decision to not attempt siphon material sample collection. Therefore, the exact materials that serve as the primary source of contamination of PCBs at the site remain unknown.

PCBs enter the canal system by leaching into surface water during flow through the inverted siphon. PCBs are hydrophobic and adhere to particles in the surface water. The rapid decrease in surface water velocity as water exits the siphon results in deposition of particulates that have adsorbed PCBs, resulting in a gradient of decreasing PCB sediment concentrations with distance from the siphon exit. Over time, fish and other aquatic organisms bioaccumulate and biomagnify PCBs.

1.3.3 Remedial Investigation Uncertainty

Following collection of RI data, the location of the primary source of PCB contamination is known (the inverted siphon). However, the exact material or source of the PCB contamination in the siphon is still unknown. The total PCB congener concentrations in surface water samples collected from along the length of the interior of the siphon generally increase from the beginning to the end of the siphon (Figure 1-19). Sediment immediately downgradient of the siphon have the highest observed PCB concentrations at the site and concentrations generally decrease with distance from the siphon exit. Passive sampler (polyoxymethylene) concentrations of total PCB congeners in both surface water and sediment pore water generally decrease with distance from the siphon exit. These data suggest that the PCBs are sourced from the siphon. The remotely operated vehicle underwater sonar and camera inspection of the siphon reveals that there is no object (e.g., transformer) inside the siphon. It is possible caulking material, a sealant, or the concrete of the siphon itself are the continuing source of the PCB contamination. In an EPA study published in 2011, 11 out of 12 caulk samples collected from buildings were found to contain Aroclor-1254 and the remaining sample contained Aroclor-1260 (EPA 2011). However, without additional investigatory activities (e.g., sampling solid materials from the interior of the siphon) the exact material or source of the PCB contamination from the siphon remains unknown. Siphon materials were not sampled during the RI because the structure is in continuous use (i.e., always full of water); technical challenges, health and safety concerns, and high cost associated with sampling a structure full of water resulted in the decision not to sample.

1.4 HUMAN HEALTH RISK ASSESSMENT

The purpose of a HHRA is to evaluate potential human health concerns from exposure to environmental media within or near the site that has been affected by past releases. To determine human health concerns, the HHRA evaluates potential sources of contamination and routes of migration based on current and potential future site uses. The HHRA results are based upon exposure pathways that are occurring, can occur, or are reasonably likely to occur in the future. Risks determined in the HHRA are considered baseline risks associated with exposure to media affected by the site. The baseline risk assumes no remedial actions or other means of exposure reduction. The HHRA evaluates the reasonable maximum exposure that has the potential to occur at the site. Therefore, HHRA results are considered potential and should be used as a guideline in making risk management decisions.

The complete HHRA is presented in the *Human Health Risk Assessment, Revision 02, Remedial Investigation/Feasibility Study, Donna Reservoir and Canal System, Donna, Hidalgo County, Texas* (EA 2016b). A summary of the HHRA conclusions are provided below.

The HHRA identified potential concerns for human health from the consumption of fish within the DRCS. The HHRA results reveal that if no remedial actions or other means of control are taken for the consumption of fish from the DRCS, then there is a potential for an increased probability of cancer for child, adolescent, and adult recreational users and adult subsistence fishers above the EPA acceptable risk range and a potential for systemic effects. Direct contact with other potentially affected media (i.e., soil, surface water, and sediment) does not reveal unacceptable human health concerns, which includes consumption of plants from the surrounding agricultural fields and consumption of drinking water from the DRCS. Based on the results of this analysis, PCBs have been retained as the only site-related COC that will be addressed in the FS because of potential risks to humans from exposure to site media identified in the table below.

Human Health Risk Assessment Summary of Conclusions

Exposure Area	Receptor	Media	Chemical of Concern
Donna Reservoir and Canal System (entire site)	Adult Recreational User	All Fish	Aroclor-1254, Aroclor-1260, Total PCB Congeners
	Adolescent Recreational User	All Fish	Aroclor-1254, Aroclor-1260, Total PCB Congeners
	Child Recreational User	All Fish	Aroclor-1254, Total PCB Congeners
	Adult Subsistence Fisher	All Fish	Aroclor-1254, Aroclor-1260, Total PCB Congeners

Note:
Individual fish species (buffalo, carp, gar, catfish, and largemouth bass) were also evaluated; each fish species evaluated revealed potential human health concerns from Aroclor-1254.
PCB – polychlorinated biphenyl

1.5 ECOLOGICAL RISK ASSESSMENT

The purpose of an ERA is to characterize and quantify potential environmental impacts from chemicals in soil, sediment, and surface water at the site. To determine environmental impacts a Screening Level Ecological Risk Assessment (SLERA) was conducted for site data. The ERA process also included the baseline risk assessment problem formulation, data collection, data evaluation, and risk characterization. The baseline risk assessment problem formulation draws from the risk evaluation performed in the SLERA to identify chemicals of potential concern, exposure pathways, assessment endpoints, and risk questions requiring further consideration. Data collection includes identification and collection of data to meet specific needs of the risk assessment; in this case, data regarding fish and mollusk tissue were compiled and utilized. Data evaluation and risk characterization use food web modeling, benchmark comparisons, and other lines of evidence to draw conclusions for the site.

The complete ERA is presented in the *Ecological Risk Assessment, Revision 03, Remedial Investigation/Feasibility Study, Donna Reservoir and Canal System, Donna, Hidalgo County, Texas* (EA 2016c). In summary, the ERA identified potential risks for ecological receptors from media at the site. Chemicals of potential concern initially identified during the ERA were further evaluated using information regarding spatial extent, magnitude of exceedance, and fate and transport information to determine if further action was required to mitigate potential ecological risks. Based on the results of this analysis, PCBs have been retained as the only site-related COC that will be addressed in the FS because of potential risks to ecological receptors from exposure to site media identified in the following table.

Ecological Risk Assessment Summary of Conclusions

Exposure Area	Receptor	Media	Chemical of Concern
3: LWMCU at Siphon Exit	Small Piscivorous Birds	Fish Tissue	Total PCB Congeners
	Piscivorous Mammals	Fish Tissue	Total PCB Congeners, Total PCB Aroclors
	Benthic Invertebrates	Sediment	Aroclor-1254, Total PCB Congeners, Total PCB Aroclors
	Threatened and Endangered Species		
	Interior Least Tern	Fish Tissue	Aroclor-1254, Total PCB Congeners, Total PCB Aroclors
	Reddish Egret	Fish Tissue	Total PCB Congeners
	Coues' Rice Rat	Sediment via ingestion of benthos	Aroclor-1242, Aroclor-1260, Total PCB Congeners, Total PCB Aroclors,
	False Spike Mussel, Salina Mucket, and Texas Hornshell	Sediment	Aroclor-1242, Aroclor-1254, Aroclor-1260, Total PCB Congeners, Total PCB Aroclors
4: LWMCU Downstream of the Siphon	Small Piscivorous Birds	Fish Tissue	Total PCB Congeners
	Piscivorous Mammals	Fish Tissue	Total PCB Congeners, Total PCB Aroclors
	Threatened and Endangered Species		
	Interior Least Tern	Fish Tissue	Aroclor-1254, Total PCB Congeners, Total PCB Aroclors
	Reddish Egret	Fish Tissue	Total PCB Congeners
	Coues' Rice Rat	Benthos Tissue	Total PCB Congeners, Total PCB Aroclors
5: Lined Canals, Reservoirs, and Soil	Threatened and Endangered Species		
	Coues' Rice Rat	Sediment via ingestion of benthos	Total PCB Congeners, Total PCB Aroclors

Note:
There is uncertainty associated with threatened and endangered species, for which little data is available regarding their actual presence on-site. Ecological exposure areas are presented on Figure 1-22.
LWMCU – Lower West Main Canal Unlined
PCB – polychlorinated biphenyl

2. DEVELOPMENT OF REMEDIAL ACTION OBJECTIVES AND PRELIMINARY REMEDIATION GOALS

This section develops RAOs and preliminary remediation goals, and identifies ARARs and To Be Considered (TBC) criteria. RAOs are general remedial objectives developed to be protective of human health and the environment; they are designed to address the threats site contaminants pose to human and ecological receptors. ARARs and TBCs constitute the body of existing statutes, regulations, ordinances, guidance, and published reports pertaining to all aspects of a potential remedial action for the site. This information typically influences the development of remedial alternatives by establishing numeric remediation goals, operating parameters, monitoring requirements, etc. Collectively, these concepts set the stage for developing effective and protective remedial alternatives.

2.1 DEVELOPMENT OF REMEDIAL ACTION OBJECTIVES

EPA guidance states that RAOs should specify the relevant COCs, the exposure route(s) to receptors by media (e.g., surface water, soil, or sediment), and an acceptable contaminant level for each exposure route (EPA 1988). ARARs and TBC information are generally identified with reference to media and COCs. For example, identifying surface water as a medium of concern triggers consideration of federal clean water regulations.

2.1.1 Chemicals of Concern

Aroclor-1254, Aroclor-1260, and total PCB congeners were identified as COCs for human health receptors (recreational users and subsistence fishers) from ingestion of fish tissue.

PCBs (including total PCB congeners, and/or total PCB Aroclors, and/or Aroclor-1254) were identified as COCs for small piscivorous birds, piscivorous mammals, and the threatened and endangered species, interior least tern and reddish egret from ingestion of fish tissue.

PCBs (including total PCB congeners, and/or total PCB Aroclors, and/or Aroclor-1254, and/or Aroclor-1242, and/or Aroclor-1260) were identified as COCs for benthic invertebrates and the threatened and endangered species, Coues' rice rat, false spike mussel, Salina mucket, and Texas hornshell from ingestion of sediment.

PCBs (including total PCB congeners, and/or total PCB Aroclors, and/or Aroclor-1254, and/or Aroclor-1242, and/or Aroclor-1260) were identified as COCs for the threatened and endangered species Coues' rice rat from ingestion of benthos or sediment via ingestion of benthos.

2.1.2 Media of Concern

Media of concern at the site include fish tissue, sediment, and benthos tissue. Addressing sediment contamination at the site will reduce concentrations in fish and benthos tissue, and thus will reduce the risks to human and ecological receptors.

2.2 SITE SPECIFIC HUMAN HEALTH PRELIMINARY REMEDIATION GOALS

Risk results from the HHRA were reviewed to determine remediation goals for the site. Aroclor-1254, Aroclor-1260, and total PCB congeners were identified as COCs for recreational users and subsistence fishers from ingestion of fish tissue (EA 2016a, 2016b). Cancer slope factors for both the Aroclors and total PCB congeners were assumed as a "high risk" PCB at 2.0 per mg/kg-day. Non-cancer reference doses are only set forth for Aroclor-1254. This reference dose is typically not used as a surrogate for other Aroclors or PCB congeners.

Determination of a fish tissue remediation goal is based upon both the PCB cancer slope factors and the exposure parameters presented for each receptor in the HHRA (EA 2016b). Exposure parameters for each receptor, as set forth in the HHRA, are presented on Table 2-1. To determine acceptable remediation goals for fish tissue, the following equation was used for cancer remediation goals:

$$Fish\ Tissue\ Cleanup\ Goal\ \left(\frac{mg}{kg}\right) = \frac{Target\ Risk\ x\ AT_c\ x\ BW}{CR\ x\ EF\ x\ ED\ x\ CSF_O}$$

Where

Target Risk	=	Selected cancer risk level (i.e., 10^{-4}, 10^{-5}, 10^{-6})
AT_c	=	Averaging Time – cancer (70 years × 365 days/year = 25,550 days)
BW	=	Body weight (kilograms [kg])
CR	=	Fish ingestion rate (kg/meal)
EF	=	Exposure frequency, meals per year (365 meals/year)
ED	=	Exposure Duration (years)
CSF_o	=	Cancer Slope Factor (2.0 per mg/kg-day).

The following equation was used for non-cancer remediation goals:

$$Fish\ Tissue\ Cleanup\ Goal\ \left(\frac{mg}{kg}\right) = \frac{Target\ HI\ x\ AT_{nc}\ x\ BW}{CR\ x\ EF\ x\ ED\ x\ (\frac{1}{RfDo})}$$

Where

Target HI	=	Selected non-cancer hazard level (i.e., 1)
AT_c	=	Averaging Time – non-cancer
BW	=	Body weight (kg)
CR	=	Fish ingestion rate (kg/meal)
EF	=	Exposure frequency, meals per year (365 meals/year)
ED	=	Exposure Duration (years)
RfD_o	=	Reference Dose (0.00002 per mg/kg-day).

Fish remediation goals were determined for each selected cancer risk level (Tables 2-2 through 2-4) and for a non-cancer hazard index (HI) of 1 for Aroclor-1254 (Table 2-5). The

primary source of PCBs at the site that result in fish PCB body burdens are found in the sediment, which are taken up through the food web into fish. In order to derive a sediment preliminary remediation goal protective of human receptors site-specific Bioaccumulation Factors (BAFs) were derived. BAFs are the ratio of a contaminant in an organism to the concentration in the ambient environment at a steady state, where the organism can take in the contaminant through ingestion with its food as well as through direct content (EPA 2010). For humans, a fish fillet BAF was derived as follows:

$$\text{BAF} = \frac{\text{Geometric Mean Fish Concentration}}{\text{Geometric Mean Sediment Concentration}}$$

The geometric mean was selected because it normalizes the concentrations being averaged and high concentrations in a skewed distribution would not overly influence the mean. The geometric mean fish concentration was determined based upon the following:

1. All fish tissue results for total PCB congeners were selected from the dataset.

2. If total PCB congeners were not analyzed for a given fish tissue sample, then the total PCB Aroclor result was selected.

3. If both PCB congeners and Aroclors were analyzed for a given fish tissue sample, only the total PCB congeners were selected.

The geometric mean for sediment within the site was based upon the total Aroclor results for all sediment samples collected down gradient of the siphon (i.e., Lower East Main Canal, Lower West Main Canal Unlined, Reservoir No. 3 East, Reservoir No. 3 West, and Cross Over Main Canal). The resulting geometric means for fish tissue and sediment were 0.37 mg/kg and 0.039 mg/kg, respectively. Tables 2-6 and 2-7 provide fish tissue and sediment concentrations used to calculate geometric means. The resulting fish fillet BAF is 9.54 mg/kg wet weight organism/mg/kg dry weight sediment.

Based upon the fish fillet BAF, a sediment preliminary remediation goal was determined based upon the following equation:

$$Sediment\ cleanup\ goal\ \left(\frac{mg}{kg}\right) = \frac{C_{fish}}{BAF}$$

Where

C_{fish} = Remediation goal for fish tissue based upon selected cancer risk level (mg/kg), or HI of 1

BAF = Bioaccumulation Factor (mg/kg wet weight organism/mg/kg dry weight sediment).

Tables 2-2 through 2-5 present the calculation for the sediment remediation goals. The table below presents both the fish tissue remediation goals and sediment remediation goals for recreational users.

Potential Preliminary Remediation Goals Based on Fish Consumption at DRCS

Chemical of Concern	Receptor	Potential Fish Remediation Goal (mg/kg)	Potential Sediment Remediation Goal (mg/kg)
Recreational Users			
Aroclor-1254 Aroclor-1260 Total PCB Congeners	Cancer Risk 10^{-4} (Adult Recreational)	0.41	0.043
Aroclor-1254 Aroclor-1260 Total PCB Congeners	Cancer Risk 10^{-5} (Adult Recreational)	0.041	0.004
Aroclor-1254	Non-Cancer HI=1 (Child Recreational)	0.031	0.003
Subsistence Fishers			
Aroclor-1254 Aroclor-1260 Total PCB Congeners	Cancer Risk 10^{-4}	0.096	0.010
Aroclor-1254 Aroclor-1260 Total PCB Congeners	Cancer Risk 10^{-5}	0.010	0.001
Aroclor-1254	Non-Cancer HI=1	0.011	0.001

Note:
The most conservative recreational user was used to calculate potential remediation goals.
HI – hazard index
mg/kg – milligrams per kilogram
PCB – polychlorinated biphenyl

Figure 2-1 presents sediment data color coded for cancer risk levels. Figures 2-2 and 2-3 present fish sampled during the RI that exceed potential preliminary remediation goals for a cancer risk of 10^{-4} and 10^{-5}, respectively.

For the selection of the recommended sediment remediation goal concentration, several items should be considered. The first consideration is that PCBs were also detected within the canal segments before and adjacent to the siphon. The range of detections were 0.000021 mg/kg to 0.012 mg/kg. The highest detections of PCBs, upstream or adjacent to the siphon, were within the Arroyo Colorado River at 0.0056 mg/kg (ACR-111-SE-0-6).

A second consideration is the spatial distribution of PCB detections throughout the site. At the 10^{-4} cancer risk level, the sediment remediation goal of 0.043 mg/kg is only exceeded within the canal segment directly after the siphon within the Lower West Main Canal Unlined. Every canal, reservoir, and river segment sampled at the site, with the exception of the Rio Grande River, contained samples that exceeded the 10^{-5} risk level (sediment remediation goal of 0.004 mg/kg), an Aroclor-1254 HI of 1 (sediment remediation goal of 0.003 mg/kg), and 10^{-6} risk level (sediment remediation goal of 0.0004 mg/kg).

The third consideration is technical practicality of PCB remediation to cancer risk levels of 10^{-6} or an Aroclor-1254 HI of 1.0. Sediment remediation at the site will likely be confirmed using an Aroclor analysis and not the PCB congener analysis. There is difficulty detecting Aroclors at levels corresponding to the 10^{-5} cancer risk level of 0.004 mg/kg and lower. For instance, detection limits for Aroclors across the site ranged from 0.0011 mg/kg to 0.076 mg/kg (note, this does not include a few samples that had elevated detection limits). Almost half of the sediment samples collected at the site had detection limits of 0.004 mg/kg or greater. Additional discussion regarding this topic is provided in Section 2.5.4.

Aroclor-1254 is the only PCB with an associated non-cancer reference dose. Fish tissue and sediment remediation goals were determined for the non-cancer endpoint assuming an acceptable level of 1. These calculations are presented on Table 2-5. The resulting fish tissue and sediment remediation goals are 0.031 mg/kg and 0.003 mg/kg. These non-cancer remediation goals are similar to the remediation goals determined for the 10^{-5} cancer risk level. It is noted that Aroclor-1254 was detected in 92 sediment samples across the entire DRCS. Of these 92 samples, Aroclor-1254 was detected in 85 of these samples at concentrations greater than 0.002 mg/kg. All of these detections were in canal segments down gradient of the siphon (Lower West Main Canal Unlined, Lower East Main Canal, West Reservoir, and Cross Over Main Canal). Additionally, approximately 88 percent of the samples analyzed for Aroclor-1254 had detection limits greater than 0.002 mg/kg.

An analysis of the PCB concentrations in sediment across the reservoir and canal system, assuming removal of the sediment locations that exceed a preliminary remediation goal of 0.043 mg/kg (calculated adult recreational fisher, fish tissue 10^{-4} cancer risk level), results in an overall 95 percent upper confidence level (95UCL) of 0.00276 mg/kg total PCBs in the remaining sediment that theoretically would result in fish tissue concentrations closer to a 10^{-5} recreational fisher cancer risk level or a Aroclor-1254 non-cancer HI of 1, and below a 10^{-4} subsistence fisher cancer risk level. The calculated sediment preliminary remediation goal based on a 10^{-5} adult recreational fisher cancer risk level is 0.004 mg/kg. The calculated sediment preliminary remediation goal based on an Aroclor-1254 child recreational fisher non-cancer HI of 1 is 0.003 mg/kg. The calculated sediment preliminary remediation goal based on a 10^{-4} subsistence fisher cancer risk level is 0.010 mg/kg.

Based on the discussion included above, the 10^{-4} and 10^{-5} cancer risk levels for Aroclor-1254, Aroclor-1260, and total PCB congeners have been retained for further consideration in remedial goal selection, as discussed in Section 2.5.

2.3 SITE SPECIFIC ECOLOGICAL PRELIMINARY REMEDIATION GOALS

The ERA evaluated risk on the basis of exposure groupings, however, a single set of preliminary remediation goals was developed to ensure consistency in risk management actions applicable across the entire site. The ERA determined benthic invertebrates, piscivorous mammals, small piscivorous birds, and threatened and endangered species (interior least tern, reddish egret, Coues' rice rat, false spike mussel, Salina mucket, and Texas hornshell) represented the most sensitive receptors evaluated for effects from PCBs. Therefore, preliminary remediation goal

development focuses on these receptors. Risk-based thresholds of effect were developed for use as risk-based preliminary remediation goals for sediment. Background was not considered because PCBs are anthropogenic and were detected in very few samples upstream of the siphon.

2.3.1 Benthic Invertebrates, False Spike Mussel, Salina Mucket, and Texas Hornshell

The preliminary remediation goal for benthic invertebrates was selected by using the toxicological data used in the ERA. Both the threshold effect concentration and probable effect concentration of total PCBs on benthic invertebrates were considered. The probable effect concentration of 0.68 mg/kg (MacDonald et al. 2000) is recommended as a preliminary remediation goal for non-threatened and endangered species. This preliminary remediation goal is intended for application on a point-by-point basis or across small areas, as benthos are typically immobile and would receive exposures at a single location.

The threatened and endangered false spike mussel, Salina mucket, and Texas hornshell may be at risk from PCBs in sediment. To ensure protection of threatened and endangered benthic organisms, the threshold effect concentration of 0.06 mg/kg (MacDonald et al. 2000) is recommended as a preliminary remediation goal for threatened and endangered species.

2.3.2 Small Piscivorous Birds and Piscivorous Mammals

In order to develop preliminary remediation goals for piscivorous receptors, exposure models were developed and are presented in Table 2-8. The ERA (2016c) found that exposure modeling for piscivorous mammals and small piscivorous birds resulted in the highest exceedance of dose-based toxicity values. Thus, the lower of the two potential preliminary remediation goals will be protective of all other non-threatened and endangered wildlife. Table 2-8 relates concentrations in sediment to the dose received by piscivorous mammals and small piscivorous birds. The same assumptions and exposure values in the ERA (EA 2016c) were utilized for preliminary remediation goal development, with the addition of a site sediment to whole body fish BAF developed for total PCBs.

Risks to small piscivorous birds and piscivorous mammals are due to exposure to PCB concentrations found in fish. The primary source of PCBs at the site that result in fish PCB body burdens can be found in the sediment of the DRCS, which are taken up into food webs and ultimately into fish. In order to derive a sediment preliminary remediation goal protective of ecological receptors site-specific BAFs were derived. The BAF was calculated by dividing the geometric mean total PCB concentration of whole body fish tissue by the geometric mean total PCB concentration of sediment (Tables 2-7 and 2-9). This provides a quantitative estimate of the contribution from site sediment into fish tissue overall and serves as a basis for linking risks from tissue consumption to exposures to environmental media that can be remediated. Calculation of the site-specific BAF, 4.1, is presented in Table 2-8. It is important to note that these BAFs differ from those used in preliminary remediation goal development for human health (Section 2.2). This is because it is standard practice to consider whole body fish tissue when assessing ecological risk and filet fish tissue when assessing human health risk. Use of these different assumptions results in different BAFs. Differences in BAFs are further increased by

the fact that higher variability was seen in filet concentrations than in whole body concentrations.

Using exposure models, sediment concentrations that resulted in doses equal to doses at known effects levels for wildlife were calculated. Several effects levels were considered: no observed adverse effect level (NOAEL), lowest observed adverse effect level (LOAEL), and NOAEL-LOAEL midpoint doses were calculated for higher trophic-level receptors. The NOAEL is an exposure level at which there are no statistically or biologically significant increases in the frequency or severity of adverse effects between the exposed population and its appropriate control. The LOAEL is the lowest exposure level at which there are biologically significant increases in frequency or severity of adverse effects between the exposed population and its appropriate control group. Therefore, the threshold between the no effects and low effects is expected to lie between the NOAEL and LOAEL. The concentration corresponding to the NOAEL-LOAEL midpoint was selected by taking the midpoint between the NOAEL and LOAEL concentrations. Calculations of exposure point concentrations based on NOAEL and LOAEL doses are presented in Table 2-8. Risk-based preliminary remediation goals are either set at the NOAEL, LOAEL, or a point in between. EPA presentations have recommended selection of a preliminary remediation goals from a point in between the NOAEL and the LOAEL, with the midpoint as a starting point (Greenberg and Charters 2005). Therefore, the NOAEL-LOAEL midpoint has been selected as an appropriate preliminary remediation goal for total PCBs for the protection of wildlife. It should be noted that this preliminary remediation goal does not take home range into consideration.

Preliminary remediation goals for wildlife are intended for use as reach-wide average exposure point concentrations. As such, it may be possible to remediate to point-by-point concentrations that are higher than the preliminary remediation goal and still achieve a reach-wide average concentration that is protective. The preliminary remediation goal for PCBs for non-threatened and endangered small piscivorous birds is 0.48 mg/kg and the preliminary remediation goal for PCBs for non-threatened and endangered piscivorous mammals is 0.07 mg/kg. Small piscivorous birds and piscivorous mammals were found to be the most sensitive species in the ERA (EA 2016), therefore, the preliminary remediation goal of 0.07 mg/kg should be protective of all wildlife. Achievement of this preliminary remediation goal may be possible by remediating all or part of the reaches in question and should be evaluated in conjunction with other goals.

2.3.3 Interior Least Tern, Reddish Egret, Coues' Rice Rat

The following threatened and endangered wildlife species may be at risk from PCBs: interior least tern, reddish egret, and Coues' rice rat. The surrogate receptors for these threatened and endangered species are: great blue heron (large piscivorous birds), belted kingfisher (small piscivorous birds), and raccoon (aquatic carnivorous mammals). Based on the ERA results, small and large piscivorous birds have similar exposure parameters but the small piscivorous bird is a more sensitive receptor. Thus, a preliminary remediation goal protective of small piscivorous birds will be protective of all piscivorous bird receptors. Preliminary remediation goals for small piscivorous birds and aquatic carnivorous mammals were developed (Table 2-10).

Table 2-10 relates concentrations in sediment to the dose received by the receptor species. The same assumptions and exposure values in the ERA (EA 2016c) were utilized for preliminary remediation goal development, with the exception of a change to the assumed diet of the Coues' rice rat and the addition of a site sediment to whole body fish BAF (Table 2-9) and a site sediment to benthos tissue BAF (Table 2-11) developed for total PCBs.

The ERA makes conservative exposure assessment assumptions in order to evaluate if there is the potential for any risk. The Coues' rice rat is represented by the raccoon surrogate receptor for which the food web models assume a 100 percent benthic prey diet. However, the Coues' rice rat is an omnivore indicating that the food web model may be overly conservative as plants and terrestrial prey are not expected to contain PCBs as high as those in benthos. Specific information regarding the species diet is not known and information on other rat rice species' diets vary in the literature. The *Oryzomys* spp. were thought to feed primarily on seeds and succulent plant parts and only supplement their diet with meat consumption (Goldman 1918). Whereas, another study found that the marsh rice rat (*Oryzomys palustris)* diet consisted equally of plant and animal materials (Wolfe 1982). Therefore, the food web modeling for raccoon as a surrogate for the Coues' rice rat has been modified to more clearly represent the diet of the protected species. For the purposes of preliminary remediation goal development, the raccoon is assumed to consume 50 percent benthos and 50 percent plant material.

As discussed above for derivation of a fish tissue BAF, in order to derive a sediment preliminary remediation goal protective of ecological receptors a site-specific benthos tissue BAF was derived. The BAF was calculated by dividing the geometric mean total PCB concentration of benthos tissue by the geometric mean total PCB concentration of sediment. This provides a quantitative estimate of the contribution from site sediment into benthos tissue overall and serves as a basis for linking risks from tissue consumption to exposures to environmental media that can be remediated. Calculation of the site-specific fish tissue BAF, 4.1, is presented in Table 2-9. Calculation of the site-specific benthos tissue BAF, 4.5, is presented in Table 2-10.

Using the exposure models, sediment concentrations that resulted in doses equal to doses at known effects levels for threatened and endangered wildlife were calculated. As discussed for non-threatened and endangered wildlife above, preliminary remediation goal development typically considers NOAEL and LOAEL values; however, preliminary remediation goals are rarely selected at the LOAEL level for threatened and endangered species. Therefore, calculation of exposure point concentrations based on the NOAEL dose are presented in Table 2-10.

Preliminary remediation goals for threatened and endangered species are intended for use as reach-wide average exposure point concentrations. As such, it may be possible to remediate to point-by-point concentrations that are higher than the preliminary remediation goal and still achieve a reach-wide average concentration that is protective. The preliminary remediation goal for PCBs in sediment is 0.023 mg/kg for Coues' rice rat and 0.088 mg/kg for least tern and reddish egret. Achievement of these preliminary remediation goals may be possible by remediating all or part of the reaches in question and should be evaluated in conjunction with

other goals.

The preliminary remediation goal for Coues' rice rat of 0.023 mg/kg PCB is the lowest of all ecological preliminary remediation goals, and thus would drive remediation. Given that the presence of Coues' rice rat has not been established for the site, it is important to consider habitat and which areas of the site the rice rat may utilize. According to the Texas Department of Parks and Wildlife, the habitat preference for Coues' rice rat is cattail-bulrush marsh and aquatic, grassy zones near oxbow lakes (Texas Parks and Wildlife 2016). The only portions of the canal and reservoir system that supports comparable habitat are portions of the reservoir, which include some areas of emergent vegetation and forested wetlands. None of the samples collected from the reservoir exceeded 0.023 mg/kg PCBs in sediment (highest detection was 0.014 mg/kg) and thus the reservoir does not require risk management for ecological receptors.

The canals do not provide habitat consistent with the needs of Coues' rice rat. The majority of the shoreline along the 7.6 miles of canal is highly disturbed. A total of 3.5 miles is lined with concrete and does not provide vegetative habitat that would support use by the species. Of the remaining 4.1 miles that are unlined, habitat consists of a grassy strip of fragmented shoreline vegetation between the canal and access roads. Shorelines are steep and support a marsh border of less than 1 to 3 feet. Several areas of shoreline vegetation are dominated by giant reed (*Phragmites australis*), an invasive species. Based on this information, the canals provide habitat that is largely inconsistent with Coues' rice rat habitat preferences. Therefore, the goal of 0.023 mg/kg should not be applied to sediment in the canals in favor of goals for species that may actually be present.

2.3.4 Summary of Potential Ecological Preliminary Remediation Goals

A summary of potential preliminary remediation goals for ecological receptors is provided in the table below.

Potential Ecological Preliminary Remediation Goals

Chemical of Concern	Receptor	Potential Sediment Remediation Goal (mg/kg)	Note
Total PCBs	Small Piscivorous Birds General Population	0.483	NOAEL-LOAEL midpoint. Intended for application as a reach-wide average.
Total PCBs	Piscivorous Mammals General Population	0.071	NOAEL-LOAEL midpoint. Intended for application as a reach-wide average.
Total PCBs	Benthic Invertebrates General Population	0.68	Probable Effect Concentration. Intended for application on a point-by-point basis or as an average across small areas.
Total PCBs	Interior Least Tern	0.088	NOAEL. Intended for application on a point-by-point basis.
Total PCBs	Reddish Egret	0.088	NOAEL. Intended for application on a point-by-point basis.
Total PCBs	Coues' Rice Rat	0.023	NOAEL. Intended for application on a point-by-point basis, applicable to the reservoir only. Reservoir is already in compliance.
Total PCBs	False Spike Mussel, Salina Mucket, Texas Hornshell	0.06	Threshold Effects Concentration. Intended for application on a point-by-point basis or as an average across small areas.

Note:
LOAEL – lowest observed adverse effect level
mg/kg – milligrams per kilogram (dry weight)
NOAEL – no observed adverse effect level
Total PCBs – Either the sum of polychlorinated biphenyls (PCBs) as Aroclors or the sum of individual PCB congeners.

Based on the discussions above, the lowest ecological preliminary remediation goal applicable for exposures throughout the site is 0.06 mg/kg, applied on a point-by-point basis.

2.4 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Section 121(d) of CERCLA and NCP Section 300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate federal and state requirements, standards, criteria, and limitations which are collectively referred to as "ARARs," unless such ARARs are waived under CERCLA Section 121(d)(4).

Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal, state, or local environmental laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. State standards that are identified by a state in a timely manner, and that are more stringent than federal requirements may be applicable. Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal, state, or local environmental laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well-suited to the particular site. Only those state standards that are identified in a

timely manner and are more stringent than federal requirements may be relevant and appropriate. Finally, there is a category of other federal or state advisories, criteria, or guidance, which may be used to develop a CERCLA remedy that falls into a category called "to be considered" guidelines 40 CFR Section 300.400(g)(3).

The ARARs pertaining to remedial action at the site are divided into chemical, location, and action specific categories as described below. In addition, TBCs criteria are discussed. These specific categories are described as follows:

- Chemical specific ARARs are promulgated values that include health or risk based standards, numerical values, or methodologies that, when applied to site-specific conditions, establish the acceptable amount or contaminant concentration that may be detected in or discharged to the ambient environment. These values focus on protecting public health and the environment. However, technological or cost limitations may influence some values, such as EPA Maximum Contaminant Levels.

- Location specific ARARs relate to the geographical position of the site, such as state and federal laws and regulations that protect wetlands or construction in flood plains. The extent to which any location specific requirements may be considered depends solely on the sensitivity of the environment and any possible impact caused by remedial activities.

- Action specific ARARs are technology or activity based requirements or limitations on actions taken regarding hazardous substances, pollutants, and contaminants.

TBC criteria are non-promulgated, non-enforceable guidelines, or criteria that may be useful for developing a remedial action or that are necessary for evaluating what is protective to human health and/or the environment. Examples of TBC criteria include EPA drinking water health advisories, reference doses, and cancer slope factors. The subsections below provide discussion regarding ARARs and TBCs, Table 2-12 provides a summary of the same information.

2.4.1 Chemical Specific ARARs or TBCs

ARARs and TBC information are generally identified with reference to media and COCs. For example, identifying surface water as a medium of concern triggers consideration of federal clean water regulations. Media of concern at the site include fish tissue, sediment, and benthos tissue. Site COCs are PCBs. One chemical specific ARAR exists regarding the concentration of PCBs in edible fish, as discussed in the subsection below. There are no chemical specific ARARs for sediment or benthos tissue. The Texas Risk Reduction Program sediment protective concentration levels should be considered as discussed in the subsection below.

2.4.1.1 U.S. Food and Drug Administration Polychlorinated Biphenyl Tolerance Level in Fish

The U.S. Food and Drug Administration is responsible for protecting the public health by assuring the safety, efficacy, and security of the nation's food supply and tolerance levels for various substances. A tolerance is a regulation that is established following formal rulemaking

procedures (Boyer et al., 1991). The U.S. Food and Drug Administration tolerance level for total PCBs in the edible portion of fish and shellfish is 2 mg/kg (21 CFR Section 109.30(a)(7)). EPA guidance on assessing chemical data for fish advisories (2000b) further clarifies:

> *"FDA [U.S. Food and Drug Administration] action levels and tolerances are indicators of chemical residue levels in fish and shellfish that should not be exceeded for the general population who consume fish and shellfish typically purchased in supermarkets or fish markets that sell products that are harvested from a wide geographic area, including imported fish and shellfish products. However, the underlying assumptions used in the FDA [U.S. Food and Drug Administration] methodology were never intended to be protective of recreational, tribal, ethnic, and subsistence fishers who typically consume larger quantities of fish than the general population and often harvest the fish and shellfish they consume from the same local waterbodies repeatedly over many years. If these local fishing and harvesting areas contain fish and shellfish with elevated tissue levels of chemical contaminants, these individuals potentially could have increased health risks associated with their consumption of the contaminated fish and shellfish."*

As indicated in EPA guidance the PCB tolerance level is not risk-based, however is an ARAR.

2.4.1.2 Texas Risk Reduction Program Sediment Protective Concentration Levels

Under the Texas Risk Reduction Program (Section 350.75[i][15]), sediment protective concentration levels must be established when the TCEQ determines that relevant exposure pathways are complete or are reasonably anticipated to be complete for a given COC. Direct human contact sediment protective concentration levels, which address the ingestion/dermal contact with sediment pathways are available. The sediment protective concentration level for PCBs is 2.33 mg/kg for non-carcinogenic risks and 5.48 mg/kg at a 10^{-5} carcinogenic risk level. However, the direct human contact protective concentration levels cannot be assumed to be protective of uptake to fish tissue and thus not protective of human exposures through the consumption of contaminated fish.

2.4.2 Location Specific ARARs or TBCs

Location specific ARARs relating to the geographical position of the site are discussed in the subsections below.

2.4.2.1 National Historical Preservation Act

The National Historical Preservation Act (16 United States Code Section 470 and 661 et seq., 36 CFR Part 65, and 36 CFR Part 800) defines procedures to preserve scientific, historical, and archeological data from potential destruction resulting from a change in the site terrain resulting from a federal construction project or federally licensed activity. If such artifacts are discovered during work at the site, work in the area will be stopped until data recovery and preservation activities are completed in accordance with the act and regulations. Applicable if scientific,

historical, and archeological data is discovered during the project, however no known artifacts have been identified at the site.

2.4.2.2 Executive Order 11988, Floodplains Management

Executive Order 11988, Floodplains Management (40 CFR Part 6 Appendix A and 40 CFR Section 6.302) requires federal agencies to evaluate the potential effects of actions they may take in a floodplain to avoid adverse impacts. Applicable because the site lies within a 100-year floodplain.

2.4.2.3 Endangered Species Act of 1973

The Endangered Species Act of 1973 (16 United States Code Section 1531 et seq., 50 CFR Sections 222-228) requires that federal agencies must confirm any action that is federally authorized, funded, or implemented by the agency is not probable to adversely affect the continued existence of any threatened and endangered species. The agency must ensure that the critical habitat is not destroyed or negatively modified. Applicable if threatened and endangered species are found onsite. There is uncertainty regarding whether or not threatened and endangered species are located at the site. The ERA, results of which are discussed in Section 1.5, assumed that any threatened or endangered species that could occur within Hidalgo County may be present at the site.

2.4.2.4 Texas Parks and Wildlife Department Threatened and Endangered Species

Texas Parks and Wildlife Department, 31 Texas Administrative Code Sections 65.171-65.176, specifies requirements for any species of wildlife listed in Texas as threatened and endangered, living or dead, including parts. Applicable if state listed threatened and endangered species are found onsite.

2.4.2.5 Migratory Bird Treaty Act

The Migratory Bird Act (16 United States Code Section 703 et seq.) requires federal responsibility for the protection of the international migratory bird resource and requires continued consultation with the U.S. Fish and Wildlife Service during remedial design and remedial action activities to ensure that the cleanup of the site does not unnecessarily impact migratory birds. Specific mitigative measures may be identified for compliance with this requirement. Applicable if the remedy may impact migratory birds.

2.4.2.6 International Boundary and Water Commission - United States and Mexico

IBWC must provide approval prior to commencement of construction of any facility which passes over, under or within the floodplain of the international reaches of the Rio Grande and Colorado Rivers. The IBWC retains right of approval on all improvements which are to pass over, under or through the walls, levees, improved channel or floodways of IBWC Flood Control

Projects, including the Rio Grande. Applicable because the site lies within the boundaries of the IBWC.

2.4.3 Action Specific ARARs or TBCs

Action specific ARARs or TBCs are technology or activity based requirements or limitations on actions taken are discussed in the subsections below.

2.4.3.1 Comprehensive Environmental Response, Compensation, and Liability Act Permits and Enforcement

Section 121e of CERCLA states that "no federal, state, or local permit shall be required for any portion of a CERCLA remedial action that is conducted on the site of the facility being remediated." This includes exemption from the Resource Conservation and Recovery Act (RCRA) permitting process. Applicable if a remedial action is conducted at the site, because the site is subject to CERCLA.

2.4.3.2 Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act (16 United States Code Section 662) is applicable when modifications to a stream or other water body are proposed or approved by any U.S. agency, such agency shall review with the U.S. Fish and Wildlife Service, Department of the Interior, and with the head of the agency overseeing the wildlife resources of the site. Applicable if remedial activities occur in streams or the canal and reservoir system.

2.4.3.3 Occupational Safety and Health Act

The Occupational Safety and Health Act (29 CFR) enacted by Congress in 1970 requires assurance of the health and safety of workers. 40 CFR 300.150 specifically requires assurance of the health and safety of workers during the remedial actions. Applicable if remedial activities are conducted at the site.

2.4.3.4 Spill Prevention and Control

Spill Prevention and Control, 30 Texas Administrative Code Chapter 327, defines reportable quantities in the event of a spill or release to environment, notification requirements, and actions required. Applicable if a release or spill to the environment occurs during remedial activities.

2.4.3.5 National Pollutant Discharge Elimination System

The National Pollutant Discharge Elimination System (40 CFR 122 and 40 CFR 125) provides conditions that must be incorporated into National Pollutant Discharge Elimination System permits. Applicable to discharge of storm water from the site if remedial activities are conducted at the site.

2.4.3.6 Texas Pollutant Discharge Elimination System - Construction General Permit

The Texas Pollutant Discharge Elimination System, Construction General Permit (TXR150000) is a general permit to discharge water from construction activities. Applicable if construction activities are performed during the remedial action.

2.4.3.7 Clean Water Act

Per the Clean Water Act, Section 304, 40 CFR part 130, EPA publishes national recommended Ambient Water Quality Criteria for the protection of aquatic life and human health. Ambient Water Quality Criteria are relevant and appropriate criteria if a remedial action includes treatment of water following dewatering sediment, and discharging to a waterway.

Section 404 of the Clean Water Act (33 CFR parts 320-330 and 40 CFR part 230) regulates the discharge of dredged or fill materials into waters of the U.S. Discharges of dredged or fill materials are not permitted unless there is no practicable alternative that would have less adverse impact on the aquatic ecosystem. Any proposed discharge must avoid, to the fullest extent practicable, adverse effects, especially on aquatic ecosystems. Unavoidable impacts must be minimized, and impacts that cannot be minimized must be mitigated. Applicable if remedial activities include discharge of dredged or fill materials into water of the U.S.

2.4.3.8 Toxic Substances Control Act

The Toxic Substances Control Act (40 CFR part 761) regulates PCBs from manufacture to disposal. The regulations provide several factors for determining whether media containing PCBs is PCB remediation waste (as defined per 40 CFR part 761.3), including the date of the spill, PCB concentration of material spilled, and PCB concentration currently at the site (i.e., the "as found" concentration). In general, material meeting the definition of PCB remediation waste may be disposed of using one of the three options under 40 CFR Part 761.61, which includes a self-implementing option (40 CFR Part 761.61[a]), a performance-based option (40 CFR Part 761.61[b]), and a risk-based option (40 CFR Part 761.61[c]). Under the regulations, however, the self-implementing option cannot be used to clean up sediment in marine or freshwater ecosystems (40 CFR 761[a][1][i]).

40 CFR 761.3 defines PCB remediation waste as

> *"…waste containing PCBs as a result of a spill, release, or other unauthorized disposal, at the following concentrations: Materials disposed of prior to April 18, 1978, that are currently at concentrations ≥50 ppm PCBs, regardless of the concentration of the original spill; materials which are currently at any volume or concentration where the original source was ≥500 ppm PCBs beginning on April 18, 1978, or ≥50 ppm PCBs beginning on July 2, 1979; and materials which are currently at any concentration if the PCBs are spilled or released from a source not authorized for use under this part. PCB remediation waste means soil, rags, and other debris generated as a result of any PCB spill cleanup, including, but not limited to:*

(1) Environmental media containing PCBs, such as soil and gravel; dredged materials, such as sediments, settled sediment fines, and aqueous decantate from sediment.

(2) Sewage sludge containing <50 ppm PCBs and not in use according to §761.20(a)(4); PCB sewage sludge; commercial or industrial sludge contaminated as the result of a spill of PCBs including sludges located in or removed from any pollution control device; aqueous decantate from an industrial sludge.

(3) Buildings and other man-made structures (such as concrete floors, wood floors, or walls contaminated from a leaking PCB or PCB-Contaminated Transformer), porous surfaces, and non-porous surfaces."

Based on the definition of PCB remediation waste (40 CFR Part 761.3) provided above, assuming the spill occurred prior to 1978 and was the result of a release from a source authorized for use, only media with concentrations greater than 50 ppm are considered PCB remediation wastes. Therefore, because the maximum detected PCB concentration in sediment at the site was 11 mg/kg, DRCS sediment is not considered PCB remediation waste. However, the maximum detected PCB concentration in fish collected from the site was 150 mg/kg, and is therefore relevant and appropriate to be considered PCB remediation waste.

According to EPA Guidance (EPA 2005) selection of disposal options under 40 CFR Part 761.61 for wastes generated at Superfund sites is generally made at the regional level. The risk-based option under 40 CFR 761.61(c) may often be the most appropriate option at Superfund sites (EPA 2005). The risk-based option (under 40 CFR 761.61[c]) for PCB remediation waste will require a site-specific disposal plan that includes a specific sampling protocol as well as detailed performance standards for on-site temporary storage and off-site disposal for remediation waste (in this case PCB-contaminated fish).

Off-site disposal of fish with concentrations of PCBs greater than 50 ppm will likely need to be in a hazardous waste landfill permitted by EPA under section 3004 of RCRA, or by a State authorized under Section 3006 of RCRA, or a PCB disposal facility approved under 40 CFR 761. It is appropriate for off-site disposal of sediment from the DRCS to be in a municipal landfill because by the Toxic Substances Control Act definition, sediment at the site is not considered to be PCB-contaminated or PCB remediation waste.

2.4.3.9 Resource Conservation and Recovery Act

The RCRA (40 CFR Parts 260 to 268) regulates general hazardous waste management including identification, generation, transportation, storage, disposal of waste; permitting, monitoring, and reporting requirements; authorizations and recognition of state hazardous waste programs; chemical release reporting. Applicable if hazardous waste as defined by RCRA (listed or

characteristic) is identified on site and requires disposal. At this time no known listed or characteristic hazardous wastes as defined by the RCRA have been identified on site.

2.4.3.10 Hazardous Substance Response

Per 40 CFR 300.400, hazardous waste generated from CERCLA cleanups must go to RCRA permitted treatment, storage, and disposal facilities that are in compliance with RCRA and state rules, and that do not have releases to the environment. Applicable if hazardous waste is generated during remedial activities. At this time no known listed or characteristic hazardous wastes as defined by the RCRA have been identified on site.

2.4.3.11 Waste Classification

The Texas Administrative Code (30 Texas Administrative Code Section 335.505 and 30 Texas Administrative Code Section 335.508) provides procedures for implementation of the Texas waste notification system and establishes standards for classification of industrial solid waste managed in Texas, including Class 1, Class 2, and Class 3 wastes. Applicable if waste is generated during remedial activities.

2.5 SUMMARY OF REMEDIAL ACTION OBJECTIVES AND REMEDIATION GOALS

Based on information relating to types of contaminants, environmental media of concern, and potential exposure pathways, RAOs were formed to aid in the development and screening of remedial alternatives. Final RAOs and remediation goals will be documented in the Record of Decision.

2.5.1 Human Health Risks

Remedial Action Objective: Reduce the long-term human health cancer risks and the non-cancer hazards from human consumption of DRCS fish contaminated with PCBs by reducing exposure to elevated concentrations of PCBs in sediment downstream from the source (i.e., the siphon) and mitigating the transport pathway from the siphon into the DRCS.

Remedial Action Objective: Reduce the short-term human health cancer risks and the non-cancer hazards from human consumption of DRCS fish contaminated with PCBs.

The HHRA determined that exposure to PCBs through consumption of fish poses an unacceptable risk for human health. Reducing PCB levels in fish and/or preventing consumption of contaminated fish are two ways to reduce risk. In order to reduce PCB levels in fish it is necessary to reduce PCB levels in sediment and remove the primary source of PCBs (the siphon).

2.5.2 Ecological Risks

Remedial Action Objective: Reduce the risks to ecological receptors (i.e., small piscivorous birds, piscivorous mammals, benthic invertebrates, and threatened/endangered species) from exposure to PCBs in sediment.

The ERA determined that exposure to PCBs through consumption of fish poses an unacceptable risk for small piscivorous birds, piscivorous mammals, and the threatened and endangered species, interior least tern and reddish egret. The ERA determined that exposure to PCBs through ingestion of sediment poses an unacceptable risk for benthic invertebrates and the threatened and endangered species, Coues' rice rat, false spike mussel, Salina mucket, and Texas hornshell. The ERA also determined that exposure to PCBs through ingestion of benthos or sediment via ingestion of benthos poses an unacceptable risk for the threatened and endangered species Coues' rice rat. Reducing PCB levels in sediment and removing the primary source of PCBs (the siphon) will reduce risk.

2.5.3 Summary of Remediation Goals

The summary of potential quantitative remediation goals that can be selected from in order to achieve the RAOs are presented in the table below, in order of decreasing concentrations for each medium of concern.

Summary of Potential Preliminary Remediation Goals

Chemical of Concern	Preliminary Remediation Goal	Basis for Preliminary Remediation Goal
Fish Tissue (mg/kg)		
Total PCBs	2	U.S. Food and Drug Administration Tolerance Level
Total PCBs	0.41	Human Health Calculated Risk-Based Value, Recreational User Cancer Risk 10^{-4}
Total PCBs	0.096	Human Health Calculated Risk-Based Value, Subsistence Fisher Cancer Risk 10^{-4}
Total PCBs	0.041	Human Health Calculated Risk-Based Value, Recreational User Cancer Risk 10^{-5}
Total PCBs	0.031	Human Health Calculated Risk-Based Value, Recreational User Aroclor-1254 Non-Cancer HI=1
Total PCBs	0.011	Human Health Calculated Risk-Based Value, Subsistence Fisher Aroclor-1254 Non-Cancer HI=1
Total PCBs	0.010	Human Health Calculated Risk-Based Value, Subsistence Fisher Cancer Risk 10^{-5}
Sediment (mg/kg)		
Total PCBs	0.68	Benthic Invertebrate Probable Effect Concentration (general population)
Total PCBs	0.483	Small Piscivorous Birds NOAEL-LOAEL Midpoint (general population)
Total PCBs	0.088	Small and Large Piscivorous Birds NOAEL (T&E species)
Total PCBs	0.071	Small Piscivorous Mammal NOAEL-LOAEL Midpoint (general population)
Total PCBs	0.06	Benthic Invertebrate Threshold Effect Concentration (T&E species)
Total PCBs	0.043	Human Health Calculated Risk-Based Value, Recreational User Cancer Risk 10^{-4}
Total PCBs	0.023[a]	Small Piscivorous Mammal NOAEL (T&E species)
Total PCBs	0.010	Human Health Calculated Risk-Based Value, Subsistence Fisher Cancer Risk 10^{-4}
Total PCBs	0.004	Human Health Calculated Risk-Based Value, Recreational User Cancer Risk 10^{-5}
Total PCBs	0.003	Human Health Calculated Risk-Based Value, Recreational User Aroclor-1254 Non-Cancer HI=1
Total PCBs	0.001	Human Health Calculated Risk-Based Value, Subsistence Fisher Cancer Risk 10^{-5} and Aroclor-1254 Non-Cancer HI=1

Note:
[a] Goal applicable to reservoir only based on evaluation of habitat as discussed in Section 2.3.3, note reservoir concentrations do not exceed 0.023 mg/kg and thus already meet this goal.
HI – hazard index
LOAEL – lowest observed adverse effect level
mg/kg – milligram per kilogram
NOAEL – no observed adverse effect level
T&E – threatened and endangered
Total PCBs – Either the sum of polychlorinated biphenyls (PCBs) as Aroclors or the sum of individual PCB congeners.

The calculated human health sediment preliminary remediation goals are based on exposure to PCBs through consumption of fish. In order to achieve the human health RAO, it is necessary to remediate sediment downgradient of the source (the siphon) at concentrations greater than the selected preliminary remediation goal. A site-wide human health preliminary remediation goal for sediment is recommended because fish are mobile throughout all reaches of the canal and reservoir system and PCBs in sediment result in fish PCB body burdens. All of the possible human health risk-based preliminary remediation goals for PCBs in sediment will result in protection of all ecological receptors of concern, including threatened and endangered species from any of the ecological exposure areas. Figure 2-4 presents the area necessary to remediate if 0.043 mg/kg of PCBs in sediment is selected as the remediation goal. Figure 2-5 presents the area necessary to remediate if 0.004 mg/kg of PCBs in sediment is selected as the remediation goal. Figure 2-6 presents the area necessary to remediate if 0.003 mg/kg of PCBs in sediment is selected as the remediation goal. The value of 0.043 mg/kg is also lower than all ecological

preliminary remedial goals applicable throughout the site, and therefore is protective of ecological receptors as well.

2.5.4 Discussion of Reporting Limits

It is important to consider whether or not the current analytical methods are capable of determining if preliminary remediation goals have been achieved during the remedial action. The table below presents a summary of contract required quantitation limits per the EPA Contract Laboratory Program (CLP).

Summary of Sediment Contract Required Quantitation Limits Available Through the EPA Contract Laboratory Program

Analyte	Contract Required Quantitation Limit (mg/kg)	Notes from the Statements of Work regarding the CRQLs
EPA Contract Laboratory Program Statement of Work for Organic Superfund Method, Multi-Media, Multi-Concentration SOM02.3, September 2015		
Aroclor-1254[1]	0.033	CRQL based on 100 percent solids. The moisture content of the samples must be used to adjust the CRQL value appropriately. A modified analysis may be requested in order to achieve a lower reporting limit, however due to matrix interferences and variable moisture content it is not possible to predict what laboratories will be able to achieve.
EPA Contract Laboratory Program Statement of Work for High Resolution Superfund Methods, Multi-Media, Multi-Concentration HRSM01.2, October 2014		
Total PCBs[2]	0.000418	The CRQL presented is the sum of the 209 individual PCB congener CRQLs which are equivalent to the concentration of the low calibration standard. Specific quantitation limits are highly matrix-dependent. The quantitation limit listed herein is provided for guidance and may not always be achievable. The values in these tables are quantitation limits, not absolute detection limits. The amount of material necessary to produce a detector response that can be identified and reliably quantified is greater than that needed to be simply detected above the background noise. For some congeners, the CRQLs may be dependent upon coelutions encountered during analysis.

Note:
[1] All Aroclors available per method (e.g., 1016, 1248, 1254, 1260, etc.) have the same CRQL.
[2] Remedial Investigation samples analyzed for PCB congeners through the EPA Contract Laboratory Program were analyzed by method EPA Analytical Services Branch Statement of Work for Analysis of Chlorinated Biphenyl Congeners (CBCs) Multi-Media, Multi-Concentration CBC01.2, December 2009. The EPA Contract Laboratory Program website indicates that during the 2016 fiscal year, HRSM01.2 is anticipated to replace CBC01.2.
CRQL – contract required quantitation limit
EPA – U.S. Environmental Protection Agency
mg/kg – milligram per kilogram
PCB – polychlorinated biphenyl

The table below presents a summary of private laboratory reporting limits and method detection limits.

Summary of Sediment Reporting Limits and Method Detection Limits Available Through a Private Laboratory

Analyte	Reporting Limit (mg/kg)	Method Detection Limit (mg/kg)	Notes
EPA Method 8082 (SW-846) Low Level: Polychlorinated Biphenyls by Gas Chromatography			
Aroclor-1254[1]	0.00083	0.000308	Limits based on 100 percent solids. The moisture content of the samples must be used to adjust the value appropriately.
EPA Method 1668: Chlorinated Biphenyl Congeners in Water, Soil, Sediment, and Tissue by HRGC/HRMS, November 2008			
Total PCBs	0.000418	--	The reporting limit presented is the sum of the 209 individual PCB congener reporting limits. Specific reporting limits are highly matrix-dependent. For some congeners, the reporting limits may be dependent upon coelutions encountered during analysis.

Note:
[1] All Aroclors available per method (e.g., 1016, 1248, 1254, 1260, etc.) have the same reporting limits, not all Aroclors have the same method detection limits.
EPA – U.S. Environmental Protection Agency
mg/kg – milligram per kilogram
PCB – polychlorinated biphenyl

The table below present the range of reporting limits reported for samples collected during the RI. The information presented below is important to consider because moisture content and matrix interferences often result in reporting limits elevated above those presented as achievable.

Summary of Reporting Limits of Nondetect Results from Remedial Investigation Samples

Analyte	Reporting Limits			Number of Samples	Laboratory
	Lowest	Highest	Arithmetic Mean		
Sediment Samples (mg/kg dry weight)					
Aroclor-1254	0.00041	0.014	0.0043	71	TestAmerica Inc.
Aroclor-1254	0.0271	0.0271	0.0271	1	EPA Region 6
Aroclor-1254	0.001	0.076	0.0291	37	EPA CLP
Total PCBs[1]	0.000002	0.000055	0.00002	6	EPA CLP
Fish Tissue Samples (mg/kg wet weight)					
Aroclor-1254	0.0041	0.0042	0.0042	9	TestAmerica Inc.
Aroclor-1254	0.032	0.033	0.0329	39	EPA CLP
Total PCBs[1]	0.000001	0.016	0.0011	17	EPA CLP

Note:
[1] All samples contained detectable PCBs, the range of reporting limits presented is as reported by the laboratory for samples with detections.
CLP – contract laboratory program
EPA – Environmental Protection Agency
mg/kg – milligram per kilogram
PCB – polychlorinated biphenyl

2.5.5 Discussion of Upgradient Sediment Polychlorinated Biphenyl Concentrations

Concentrations of Aroclor-1254 measured in all sediment samples collected in the Main Canal (canal segment from the Rio Grande River to the Siphon) and in the Arroyo Colorado River were either below detection limits or rejected. Reporting limits for Aroclor-1254 in sediment samples collected in these areas ranged from 0.00041 to 0.076 mg/kg, the arithmetic mean of the reporting limits was 0.019 mg/kg, and 23 of the 56 nondetect results had reporting limits above 0.004 mg/kg.

Nine sediment samples from the Main Canal, the canal segment that extends from the Rio Grande River to the siphon entrance, were analyzed for PCB congeners. One sediment sample collected from the Rio Grande River was analyzed for PCB congeners. These samples can be considered upgradient reference samples, or background samples, because they are upstream of impacts from the siphon. Total PCB congener concentrations in these samples range from 0.000021 to 0.0077 mg/kg, with an arithmetic mean of 0.0012 mg/kg.

2.5.6 Analytical Methods Capable of Evaluating Preliminary Remediation Goals

Table 2-13 presents a summary of the information presented in Sections 2.5.4 and 2.5.5 in tabular format to allow for comparison of analytical methods capable of achieving the proposed preliminary remediation goals and upgradient sediment PCB congener concentrations. Analysis of sediment samples for PCBs as Aroclors should provide low enough reporting limits to evaluate sediment confirmation samples post remedial activities for a cleanup goal based on a human health 10^{-4} PCB cancer risk level (0.043 mg/kg). Matrix interference and moisture content may result in reporting limits above sediment cleanup goals based on either a 10^{-5} PCB cancer risk level (0.004 mg/kg) or non-cancer HI of 1 (0.003 mg/kg). For the 10^{-5} or non-cancer HI of 1 preliminary remediation goals, it may be necessary to analyze for PCBs as congeners in order to achieve reporting limits low enough to confirm cleanup goals have been met.
Fish tissue preliminary remediation goals are 0.41, 0.041, or 0.031 mg/kg for a 10^{-4} cancer risk, 10^{-5} cancer risk, or non-cancer HI of 1, respectively. The EPA CLP does not have contract required reporting limits for tissue analyses, despite their capability of performing the analyses. However, based on review of reporting limits from samples collected during the RI (Section 2.5.4), any analytical method previously used to evaluate samples (i.e., SW-846 Method 8082, SOM01.2, or CBC01.2) should be able to meet either the 10^{-4} or 10^{-5} preliminary remediation goals for fish tissue. The non-cancer HI of 1 preliminary remediation goal of 0.031 mg/kg could likely be met with the PCB as Aroclors analysis through the EPA CLP with a modified analysis request (requesting lower reporting limits). The average reporting limit for nondetect fish tissue samples during the RI was 0.0329 mg/kg using SOM01.2 as a routine analysis.

3. IDENTIFICATION AND SCREENING OF GENERAL RESPONSE ACTIONS AND TECHNOLOGIES

Remedial technologies were developed in accordance with EPA Guidance (EPA 1988). The development process starts by identifying GRAs and associated technologies for each media of interest that will satisfy the RAOs. GRAs are generic, medium specific remedial actions and may include no action, institutional controls, containment, removal, treatment, disposal, monitoring, or a combination thereof (EPA 1988).

The GRAs and remedial technologies for each of the media of interest are identified and presented in Section 3.2. The GRAs and remedial technologies are then screened for effectiveness, implementability, and cost in Section 3.3 before being developed into remedial alternatives in Section 4.

3.1 MEDIA OF INTEREST

EPA contaminated sediment remediation guidance (EPA 2005) states the following,

> *"Identifying and controlling contaminant sources typically is critical to the effectiveness of any Superfund sediment cleanup. Source control generally is defined … as those efforts taken to eliminate or reduce, to the extent practicable, the release of contaminants from direct and indirect continuing sources to the water body under investigation. … If a site includes a source that could result in significant recontamination, source control measures will be likely necessary as part of that response action."*

Based on the results presented in the *Remedial Investigation Report* (EA 2016a), *Human Health Risk Assessment* (EA 2016b), and *Ecological Risk Assessment* (EA 2016c), and discussion in the Section 1 regarding the risk assessments, the siphon and site sediment are subject to remedial alternative evaluation in this FS.

The inverted siphon is a continuing source of PCB contamination to surface water, sediment, ecological receptors through bioaccumulation and biomagnification, and humans through consumption of fish that have bioaccumulated and biomagnified PCBs. Without controlling or eliminating the source of contamination, any other remedial actions taken at the site will not have long-term effectiveness.

PCBs in site sediment pose unacceptable risk to human and ecological receptors as identified in Section 2.1.1. Addressing sediment contamination will have the greatest impact on improving fish tissue concentrations and thus on reducing risks to receptors of concern. Reductions in fish tissue PCB concentrations will occur naturally once the sources of contamination to surface water, sediment, and biota, specifically the siphon and contaminated sediment are removed or contained. Although this reduction of fish tissue PCB concentration may take a considerable length of time.

3.2 GENERAL RESPONSE ACTIONS AND REMEDIAL TECHNOLOGIES

GRAs may include no action, institutional controls, containment, removal, treatment, disposal, monitoring, or a combination thereof (EPA 1988). GRAs considered for this site include no action, institutional controls, engineering controls, community involvement, siphon containment and replacement, and sediment monitored natural recovery, containment, treatment, removal, and replacement. Each of the GRAs considered are discussed in the subsections below.

3.2.1 No Action

As required by the NCP (40 CFR Section 300.430 [e][6]), the selected remedial alternatives must include a no action alternative to be used as the baseline alternative against which the effectiveness of all other remedial alternatives are judged.

3.2.2 Institutional Controls

Institutional Controls are administrative and/or legal instruments that place restrictions on the use or development of land and/or ground water within a defined area. These legal and administrative tools are used to maintain protection of public health and/or the environment, and to protect the integrity of a remedy by limiting land or resource use.

Institutional control instruments include restrictive covenants, deed notices, ordinances, zoning restrictions, building and excavation permits, easements, well drilling prohibitions, or a combination thereof. Institutional controls are incorporated into alternatives that call for materials to remain onsite at concentrations exceeding preliminary remediation goals in order to ensure protectiveness of the remedy.

3.2.3 Engineering Controls

Engineering controls are instruments such as fencing or signage that are used to limit access to contaminated areas or areas that may pose a physical hazard. Engineering controls can be used in all stages of the remedial process to accomplish various remedial objectives and are implemented to provide overlapping assurances of protection against exposure to contaminants.

3.2.4 Community Involvement

Public outreach, education, and community involvement can play important roles in the long-term success of institutional controls. Community involvement activities can include door-to-door educational campaigns, periodic public meetings, fact sheets, pamphlets, flyers, radio and television broadcast interviews, and public service announcements.

3.2.5 Siphon Containment

Containment is an engineered remedy designed to prevent migration of contaminants and eliminate exposure pathways to potential receptors. A containment option for the siphon

includes placing a smaller pipe inside the existing siphon and filling the void space between the siphon and inside pipe. This process is known as sliplining. The smaller pipe would create a barrier between the walls of the existing siphon and water that flows through the siphon. The smaller pipe would allow water to flow through the existing siphon while not being in contact with the primary source of PCBs at the site.

3.2.6 Siphon Replacement

Replacement of the siphon is a GRA that entails construction of a new siphon adjacent to the existing siphon. Construction of a new siphon, with environmentally neutral materials, would prevent water flowing through the system from coming in contact with the primary source of PCBs at the site. After construction of a replacement siphon is complete, water would be diverted into the new siphon and the existing siphon would be sealed off and abandoned in place, or otherwise appropriately disposed (i.e., completely removed).

3.2.7 Sediment Monitored Natural Recovery

Monitored Natural Recovery (MNR) is a technology in which contaminant concentrations are monitored with no other remedial actions taken to address contamination. MNR assesses the natural attenuation of contaminants by physical, chemical, and biological processes. MNR is recommended by EPA to be evaluated at contaminated sediment sites (EPA 2005). EPA indicates that burial by clean sediment is often the dominant process relied upon for natural recovery, however other physical, biological, and chemical mechanisms can act together to reduce risk (EPA 2005).

3.2.8 Sediment Containment

Containment is an engineered remedy designed to prevent migration of the contaminants and eliminate exposure pathways to potential receptors. Contaminated sediment would be contained *in situ* under a clean sediment cover (cap of clean cover material) or a cap of reactive material to physically isolate contaminated sediment.

3.2.9 Sediment Treatment

Treatment of contaminated sediment could include stabilization. Stabilization converts contaminants into less soluble, less mobile, or less toxic forms. An example of a stabilizing agent is activated carbon, which binds to PCBs and reduces uptake in the aquatic food chain.

3.2.10 Sediment Removal

Physical removal of contaminated sediment is a GRA that entails removing material for disposal (i.e., dredging) using standard equipment, such as a clamshell excavator, bucket dredge, or hydraulic dredge. Contaminated material is collected and either transported to an approved off-site disposal or treatment facility, or to an on-site facility.

3.2.11 Sediment (Canal or Reservoir) Replacement

Replacement of a section of irrigation canal or reservoir is a GRA that entails the construction of a new irrigation conveyance or reservoir adjacent to the exiting irrigation canal or reservoir. Construction of a new canal or reservoir, with environmentally neutral materials, would prevent water flowing through the system from coming in contact with contaminated sediment at the site. After construction of a replacement canal or reservoir is complete, water would be diverted into the new canal. The existing canal or reservoir would require additional remediation (e.g., removal, containment, treatment) in order to prevent exposure to contaminated sediment.

3.3 SCREENING OF GENERAL RESPONSE ACTIONS AND REMEDIAL TECHNOLOGIES

This section presents and screens the GRAs and remedial technologies discussed above.

3.3.1 Screening Criteria

Three preliminary screening criteria (i.e., effectiveness, implementability, and cost) were used to screen these remedial technologies. Definitions for these criteria are presented in the subsections below.

3.3.1.1 Effectiveness

This criterion is a measure of the ability of an option to: (1) reduce toxicity, mobility, or volume; (2) minimize residual risks; (3) afford long-term protection; (4) comply with ARARs; (5) minimize short-term impacts; and (6) achieve protectiveness in a limited duration. Technologies that offer significantly less effectiveness than other proposed technologies may be eliminated from the alternative development process. Options that do not provide adequate protection of human health and the environment likewise are eliminated from further consideration.

3.3.1.2 Implementability

Implementability is a measure of the technical feasibility and availability of the option and the administrative feasibility of implementing it (e.g., obtaining permits for activities, right-of-way, or construction). Options that are technically or administratively infeasible or that would require equipment, specialists, or facilities that are not available within a reasonable period may be eliminated from further consideration.

3.3.1.3 Cost

Qualitative relative costs for implementing the remedy are considered. Costs were obtained from published sources. Technologies that cost more to implement, but that offer no benefit in effectiveness or implementability over other technologies, may be excluded from the alternative development process.

3.3.2 Discussion of Screening

Tables 3-1 and 3-2 present a summary of screening for the siphon and sediment. GRAs and technologies are discussed in the subsections below.

3.3.2.1 Institutional and Engineering Controls

Institutional and engineering controls have been implemented at DRCS for a number of years and have included measures taken by both state and federal agencies. In 1994, the Texas Department of Health signed Aquatic Life Order Number 9, which prohibits the harvest of any species of aquatic life from the DRCS (Texas Department of Health 1994). In 2009 the EPA installed signage throughout the DRCS to warn the public about the contaminated fish and inform them of the harvesting ban. Institutional and engineering controls used at the site to date have resulted in limited effectiveness. These GRAs will be retained for further consideration in alternative development.

Enforcement

The TDSHS is responsible for the ongoing administration of the harvesting ban through Aquatic Life Order Number 9. Interviews with local residents have indicated that harvesting and consumption of fish from DRCS still occurs. It has also been noted that fish removed from the site may be passed on or sold to individuals who are unaware of where the fish came from or that consumption may pose health risks. Improved compliance with the harvesting ban might be achieved through taking enforcement action against those found to be removing aquatic life from the site. A system of escalating warnings and fines could encourage compliance and reduce potential risks to residents or uninformed consumers. If implemented, administration of the enforcement program would be the responsibility of Texas Parks and Wildlife.

Maintenance

It should be noted that periodic maintenance activities will be needed to ensure signage remains in place and in good condition. Periodic review of sign placement should be considered in remedial alternative developed in order to verify it provides adequate coverage at the site to reach the intended audience.

3.3.2.2 Community Involvement

Public outreach, education, and community involvement can play important roles in the long-term success of institutional controls. In 2009, 2011, and 2012, the EPA and the TDSHS completed door-to-door educational campaigns to inform residents about the potential health risks associated with consuming fish from the DRCS and to ensure they were aware of the harvesting ban. The EPA has also held periodic public meetings, distributed fact sheets, pamphlets, and flyers, and broadcast a number of televised interviews and public service announcements to keep residents informed about the

progress of the investigation and status of site risks. A complete history of community involvement efforts is included in the Community Involvement Plan (EPA 2016b). This GRA will be retained for further consideration in alternative development.

3.3.2.3 Siphon General Response Actions, Technologies, and Process Options

Containment and replacement have been retained as GRAs to remediate the siphon. For containment, sliplining the siphon in order to create a physical barrier between the existing siphon and water that flows through the siphon has been retained. The use of a geopolymer liner in order to create a physical barrier has been eliminated during the screening process due to challenges with implementation and high cost relative to other similarly effective process options.

3.3.2.4 Sediment General Response Actions, Technologies, and Process Options

GRAs and technologies used to remediate contaminated sediment in the DRCS may vary depending on where the sediment are located (e.g., canal, reservoir). Each GRA and technology evaluated is further discussed in below, a summary is provided in Table 3-2.

Monitored Natural Recovery

It is possible that natural recovery of sediment at the site could occur if the source of PCBs were removed, however because of the persistence of PCBs and anticipated land use (as an irrigation canal which requires periodic dredging to maintain system capacity which would potentially disperse sediment and its associated PCB contamination, as well as eliminate any natural sedimentation that has occurred), MNR is considered to be ineffective as a technology for canal sediment at the DRCS. However, if the source of PCBs were removed and no dredging were to occur in the reservoir, MNR may be an effective technology for the reservoir only.

MNR is considered a viable technology for the DRCS reservoir based on the following assumptions. The west reservoir was constructed in 1954-1955 and has accumulated approximately 2.5 feet of sediment in 60 years. It is estimated that approximately 0.5 inches of sediment accumulate in the reservoir per year. Because physical isolation is often the primary form of natural recovery at sites with PCBs, assuming no disturbance of reservoir sediment will occur, clean sediment (after removal of the source) will deposit in the reservoir and physically isolate contaminated sediment.

Containment

Containment with the use of an engineered barrier has been retained as a possible remedial alternative component for the reservoir however, not in the canal. The DRCS is an active irrigation canal and reservoir system that in order to function properly needs to be able to transfer large volumes of water to users. The canals were constructed in order to maintain a specific capacity. In order to not decrease capacity of the canal system, engineered barriers would require removal of sediment prior to their installment. The high cost of removal coupled with

installment of the engineered barrier have resulted in this technology being eliminated for consideration in the canals; other technologies are lower cost and more protective because they do not leave contaminated material in place. However, containment in the form of a sand layer has been retained in order to develop alternatives for the reservoir. The size of the reservoir results in this GRA as being an effective and implementable option which is not cost prohibitive compared to other GRAs for this area of the site.

Treatment

Treatment of contaminated sediment in the form of stabilization has been eliminated for further consideration due to challenges with implementation.

Removal

Physical removal with off-site disposal has been retained for further consideration in the FS. Physical removal with on-site disposal has not been retained because the site has limited space and may require purchasing land in order to dispose material.

Replacement

Replacement of canal or reservoir segments will have implementation challenges, space is limited, and would have to be performed with other remedial technologies to prevent exposure to contaminated sediment. The cost of this GRA, when compared to other GRAs which are similarly protective, is high and therefore it has been eliminated for further consideration in the FS.

3.3.3 Screening Summary

The GRAs evaluated for the siphon include containment and replacement. The GRAs evaluated for sediment include monitored natural recovery, containment, treatment, removal, and replacement. From the list of GRAs potentially applicable, the following were retained for development into alternatives because they were considered effective, implementable, and cost effective relative to the other GRAs under consideration: containment of the siphon, replacement of the siphon, monitored natural recovery of sediment, containment of sediment, and removal of sediment. Technologies associated with the retained GRAs include using a physical barrier in the siphon (e.g., slipline), construction of a new siphon, relying on un-enhanced natural processes for sediment in the reservoir, using an engineered barrier for sediment in the reservoir, and dredging and disposal of canal and/or reservoir sediment.

4. DEVELOPMENT OF REMEDIAL ALTERNATIVES

This section combines the GRAs and technologies that were retained after screening to develop remedial alternatives. Remedy components were developed based on the media that they are designed to treat.

The following potential alternative components were developed for the remediation of the siphon:

- Component SI-A: Slipline Siphon
- Component SI-B: Replace Siphon.

The following remedial remedy components were identified for the remediation of impacted sediment in the canal and reservoir system:

- Component SE-A: Dredging of Canal Sediment with Off-Site Disposal. Preliminary remediation goals of 0.031 mg/kg PCBs in fish tissue and 0.043 mg/kg PCBs in sediment.

- Component SE-B: Dredging of Canal Sediment with Off-Site Disposal and Reservoir Monitored Natural Recovery. Preliminary remediation goals of 0.041 mg/kg PCBs in fish tissue and 0.004 mg/kg PCBs in sediment, corresponding to a 10^{-5} cancer risk level. Alternatively, preliminary remediation goals of 0.031 mg/kg PCBs in fish tissue and 0.003 mg/kg PCBs in sediment, corresponding to a Hazard Index of 1, could also be selected for this remedy component. Choosing these goals will not result in a change to the area subject to remediation or the assumptions made in the FS cost estimate.

- Component SE-C: Dredging of Canal Sediment with Off-Site Disposal and Reservoir Dredging with Sand Layer. Preliminary remediation goals 0.041 mg/kg PCBs in fish tissue and 0.004 mg/kg PCBs in sediment, corresponding to a 10^{-5} cancer risk level. Alternatively, preliminary remediation goals of 0.031 mg/kg PCBs in fish tissue and 0.003 mg/kg PCBs in sediment, corresponding to a Hazard Index of 1, could also be selected for this remedy component. Choosing these goals will not result in a change to the area subject to remediation or the assumptions made in the FS cost estimate.

These remedy components were assembled into alternatives as discussed in the subsections below.

4.1 ALTERNATIVE 1: NO FURTHER ACTION

Estimated Time for Design/Construction: Not Applicable
Estimated Time to Reach Remediation Goals: Not Applicable
Estimated Capital Costs: $0
Estimated Lifetime Costs: $0
Estimated Total Present Worth Costs: $0
Discount Rate: 7%
Number of Years Costs are Projected: Not Applicable

As required by the NCP (40 CFR Section 300.430 [e][6]), the alternatives must include the no further action (NFA) alternative. This is to be used as the baseline alternative against which the effectiveness of all other remedial alternatives are judged. Under NFA, no remedial actions will be conducted at the site. All contaminants will remain in place and will be subject to environmental influences. Furthermore, no action will be taken to prevent unauthorized access or development at the site. No deed notices to inform interested parties regarding the site conditions will be implemented.

4.2 ALTERNATIVE 2: LIMITED ACTION

Estimated Time for Construction: Not Applicable
Estimated Time to Reach Remediation Goals: Not Applicable
Estimated Capital Costs: $8,000
Estimated Lifetime Community Involvement and Engineering Controls: $1,630,000
Estimated Total Present Worth Costs: $1,640,000
Discount Rate: 7%
Number of Years Costs are Projected: 30 Years

Alternative 2 includes community involvement and engineering and institutional controls. The community involvement campaign includes monthly events for 30 years and assumes 3 days of work for 2 community involvement specialists each month. Engineering controls include installation and maintenance of signs warning of the hazards of fish consumption. Institutional controls are discussed in Section 4.2.1.2 below. Table 4-1 provides a summary of costs. Appendix A provides detailed costs for Alternative 2.

4.2.1.1 Community Involvement

Community involvement activities will be performed only as needed for the duration of the Remedial Action, and will rely on partnerships with state (i.e., TDSHS and TPWD), city (i.e., Cities of Donna and Alamo), and other local entities (i.e., irrigation district and counties [Precincts 1 and 2]), as well as community-based organizations, to develop activities and measures to reduce the public's exposure to fish from the site. Specific activities would be identified during the Remedial Design, but could include:

- Warnings on water utility bills received by the public which could state: "Warning: Do not eat fish from Donna Lake, they are contaminated. For more information contact the Texas Department of State Health Services…" These bills are expected to reach a large portion of the nearby communities, such as every residence and business in Donna and Alamo.

- Support from community-based organizations such as non-governmental organizations, media, and community relations specialists to inform people about behaviors that reduce the risk of consuming contaminated fish.

- Partnering with health fairs, community fairs, and local health departments to provide educational materials and training in multiple languages.

- Distribution of specific outreach materials and messages focused on women of child bearing age who consume fish as a part of their diet.

- Conduct outreach, in coordination with the TDSHS, to commercial fish market owners to inform them about the risks of buying fish from unlicensed dealers.

- Educate anglers about the contaminated fish at the Site and the TDSHS' enforceable aquatic life order which prohibits the taking of all species of aquatic life from the Site.

- Coordinate enforcement efforts, of the TDSHS' aquatic life order, with the TPWD and appropriate law enforcement officials by notifying the appropriate authorities of individuals accessing the irrigation district's private property.

- Reducing the potential risks posed by consumption of contaminated fish from the site by coordinating with the local communities to identify an alternate fishing location(s) near the site, routinely stock this nearby lake/reservoir, and advertise the alternate fishing location.

- Coordinate with state agencies and local community groups (e.g., non-governmental organizations) to organize a fishing derby that would allow an opportunity to educate the public about the site in a fun and engaging environment. The derby would help reduce the number of contaminated fish in the reservoir and canal system while involving the community in the remedial process. The derby organizers could offer incentives to encourage community members to participate, and this derby could be implemented on a yearly basis to complement the remedial action for the site.

- Coordinate the placement of warning signs at the site informing the local anglers of the risks associated with eating fish from the site.

4.2.1.2 Institutional Controls

An institutional control in the form of a deed notice will be required. A deed notice is an instrument filed in the real property records of the county where the affected property is located and is intended to provide notice regarding the conditions of the affected property.

In addition, the existing aquatic life order issued by the TDSHS should remain in place until fish tissue levels are safe for human consumption.

4.3 ALTERNATIVE 3: SLIPLINE SIPHON, CANAL DREDGING, AND FISH REMOVALS

Estimated Time for Construction: 7 months
Estimated Time to Reach Remediation Goals: 10 years
Estimated Remedial Action Costs: $14,410,000
Estimated Post Remedial Action Costs: $1,150,000
Estimated Total Present Worth Costs: $15,600,000
Discount Rate: 7%
Number of Years Costs are Projected: 10 Years

Alternative 3 is composed of remedial alternative components SI-A and SE-A. These components include sliplining the siphon, dredging sediment with PCB concentrations above 0.043 mg/kg, annual fish removals for 5 years, downstream siphon sediment sampling for 5 years post construction, fish tissue monitoring annually for 5 years post construction and at years 7 and 9 post construction, site-wide sediment sampling 4 years post construction, routine community involvement activities for 10 years, maintenance on engineering controls, and institutional controls. Table 4-1 provides a summary of costs. Appendix A provides detailed costs by remedy component. Remedy components are discussed in further detail in the subsections below.

4.3.1 Component SI-A: Slipline Siphon

4.3.1.1 Slipline Siphon

Remedial alternative component SI-A utilizes a barrier between the interior wall of the siphon and the water that flows through it from the Main Canal to the Lower West Main Canal Unlined to isolate contaminant migration pathways. Sliplining of existing pipelines is typically used to restore the structural integrity of a pipeline and is accomplished by installing a smaller pipe into the existing pipeline. The smaller pipe is anchored into the existing pipeline by filling the void space with grout. Upon completion, the existing siphon would no longer be in contact with water that flows through the DRCS.

Prior to construction activities, work would need to be coordinated with the irrigation district. During sliplining activities, the flow of water through the siphon would have to be temporarily suspended for an estimated period of two weeks to allow construction to be performed.

However, for the purposes of cost estimation, this FS assumed a temporary bypass pump and pipeline system would be setup during construction activities so that the canal system can continue to move water from the Main Canal to the Lower West Main Canal Unlined.

In order to install the slipline into the siphon, water in the siphon would be removed and the area would be prepared for construction activity (i.e. surveyed, cleared of brush, etc.). Temporary cofferdams would be placed at the entrance and exit of the siphon (in the Main Canal and Lower West Main Canal Unlined), and the water would bypass the siphon through a series of pumps and a temporary pipeline. Centrifugal pumps or similar would be used to empty water from the siphon. Fish in the siphon at the time of dewatering would be removed and properly disposed. After emptying water from the siphon, approximately seven temporary access points would be created in areas where directional changes in the siphon occur in order to insert the slipline. Constructing these access points would involve excavation of the overlying material (e.g., soils) and demolition of the top of the siphon to expose its interior. If needed, access points near the Arroyo Colorado would require temporary diversion of the river. Cofferdams and dewatering pumps would be used to access these areas. Once the siphon is open, 20-foot lengths of 96-inch diameter fiberglass reinforced pipe and pipe joints would be pushed into the siphon. After each segment of pipe is in its final position, the annular space between the siphon and slipline would be grouted in place. Once the slipline pipes have been installed and anchored, water flow through the siphon can resume. Although the diameter of the siphon will be narrowed, the capacity of flow would not be reduced. The friction loss in a fiberglass slipline compared to a concrete pipe would compensate for the reduction of cross sectional area. The estimated length of time required for bypassing the siphon would be two weeks.

Post slipline installation activities would include backfill, grading, and vegetation of the temporary access points to prevent erosion in the area. The entire construction phase of the Slipline Siphon component is estimated to take 2 months to complete.

4.3.1.2 Downstream Siphon Sediment Sampling

Post construction sediment sampling would be completed to evaluate effectiveness of the slipline. Sediment samples would be collected directly downstream of the siphon and analyzed for PCB congeners.

4.3.2 Component SE-A: Dredging of Canal Sediment with Off-Site Disposal

4.3.2.1 Dredging and Disposal

The area of remediation for a sediment preliminary remediation goal of 0.043 mg/kg PCBs spans the width of the Lower West Main Canal Unlined approximately 4,500 feet beyond the siphon exit (an area approximately 55 feet by 4,500 feet) as shown in Figure 2-4. Approximately 20 inches of sediment would be mechanically dredged from the canal using clamshell excavation or similar equipment. A volume of approximately 20,000 cubic yards would be excavated from the canal, which accounts for approximately 6 inches of operator error during removal.

During canal sediment dredging, a temporary bridge would be installed adjacent to the existing bridge downstream of the siphon exit to allow agricultural equipment and vehicles to cross the canal during the remedial action. During the remediation of the area, the bridge can be left in place without complicating the remedy. In order to prevent migration of contamination into the water column and downstream during dredging activities, silt curtains would be installed to capture the disturbed sediment. Contaminated material would be partially dewatered on site using a series of watertight rolloffs and fractionation tanks, sediment would be stabilized and transported to an approved off-site disposal facility.

Disposal of sediment would comply with waste disposal requirements. It was assumed that the sediment would be disposed as nonhazardous waste due to low PCB concentrations. Prior to restoration of the remediation area, confirmation samples would be collected as necessary to ensure that remediation satisfies the RAOs.

During remedial action construction, the levees will be stabilized using imported material to protect against construction activity and erosion that may occur.

The estimated construction time for this remedy component is 5 months, and at no time during these activities would the canal system need to be shutdown.

4.3.2.2 Fish Removals

Fish removals would be performed to reduce the exposure pathway to human receptors. Fish removals would take place in all sections of the canal and reservoir system. Fish removals would occur by electrofishing methods. During periods where low water conditions exist at the site, fish accumulate in certain areas and could be removed using seine netting or other applicable methods. Coordination with the irrigation district would be required in order to anticipate low water conditions and plan fish removals. The fish would be collected in drums and disposed of to an off-site disposal facility. Other fish removal methods such as hoop, fyke, and pound nets could be used to supplement the removal efforts.

4.3.2.3 Fish Tissue Monitoring

Post remedial action monitoring of fish tissue concentrations would be performed to evaluate potential risks to human health and attainment of preliminary remediation goals. For example, a minimum of 10 bottom feeders and 10 predatory fish could be collected from each of the following 5 established fish collection areas:

- Main Canal – Near the Rio Grande Pump Station
- Main Canal – Near the weir and siphon entrance
- Lower West Main Canal Unlined – Near the siphon exit
- Lower West Main Canal Unlined – Near the bridge at FM 1493
- West Reservoir.

Actual sampling will be determined during the Remedial Design, targeted fish could be a minimum of 8 inches in length and processed into fillets by the laboratory for analysis of PCBs as Aroclors. Collection efforts could focus on the primary targeted species identified in the table below; however, in the event that primary targeted species are not available, secondary targeted species could be collected.

Predator Species

- Primary
  - Largemouth Bass
- Secondary
  - Smallmouth Bass
  - Alligator Gar

Bottom Feeder Species

- Primary
  - Smallmouth Buffalo
- Secondary
  - Common Carp
  - Channel Catfish.

4.3.2.4 Site-wide Sediment Sampling

A site-wide sediment sampling event would occur to evaluate remedy performance. Sediment samples collected from the DRCS would be analyzed for PCB congeners.

4.3.2.5 Community Involvement

Community involvement activities will be as described in Section 4.2.1.1.

4.3.2.6 Engineering Controls

Engineering controls include installation and maintenance of signs warning of the hazards of fish consumption.

4.3.2.7 Institutional Controls

Land-use institutional controls that provide restrictions on modifications to the siphon will be required. Land use restrictions could consist of either a restrictive covenant or a deed notice. A restrictive covenant is an instrument filed in the real property records of the county where the affected property is located, which ensures that the restrictions will be legally enforceable by the TCEQ when the person owning the property is the innocent landowner. The covenant can only be filed by the property owner and is binding on current and future owners and lessees even if they are innocent owners or operators. A deed notice is an instrument filed in the real property records of the county where the affected property is located and is intended to provide notice regarding the conditions of the affected property. The details regarding land-use restrictions will be determined during the Remedial Design or negotiated in a consent decree.

The existing aquatic life order issued by the TDSHS should remain in place until fish tissue levels are safe for human consumption.

4.4 ALTERNATIVE 4: SLIPLINE SIPHON, CANAL DREDGING, AND RESERVOIR MONITORED NATURAL RECOVERY

Estimated Time for Construction: 15 months
Estimated Time to Reach Remediation Goals: 20 years
Estimated Remedial Action Costs: $34,050,000
Estimated Post Remedial Action Costs: $3,860,000
Estimated Total Present Worth Costs: $37,900,000
Discount Rate: 7%
Number of Years Costs are Projected: 20 Years

Alternative 4 is composed of remedial alternative components SI-A and SE-B. These components include sliplining the siphon (as described in Section 4.3.1), dredging canal sediment with PCB concentrations above 0.004 mg/kg, monitored natural recovery of the reservoir to achieve the preliminary remediation goal of 0.004 mg/kg of PCBs in sediment, annual fish removals for 5 years, downstream siphon sediment sampling for 5 years post construction, fish tissue and sediment monitoring biennially for 20 years post construction, routine community involvement activities for 20 years, maintenance on engineering controls, and institutional controls. If after 20 years post construction, the fish tissue remedial goals have not been achieved, revaluation of the remedy and continued monitoring may be necessary. Table 4-1 provides a summary of costs. Appendix A provides detailed costs by remedy component. Remedy components are discussed in further detail below.

Alternatively, preliminary remediation goal of 0.003 mg/kg PCBs in sediment could also be selected for this remedy component, choosing these goals will not result in a change to the area subject to remediation or the assumptions made in the FS cost estimate.

4.4.1 Component SE-B: Dredging of Canal Sediment with Off-Site Disposal and Reservoir Monitored Natural Recovery

4.4.1.1 Dredging and Disposal

The area of remediation using dredging to achieve a sediment preliminary remediation goal of 0.004 mg/kg of PCBs includes the entire Lower West Main Canal Unlined, Lower East Main Canal, Cross Over Main Canal (an area approximately 55 feet by 29,000 feet) as shown in Figure 2-5. Approximately 20 inches of sediment would be mechanically dredged from the unlined portions of canal using clamshell excavation or similar equipment. Approximately 6 inches of sediment would be excavated and vacuumed from the lined portions of the canal. The lined canals would be drained where possible by using the existing flow control system. A total volume of approximately 71,000 cubic yards of sediment would be removed from the canals, which accounts for approximately 6 inches of operator error in the unlined portion of the canal during removal.

During canal sediment dredging, a temporary bridge would be installed adjacent to the existing bridge downstream of the siphon exit to allow agricultural equipment and vehicles to cross the

canal during the remedial action. In order to prevent migration of contamination into the water column and downstream during dredging activities, silt curtains would be installed to capture the disturbed sediment. Contaminated material would be partially dewatered on site using a series of watertight rolloffs and fractionation tanks, sediment would be stabilized and transported to an approved off-site disposal facility.

Disposal of sediment would comply with waste requirements. It was assumed that the sediment would be disposed as nonhazardous waste due to low PCB concentrations. Prior to restoration of the remediation area, confirmation samples would be collected as necessary to ensure that remediation satisfies the RAOs.

The estimated construction time for this alternative is 13 months, and at no time during these activities would the canal system need to be shutdown.

Addition of a clean sand layer may be needed in the reservoir in order to achieve the low preliminary remediation goal in sediment. The need for this sand layer cannot be evaluated with the existing RI dataset and costs have not been included in this FS. It is not anticipated that clean sand will be needed in the unlined portion of the canals because it is assumed that due to the age of unlined canal construction, the clay liner will not be impacted by PCBs.

4.4.1.2 Fish Removals

Fish removals will be as described in Section 4.3.2.2.

4.4.1.3 Fish Tissue Monitoring

Fish tissue monitoring will be as described in Section 4.3.2.3.

4.4.1.4 Monitored Natural Recovery of the Reservoir

MNR of the reservoir would include sampling sediment for PCB congeners. Costs have been included for pre-design baseline sampling of the reservoir. Baseline sampling would include collection of samples from the Northwest, West, and East Reservoirs (the area depicted as Remedial Design Confirmation Area and the Remediation Area of the East and West Reservoirs in Figure 2-5). The number of samples is based on approximately 500-foot centers at four depth intervals. Long term monitoring assumes the same sampling assumptions as the baseline sampling, however evaluation of the baseline sampling is needed to determine if the number of long term monitoring samples can be reduced. Specific details of the monitoring program would be determined during the Remedial Design.

4.4.1.5 Community Involvement

Community involvement activities will be as described in Section 4.2.1.1.

4.4.1.6 Engineering Controls

Engineering controls include installation and maintenance of signs warning of the hazards of fish consumption.

4.4.1.7 Institutional Controls

Institutional controls will be as described in Section 4.3.2.7.

4.5 ALTERNATIVE 5: SLIPLINE SIPHON, CANAL DREDGING, AND RESERVOIR DREDGING WITH SAND LAYER

Estimated Time for Design/Construction: 51 months
Estimated Time to Reach Remediation Goals: 10 years
Estimated Remedial Action Costs: $166,010,000
Estimated Post Remedial Action Costs: $1,000,000
Estimated Total Present Worth Costs: $167,000,000
Discount Rate: 7%
Number of Years Costs are Projected: 10 years

Alternative 5 is composed of remedial alternative components SI-A and SE-C. These components include sliplining the siphon (as described in Section 4.3.1), dredging canal and reservoir sediment with PCB concentrations above 0.004 mg/kg, adding a 6-inch sand layer to the reservoir, annual fish removals for 5 years, downstream siphon sediment sampling for 5 years post construction, fish tissue monitoring biennially for 10 years post construction, site-wide sediment sampling 4 years post construction, routine community involvement activities for 10 years, maintenance on engineering controls, and institutional controls. Table 4-1 provides a summary of costs. Appendix A provides detailed costs by remedy component. Remedy components are discussed in further detail below.

Alternatively, preliminary remediation goal of 0.003 mg/kg PCBs in sediment could also be selected for this remedy component, choosing these goals will not result in a change to the area subject to remediation or the assumptions made in the FS cost estimate.

4.5.1 Component SE-C: Dredging of Canal Sediment with Off-Site Disposal and Reservoir Dredging with Sand Layer

4.5.1.1 Dredging and Disposal

This remedial component includes dredging of canals as discussed in Section 4.4.1.1 and dredging of the East and West Reservoirs (Figure 2-5) as discussed below. Costs have been included for pre-design baseline sampling of the reservoir and canals extending north from this area (the area depicted as Remedial Design Confirmation Area and the Remediation Area of the East and West Reservoirs in Figure 2-5). Costs for reservoir dredging and an addition of a sand layer have only been included for the areas depicted in dark blue on Figure 2-5, the Remediation

Area (West and East Reservoirs). Adjustments to this area may be necessary based on evaluation of the pre-design reservoir and canal baseline sampling.

Remedial action in the reservoir would entail removing the top 6 inches of contaminated sediment from an approximately 350-acre area for a total volume of approximately 285,000 cubic yards. Based on the amount of sediment volume to be removed and unconsolidated nature of the reservoir sediment, hydraulic dredging would be used for removal. An in-water barrier (e.g., silt curtain) would also be installed to limit resuspension and transport of disturbed sediment outside the remediation area. Placement of a 6-inch cover of clean sand would be applied over the remaining reservoir sediment and in the unlined canals dredged as a part of this alternative following the removal activities. The placement of the cap would be achieved by a barge-mounted long reach excavator or amphibious excavation equipment. The reservoir is approximately 5 feet high and clay lined, with a concrete and rubble perimeter posing access limitations for heavy equipment. The heavy equipment to perform the dredging and capping activities would be deployed and retrieved in the reservoir using a crane lift.

Dredged sediment slurry would contain a high percentage of water. The sediment would be passively dewatered using Geotubes®, which are permeable geotextiles that allow passage of water but not particulate matter. The dewatered sediment would then be stabilized and transported offsite for disposal. The water removed from the sediment would be collected in a holding tank and sampled for PCB congeners and PCBs as Aroclors prior to discharge back to the reservoir. A staging and Geotube® dewatering area would be established on the land parcel adjacent to the reservoir.

Disposal of sediment would comply with waste requirements. It was assumed that the sediment would be disposed as nonhazardous waste due to low PCB concentrations. Prior to restoration of the remediation area, confirmation samples would be collected as necessary to ensure that remediation satisfies the RAOs.

The estimated construction time for this alternative is approximately 4 years of dredging, assuming the canal and reservoir can be performed simultaneously.

4.5.1.2 Fish Removals

Fish removals will be as described in Section 4.3.2.2.

4.5.1.3 Fish Tissue Monitoring

Fish tissue monitoring will be as described in Section 4.3.2.3.

4.5.1.4 Site-wide Sediment Sampling

A site-wide sediment sampling event would occur to evaluate remedy performance. Sediment samples collected from the DRCS would be analyzed for PCB congeners.

4.5.1.5 Community Involvement

Community involvement activities will be as described in Section 4.2.1.1.

4.5.1.6 Engineering Controls

Engineering controls include installation and maintenance of signs warning of the hazards of fish consumption.

4.5.1.7 Institutional Controls

Institutional controls will be as described in Section 4.3.2.7.

4.6 ALTERNATIVE 6: REPLACE SIPHON, CANAL DREDGING, AND FISH REMOVALS

Estimated Time for Construction: 9 months
Estimated Time to Reach Remediation Goals: 10 years
Estimated Remedial Action Costs: $18,710,000
Estimated Post Remedial Action Costs: $700,000
Estimated Total Present Worth Costs: $19,400,000
Discount Rate: 7%
Number of Years Costs are Projected: 10 years

Alternative 6 is composed of remedial alternative components SI-B and SE-A (as discussed in Section 4.3.2). These components include replacing the siphon, dredging sediment with PCB concentrations above 0.043 mg/kg, annual fish removals for 5 years, fish tissue monitoring annually for 5 years post construction and at years 7 and 9 post construction, site-wide sediment sampling 4 years after construction, routine community involvement activities for 10 years, maintenance on engineering controls, and institutional controls. Table 4-1 provides a summary of costs. Appendix A provides detailed costs split by treatment of the siphon and canal sediment. Remedy components are discussed in further detail below.

4.6.1 Component SI-B: Replace Siphon

Remedial alternative component SI-B involves the construction of a new siphon to replace the existing one. Because the irrigation canal system can only be inoperable for short periods of time, a new siphon would be constructed adjacent to the existing one. The profile of the new siphon would roughly follow the profile of the existing siphon which is displayed in Figure 1-3, and a possible location for the replacement siphon is included in Figure 4-1. Prior to siphon installation, the area would be prepared for construction activities (i.e. surveyed, cleared of brush, etc.).

The new siphon would be built using 108-inch inner diameter pre-stressed concrete pipe placed in a trench 15 to 20 feet deep. The greatest challenge to installation occurs where the new siphon

intersects the Arroyo Colorado River. The river would be temporarily diverted with cofferdams and dewatering pumps to allow for construction to be completed in this area.

In addition to a new siphon, approximately 200 feet of the north end of the Main Canal and 400 feet of the south end of the Lower West Main Canal Unlined would need to be modified in order to connect to the new siphon. The new canal segments would contain concrete lining and transition to the siphon entrance and from the siphon exit. This alternative would require the construction of a new flow control gate (i.e., weir) near the entrance of the siphon (Figure 4-1) in order control water flow into the siphon because the existing weir would no longer be in alignment with the canal system.

Once siphon construction and canal modification are complete, water can be diverted into the new siphon and the existing siphon would be dewatered and sealed to prevent exposure to human and ecological receptors. Any fish in the siphon at the time of dewatering would be removed and properly disposed. Grout would be injected from both ends of the siphon with a possibility of injection from above the alignment. The grout would have a permeability of no more than 1×10^{-6} centimeter per second.

This alternative assumes no shutdown of the existing irrigation canal is necessary to complete work. Cofferdams would be installed around the canal modification areas and a series of pumps would be used to bypass the construction area. Cost savings may be achieved if temporary shutdown is possible during construction of the new siphon.

Post siphon replacement activities would include backfill, grading, and vegetation of the temporary access points used to abandon the existing siphon. The entire construction phase of this remedy component is estimated to take 4 months to complete.

The cost to negotiate land easements or land purchase have not been included in this alternative but may be necessary.

4.7 ALTERNATIVE 7: REPLACE SIPHON, CANAL DREDGING, AND RESERVOIR MONITORED NATURAL RECOVERY

Estimated Time for Design/Construction: 17 months
Estimated Time to Reach Remediation Goals: 20 years
Estimated Remedial Action Costs: $38,350,000
Estimated Post Remedial Action Costs: $3,410,000
Estimated Total Present Worth Costs: $41,800,000
Discount Rate: 7%
Number of Years Costs are Projected: 20 years

Alternative 7 is composed of remedial alternative components SI-B and SE-B. These components include replacing the siphon (as described in Section 4.6.1), dredging canal sediment with PCB concentrations above 0.004 mg/kg, MNR of the reservoir to achieve the preliminary remediation goal of 0.004 mg/kg of PCBs in sediment, annual fish removals for

5 years, fish tissue and sediment monitoring biennially for 20 years post construction, routine community involvement activities for 20 years, maintenance on engineering controls, and institutional controls (as discussed in Section 4.4.1). Table 4-1 provides a summary of costs. Appendix A provides detailed costs by remedy component.

Alternatively, preliminary remediation goal of 0.003 mg/kg PCBs in sediment could also be selected for this remedy component, choosing these goals will not result in a change to the area subject to remediation or the assumptions made in the FS cost estimate.

4.8 ALTERNATIVE 8: REPLACE SIPHON, CANAL DREDGING, AND RESERVOIR DREDGING WITH SAND LAYER

Estimated Time for Design/Construction: 53 months
Estimated Time to Reach Remediation Goals: 10 years
Estimated Remedial Action Costs: $170,310,000
Estimated Post Remedial Action Costs: $550,000
Estimated Total Present Worth Costs: $170,900,000
Discount Rate: 7%
Number of Years Costs are Projected: 10 years

Alternative 8 is composed of remedial alternative components SI-B and SE-C. These components include replacing the siphon (as described in Section 4.6.1), dredging canal and reservoir sediment with PCB concentrations above 0.004 mg/kg, adding a 6-inch sand layer to the reservoir, annual fish removals for 5 years, fish tissue monitoring biennially for 10 years post construction, site-wide sediment sampling 4 years post construction, routine community involvement activities for 10 years, maintenance on engineering controls, and institutional controls (as described in Section 4.5.1). Table 4-1 provides a summary of costs. Appendix A provides detailed costs by remedy component.

Alternatively, preliminary remediation goal of 0.003 mg/kg PCBs in sediment could also be selected for this remedy component, choosing these goals will not result in a change to the area subject to remediation or the assumptions made in the FS cost estimate.

5. SCREENING OF REMEDIAL ALTERNATIVES

The developed alternatives were evaluated against the short- and long-term aspects of effectiveness, implementability, and cost. The purpose of screening these alternatives against the three broad criteria is to reduce the number of alternatives that will undergo a detailed analysis. This section presents a screening of remedial alternatives developed in Section 4, following protocols outlined in EPA's RI/FS guidance (EPA 1988).

5.1 SCREENING EVALUATION

The alternative screening evaluation will evaluate the developed alternatives based on the three criteria outlined below.

5.1.1 Effectiveness Evaluation

The main aspect of the effectiveness screening evaluation is to ensure the protection to human health and the environment in the short- and long-term. Short-term effectiveness refers to the construction and implementation period, while long-term effectiveness refers to the period after remedial action is complete.

Alternative 1 does not provide short- or long-term effectiveness since no measures would be taken to protect human health and the environment. Alternative 2 (Limited Action) provides protection to human health, based on the assumption that the institutional controls, engineering controls and community involvement are effective. Alternative 2 is not protective of ecological receptors. Alternatives 3 through 8 provide long-term effectiveness since the contamination at the site would be actively addressed and monitored over time.

5.1.2 Implementability Evaluation

The implementability evaluation screens the remedial alternatives with respect to conditions at the site. The screening will consider technical and administrative feasibility of constructing, operating, and maintaining a remedial action alternative.

Since no action would take place, the implementability evaluation is not applicable for Alternative 1. Alternative 2 is highly implementable as no construction is required. The alternative components addressing the siphon in Alternatives 3 and 6 are implementable.

The degree of implementability of the sediment remedial components in Alternatives 4 (Slipline Siphon, Canal Dredging, and Reservoir Monitored Natural Recovery), 5 (Slipline Siphon, Canal Dredging, and Reservoir Dredging with Sand Layer), 7 (Replace Siphon, Canal Dredging, and Reservoir Monitored Natural Recovery), and 8 (Replace Siphon, Canal Dredging, and Reservoir Dredging with Sand Layer) is linked to the selection of a sediment preliminary remediation goal of 0.004 mg/kg total PCBs or lower. Implementability issues linked to selection of a preliminary remediation goal of 0.004 mg/kg total PCBs are that RI data suggests that background PCB sources exceed 0.004 mg/kg total PCBs, the RI has not adequately delineated the horizontal or

vertical extent of PCB contamination in sediment to 0.004 mg/kg, dredge residuals may complicate the ability of achieving 0.004 mg/kg total PCBs with MNR in the reservoir, and alternatives that achieve a sediment cleanup goal of 0.004 mg/kg rely on no disturbance of the reservoir. These issues are further discussed in the subsections below.

5.1.2.1 Upgradient Sediment PCB Concentrations

Five sediment samples collected upgradient of the siphon (Arroyo Colorado River, Main Canal, or Rio Grande River) meet or exceed 0.004 mg/kg total PCBs in sediment and the 95UCL of total PCB congeners of Main Canal and Arroyo Colorado River samples both exceed 0.004 mg/kg. Concentrations of total PCB Aroclors were 0.0056, 0.0048, and 0.004 mg/kg (samples collected from the Arroyo Colorado River). Concentrations of total PCB congeners were 0.012 and 0.0077 mg/kg (Samples collected from the Arroyo Colorado River and Main Canal). The 95UCL of total PCB congeners in sediment samples collected in the Main Canal is 0.0046 mg/kg. The 95UCL of total PCB congeners in sediment samples collected in the Arroyo Colorado River is 0.010 mg/kg. Based on this in all probability, there are potential existing upstream sources exceeding the cleanup goal.

In the RI dataset, only 14 samples collected upgradient of the siphon were analyzed for PCB congeners, which all have reporting limits below 0.004 mg/kg. Fifty-one sediment samples collected upgradient of the siphon were analyzed for Aroclors, reporting limits ranged from 0.00041 to 0.076 mg/kg, with an arithmetic mean of 0.022 mg/kg (more than 5 times the proposed cleanup goal of 0.004 mg/kg). Of the 441 nondetect Aroclor analyses conducted on samples collected upgradient of the siphon (counting each Aroclor analyzed for separately, e.g., Aroclor-1254, Aroclor-1260, Aroclor-1016), only 197 had detections or reporting limits above 0.004 mg/kg. To summarize, less than half of the Remedial Investigation sediment Aroclor analyses from upgradient of the contaminant source have low enough reporting limits to determine if upgradient concentrations are below 0.004 mg/kg total PCBs. It should be noted that the nature and extent of contamination was delineated based on the sediment screening level of 0.23 mg/kg of Aroclor-1254.

5.1.2.2 Vertical Delineation of PCBs in Canal and Reservoir Sediment

Of the 127 sediment samples collected downgradient of the siphon, 93 were collected from 0 to 6 inches below surface. That means for more than 8 miles of canal and approximately 400 acres of reservoir, only 34 samples have been collected to evaluate PCB contamination at depth. Of the 278 Aroclor or total PCB congener analyses for samples greater than 6 inches in depth, 50 of the analyses do not have reporting limits low enough to evaluate whether or not the results are below 0.004 mg/kg. In summary, approximately 20 percent of the sediment samples collected at depth, downgradient of the siphon, and analyzed for PCBs do not have reporting limits low enough to evaluate the vertical extent of contamination at 0.004 mg/kg total PCBs. If it is assumed that over time the concentration of PCBs leaching out of the siphon into the system have decreased, then it is possible that the sediment at depth within the reservoir is higher in PCB concentration than the sediment at the surface of the reservoir. However, the existing

dataset is not sufficient to evaluate the vertical extent of contamination at 0.004 mg/kg total PCBs.

5.1.2.3 Horizontal Delineation of PCBs in Reservoir Sediment

Of the 167 Aroclor or total PCB congener analyses conducted on sediment from the reservoirs, 87 results fell below 0.004 mg/kg. Only 4 of the results above 0.004 mg/kg were actual detections, 76 results were nondetect and reported at the reporting limit. In summary, the limited PCB congener specific dataset and elevated reporting limits associated with sediment samples collected from the reservoirs during the Remedial Investigation result in a very small dataset available to evaluate the horizontal extent of PCB contamination at 0.004 mg/kg. Approximately 45 percent of results did not have detection limits low enough to evaluate PCB contamination at 0.004 mg/kg.

5.1.2.4 Site Soil PCB Concentrations

Soil samples collected from 10 of 41 locations meet or exceed 0.004 mg/kg total PCB Aroclors or total PCB congeners, three on the banks of the Lower West Main Canal Unlined, five from the banks of the Arroyo Colorado River, and two from Irrigation Risers in adjacent agricultural fields. PCBs in the Arroyo Colorado River exposure area are not considered to be site related. The maximum detected total PCB concentration in soil of the Arroyo Colorado was 0.013 mg/kg, more than 3 times the proposed sediment cleanup goal of 0.004 mg/kg. Concentrations of total PCB congeners in Arroyo Colorado River soil range from 0.0007 to 0.013 mg/kg, with an arithmetic average of 0.004 mg/kg. Soil with concentrations above 0.004 mg/kg may become airborne and deposited in the reservoir, and may complicate attempts to reach sediment cleanup goals of 0.004 mg/kg by serving as a residual source of contamination.

5.1.2.5 Dredge Residuals

Sediment removal, whether achieved with wet dredging or dry excavation will face substantial challenges to reach a cleanup goal of 0.004 mg/kg without a combined remedy including a residual cover. Dredging operations including both hydraulic and mechanical technologies release sediment into the water column containing contaminants. The re-suspended sediment will consist of fine particulate and colloidal materials. Even incorporating curtains in the water column to control the release and transport of suspended sediment will not be totally effective at the cleanup level of 0.004 mg/kg. Additionally, the use of dry excavation similarly creates a separate set of technical challenges to achieve this cleanup goal with operating heavy equipment on the reservoir and canal bottoms. In consideration of MNR (Alternatives 4 and 7), it should be noted that resuspension and redistribution of materials may increase concentrations of PCBs in sediment in the reservoir which may have been considered below the cleanup goal. This increase of sediment concentrations in the reservoir may result in difficulty in MNR achieving a cleanup goal of 0.004 mg/kg.

5.1.2.6 Alternatives Rely on Non-Disturbance of Reservoir Sediment

All alternatives developed to achieve a cleanup goal of 0.004 mg/kg require future non-disturbance of the reservoir. MNR of the reservoir will require time for new sediment that have been unimpacted by the siphon to be deposited. It is assumed that a cover of unimpacted sediment will develop in the reservoir that will isolate sediment with concentrations of PCBs above 0.004 mg/kg. In order for this technology to be effective, no disturbance of the sediment in the reservoir can occur. This means that the irrigation district will not be able to perform maintenance in the reservoir to maintain or increase current capacity. Based on EPA interviews of the irrigation district, dredging of the reservoir to maintain or increase capacity cannot be ruled out in the future.

5.1.3 Cost Evaluation

The cost evaluation must consider both capital and long term monitoring costs, where appropriate, during the alternatives screening process. The estimated total present value for the remedial alternatives developed in Section 4 are presented in the table below.

Estimated Total Present Value of Remedial Alternatives

Alternative	Cost[(1)]	Description of Remedy
1	$0	No Further Action
2	$1,640,000	Limited Action
3	$15,600,000	Slipline Siphon, Canal Dredging, and Fish Removals
4	$37,900,000	Slipline Siphon, Canal Dredging, and Reservoir Monitored Natural Recovery
5	$167,000,000	Slipline Siphon, Canal Dredging, and Reservoir Dredging with Sand Layer
6	$19,400,000	Replace Siphon, Canal Dredging, and Fish Removals
7	$41,800,000	Replace Siphon, Canal Dredging, and Reservoir Monitored Natural Recovery
8	$170,900,000	Replace Siphon, Canal Dredging, and Reservoir Dredging with Sand Layer

Note:
(1) Present value of capital and long-term monitoring costs

5.2 SCREENING SUMMARY

From the list of alternatives developed in Section 4, the following were selected for detailed analysis: Alternative 1 (No Further Action), Alternative 2 (Limited Action), Alternative 3 (Slipline Siphon, Canal Dredging, and Fish Removals), and Alternative 6 (Replace Siphon, Canal Dredging, and Fish Removals). Alternatives 4 (Slipline Siphon, Canal Dredging, and Reservoir Monitored Natural Recovery), 5 (Slipline Siphon, Canal Dredging, and Reservoir Dredging with Sand Layer), 7 (Replace Siphon, Canal Dredging, and Reservoir Monitored Natural Recovery), and 8 (Replace Siphon, Canal Dredging, and Reservoir Dredging with Sand Layer) were screened out for issues associated with implementability and cost. Table 5-1 provides a summary of the screening process results.

6. DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

This section presents a detailed analysis of the remedial alternatives retained in Section 5, following protocols outlined in EPA's RI/FS guidance (EPA 1988), and using the FS criteria outlined in the CERCLA, the NCP, and other relevant guidance.

6.1 EVALUATION CRITERIA

The assembled alternatives are evaluated in this section based on the nine criteria required by 40 CFR Section 300.430(e) of the NCP. As stated in EPA guidance (EPA 1988), remedial actions must accomplish the following:

- Be protective of human health and the environment
- Comply with ARARs (or provide grounds for invoking a waiver)
- Be cost effective
- Use permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable
- Evaluate the CERCLA preference for treatment that reduces toxicity, mobility, and volume as a principal element, or explain why it does not.

The nine criteria used to evaluate each alternative are listed below and are discussed in the paragraphs that follow:

- Overall protection of human health and the environment
- Compliance with ARARs
- Long-term effectiveness and permanence
- Reduction in toxicity, mobility, or volume through treatment
- Short-term effectiveness
- Implementability
- Cost
- State acceptance
- Community acceptance.

The first two criteria in the list above are referred to as the threshold criteria. The next five criteria are considered the primary balancing criteria. The final two modifying criteria (state and community acceptance) are to be evaluated by EPA following receipt of feedback from the State and community. These nine criteria are discussed in the following subsections.

6.1.1 Overall Protection of Human Health and the Environment

This criterion assesses whether each alternative provides adequate protection of human health and the environment. The overall assessment of protection considers the alternative's long-term effectiveness, permanence, short-term effectiveness, and compliance with ARARs. The evaluation of protectiveness focuses on the reduction or elimination of site risks by the proposed remedial alternative. This criterion is considered a threshold and must be met by the selected alternative.

6.1.2 Compliance with Applicable or Relevant and Appropriate Requirements

This criterion is used to evaluate whether each alternative will meet all of the federal and state ARARs identified or whether there is justification for waiving one or more ARARs. This criterion is also a threshold that must be met by the alternative selected.

ARARs for remedial action at the DRCS were presented in Section 2.4. The only ARAR discussed in this section and used to evaluate remedial alternatives is the U.S. Food and Drug Administration tolerance level for total PCBs in the edible portion of fish. The other ARARs identified in Section 2.4 are not discussed explicitly as part of the evaluating the remedial alternatives. The remedial alternatives developed in Section 4, with the exception of Alternative 1: No Further Action and Alternative 2: Limited Action, are assumed to comply with the location and action specific ARARs presented, because the required engineering design and agency review process can ensure that the selected remedy is in compliance. For example, the construction elements for the remedial alternatives are similar in nature and scope to other industrial applications (e.g., sliplining the siphon), irrigation aqueduct applications (e.g., construction of a new siphon), and sediment remediation projects (e.g., dredging). All of the alternatives can be designed and implemented in compliance with ARARs pertaining to management and disposal of generated materials (e.g., sediment, fish). Such ARARs may affect implementation but do not have a marked effect on whether a remedial alternative is fundamentally viable. Further, the remedial design phase can address the various land use and resource protection ARAR requirements (e.g., habitat preservation, mitigation).

6.1.3 Long-term Effectiveness and Permanence

Each alternative is evaluated in terms of risk that remains at the site after the RAO has been met. The primary focus of this evaluation is the extent and effectiveness of controls used to manage the risk posed by treatment residuals or untreated wastes. Long-term effectiveness is one of the balancing criteria. The following factors will be considered in evaluating this criterion:

- Adequacy of remedial controls
- Reliability of remedial controls
- Magnitude of the residual risk.

6.1.4 Reduction in Toxicity, Mobility, or Volume through Treatment

This evaluation criterion addresses the CERCLA statutory preference for treatment options that permanently and significantly reduce the toxicity, mobility, or volume of the contaminants. The preference is satisfied when treatment reduces the principal threats through the following:

- Destruction of toxic contaminants
- Reduction in contaminant mobility
- Reduction in the total mass of toxic contaminants
- Reduction in the total volume of contaminated media.

The NCP (40 CFR Section 300.430(a)(1)(iii)) states that EPA "generally shall consider the following expectations in developing appropriate remedial alternatives:

- …use treatment to address principal threats posed by a site, wherever practicable. Principal threats for which treatment is most likely to be appropriate include liquids, areas contaminated with high concentrations of toxic compounds, and highly mobile materials.

- …use engineering controls, such as containment, for waste that poses a relatively low long-term threat or where treatment is impracticable."

EPA guidance defines principal threat waste as a source material that is highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur, such as drummed waste or pools of non-aqueous phase liquids (EPA 1991). The siphon and the contaminated sediment in the DRCS are not highly toxic or highly mobile and are considered to be low level threat waste. No direct evidence of any non-aqueous phase liquids has been found at the site. The maximum detected concentration of total PCB Aroclors in sediment was 11 mg/kg, which was reported entirely as Aroclor-1254, and the maximum concentration of total PCB congeners in sediment was 6.1 mg/kg. The HHRA identified potential concerns for human health from the consumption of fish within the DRCS (the maximum recreational user cancer risk is 2×10^{-4} for all fish species, the maximum recreational user non-cancer hazard is 23 for all fish species). Direct contact with other potentially affected media (i.e., soil, surface water, and sediment) does not reveal potential unacceptable human health concerns above EPA's acceptable risk range (10^{-4} to 10^{-6}) for cancer or systemic (non-cancer) effects.

6.1.5 Short-term Effectiveness

This evaluation criterion addresses the effects of the alternative during the construction and implementation phase until the RAO is met. Under this criterion, alternatives are evaluated for their effects on human health and the environment during implementation of the remedial action. The following factors will be considered:

- Exposure of the community during implementation
- Exposure of workers during construction
- Environmental impacts
- Time to achieve RAOs
- Sustainability.

The Green Remediation Evaluation Matrix (GREM) (California Environmental Protection Agency 2009) is a simple tool used to qualitatively compare the sustainability of treatment alternatives. It evaluates potential impacts to environmental stressors considering multiple remediation options and provides a means of rating or ranking the asperity or importance of the impacts. Also, it accounts for social, economic, and environmental impacts that occur during the remediation. The GREM is populated by the environmental impacts associated with biological, chemical and/or physical stress factors, and provides a framework for qualitative comparison of multiple remediation options. This simple framework allows for a relative comparison of remedial alternatives to evaluate sustainability and environmental impacts. Higher scores generally reflect more of an environmentally-friendly/sustainable alternative. The GREM for the applicable remedial alternatives are presented in Appendix B.

6.1.6 Implementability

This criterion addresses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials that may be required during its implementation. The following factors were considered:

- Ability to construct the technology
- Monitoring requirements
- Availability of equipment and specialists
- Ability to obtain approvals from regulatory agencies.

6.1.7 Cost

Generally, the cost for each alternative is calculated from estimates of capital, and operation and maintenance costs. Capital costs consist of direct and indirect costs. Direct costs include the purchase of equipment, labor, and materials necessary to implement the alternative. Indirect costs include engineering, financial, and other services such as testing and monitoring. Annual operation and maintenance costs for each alternative include operating labor, maintenance materials and labor, auxiliary materials, and energy.

A cost estimate in a CERCLA FS is normally expected to fall within the range of 30 percent below to 50 percent above the actual project cost (accuracy of minus 30 percent and plus 50 percent) (EPA 2000a). The FS should indicate when it is not realistic to achieve this degree of accuracy based on existing data collected during the RI (EPA 1988).

6.1.8 State and Community Acceptance

These two criteria evaluate the issues and concerns of the state and community regarding each alternative. These criteria cannot be evaluated until the state and community have reviewed and commented on the alternatives.

6.2 ALTERNATIVE 1: NO FURTHER ACTION

6.2.1 Overall Protection of Human Health and the Environment

Alternative 1, the NFA alternative, takes no measures to protect human health and the environment. The siphon would continue to act as the primary source of contamination which poses an unacceptable risk to human health and ecological receptors. Ecological receptors would continue to be exposed to contaminated sediment in the canal system and the fish would continue to pose an unacceptable risk to human receptors.

6.2.2 Compliance with Applicable or Relevant and Appropriate Requirements

This criterion is used to evaluate whether each alternative will meet all of the federal and state ARARs identified or whether there is justification for waiving one or more ARARs. This criterion is also a threshold that must be met by the alternative selected. Alternative 1 will not meet the U.S. Food and Drug Administration PCB tolerance level for PCB concentrations in fish.

6.2.3 Long-term Effectiveness and Permanence

The NFA alternative would not provide long-term effectiveness and permanence. The siphon would continue to release source contamination that would be deposited in sediment. The ecological receptors interacting with the sediment would continue to bioaccumulate the contaminants deposited in the sediment. The long-term effectiveness and permanence of Alternative 1 is low because the source material would continue to deposit contaminants in the downstream sediment until the contaminants in the source material is depleted.

6.2.4 Reduction in Toxicity, Mobility, or Volume through Treatment

The NFA alternative does not reduce the toxicity, mobility, or volume of contamination in the siphon or the sediment through treatment.

6.2.5 Short-term Effectiveness

The NFA alternative would not increase short-term risk to the community, workers, or the environment since no action would occur.

6.2.6 Implementability

Implementability is not applicable to Alternative 1 since no action would be taken.

6.2.7 Cost

There are no costs associated with Alternative 1.

6.2.8 State and Community Acceptance

These criteria cannot be evaluated until the state and community have reviewed and commented on the alternatives.

6.3 ALTERNATIVE 2: LIMITED ACTION

6.3.1 Overall Protection of Human Health and the Environment

The implementation of Alternative 2 would do little to minimize the unacceptable risk to human health and take no action in protecting the environment. Engineering controls in the form of signs and community involvement would only warn the public of the dangers of fish consumption and may not be effective. There is a low overall protection to human health and no protection to the environment for Alternative 2.

6.3.2 Compliance with Applicable or Relevant and Appropriate Requirements

This criterion is used to evaluate whether each alternative will meet all of the federal and state ARARs identified or whether there is justification for waiving one or more ARARs. This criterion is also a threshold that must be met by the alternative selected. Alternative 2 would meet ARARs. As discussed in Section 2.4.1.1, the only chemical specific ARAR identified is the U.S. Food and Drug Administration tolerance level for total PCBs in the edible portion of fish and shellfish (21 CFR Section 109.30(a)(7)). Assuming the institutional controls, engineering controls, and community involvement campaigns are effective at preventing consumption of fish, this ARAR will be met.

6.3.3 Long-term Effectiveness and Permanence

Alternative 2 would not provide long-term effectiveness and permanence since the siphon would continue to release source contamination that would be deposited in sediment. The ecological receptors interacting with the sediment would continue to bioaccumulate the contaminants deposited in the sediment and therefore this alternative is not effective for ecological receptors. The long-term effectiveness and permanence of Alternative 2 is low because the source material would continue to deposit contaminants in the downstream sediment until the contaminants in the source material is depleted. It is also likely that the institutional controls, engineering controls, and community involvement will not be successful at preventing fish consumption of fish collected from the canal and reservoir system. Past institutional controls and engineering controls (i.e., signs) at the site have not been effective; therefore the effectiveness for this alternative is questionable.

6.3.4 Reduction in Toxicity, Mobility, or Volume through Treatment

Alternative 2 does not reduce the toxicity, mobility, or volume of contamination in the siphon or the sediment through treatment.

6.3.5 Short-term Effectiveness

The only short-term risk in Alternative 2 is the carbon footprint associated with installation of signs and travel for the community involvement representatives.

6.3.6 Implementability

Alternative 2 is highly implementable as no construction is required.

6.3.7 Cost

The estimated total present worth cost for Alternative 2 is $1,640,000.

6.3.8 State and Community Acceptance

These criteria cannot be evaluated until the state and community have reviewed and commented on the alternatives.

6.4 ALTERNATIVE 3: SLIPLINE SIPHON, CANAL DREDGING, AND FISH REMOVALS

6.4.1 Overall Protection of Human Health and the Environment

The implementation of Alternative 3 would minimize the unacceptable risk to human health and ecological receptors. The slipline in the siphon would act as a barrier between the source of contamination and migration pathways into the DRCS. Leaving the siphon in place is not anticipated to be a source of contamination to the Arroyo Colorado River based on analytical data collected during the RI. Soil and sediment samples collected from the Arroyo Colorado River and adjacent to the river indicate that Aroclor-1260 and total PCB congener concentrations upgradient of the siphon are higher than those downgradient of the siphon, which suggests that the siphon is not a source of PCBs to the Arroyo Colorado. Note Aroclor-1254 was not detected in any of the soil or sediment samples from the Arroyo Colorado River. PCBs are hydrophobic and therefore bind to sediment as further discussed in the RI report. Therefore, the siphon is not anticipated to cause future issues to ground water. Monitor wells were installed during the RI and samples were collected to evaluate PCBs in ground water, no unacceptable risk was found.

The canal would be dredged to remove sediment concentrations above 0.043 mg/kg total PCBs, this will reduce the risk to benthic invertebrates. Reductions in fish tissue and mollusk PCB concentrations will occur naturally once the sources of contamination are contained (slipling of the siphon) or removed (dredging of sediment), this will reduce the risk to humans, piscivorous birds and mammals, and aquatic carnivorous mammals. While reductions in fish tissue will

occur naturally, annual fish removals would reduce unacceptable risk to human receptors faster than if no fish removals will occur. Alternative 3 is protective of human health and the environment.

An analysis of the PCB concentrations in remaining sediment across the reservoir and canal system, after removal of the sediment locations that exceed a preliminary remediation goal of 0.043 mg/kg, results in an overall 95UCL of 0.00276 mg/kg total PCBs in sediment. This number is below the calculated sediment preliminary remediation goals based on, 1) a 10^{-5} adult recreational fisher cancer risk level (0.004 mg/kg), 2) an Aroclor-1254 child recreational fisher non-cancer HI of 1 (0.003 mg/kg), and 3) a 10^{-4} subsistence fisher cancer risk level (0.010 mg/kg). Therefore, removal of sediment greater than 0.043 mg/kg should result in fish tissue concentrations that will be protective of recreational fishers below a 10^{-5} cancer risk level and an Aroclor-1254 non-cancer HI of 1, and will be protective of subsistence fishers below a 10^{-4} cancer risk level. Non-cancer hazards to subsistence fishers should be reduced.

6.4.2 Compliance with Applicable or Relevant and Appropriate Requirements

This criterion is used to evaluate whether each alternative will meet all of the federal and state ARARs identified or whether there is justification for waiving one or more ARARs. This criterion is also a threshold that must be met by the alternative selected. It is anticipated that Alternative 3 would meet ARARs, specifically the U.S. Food and Drug Administration PCB fish tolerance level.

6.4.3 Long-term Effectiveness and Permanence

Alternative 3 provides long-term effectiveness and permanence. The installation of the slipline would satisfy the criteria of long-term effectiveness because the slipline would act as a permanently installed barrier and prevent contaminant migration out of the source material. Sediment dredging and annual fish removals would eliminate residual contamination from the system. Barring a catastrophic failure of the slipline, Alternative 3 should provide long-term effectiveness and permanence at a high level. Evaluation of fish tissue concentrations over time will be necessary to verify long term effectiveness.

6.4.4 Reduction in Toxicity, Mobility, or Volume through Treatment

Alternative 3 does not reduce the toxicity, mobility, or volume of contamination through treatment. Although the slipline would reduce the mobility through the means of a barrier and sediment dredging would reduce volume by removing material from the site, these methods are not considered treatment.

6.4.5 Short-term Effectiveness

Short term risks are elevated in Alternative 3. The community is affected by an increase in traffic caused by the transportation of equipment and material. The local agricultural industry may be affected by limited road access near remedial action construction areas. Costs have been included for a temporary bridge to facilitate agricultural traffic over the canal during remedial

activities, however access to fields located directly adjacent to the canal segment at the exit of the siphon may be impeded. Additionally, dust may be produced during construction and transportation activities, but can be mitigated through standard construction practices. Environmental impacts associated with construction around the siphon include the effects of diverting/dewatering the Arroyo Colorado and the siphon. Environmental impacts associated with dredging the canal and fish removal include reducing the population of benthic organisms and fish. Although silt curtains would be used, dredging the canal would also disturb sediment which could increase exposure to downstream ecological receptors. Additionally, air emissions from heavy equipment and vehicles would contribute to negative impacts to the environment. The sustainability GREM score for this alternative was 6.9. The estimated construction time for this alternative is approximately 7 months.

6.4.6 Implementability

The feasibility of implementing Alternative 3 is dependent on which season construction takes place. During periods of high water demand, sliplining may be more difficult to implement because water would be pumped at a higher flowrate to bypass the siphon. A higher flowrate in the canal would also result in an increase in the level of suspended sediment when the material is disturbed during dredging. Implementing fish removal is feasible because this field activity in these areas have been previously performed. Equipment and specialists are available for all components of Alternative 3. If construction activity takes place during periods of low water demand, the implementability of Alternative 3 becomes much higher. Coordination with the irrigation district would be necessary prior to remedial action.

6.4.7 Cost

The estimated total present worth cost for Alternative 3 is $15,600,000.

6.4.8 State and Community Acceptance

The State, through TCEQ, has commented that "…under TRRP [Texas Risk Reduction Program], chemicals representing a risk greater than the individual chemical target risk of l.0E-05 (based on the appropriate receptor considering the land use classification under TRRP (see §350.53)) warrant a response."

The community has not had the opportunity to review and comment on the alternatives at this time.

6.5 ALTERNATIVE 6: REPLACE SIPHON, CANAL DREDGING, AND FISH REMOVALS

6.5.1 Overall Protection of Human Health and the Environment

The implementation of Alternative 6 would minimize the unacceptable risk to human health and ecological receptors. Replacing the siphon would eliminate the migration pathway from source material by bypassing the source of contamination. As discussed in Section 6.4.1, leaving the

siphon in place is not anticipated to be a source of contamination to the Arroyo Colorado River based on analytical data collected during the RI. The canal would be dredged to remove sediment with concentrations above 0.043 mg/kg total PCBs, which will reduce the risk to benthic invertebrates. Reductions in fish tissue and mollusk PCB concentrations will occur naturally once the sources of contamination are removed, this will reduce the risk to humans, piscivorous birds and mammals, and aquatic carnivorous mammals. While reductions in fish tissue will occur naturally, annual fish removals would reduce unacceptable risk to human receptors faster than if no fish removals will occur. Alternative 6 is protective of human health and the environment.

An analysis of the PCB concentrations in remaining sediment across the reservoir and canal system, after removal of the sediment locations that exceed a preliminary remediation goal of 0.043 mg/kg, results in an overall 95UCL of 0.00276 mg/kg total PCBs in sediment. This number is below the calculated sediment preliminary remediation goals based on, 1) a 10^{-5} adult recreational fisher cancer risk level (0.004 mg/kg), 2) an Aroclor-1254 child recreational fisher non-cancer HI of 1 (0.003 mg/kg), and 3) a 10^{-4} subsistence fisher cancer risk level (0.010 mg/kg). Therefore, removal of sediment greater than 0.043 mg/kg should result in fish tissue concentrations that will be protective of recreational fishers below a 10^{-5} cancer risk level and an Aroclor-1254 non-cancer HI of 1, and will be protective of subsistence fishers below a 10^{-4} cancer risk level. Non-cancer hazards to subsistence fishers should be reduced.

6.5.2 Compliance with Applicable or Relevant and Appropriate Requirements

This criterion is used to evaluate whether each alternative will meet all of the federal and state ARARs identified or whether there is justification for waiving one or more ARARs. This criterion is also a threshold that must be met by the alternative selected. It is anticipated that Alternative 6 would meet ARARs, specifically the U.S. Food and Drug Administration PCB fish tolerance level.

6.5.3 Long-term Effectiveness and Permanence

Alternative 6 provides long-term effectiveness and permanence. The installation of a new siphon would satisfy the criteria of long-term effectiveness because the pathway of contaminated material to ecological and human receptors is eliminated. Sediment dredging and annual fish removals would eliminate the residual contamination from the system. Alternative 6 should provide long-term effectiveness and permanence at a high level. Evaluation of fish tissue concentrations over time will be necessary to verify long term effectiveness.

6.5.4 Reduction in Toxicity, Mobility, or Volume through Treatment

Alternative 6 does not reduce the toxicity, mobility, or volume of contamination through treatment. Although the new siphon would reduce the mobility by bypassing the source, the existing siphon would remain in place. Sediment dredging would reduce volume by removing material from the site. These methods are not considered treatment.

6.5.5 Short-term Effectiveness

Short-term risks are elevated in Alternative 6. The community is affected by an increase in traffic caused by the transportation of equipment and material. The local agricultural industry may be effected by limited road access near remedial action construction areas. Costs have been included for a temporary bridge to facilitate agricultural traffic over the canal during remedial activities, however access to fields located directly adjacent to the canal segment at the exit of the siphon may be impeded. Additionally, dust may be produced during construction and transportation activities, but can be mitigated through standard construction practices. Environmental impacts associated with the construction of the new siphon include the effects of diverting/dewatering the Arroyo Colorado. Environmental impacts associated with dredging the canal and fish removal include reducing the population of benthic organisms and fish. Although silt curtains would be used, dredging the canal would also disturb sediment which could increase exposure to downstream ecological receptors. Additionally, air emissions from heavy equipment and vehicles would contribute to negative impacts to the environment. The sustainability GREM score for this alternative was 5.9. The estimated construction time for this alternative is approximately 9 months.

6.5.6 Implementability

The feasibility of implementing Alternative 6 is dependent on the season in which construction takes place. During periods of high water demand, construction may be more difficult when installing the new weir and transitioning water flow to the new siphon. The new siphon would also require property access or land purchase in the areas where the new siphon and canal segments would be installed. A higher flowrate in the canal would increase the level of suspended sediment when the material is disturbed during dredging. Implementing fish removal is feasible because this field activity in these areas have been previously performed. Equipment and specialists are available for all components of Alternative 6. If construction activity takes place during periods of low water demand, implementability of Alternative 6 becomes much higher. Coordination with the irrigation district would be necessary prior to construction.

6.5.7 Cost

The estimated total present worth cost for Alternative 6 is $19,400,000. The cost to negotiate land easements or land purchase have not been included in this alternative but may be necessary.

6.5.8 State and Community Acceptance

The State, through TCEQ, has commented that "…under TRRP, chemicals representing a risk greater than the individual chemical target risk of l.0E-05 (based on the appropriate receptor considering the land use classification under TRRP (see §350.53)) warrant a response."

The community has not had the opportunity to review and comment on the alternatives at this time.

7. COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

A comparative evaluation of the remedial alternatives was conducted for each of the evaluation criteria. Table 7-1 presents a comparison of alternatives in each evaluation criteria. The following alternatives were compared:

- Alternative 1: No Further Action
- Alternative 2: Limited Action
- Alternative 3: Slipline Siphon, Canal Dredging, and Fish Removals
- Alternative 6: Replace Siphon, Canal Dredging, and Fish Removals.

The relative ranking of these alternatives is summarized below.

7.1 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The NFA alternative ranks lowest in this evaluation criteria followed by Alternative 2 (Limited Action) because they do not ensure protection of human health or the environment and chemicals exceeding preliminary remediation goals would remain on-site. Alternative 2 would provide limited protection to human health with institutional and engineering controls implemented at the site.

Alternative 3 (Slipline Siphon, Canal Dredging, and Fish Removals) and Alternative 6 (Replace Siphon, Canal Dredging, and Fish Removals) provide a high level of protection to human health and the environment since contamination above the preliminary remediation level would be actively addressed during the remedial action.

7.2 COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

It is anticipated that ARARs would be met by Alternatives 2, 3 and 6. Alternative 1 would not meet the U.S. Food and Drug Administration tolerance level for PCBs in fish.

7.3 LONG-TERM EFFECTIVENESS

The NFA alternative ranks lowest in this evaluation criteria followed by Alternative 2 because they do not provide long-term effectiveness as there is no active remediation to the contaminants at the site. Source material would continue to deposit contaminants in the downstream sediment until the contaminants in the source material is depleted.

Alternative 3 (Slipline Siphon, Canal Dredging, and Fish Removals) and Alternative 6 (Replace Siphon, Canal Dredging, and Fish Removals) would provide a high level of long term effectiveness because contaminated sediment and fish would be removed from the site. Additionally, the source of contamination would either be isolated or bypassed which would block the migration pathway to human and ecological receptors.

7.4 REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT

Although none of the alternatives are *in situ* treatment technologies, Alternatives 3 and 6 reduce mobility and volume of contaminants at the site. Alternative 3 (Slipline Siphon, Canal Dredging, and Fish Removals) and Alternative 6 (Replace Siphon, Canal Dredging, and Fish Removals) would reduce the volume of contaminated sediment and effectively reduce the mobility of source contamination at the site. The NFA alternative and Alternative 2 do not provide any reduction in toxicity, mobility, or volume, therefore are ranked lowest out of the alternatives.

7.5 SHORT-TERM EFFECTIVENESS

No activity is performed under the NFA alternative, therefore it poses no additional short-term threat to the community. Alternative 2 provides minimal short-term risk to the community in terms of the carbon footprint associated with community involvement and engineering controls implemented at the site.

The largest factor when evaluating short term effectiveness is the length of time it would take to perform construction activities. The construction time has a direct correlation to risks associated with construction and transportation activities as well as the carbon footprint. Alternative 6 (Replace Siphon, Canal Dredging, and Fish Removals) is ranked the lowest because it requires an estimated 9 months to implement and has a sustainability GREM score of 5.9. Alternative 3 (Slipline Siphon, Canal Dredging, and Fish Removals) requires an estimated 7 months to implement and has a sustainability GREM score of 6.9.

7.6 IMPLEMENTABILITY

Alternative 2 has the highest implementability due to the absence of a construction component. The implementability evaluation criteria is highest when complication of construction is the lowest. Complexities in construction include the possible purchase of land for the new siphon, coordination with the irrigation district for sediment dredging, seasonal construction, and length of construction time. Alternative 6 (Replace Siphon, Canal Dredging, and Fish Removals) ranks the lowest in this evaluation because it contains the most significant and numerous amount of complexities and requires approximately 9 months of construction. Alternative 3 (Slipline Siphon, Canal Dredging, and Fish Removals) ranks higher than Alternative 6 because it would require approximately 7 months of construction time and does not require the potential purchase of land.

7.7 COST

Cost estimates summaries are provided in the comparative analysis of the remedial alternatives presented in Table 7-1 and the Executive Summary. Additionally, detailed cost estimates for alternative components are presented in Appendix A. Selection of the remedial alternative is not solely based on cost. However cost can be used to select between alternatives that perform favorably when comparing the other criteria.

8. REMEDY PERFORMANCE

In the event EPA selects a remedy that results in hazardous substances remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review will need to be conducted pursuant to 40 CFR § 300.430(f)(4)(ii) within 5 years after initiation of the remedial action to ensure that the remedy is, or will be, protective of human health and the environment. All alternatives presented in this FS will result in hazardous substances remaining on-site above levels that allow for unlimited use and unrestricted exposure. During statutory reviews, EPA will evaluate monitoring data collected prior to the review period and assess the effectiveness of the remedy. In the event that EPA determines that the RAOs are not being met or the remedy is no longer protective, the remedy will be reevaluated and an Explanation of Significant Differences document or Record of Decision Amendment may be required.

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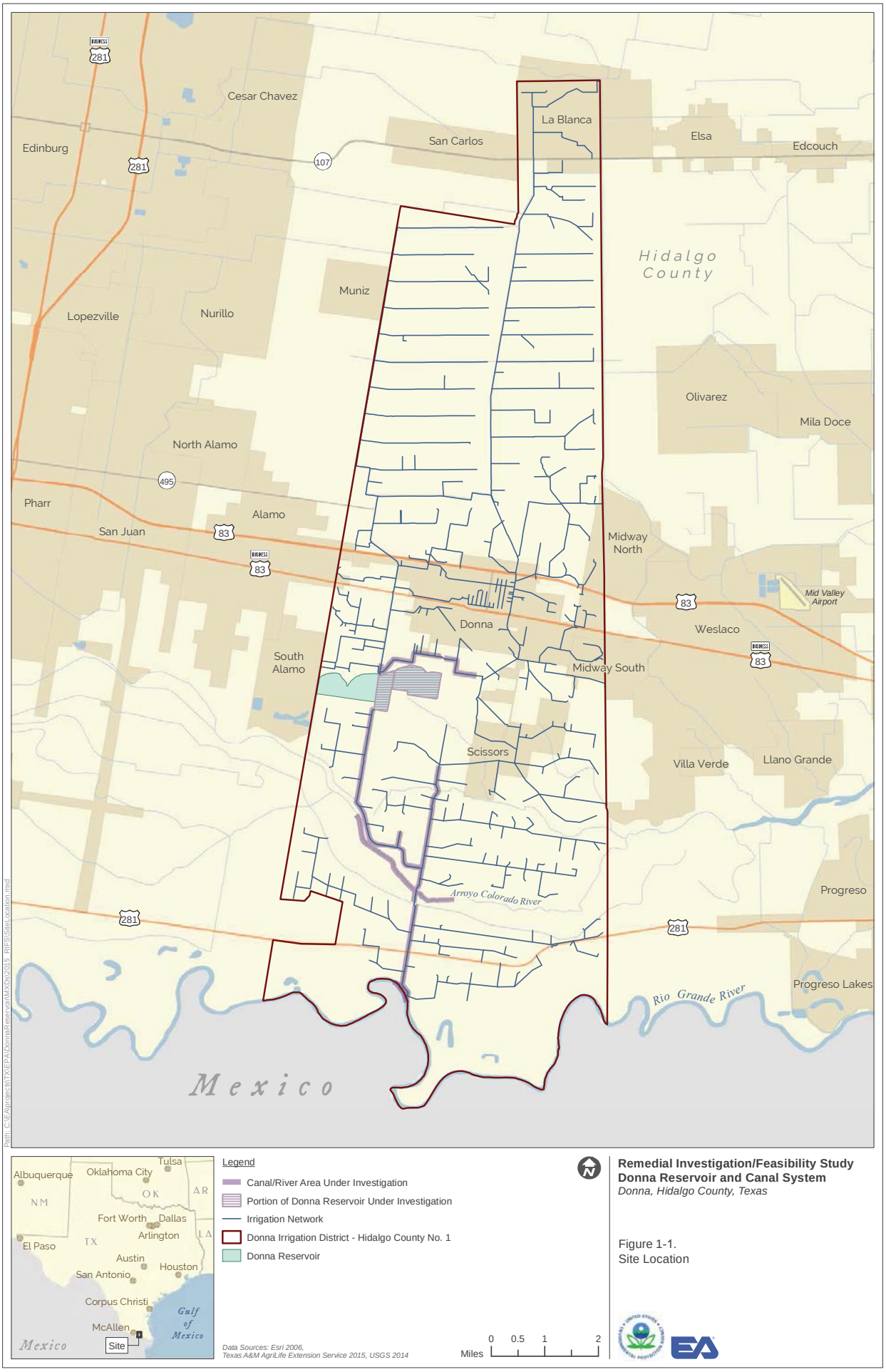
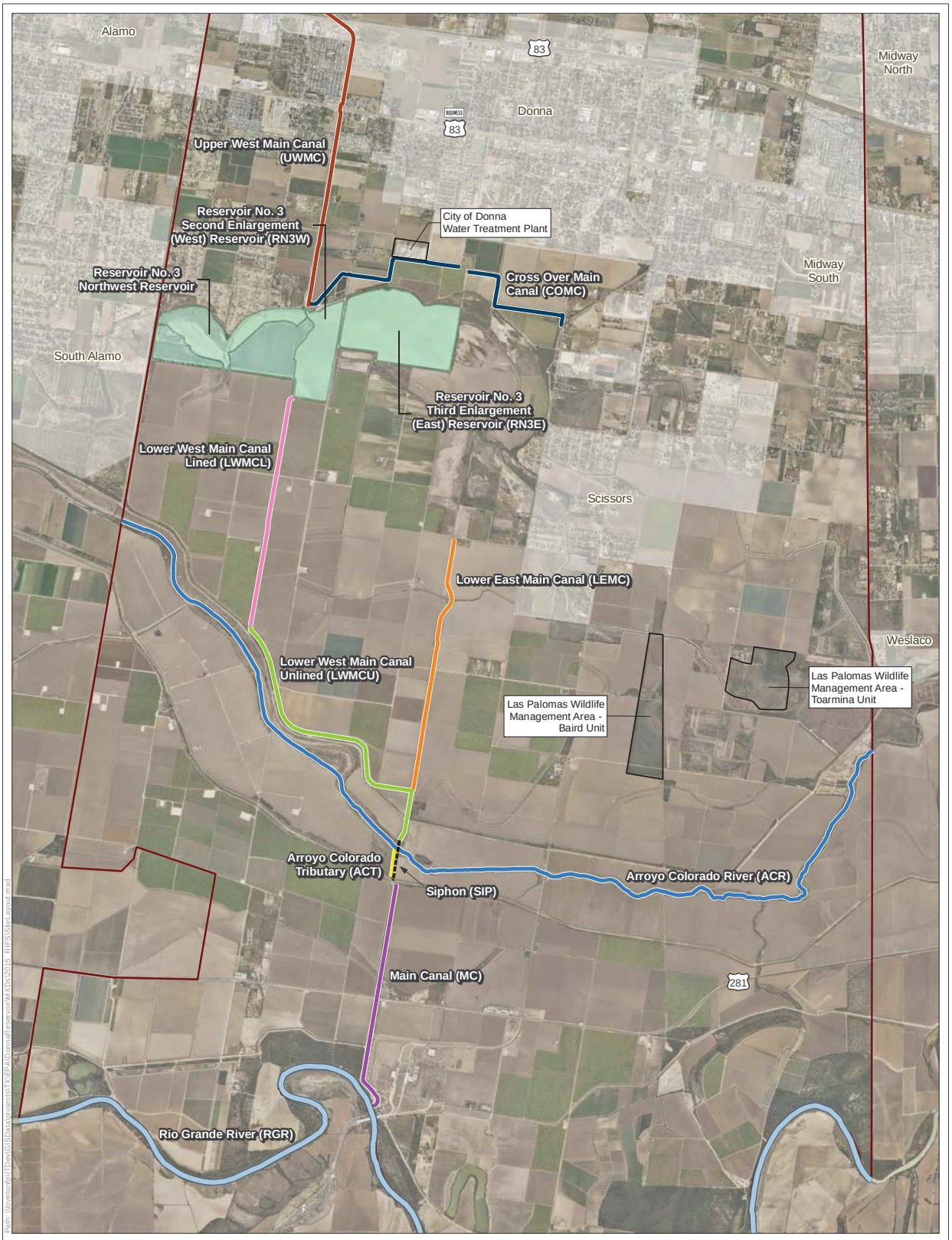
Zapata, N. 2016. Email to Casanova, R. of the U.S. Environmental Protection Agency. 30 May.

Figures


Cesar Chavez
Edinburg
La Blanca
San Carlos
Elsa
Edcouch
Hidalgo County
Muniz
Lopezville
Nurillo
Olivarez
Mila Doce
North Alamo
Pharr
Alamo
San Juan
Midway North
Mid Valley Airport
Donna
Weslaco
South Alamo
Midway South
Scissors
Villa Verde
Llano Grande
Arroyo Colorado River
Progreso
Progreso Lakes
Rio Grande River
Mexico
281
107
495
83
Albuquerque
Oklahoma City
Tulsa
NM
OK
AR
Fort Worth
Dallas
Arlington
TX
LA
El Paso
Austin
Houston
San Antonio
Corpus Christi
McAllen
Gulf of Mexico
Site
Legend
Canal/River Area Under Investigation
Portion of Donna Reservoir Under Investigation
Irrigation Network
Donna Irrigation District - Hidalgo County No. 1
Donna Reservoir
Data Sources: Esri 2006,
Texas A&M AgriLife Extension Service 2015, USGS 2014
0 0.5 1 2
Miles
Remedial Investigation/Feasibility Study
Donna Reservoir and Canal System
Donna, Hidalgo County, Texas
Figure 1-1.
Site Location

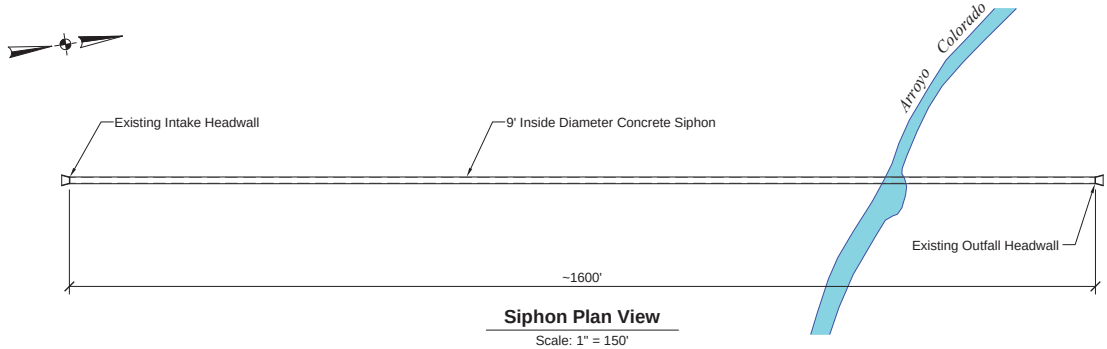
099904



Remedial Investigation/Feasibility Study
Donna Reservoir and Canal System
Donna, Hidalgo County, Texas

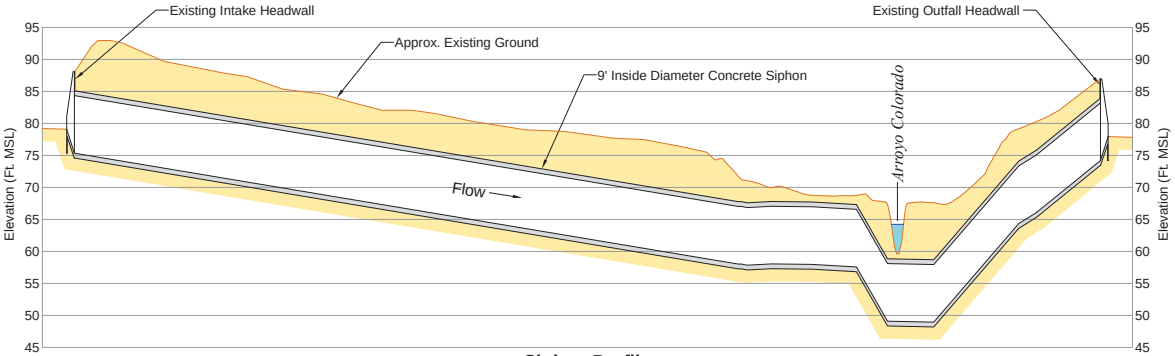
Figure 1-2.
Site Layout

099905



Siphon Plan View

Scale: 1" = 150'

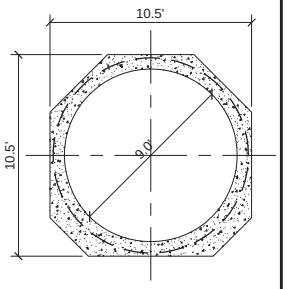


Siphon Profile

Scale: 1" = 150' Horiz.; 1" = 15' Vert.
(10X Vertical Exaggeration)

Siphon Profile

Scale: 1" = 150' Vert. & Horiz.
(No Vertical Exaggeration)



Typical Siphon Section

Scale: 1" = 5'

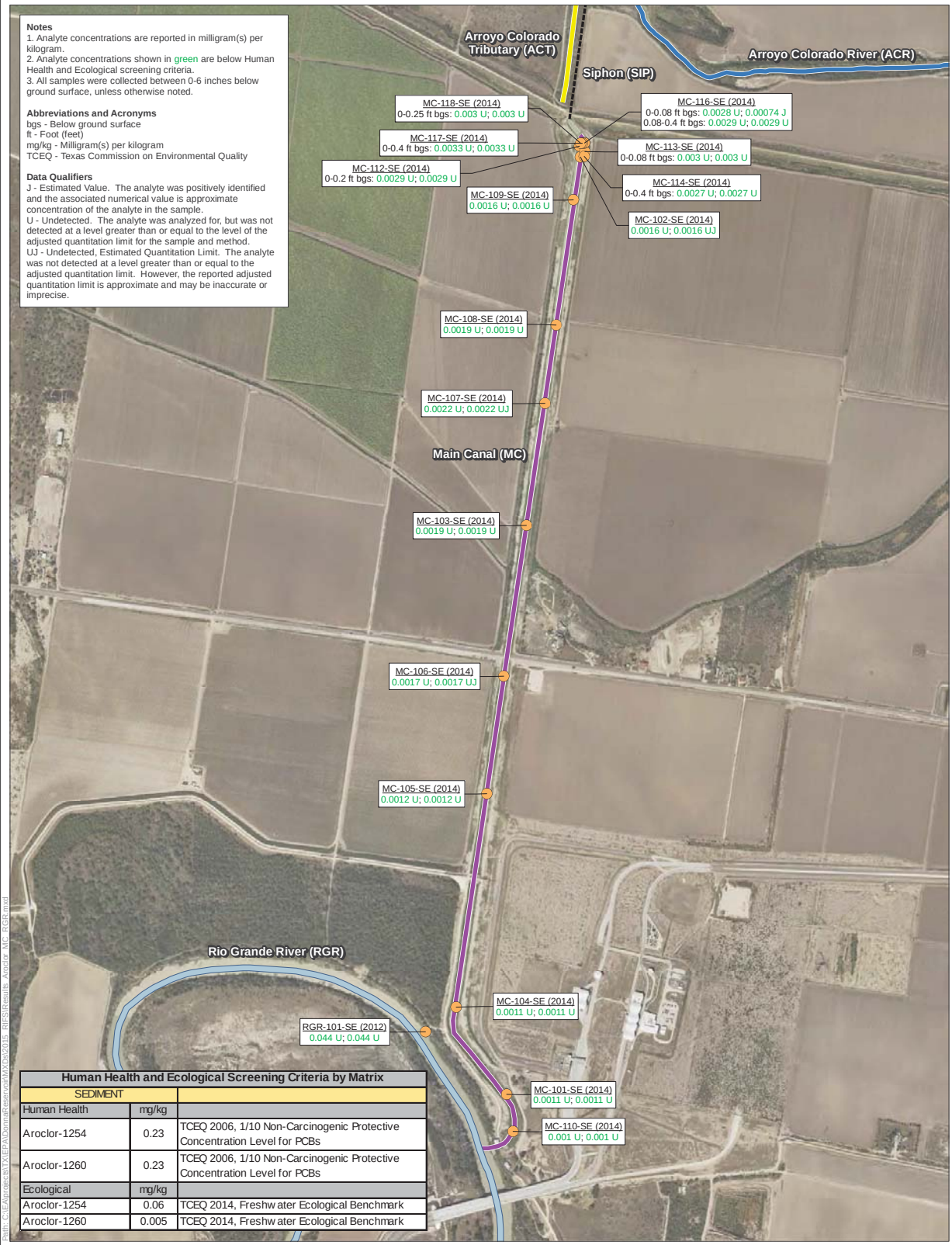
Note:
This figure has been adopted from:
URS Corporation. 2006. *Feasibility Study Report, Donna Reservoir and Canal System, Donna Hidalgo County, Texas.* Prepared for the Texas Commission on Environmental Quality. June.

The siphon plan, profile, and sections shown on this drawing are based on historic siphon drawings from the report *Inverted Siphon Inspection by Remotely Operated Vehicle* (ASI Marine, 2001), and from construction plans entitled *Rehabilitation of Irrigation Facilities - First Lift Main Canal* prepared by Sigler, Clark & Associates, Weslaco, Texas and dated July 1961. The accuracy of the historic siphon drawings has not been verified and all information is approximate and should not be used for design purposes.

Remedial Investigation/Feasibility Study
Donna Reservoir and Canal System
Donna, Hidalgo County, Texas

Figure 1-3
Existing Siphon
Plan, Profile, and Sections

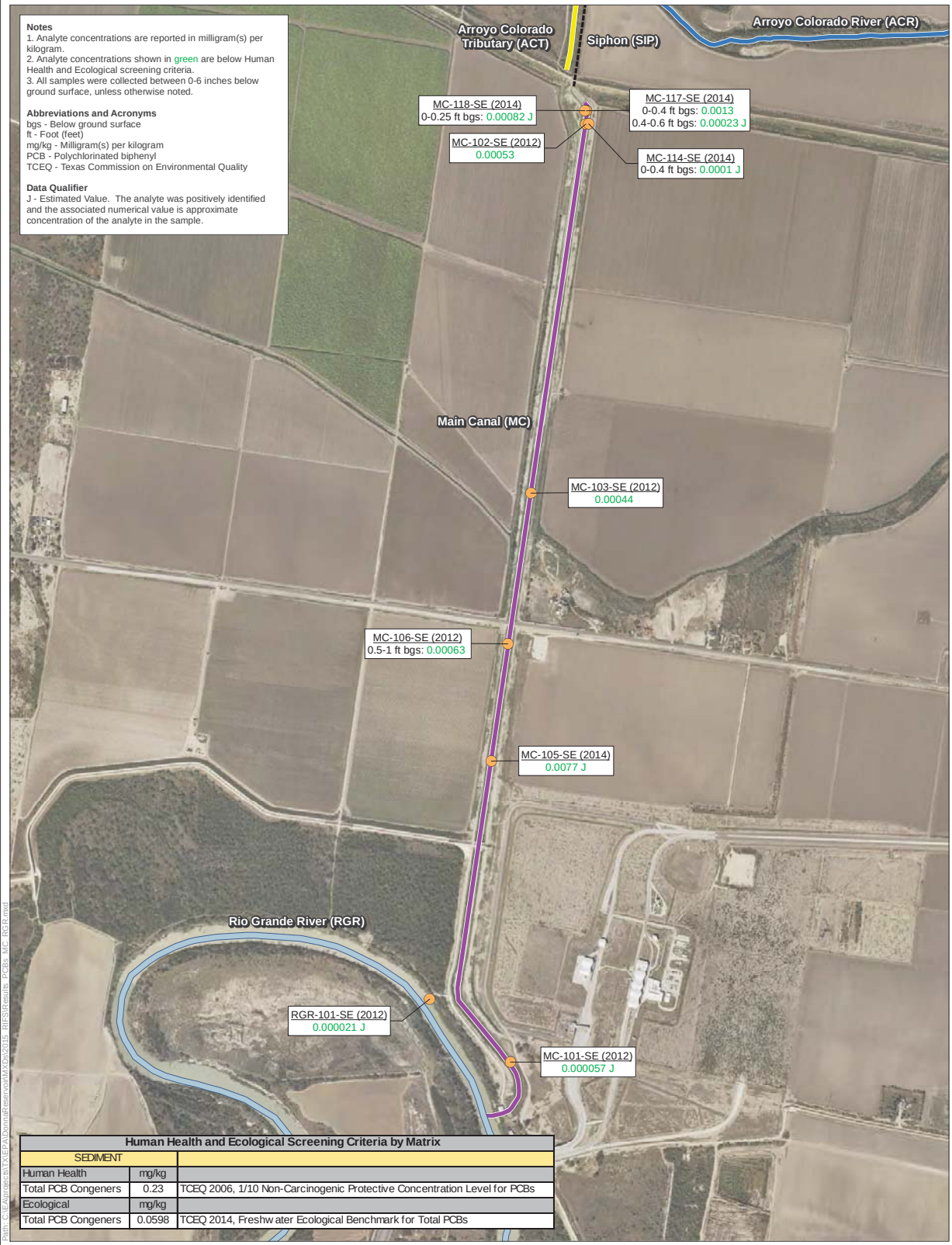
099906



Remedial Investigation/Feasibility Study
Donna Reservoir and Canal System
Donna, Hidalgo County, Texas

Figure 1-4.
Concentrations of Aroclor-1254 and Aroclor-1260 in Sediment in the Main Canal and Rio Grande River

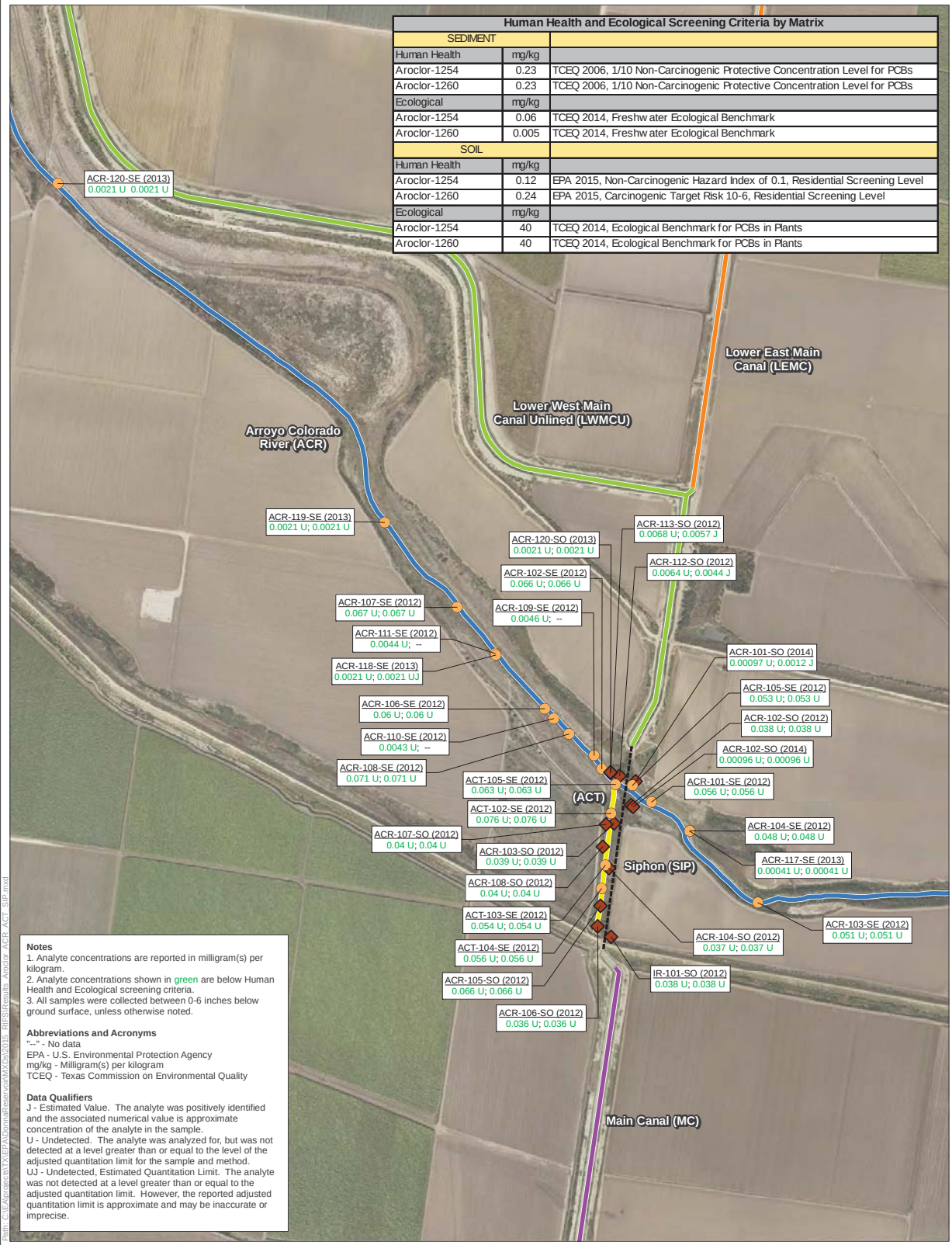
099907



Remedial Investigation/Feasibility Study
Donna Reservoir and Canal System
Donna, Hidalgo County, Texas

Figure 1-5.
Concentrations of Total Polychlorinated Biphenyl Congeners in Sediment in the Main Canal and Rio Grande River

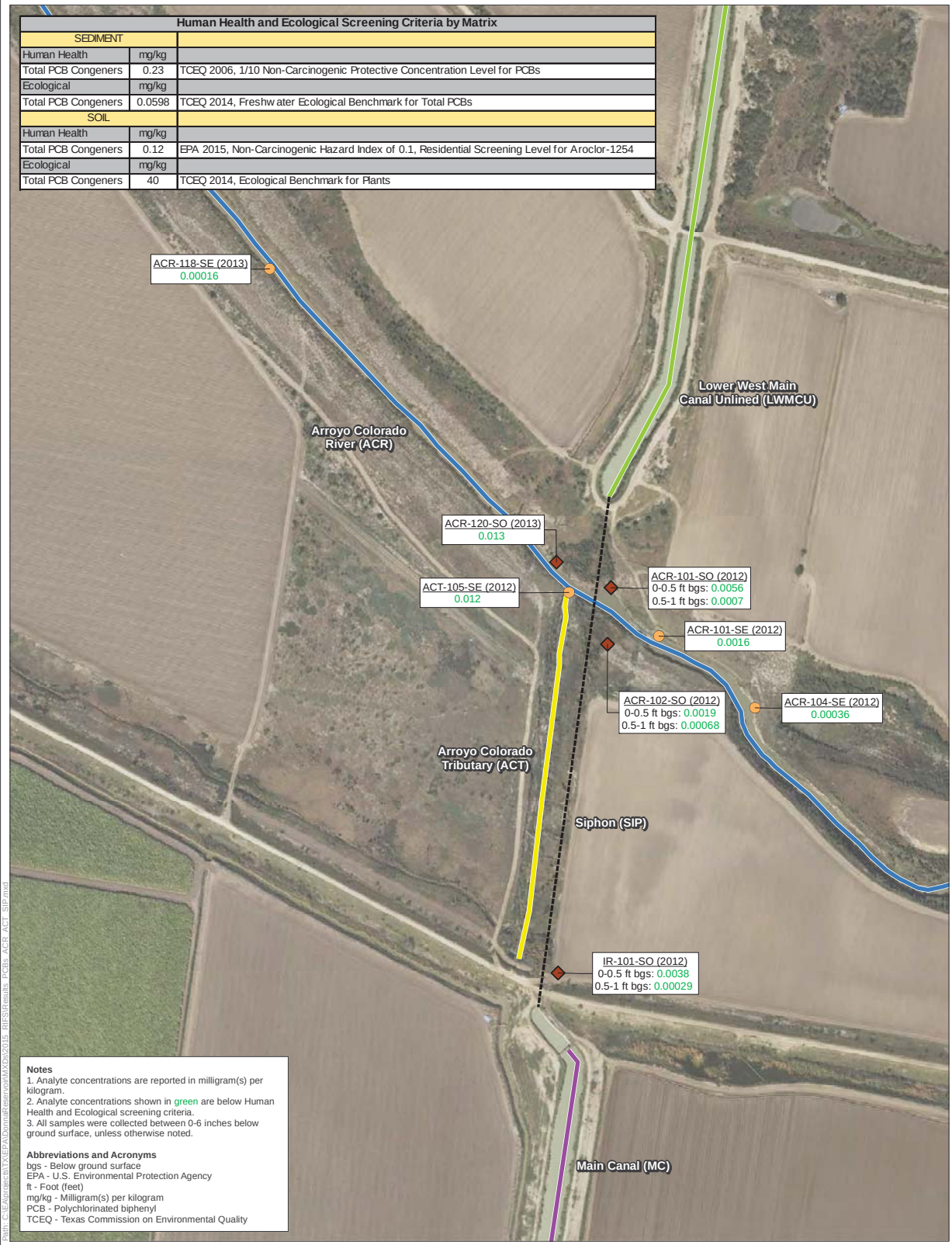
099908



Remedial Investigation/Feasibility Study
Donna Reservoir and Canal System
Donna, Hidalgo County, Texas

Figure 1-6.
Concentrations of Aroclor-1254 and Aroclor-1260 in Sediment and Soil in the Arroyo Colorado River and Tributary

099909


Human Health and Ecological Screening Criteria by Matrix
SEDIMENT
Human Health | mg/kg |
Total PCB Congeners | 0.23 | TCEQ 2006, 1/10 Non-Carcinogenic Protective Concentration Level for PCBs
Ecological | mg/kg |
Total PCB Congeners | 0.0598 | TCEQ 2014, Freshwater Ecological Benchmark for Total PCBs
SOIL
Human Health | mg/kg |
Total PCB Congeners | 0.12 | EPA 2015, Non-Carcinogenic Hazard Index of 0.1, Residential Screening Level for Aroclor-1254
Ecological | mg/kg |
Total PCB Congeners | 40 | TCEQ 2014, Ecological Benchmark for Plants
ACR-118-SE (2013)
0.00016
Lower West Main Canal Unlined (LWMCU)
Arroyo Colorado River (ACR)
ACR-120-SO (2013)
0.013
ACT-105-SE (2012)
0.012
ACR-101-SO (2012)
0-0.5 ft bgs: 0.0056
0.5-1 ft bgs: 0.0007
ACR-101-SE (2012)
0.0016
ACR-102-SO (2012)
0-0.5 ft bgs: 0.0019
0.5-1 ft bgs: 0.00068
ACR-104-SE (2012)
0.00036
Arroyo Colorado Tributary (ACT)
Siphon (SIP)
IR-101-SO (2012)
0-0.5 ft bgs: 0.0038
0.5-1 ft bgs: 0.00029
Main Canal (MC)
Notes
1. Analyte concentrations are reported in milligram(s) per kilogram.
2. Analyte concentrations shown in green are below Human Health and Ecological screening criteria.
3. All samples were collected between 0-6 inches below ground surface, unless otherwise noted.
Abbreviations and Acronyms
bgs - Below ground surface
EPA - U.S. Environmental Protection Agency
ft - Foot (feet)
mg/kg - Milligram(s) per kilogram
PCB - Polychlorinated biphenyl
TCEQ - Texas Commission on Environmental Quality
Path: C:\EA\projects\TX\EPA\Donna\Reservoir\MXDs\2015_RIFS\RIFSresults_PCBs_ACR_ACT_SIP.mxd
Area Enlarged Above
Legend
Lower West Main Canal Unlined
Arroyo Colorado River
Arroyo Colorado Tributary
Siphon (Underground)
Main Canal
Sample Locations by Matrix
Sediment
Soil
Sample Identification
Sample Depth (if multiple depths): Total PCB Congener Results
Data Sources: Esri 2006, Texas A&M AgriLife Extension Service 2015, USGS 2014
0
200
400
Feet
Remedial Investigation/Feasibility Study
Donna Reservoir and Canal System
Donna, Hidalgo County, Texas
Figure 1-7.
Concentrations of Total Polychlorinated Biphenyl Congeners in Sediment and Soil in the Arroyo Colorado River and Tributary

099910

Human Health and Ecological Screening Criteria by Matrix		
SEDIMENT		
Human Health	mg/kg	
Aroclor-1254	0.23	TCEQ 2006, 1/10 Non-Carcinogenic Protective Concentration Level for PCBs
Aroclor-1260	0.23	TCEQ 2006, 1/10 Non-Carcinogenic Protective Concentration Level for PCBs
Ecological	mg/kg	
Aroclor-1254	0.06	TCEQ 2014, Freshw ater Ecological Benchmark
Aroclor-1260	0.005	TCEQ 2014, Freshw ater Ecological Benchmark
SOIL		
Human Health	mg/kg	
Aroclor-1254	0.12	EPA 2015, Non-Carcinogenic Hazard Index of 0.1, Residential Screening Level
Aroclor-1260	0.24	EPA 2015, Carcinogenic Target Risk 10-6, Residential Screening Level
Ecological	mg/kg	
Aroclor-1254	40	TCEQ 2014, Ecological Benchmark for PCBs in Plants
Aroclor-1260	40	TCEQ 2014, Ecological Benchmark for PCBs in Plants

Notes
1. Analyte concentrations are reported in milligram(s) per kilogram.
2. Analyte concentrations shown in green are below Human Health and Ecological screening criteria.
3. Analyte concentrations shown in red are equal to or exceed Human Health and/or Ecological screening criteria.
4. All samples were collected between 0-6 inches below ground surface, unless otherwise noted.

Abbreviations and Acronyms
"--" - No data
bgs - Below ground surface
EPA - U.S. Environmental Protection Agency
ft - Foot (feet)
mg/kg - Milligram(s) per kilogram
TCEQ - Texas Commission on Environmental Quality

Data Qualifiers
J - Estimated Value. The analyte was positively identified and the associated numerical value is approximate concentration of the analyte in the sample.
U - Undetected. The analyte was analyzed for, but was not detected at a level greater than or equal to the level of the adjusted quantitation limit for the sample and method.
UJ - Undetected, Estimated Quantitation Limit. The analyte was not detected at a level greater than or equal to the adjusted quantitation limit. However, the reported adjusted quantitation limit is approximate and may be inaccurate or imprecise.

Lower East Main Canal (LEMC)
Lower West Main Canal Unlined (LWMCU)
Arroyo Colorado River (ACR)
Arroyo Colorado Tributary (ACT)
Siphon (SIP)

LWMCU-104-SO (2014) 0.00091 UJ; 0.0037 J
LWMCU-154-SE (2013) 0.061; 0.0032 U
LWMCU-123-SE (2013) 0.031; 0.0021 U
LWMCU-124-SE (2013) 0.011; 0.0021 U
LWMCU-110-SE (2014) 0.038 J; 0.0062 UJ
LWMCU-111-SE (2014) 0.2 J; 0.013 UJ
LWMCU-125-SE (2013) 0.017; 0.0036
LWMCU-103-SO (2014) 0.00098 U; 0.00098 U
LWMCU-111-SO (2014) 0.00091 U; 0.00091 U
LWMCU-155-SE (2013) 0.022; 0.0031 U
LWMCU-112-SE (2014) 0.16 J; 0.061 UJ
LWMCU-126-SE (2013) 0.017; 0.0021 U
LWMCU-107-SO (2014) 0.00093 U; 0.00093 U
LWMCU-112-SO (2014) 0.00092 UJ; 0.0017 J
LWMCU-127-SE (2013) 0.016 J; 0.0021 U
LWMCU-102-SE (2014) 0.16 J; 0.063 UJ
LWMCU-128-SE (2013) 0.0057; 0.0021 U
LWMCU-114-SO (2014) 0.00095 U; 0.0024 J
LWMCU-171-SE (2014) 0.0271 U; 0.0271 U
LWMCU-172-SE (2014) 0.0851 J; 0.0296 U
LWMCU-167-SE (2014) 0-0.4 ft bgs: 0.0028 U; 0.0028 U
LWMCU-106-SO (2014) 0.00092 U; 0.00094 J
LWMCU-113-SE (2014) 0.14 J; 0.024 UJ
LWMCU-129-SE (2013) 0.21; 0.0021 U
LWMCU-131-SE (2013) 0.096; 0.0021 U
LWMCU-156-SE (2013) 0.045; 0.0028 U
LWMCU-136-SE (2013) 0.0024; 0.0063
LWMCU-130-SE (2013) 0.05; 0.064
IR-102-SO (2012) 0.037 U; 0.037 U
LWMCU-135-SE (2013) 0.11; 0.02
LWMCU-132-SE (2013) 0.033; 0.0021 U
LWMCU-134-SE (2013) 0.0023; 0.0021 U
LWMCU-158-SE (2013) 0.065; 0.0027 U
LWMCU-168-SE (2014) 0-0.25 ft bgs: 0.0028 U; 0.0028 U
LWMCU-138-SE (2013) 0.0021 U; 0.18
LWMCU-133-SE (2013) 0.0033; 0.0021 U
LWMCU-137-SE (2013) 0.0021 UJ; 0.0026
LWMCU-101-SE (2012) 0.4; --
LWMCU-114-SE (2014) 1.1; 0.25 U
LWMCU-157-SE (2013) 0-0.17 ft bgs: 0.32; 0.0029 U 0.17-0.5 ft bgs: 0.015; 0.0027 U
LWMCU-140-SE (2013) 0.0021 U; 0.0021 U
LWMCU-113-SO (2014) 0.00093 UJ; 0.0016 J
LWMCU-101-SE (2014) 0.61; --
LWMCU-159-SE (2013) 0-0.25 ft bgs: 0.73; 0.003 U 0.25-0.5 ft bgs: 0.063; 0.0027 U
IR-106-SO (2012) 0.035 U; 0.035 U
LWMCU-141-SE (2013) 0.084; 0.0093
LWMCU-105-SO (2014) 0.0026 J; 0.00095 UJ
LWMCU-142-SE (2013) 0.27; 0.0021 U
LWMCU-139-SE (2013) 0.0021 U; 0.0021 U
LWMCU-115-SE (2014) 1.1; --
LWMCU-101-SO (2014) 0.00093 U; 0.0066 J
LWMCU-143-SE (2013) 0.53; 0.0021 U
LWMCU-145-SE (2013) 0.0021 U; 0.014
LWMCU-147-SE (2013) 0.22; 0.0021 U
LWMCU-148-SE (2013) 0.0016 J; 0.0039 J
LWMCU-150-SE (2013) 0.018; 0.012
LWMCU-160-SE (2013) 11; 0.13 U
LWMCU-170-SE (2014) 0-0.08 ft bgs: 0.59; 0.029 U 0.08-0.13 ft bgs: 0.36; 0.027 U
LWMCU-146-SE (2013) 3.8; 0.042 U

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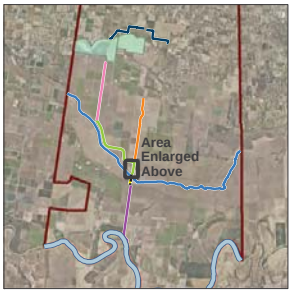


Legend
- Lower West Main Canal Unlined
- Lower East Main Canal
- Arroyo Colorado River
- Arroyo Colorado Tributary
- Siphon (Underground)

Sample Locations by Matrix
- Sediment
- Soil

Sample Identification
Sample Depth (if multiple depths): Aroclor-1254; Aroclor-1260 Results (Exceedances in red)

Data Sources: Esri 2006, Texas A&M AgriLife Extension Service 2015, USGS 2014

0 100 200
Feet

Remedial Investigation/Feasibility Study
Donna Reservoir and Canal System
Donna, Hidalgo County, Texas

Figure 1-8.
Concentrations of Aroclor-1254 and Aroclor-1260 in Sediment and Soil in the Lower West Main Canal Unlined South of 90 Degree Bend

099911

Human Health and Ecological Screening Criteria by Matrix		
SEDIMENT		
Human Health	mg/kg	
Total PCB Congeners	0.23	TCEQ 2006, 1/10 Non-Carcinogenic Protective Concentration Level for PCBs
Ecological	mg/kg	
Total PCB Congeners	0.0598	TCEQ 2014, Freshwater Ecological Benchmark for Total PCBs
SOIL		
Human Health	mg/kg	
Total PCB Congeners	0.12	EPA 2015, Non-Carcinogenic Hazard Index of 0.1, Residential Screening Level for Aroclor-1254
Ecological	mg/kg	
Total PCB Congeners	40	TCEQ 2014, Ecological Benchmark for Plants

Notes
1. Analyte concentrations are reported in milligram(s) per kilogram.
2. Analyte concentrations shown in green are below Human Health and Ecological screening criteria.
3. Analyte concentrations shown in red are equal to or exceed Human Health and/or Ecological screening criteria.
4. All samples were collected between 0-6 inches below ground surface, unless otherwise noted.

Abbreviations and Acronyms
bgs - Below ground surface
EPA - U.S. Environmental Protection Agency
ft - Foot (feet)
mg/kg - Milligram(s) per kilogram
PCB - Polychlorinated biphenyl
TCEQ - Texas Commission on Environmental Quality

Data Qualifier
J - Estimated Value. The analyte was positively identified and the associated numerical value is approximate concentration of the analyte in the sample.

Lower East Main Canal (LEMC)

LWMCU-104-SO (2012)
0-0.5 ft bgs: 0.0013
0.5-1 ft bgs: 0.00052

LWMCU-124-SE (2013)
0.12

LWMCU-103-SO (2012)
0-0.5 ft bgs: 0.00062
0.5-1 ft bgs: 0.00013 J

Lower West Main Canal Unlined (LWMCU)

LWMCU-102-SE (2012)
0-0.5 ft bgs: 0.34
0.5-1 ft bgs: 0.34

LWMCU-171-SE (2014)
0.031

LWMCU-172-SE (2014)
0.021

LWMCU-106-SO (2014)
0.00013 J

LWMCU-129-SE (2013)
0.8

IR-102-SO (2012)
0-0.5 ft bgs: 0.0096
0.5-1 ft bgs: 0.0064

Arroyo Colorado River (ACR)

LWMCU-102-SO (2012)
0-0.5 ft bgs: 0.00027
0.5-1 ft bgs: 0.00056

LWMCU-132-SE (2013)
0.19

LWMCU-168-SE (2014)
0.00033

LWMCU-158-SE (2013)
0-0.5 ft bgs: 0.24
1-1.25 ft bgs: 0.0025

LWMCU-101-SE (2012)
0.63

LWMCU-113-SO (2014)
0.00065 J

LWMCU-139-SE (2013)
0.0019

LWMCU-115-SE (2014)
4.3

MW-101 (2013)
0-2 ft bgs: 0.00039 J
2-5 ft bgs: 0.00027 J

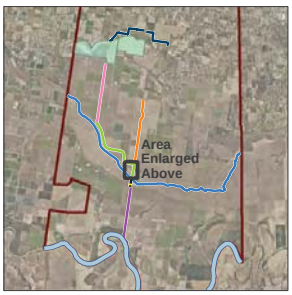
LWMCU-101-SO (2012)
0-0.5 ft bgs: 0.045
0.5-1 ft bgs: 0.034

LWMCU-160-SE (2013)
0-0.5 ft bgs: 6.1
0.5-0.75 ft bgs: 2.1

MW-102 (2013)
0-2 ft bgs: 0.00051
4-6 ft bgs: 0.00045 J

Siphon (SIP)

Path: C:\EA\projects\TX\EPA\Donna\Reservoir\MXDs\2015_RIFS\Results_PCBs_LWMCU_NSIP_MW.mxd



Legend
- Lower West Main Canal Unlined
- Lower East Main Canal
- Arroyo Colorado River
- Siphon (Underground)

Sample Locations by Matrix
- Sediment
- Soil

Sample Identification
Sample Depth (if multiple depths): Total PCB Congener Results (Exceedances in red)

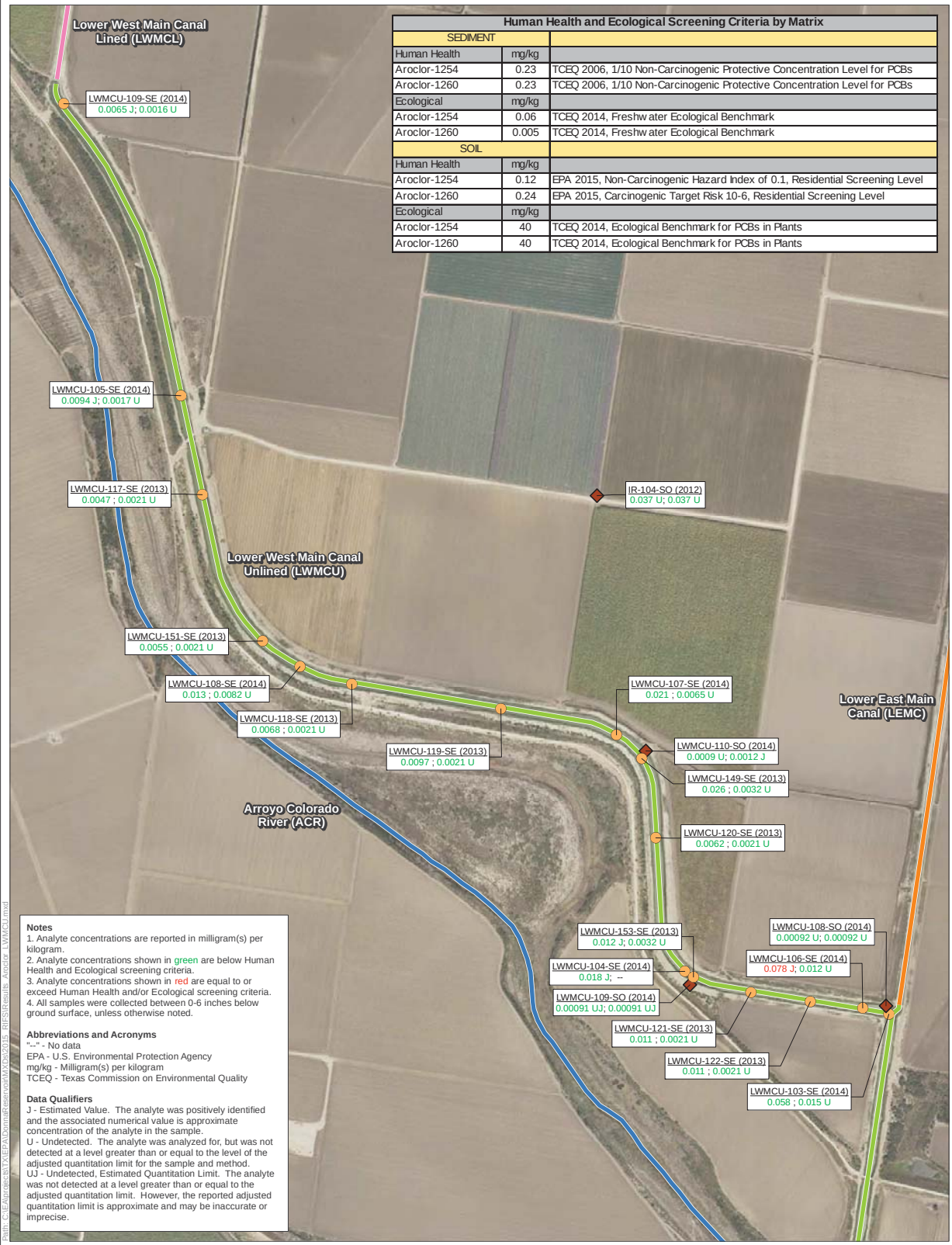
Data Sources: Esri 2006, Texas A&M AgriLife Extension Service 2015, USGS 2014

0 100 200
Feet

Remedial Investigation/Feasibility Study
Donna Reservoir and Canal System
Donna, Hidalgo County, Texas

Figure 1-9.
Concentrations of Total Polychlorinated Biphenyl Congeners in Sediment and Soil in the Lower West Main Canal Unlined South of 90 Degree Bend

099912

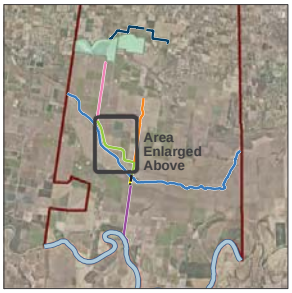


Human Health and Ecological Screening Criteria by Matrix		
SEDIMENT		
Human Health	mg/kg	
Aroclor-1254	0.23	TCEQ 2006, 1/10 Non-Carcinogenic Protective Concentration Level for PCBs
Aroclor-1260	0.23	TCEQ 2006, 1/10 Non-Carcinogenic Protective Concentration Level for PCBs
Ecological	mg/kg	
Aroclor-1254	0.06	TCEQ 2014, Freshwater Ecological Benchmark
Aroclor-1260	0.005	TCEQ 2014, Freshwater Ecological Benchmark
SOIL		
Human Health	mg/kg	
Aroclor-1254	0.12	EPA 2015, Non-Carcinogenic Hazard Index of 0.1, Residential Screening Level
Aroclor-1260	0.24	EPA 2015, Carcinogenic Target Risk 10-6, Residential Screening Level
Ecological	mg/kg	
Aroclor-1254	40	TCEQ 2014, Ecological Benchmark for PCBs in Plants
Aroclor-1260	40	TCEQ 2014, Ecological Benchmark for PCBs in Plants

Notes
1. Analyte concentrations are reported in milligram(s) per kilogram.
2. Analyte concentrations shown in green are below Human Health and Ecological screening criteria.
3. Analyte concentrations shown in red are equal to or exceed Human Health and/or Ecological screening criteria.
4. All samples were collected between 0-6 inches below ground surface, unless otherwise noted.

Abbreviations and Acronyms
"--" - No data
EPA - U.S. Environmental Protection Agency
mg/kg - Milligram(s) per kilogram
TCEQ - Texas Commission on Environmental Quality

Data Qualifiers
J - Estimated Value. The analyte was positively identified and the associated numerical value is approximate concentration of the analyte in the sample.
U - Undetected. The analyte was analyzed for, but was not detected at a level greater than or equal to the level of the adjusted quantitation limit for the sample and method.
UJ - Undetected, Estimated Quantitation Limit. The analyte was not detected at a level greater than or equal to the adjusted quantitation limit. However, the reported adjusted quantitation limit is approximate and may be inaccurate or imprecise.



Legend
- Lower West Main Canal Lined
- Lower West Main Canal Unlined
- Lower East Main Canal
- Arroyo Colorado River

Sample Locations by Matrix
- Sediment
- Soil

Sample Identification
Sample Depth (if multiple depths): Aroclor-1254; Aroclor-1260 Results (Exceedances in red)

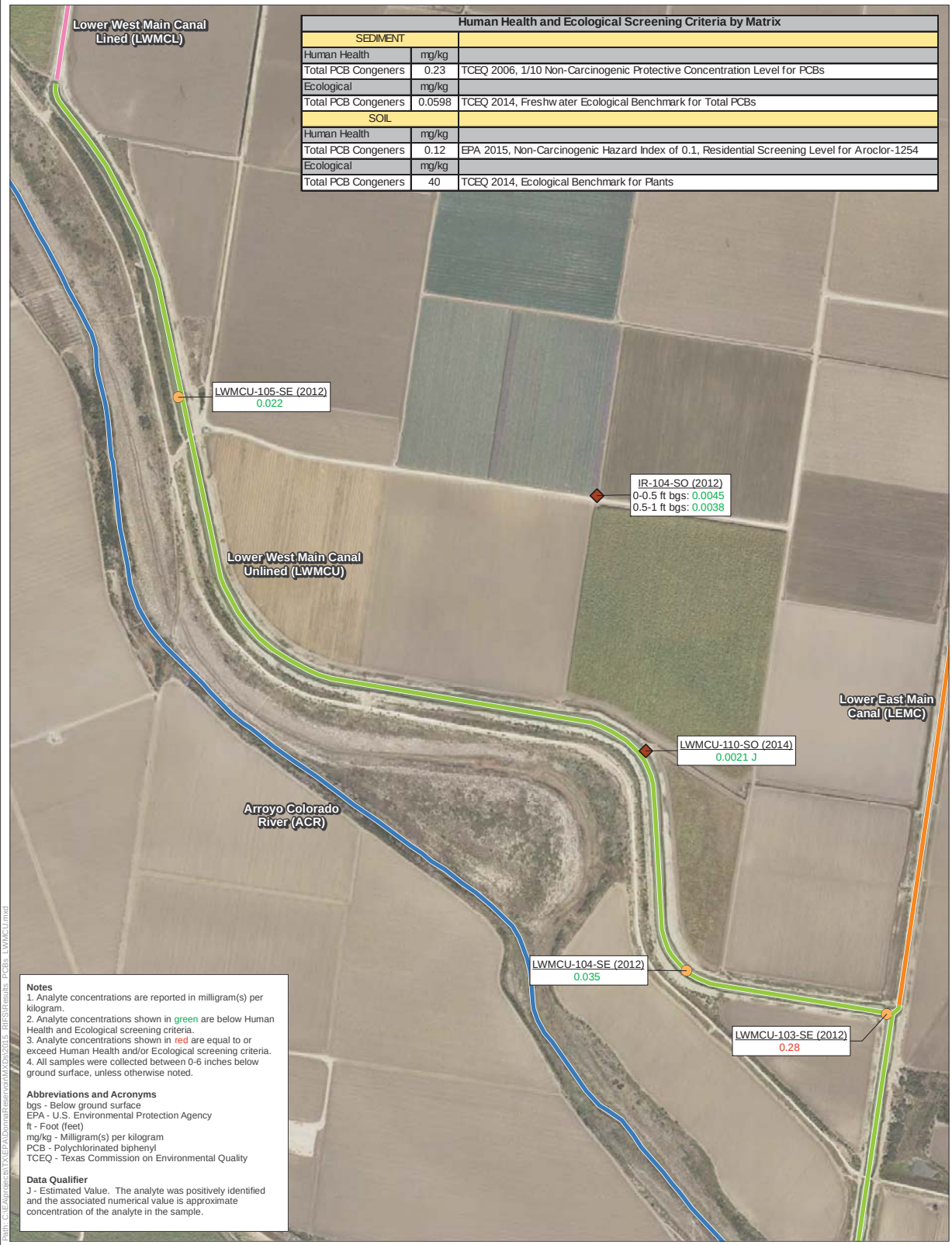
Data Sources: Esri 2006, Texas A&M AgriLife Extension Service 2015, USGS 2014

0 500 1,000
Feet

Remedial Investigation/Feasibility Study
Donna Reservoir and Canal System
Donna, Hidalgo County, Texas

Figure 1-10.
Concentrations of Aroclor-1254 and Aroclor-1260 in Sediment and Soil in the Lower West Main Canal Unlined North of 90 Degree Bend

099913



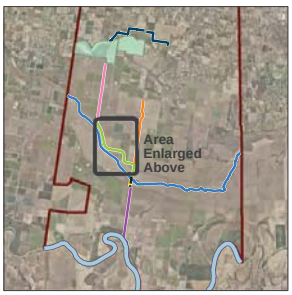
Human Health and Ecological Screening Criteria by Matrix		
SEDIMENT		
Human Health	mg/kg	
Total PCB Congeners	0.23	TCEQ 2006, 1/10 Non-Carcinogenic Protective Concentration Level for PCBs
Ecological	mg/kg	
Total PCB Congeners	0.0598	TCEQ 2014, Freshwater Ecological Benchmark for Total PCBs
SOIL		
Human Health	mg/kg	
Total PCB Congeners	0.12	EPA 2015, Non-Carcinogenic Hazard Index of 0.1, Residential Screening Level for Aroclor-1254
Ecological	mg/kg	
Total PCB Congeners	40	TCEQ 2014, Ecological Benchmark for Plants

Notes
1. Analyte concentrations are reported in milligram(s) per kilogram.
2. Analyte concentrations shown in green are below Human Health and Ecological screening criteria.
3. Analyte concentrations shown in red are equal to or exceed Human Health and/or Ecological screening criteria.
4. All samples were collected between 0-6 inches below ground surface, unless otherwise noted.

Abbreviations and Acronyms
bgs - Below ground surface
EPA - U.S. Environmental Protection Agency
ft - Foot (feet)
mg/kg - Milligram(s) per kilogram
PCB - Polychlorinated biphenyl
TCEQ - Texas Commission on Environmental Quality

Data Qualifier
J - Estimated Value. The analyte was positively identified and the associated numerical value is approximate concentration of the analyte in the sample.

Path: C:\EA\projects\TX\EPA\DonnaReservoir\MXDs\2015_RIFS\Results_PCBs_LWMCU.mxd



Legend
- Lower West Main Canal Lined
- Lower West Main Canal Unlined
- Lower East Main Canal
- Arroyo Colorado River

Sample Locations by Matrix
- Sediment
- Soil

Sample Identification
Sample Depth (if multiple depths): Total PCB Congener Results (Exceedances in red)

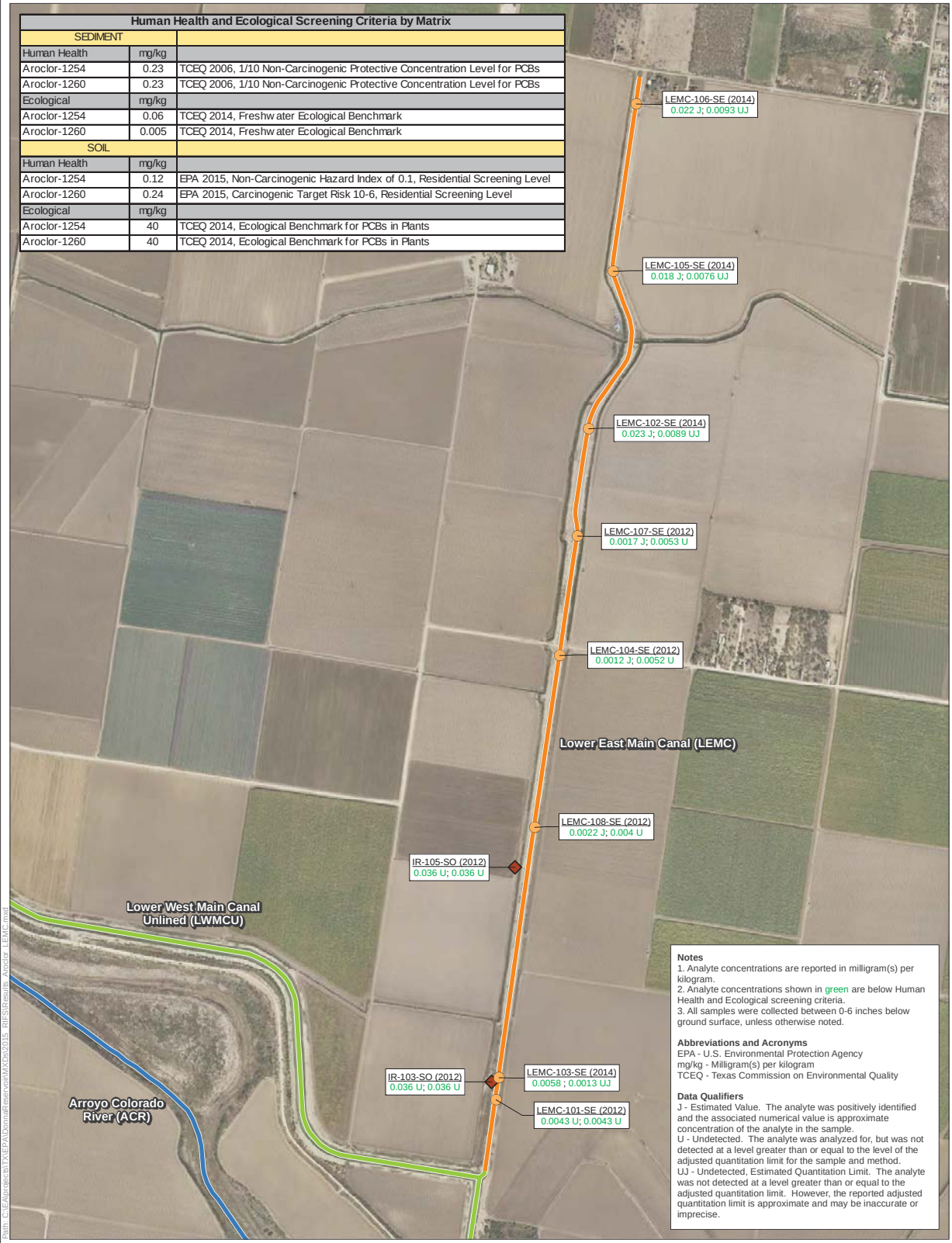
Data Sources: Esri 2006, Texas A&M AgriLife Extension Service 2015, USGS 2014

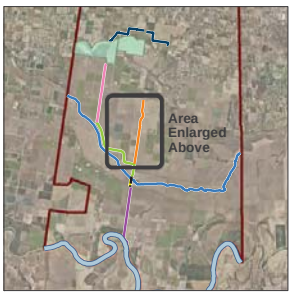
0 500 1,000
Feet

Remedial Investigation/Feasibility Study
Donna Reservoir and Canal System
Donna, Hidalgo County, Texas

Figure 1-11.
Concentrations of Total Polychlorinated Biphenyl Congeners in Sediment and Soil in the Lower West Main Canal Unlined North of 90 Degree Bend

Human Health and Ecological Screening Criteria by Matrix		
SEDIMENT		
Human Health	mg/kg	
Aroclor-1254	0.23	TCEQ 2006, 1/10 Non-Carcinogenic Protective Concentration Level for PCBs
Aroclor-1260	0.23	TCEQ 2006, 1/10 Non-Carcinogenic Protective Concentration Level for PCBs
Ecological	mg/kg	
Aroclor-1254	0.06	TCEQ 2014, Freshwater Ecological Benchmark
Aroclor-1260	0.005	TCEQ 2014, Freshwater Ecological Benchmark
SOIL		
Human Health	mg/kg	
Aroclor-1254	0.12	EPA 2015, Non-Carcinogenic Hazard Index of 0.1, Residential Screening Level
Aroclor-1260	0.24	EPA 2015, Carcinogenic Target Risk 10-6, Residential Screening Level
Ecological	mg/kg	
Aroclor-1254	40	TCEQ 2014, Ecological Benchmark for PCBs in Plants
Aroclor-1260	40	TCEQ 2014, Ecological Benchmark for PCBs in Plants





Legend
- Lower West Main Canal Unlined
- Lower East Main Canal
- Arroyo Colorado River

Sample Locations by Matrix
- Sediment
- Soil

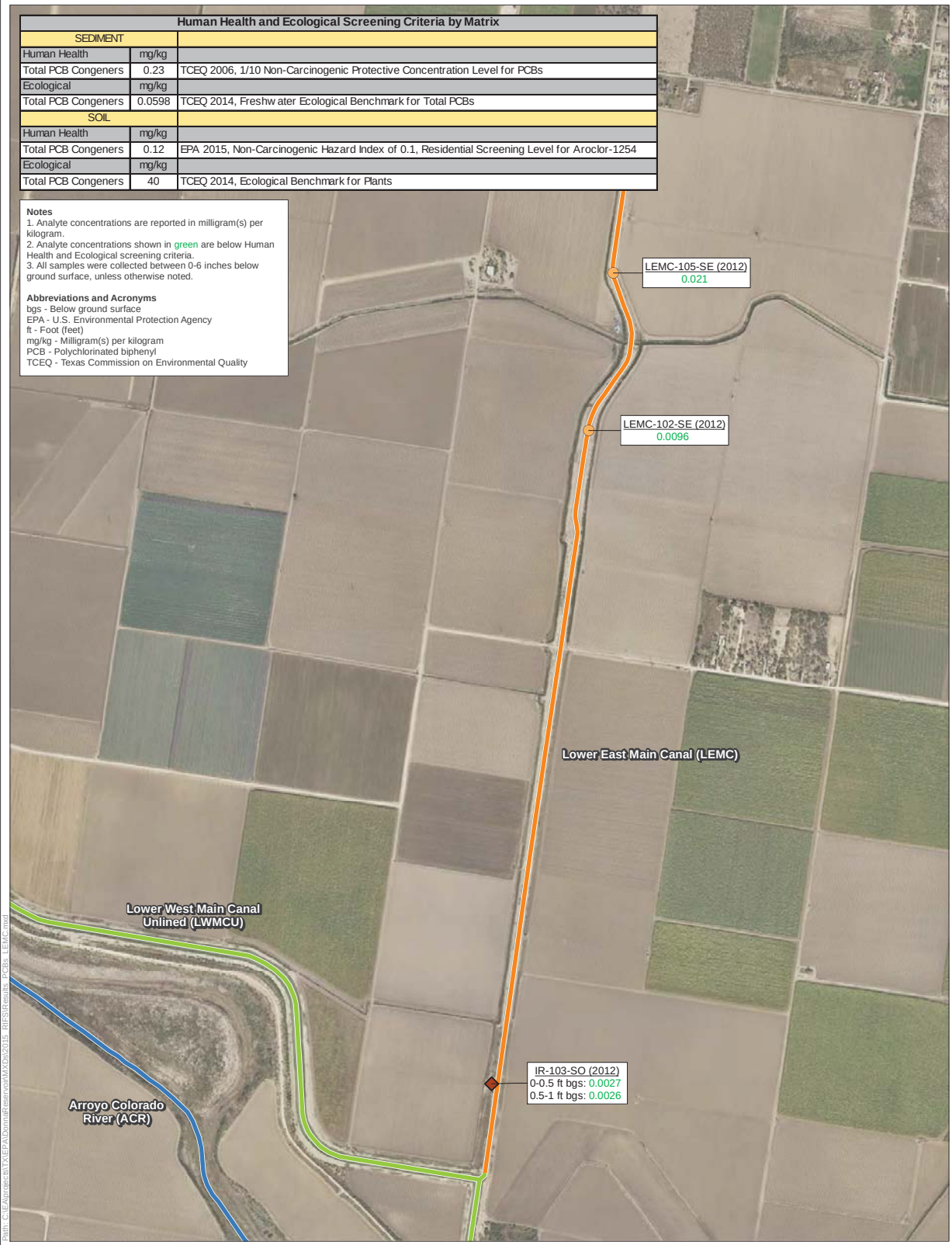
Sample Identification
Sample Depth (if multiple depths): Aroclor-1254; Aroclor-1260 Results

Data Sources: Esri 2006, Texas A&M AgriLife Extension Service 2015, USGS 2014

0 500 1,000
Feet

Remedial Investigation/Feasibility Study
Donna Reservoir and Canal System
Donna, Hidalgo County, Texas

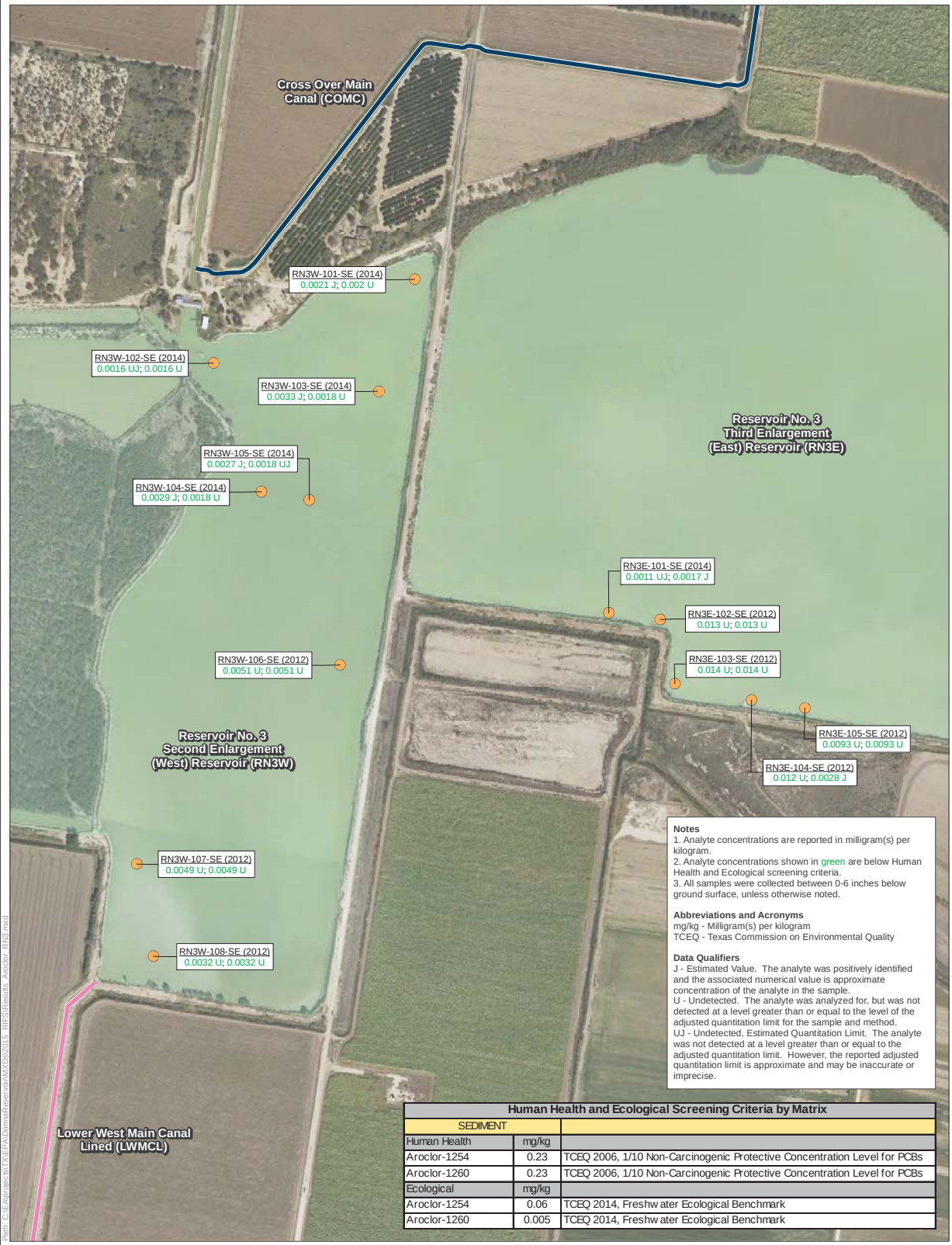
Figure 1-12.
Concentrations of Aroclor-1254 and Aroclor-1260 in Sediment and Soil in the Lower East Main Canal



Remedial Investigation/Feasibility Study
Donna Reservoir and Canal System
Donna, Hidalgo County, Texas

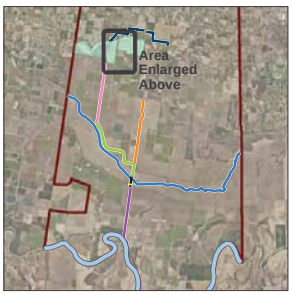
Figure 1-13.
Concentrations of Total Polychlorinated Biphenyl Congeners in Sediment and Soil in the Lower East Main Canal

099916



Human Health and Ecological Screening Criteria by Matrix

SEDIMENT		
Human Health	mg/kg	
Aroclor-1254	0.23	TCEQ 2006, 1/10 Non-Carcinogenic Protective Concentration Level for PCBs
Aroclor-1260	0.23	TCEQ 2006, 1/10 Non-Carcinogenic Protective Concentration Level for PCBs
Ecological	mg/kg	
Aroclor-1254	0.06	TCEQ 2014, Freshwater Ecological Benchmark
Aroclor-1260	0.005	TCEQ 2014, Freshwater Ecological Benchmark



Legend
- Cross Over Main Canal
- Lower West Main Canal Lined

Sample Locations by Matrix
- Sediment

Sample Identification
Sample Depth (if multiple depths): Aroclor-1254; Aroclor-1260 Results

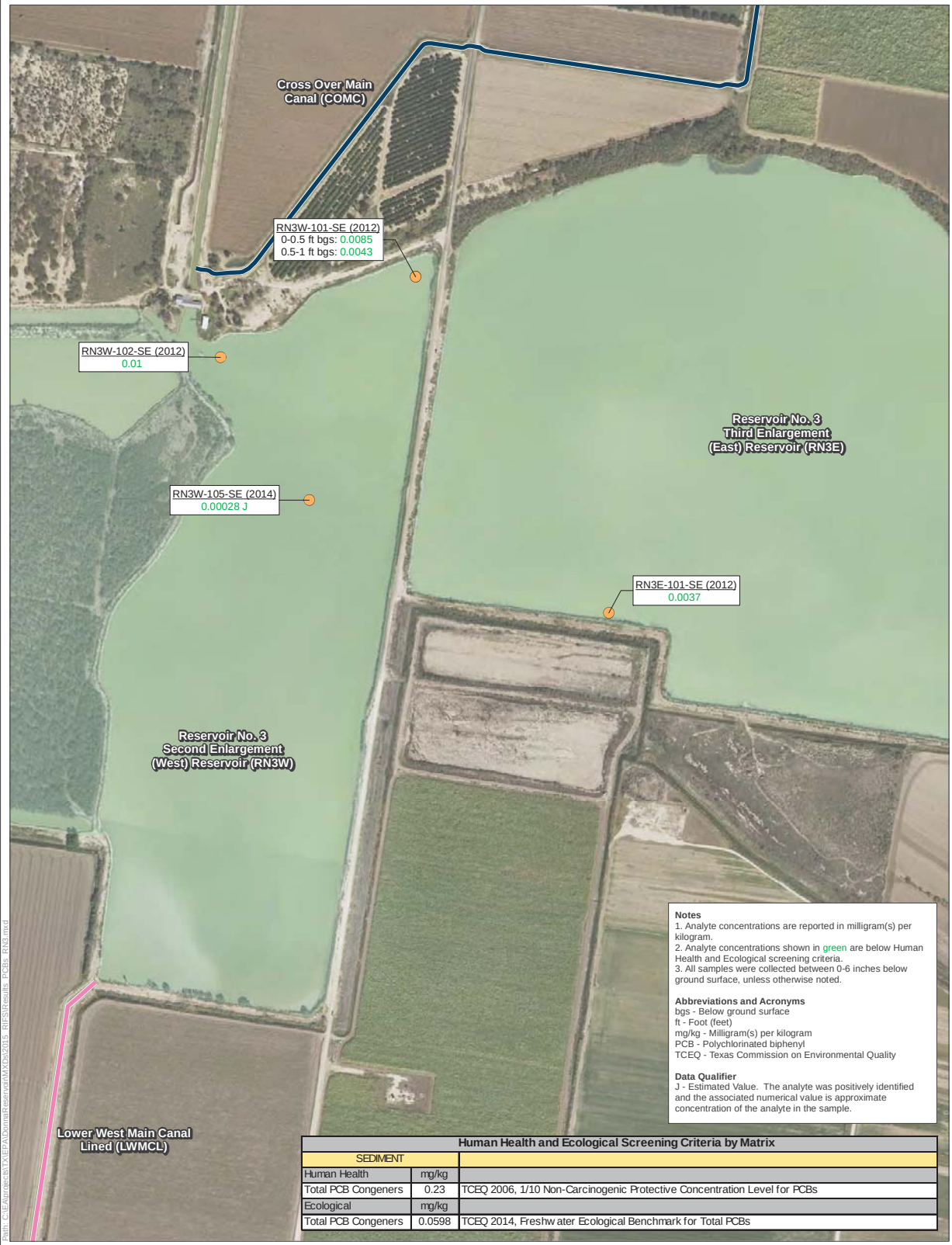
Data Sources: Esri 2006, Texas A&M AgriLife Extension Service 2015, USGS 2014

0 400 800
Feet

Remedial Investigation/Feasibility Study
Donna Reservoir and Canal System
Donna, Hidalgo County, Texas

Figure 1-14.
Concentrations of Aroclor-1254 and Aroclor-1260 in Sediment in Reservoir No. 3

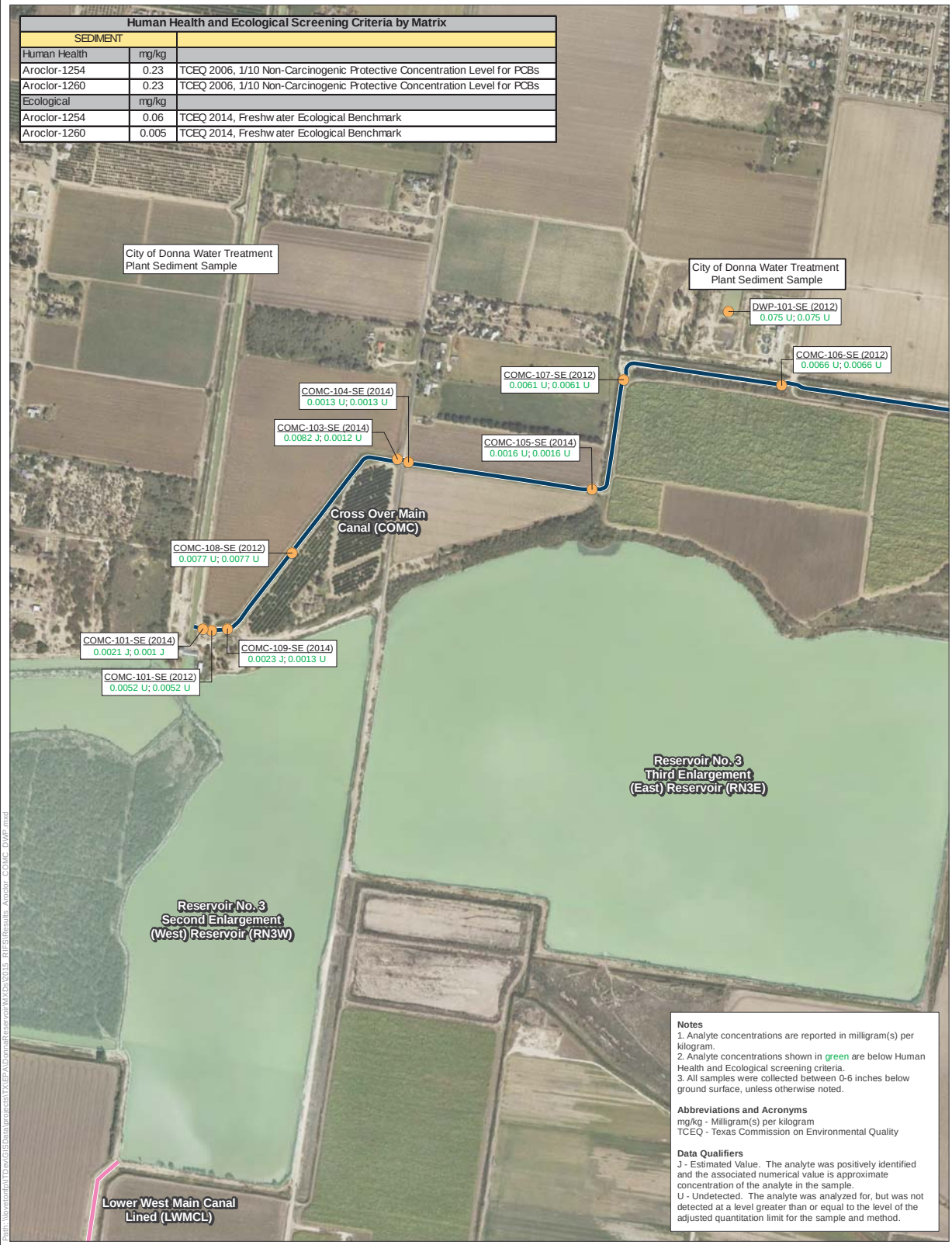
099917



Remedial Investigation/Feasibility Study
Donna Reservoir and Canal System
Donna, Hidalgo County, Texas

Figure 1-15.
Concentrations of Total Polychlorinated Biphenyl Congeners in Sediment in Reservoir No. 3

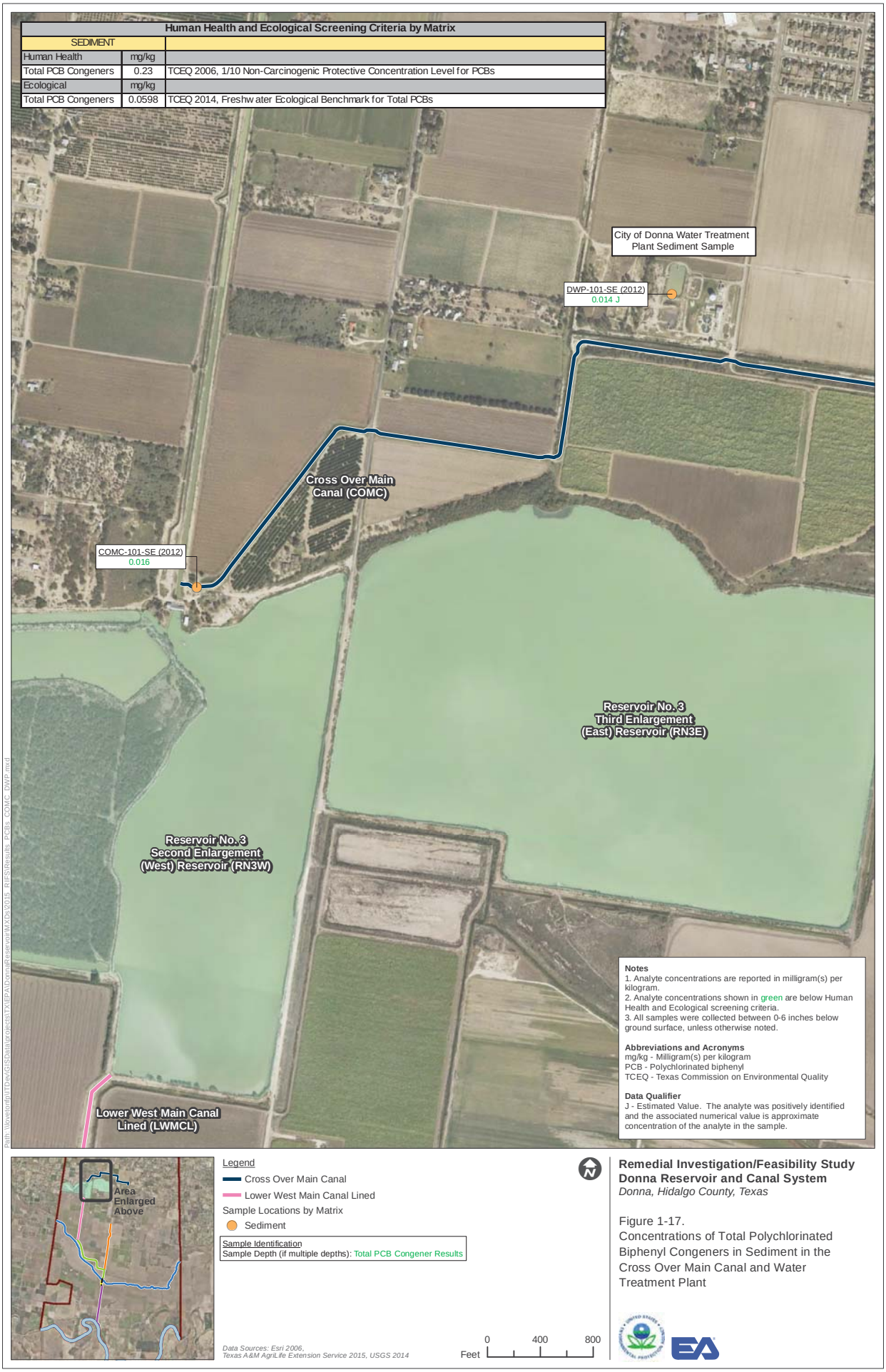
099918



Remedial Investigation/Feasibility Study
Donna Reservoir and Canal System
Donna, Hidalgo County, Texas

Figure 1-16.
Concentrations of Aroclor-1254 and Aroclor-1260 in Sediment in the Cross Over Main Canal and Water Treatment Plant

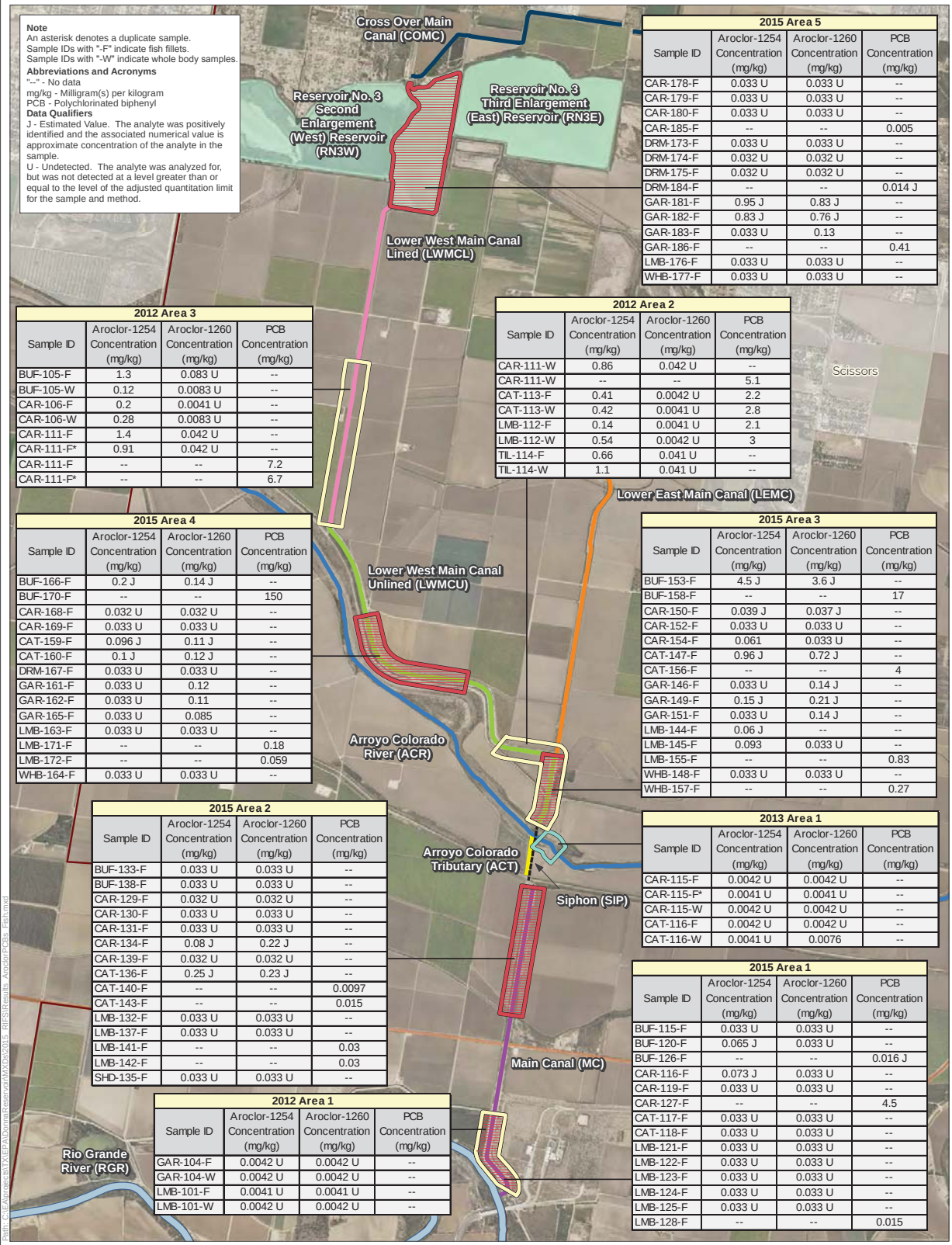
099919



Remedial Investigation/Feasibility Study
Donna Reservoir and Canal System
Donna, Hidalgo County, Texas

Figure 1-17.
Concentrations of Total Polychlorinated Biphenyl Congeners in Sediment in the Cross Over Main Canal and Water Treatment Plant

099920



2015 Area 5

Sample ID	Aroclor-1254 Concentration (mg/kg)	Aroclor-1260 Concentration (mg/kg)	PCB Concentration (mg/kg)
CAR-178-F	0.033 U	0.033 U	--
CAR-179-F	0.033 U	0.033 U	--
CAR-180-F	0.033 U	0.033 U	--
CAR-185-F	--	--	0.005
DRM-173-F	0.033 U	0.033 U	--
DRM-174-F	0.032 U	0.032 U	--
DRM-175-F	0.032 U	0.032 U	--
DRM-184-F	--	--	0.014 J
GAR-181-F	0.95 J	0.83 J	--
GAR-182-F	0.83 J	0.76 J	--
GAR-183-F	0.033 U	0.13	--
GAR-186-F	--	--	0.41
LMB-176-F	0.033 U	0.033 U	--
WHB-177-F	0.033 U	0.033 U	--

2012 Area 3

Sample ID	Aroclor-1254 Concentration (mg/kg)	Aroclor-1260 Concentration (mg/kg)	PCB Concentration (mg/kg)
BUF-105-F	1.3	0.083 U	--
BUF-105-W	0.12	0.0083 U	--
CAR-106-F	0.2	0.0041 U	--
CAR-106-W	0.28	0.0083 U	--
CAR-111-F	1.4	0.042 U	--
CAR-111-F*	0.91	0.042 U	--
CAR-111-F	--	--	7.2
CAR-111-F*	--	--	6.7

2012 Area 2

Sample ID	Aroclor-1254 Concentration (mg/kg)	Aroclor-1260 Concentration (mg/kg)	PCB Concentration (mg/kg)
CAR-111-W	0.86	0.042 U	--
CAR-111-W	--	--	5.1
CAT-113-F	0.41	0.0042 U	2.2
CAT-113-W	0.42	0.0041 U	2.8
LMB-112-F	0.14	0.0041 U	2.1
LMB-112-W	0.54	0.0042 U	3
TIL-114-F	0.66	0.041 U	--
TIL-114-W	1.1	0.041 U	--

2015 Area 4

Sample ID	Aroclor-1254 Concentration (mg/kg)	Aroclor-1260 Concentration (mg/kg)	PCB Concentration (mg/kg)
BUF-166-F	0.2 J	0.14 J	--
BUF-170-F	--	--	150
CAR-168-F	0.032 U	0.032 U	--
CAR-169-F	0.033 U	0.033 U	--
CAT-159-F	0.096 J	0.11 J	--
CAT-160-F	0.1 J	0.12 J	--
DRM-167-F	0.033 U	0.033 U	--
GAR-161-F	0.033 U	0.12	--
GAR-162-F	0.033 U	0.11	--
GAR-165-F	0.033 U	0.085	--
LMB-163-F	0.033 U	0.033 U	--
LMB-171-F	--	--	0.18
LMB-172-F	--	--	0.059
WHB-164-F	0.033 U	0.033 U	--

2015 Area 3

Sample ID	Aroclor-1254 Concentration (mg/kg)	Aroclor-1260 Concentration (mg/kg)	PCB Concentration (mg/kg)
BUF-153-F	4.5 J	3.6 J	--
BUF-158-F	--	--	17
CAR-150-F	0.039 J	0.037 J	--
CAR-152-F	0.033 U	0.033 U	--
CAR-154-F	0.061	0.033 U	--
CAT-147-F	0.96 J	0.72 J	--
CAT-156-F	--	--	4
GAR-146-F	0.033 U	0.14 J	--
GAR-149-F	0.15 J	0.21 J	--
GAR-151-F	0.033 U	0.14 J	--
LMB-144-F	0.06 J	--	--
LMB-145-F	0.093	0.033 U	--
LMB-155-F	--	--	0.83
WHB-148-F	0.033 U	0.033 U	--
WHB-157-F	--	--	0.27

2015 Area 2

Sample ID	Aroclor-1254 Concentration (mg/kg)	Aroclor-1260 Concentration (mg/kg)	PCB Concentration (mg/kg)
BUF-133-F	0.033 U	0.033 U	--
BUF-138-F	0.033 U	0.033 U	--
CAR-129-F	0.032 U	0.032 U	--
CAR-130-F	0.033 U	0.033 U	--
CAR-131-F	0.033 U	0.033 U	--
CAR-134-F	0.08 J	0.22 J	--
CAR-139-F	0.032 U	0.032 U	--
CAT-136-F	0.25 J	0.23 J	--
CAT-140-F	--	--	0.0097
CAT-143-F	--	--	0.015
LMB-132-F	0.033 U	0.033 U	--
LMB-137-F	0.033 U	0.033 U	--
LMB-141-F	--	--	0.03
LMB-142-F	--	--	0.03
SHD-135-F	0.033 U	0.033 U	--

2013 Area 1

Sample ID	Aroclor-1254 Concentration (mg/kg)	Aroclor-1260 Concentration (mg/kg)	PCB Concentration (mg/kg)
CAR-115-F	0.0042 U	0.0042 U	--
CAR-115-F*	0.0041 U	0.0041 U	--
CAR-115-W	0.0042 U	0.0042 U	--
CAT-116-F	0.0042 U	0.0042 U	--
CAT-116-W	0.0041 U	0.0076	--

2015 Area 1

Sample ID	Aroclor-1254 Concentration (mg/kg)	Aroclor-1260 Concentration (mg/kg)	PCB Concentration (mg/kg)
BUF-115-F	0.033 U	0.033 U	--
BUF-120-F	0.065 J	0.033 U	--
BUF-126-F	--	--	0.016 J
CAR-116-F	0.073 J	0.033 U	--
CAR-119-F	0.033 U	0.033 U	--
CAR-127-F	--	--	4.5
CAT-117-F	0.033 U	0.033 U	--
CAT-118-F	0.033 U	0.033 U	--
LMB-121-F	0.033 U	0.033 U	--
LMB-122-F	0.033 U	0.033 U	--
LMB-123-F	0.033 U	0.033 U	--
LMB-124-F	0.033 U	0.033 U	--
LMB-125-F	0.033 U	0.033 U	--
LMB-128-F	--	--	0.015

2012 Area 1

Sample ID	Aroclor-1254 Concentration (mg/kg)	Aroclor-1260 Concentration (mg/kg)	PCB Concentration (mg/kg)
GAR-104-F	0.0042 U	0.0042 U	--
GAR-104-W	0.0042 U	0.0042 U	--
LMB-101-F	0.0041 U	0.0041 U	--
LMB-101-W	0.0042 U	0.0042 U	--

Legend

- Cross Over Main Canal
- Lower West Main Canal Lined
- Lower West Main Canal Unlined
- Lower East Main Canal
- Arroyo Colorado River
- Arroyo Colorado Tributary
- Siphon (Underground)
- Main Canal
- Rio Grande River
- Donna Reservoir
- Donna Irrigation District - Hidalgo County No. 1
- 2012 Fish Sample Area
- 2013 Fish Sample Area
- 2015 Fish Sample Area

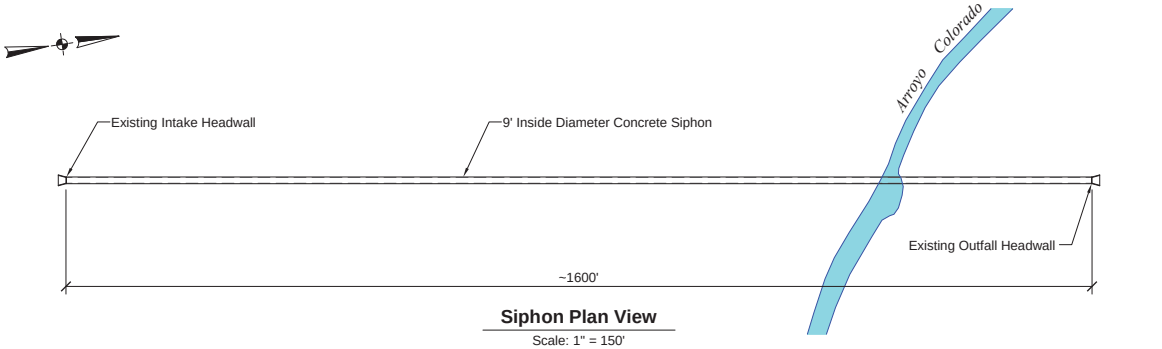
Data Sources: Esri 2006, Texas A&M AgriLife Extension Service 2015, USGS 2014

0 2,000 4,000
Feet

Remedial Investigation/Feasibility Study
Donna Reservoir and Canal System
Donna, Hidalgo County, Texas

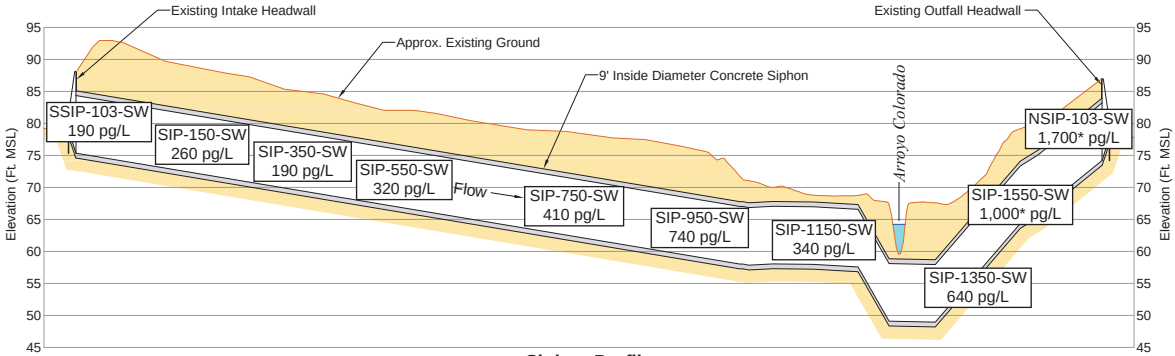
Figure 1-18.
Fish Concentrations of Aroclor-1254, Aroclor-1260, and Total Polychlorinated Biphenyl Congeners

099921



Siphon Plan View

Scale: 1" = 150'



Siphon Profile

Scale: 1" = 150' Horiz.; 1" = 15' Vert.
(10X Vertical Exaggeration)

Siphon Profile

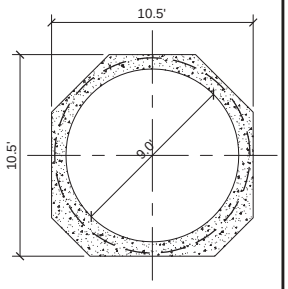
Scale: 1" = 150' Vert. & Horiz.
(No Vertical Exaggeration)

Note:

pg/L - picograms per liter

Sample locations should be considered approximate.

Flow measured at the Rio Grande Pumping Station was 40 cubic feet per second (cfs) during sampling, with the exception of samples marked with an asterisk (*). Asterisk marked results indicate the sample was collected during a flow of 100 cfs.



Typical Siphon Section

Scale: 1" = 5'

Note:
This figure has been adopted from:
URS Corporation. 2006. *Feasibility Study Report, Donna Reservoir and Canal System, Donna Hidalgo County, Texas.* Prepared for the Texas Commission on Environmental Quality. June.

The siphon plan, profile, and sections shown on this drawing are based on historic siphon drawings from the report *Inverted Siphon Inspection by Remotely Operated Vehicle* (ASI Marine, 2001), and from construction plans entitled *Rehabilitation of Irrigation Facilities - First Lift Main Canal* prepared by Sigler, Clark & Associates, Weslaco, Texas and dated July 1961. The accuracy of the historic siphon drawings has not been verified and all information is approximate and should not be used for design purposes.

Remedial Investigation/Feasibility Study
Donna Reservoir and Canal System
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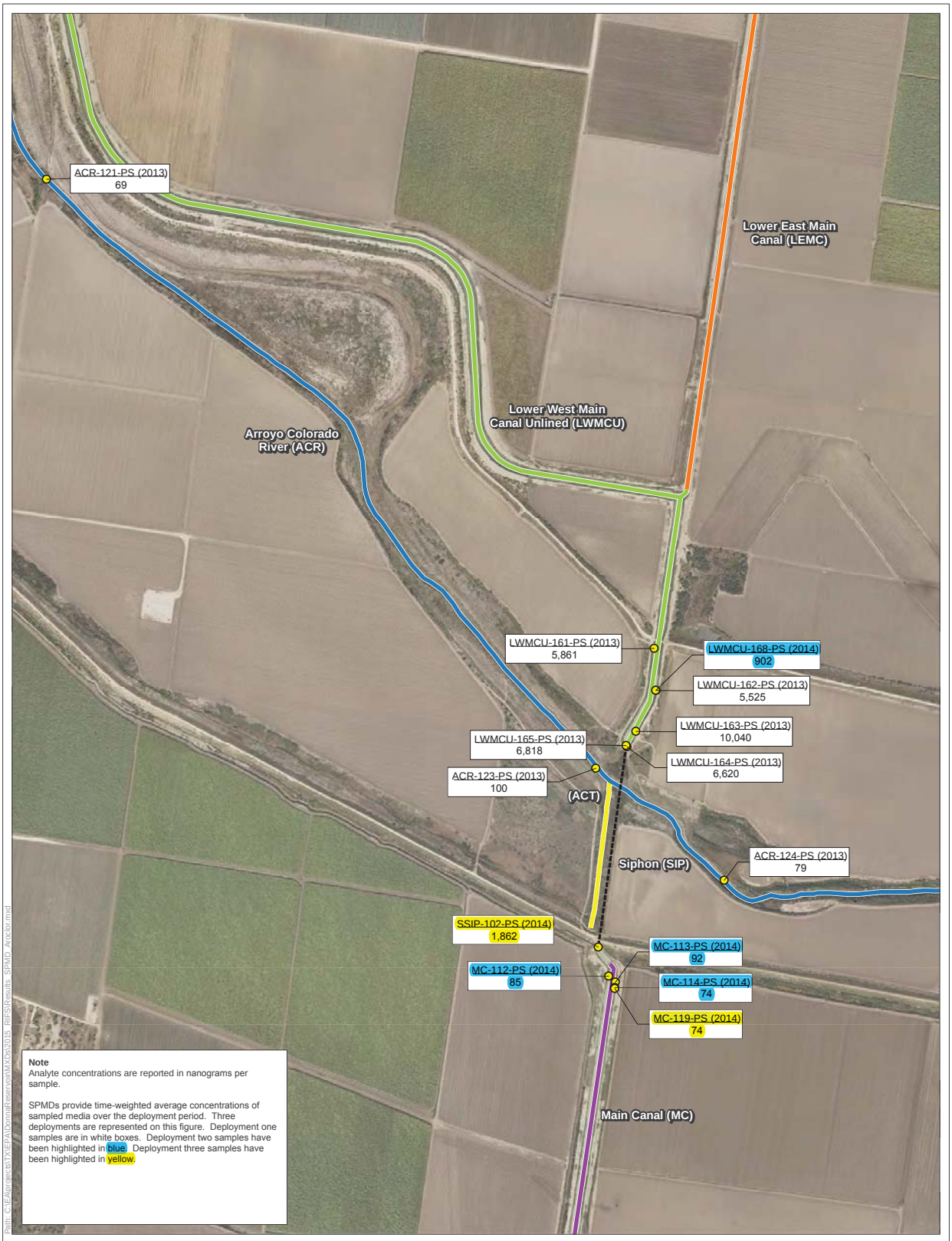
Figure 1-19
Total Polychlorinated Biphenyl Congeners in Surface Water Samples Collected from Inside the Siphon

099922



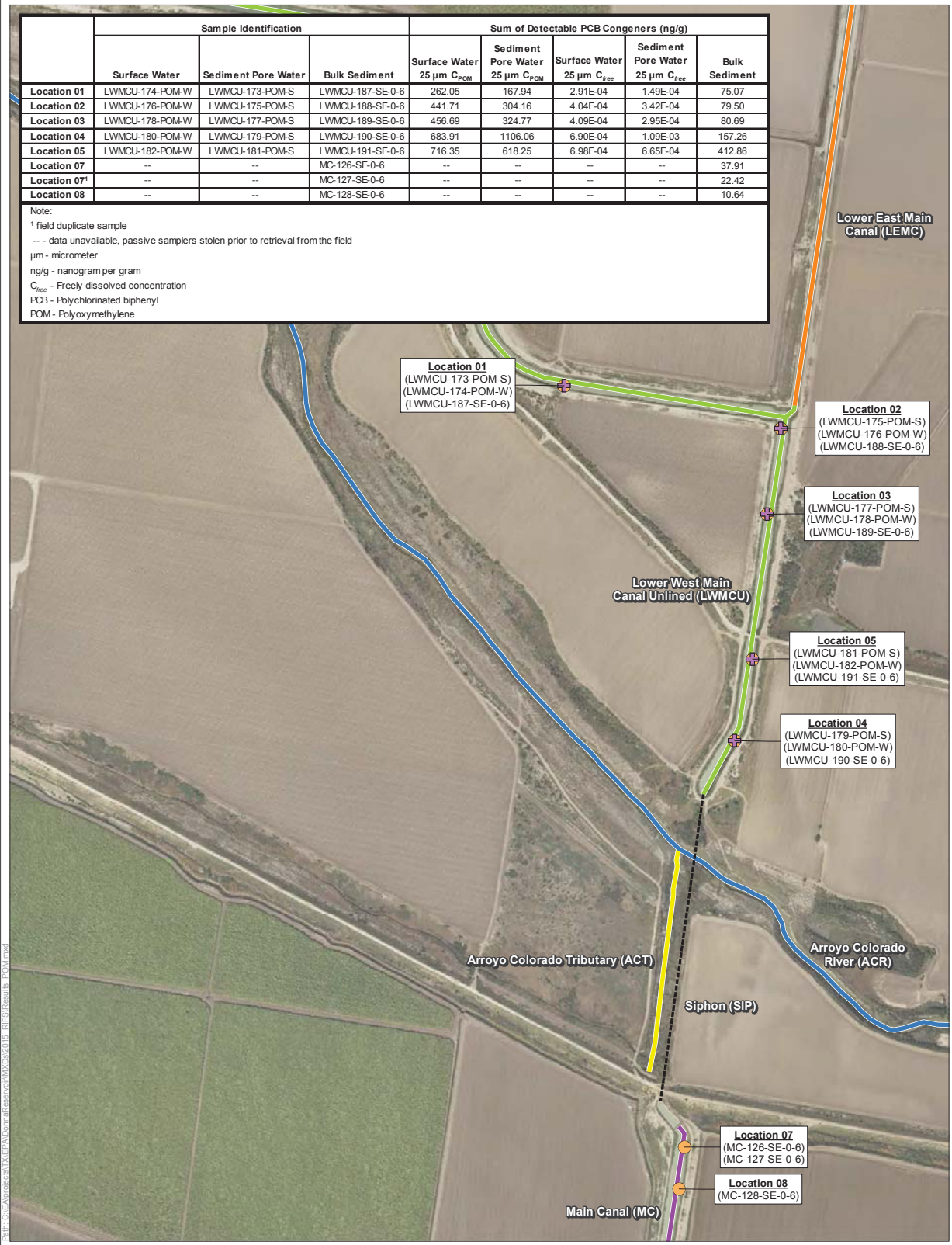
Remedial Investigation/Feasibility Study
Donna Reservoir and Canal System
Donna, Hidalgo County, Texas

Figure 1-20.
Semi-Permeable Membrane Device Concentrations of Total Polychlorinated Biphenyl Congeners

099923

	Sample Identification			Sum of Detectable PCB Congeners (ng/g)				
	Surface Water	Sediment Pore Water	Bulk Sediment	Surface Water 25 µm C_{POM}	Sediment Pore Water 25 µm C_{POM}	Surface Water 25 µm C_{free}	Sediment Pore Water 25 µm C_{free}	Bulk Sediment
Location 01	LWMCU-174-POM-W	LWMCU-173-POM-S	LWMCU-187-SE-0-6	262.05	167.94	2.91E-04	1.49E-04	75.07
Location 02	LWMCU-176-POM-W	LWMCU-175-POM-S	LWMCU-188-SE-0-6	441.71	304.16	4.04E-04	3.42E-04	79.50
Location 03	LWMCU-178-POM-W	LWMCU-177-POM-S	LWMCU-189-SE-0-6	456.69	324.77	4.09E-04	2.95E-04	80.69
Location 04	LWMCU-180-POM-W	LWMCU-179-POM-S	LWMCU-190-SE-0-6	683.91	1106.06	6.90E-04	1.09E-03	157.26
Location 05	LWMCU-182-POM-W	LWMCU-181-POM-S	LWMCU-191-SE-0-6	716.35	618.25	6.98E-04	6.65E-04	412.86
Location 07	--	--	MC-126-SE-0-6	--	--	--	--	37.91
Location 07[1]	--	--	MC-127-SE-0-6	--	--	--	--	22.42
Location 08	--	--	MC-128-SE-0-6	--	--	--	--	10.64

Note:
[1] field duplicate sample
-- - data unavailable, passive samplers stolen prior to retrieval from the field
µm - micrometer
ng/g - nanogram per gram
C_{free} - Freely dissolved concentration
PCB - Polychlorinated biphenyl
POM - Polyoxymethylene



Path: C:\EA\projects\TX\EPA\Donna\Reservoir\MXDs\2015_RIFS\Results_POM.mxd

Legend
- Lower West Main Canal Unlined
- Lower East Main Canal
- Arroyo Colorado River
- Arroyo Colorado Tributary
- Siphon (Underground)
- Main Canal

Sample Locations by Matrix
- Polyoxymethylene
- Sediment

Location (Sample Identification)

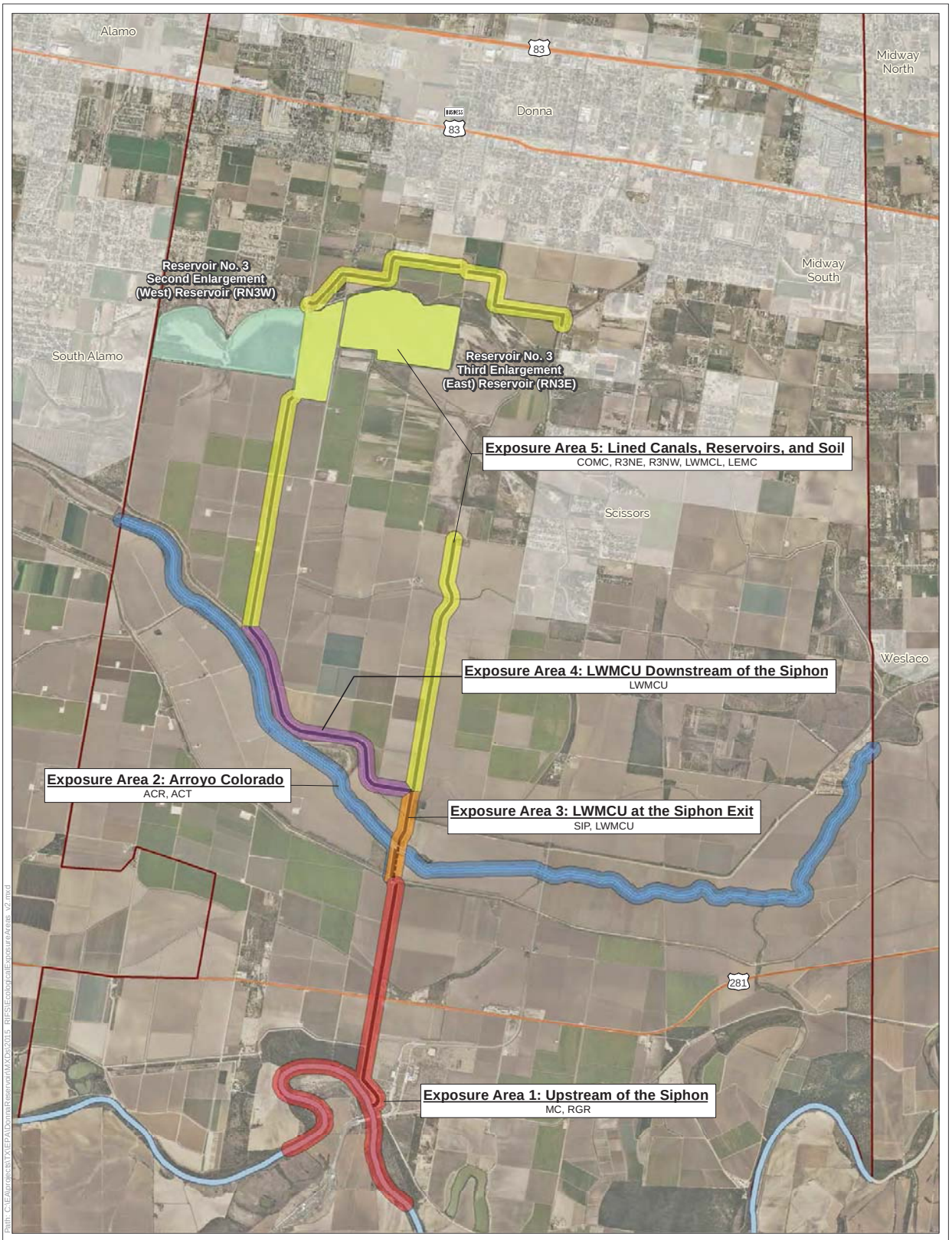
Data Sources: Esri 2006, Texas A&M AgriLife Extension Service 2015, USGS 2014

0 400 800
Feet

Remedial Investigation/Feasibility Study
Donna Reservoir and Canal System
Donna, Hidalgo County, Texas

Figure 1-21.
Polyoxymethylene Concentrations of
Total Polychlorinated Biphenyl Congeners

099924



Legend

- Donna Irrigation District - Hidalgo County No. 1
- Donna Reservoir
- Exposure Area 1: Upstream of the Siphon
- Exposure Area 2: Arroyo Colorado
- Exposure Area 3: LWMCU at the Siphon Exit
- Exposure Area 4: LWMCU Downstream of the Siphon
- Exposure Area 5: Lined Canals, Reservoirs, and Soil

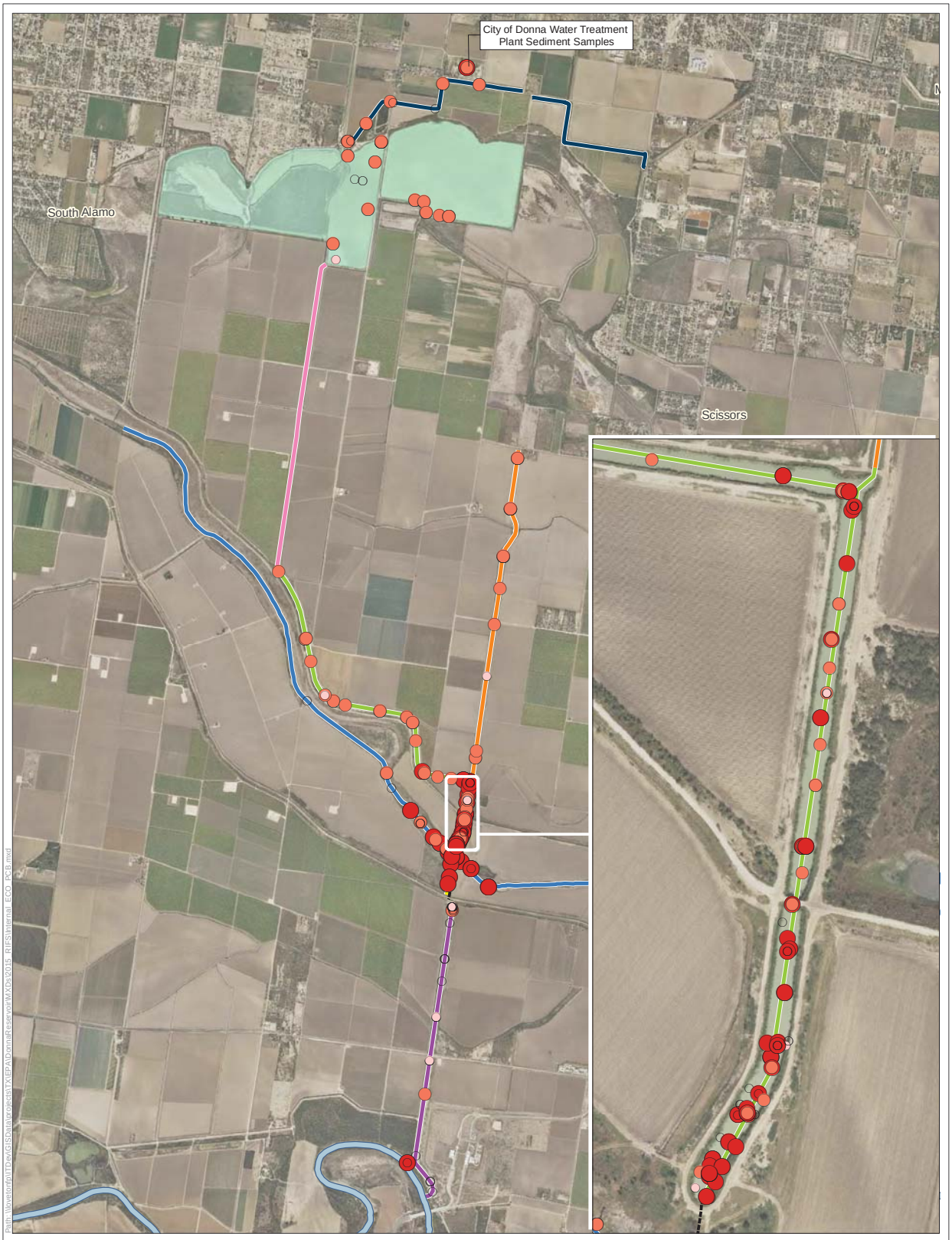
Data Sources: Esri 2006, Texas A&M AgriLife Extension Service 2015, USGS 2014

0 2,000 4,000
Feet

Remedial Investigation/Feasibility Study
Donna Reservoir and Canal System
Donna, Hidalgo County, Texas

Figure 1-22.
Ecological Exposure Areas

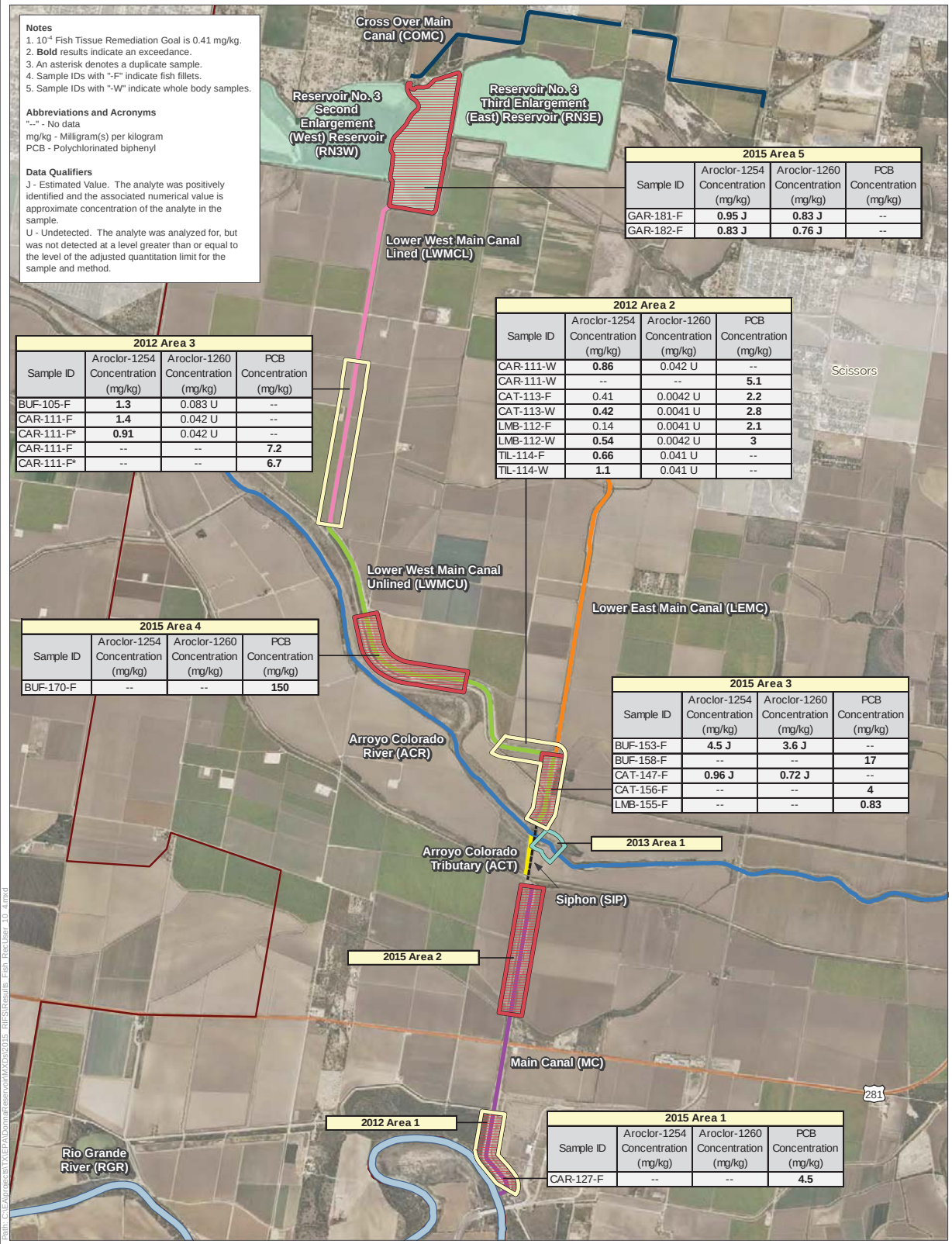
099925



Remedial Investigation/Feasibility Study
Donna Reservoir and Canal System
Donna, Hidalgo County, Texas

Figure 2-1.
Polychlorinated Biphenyls in Sediment, Color Coded by Remediation Goals Under Consideration

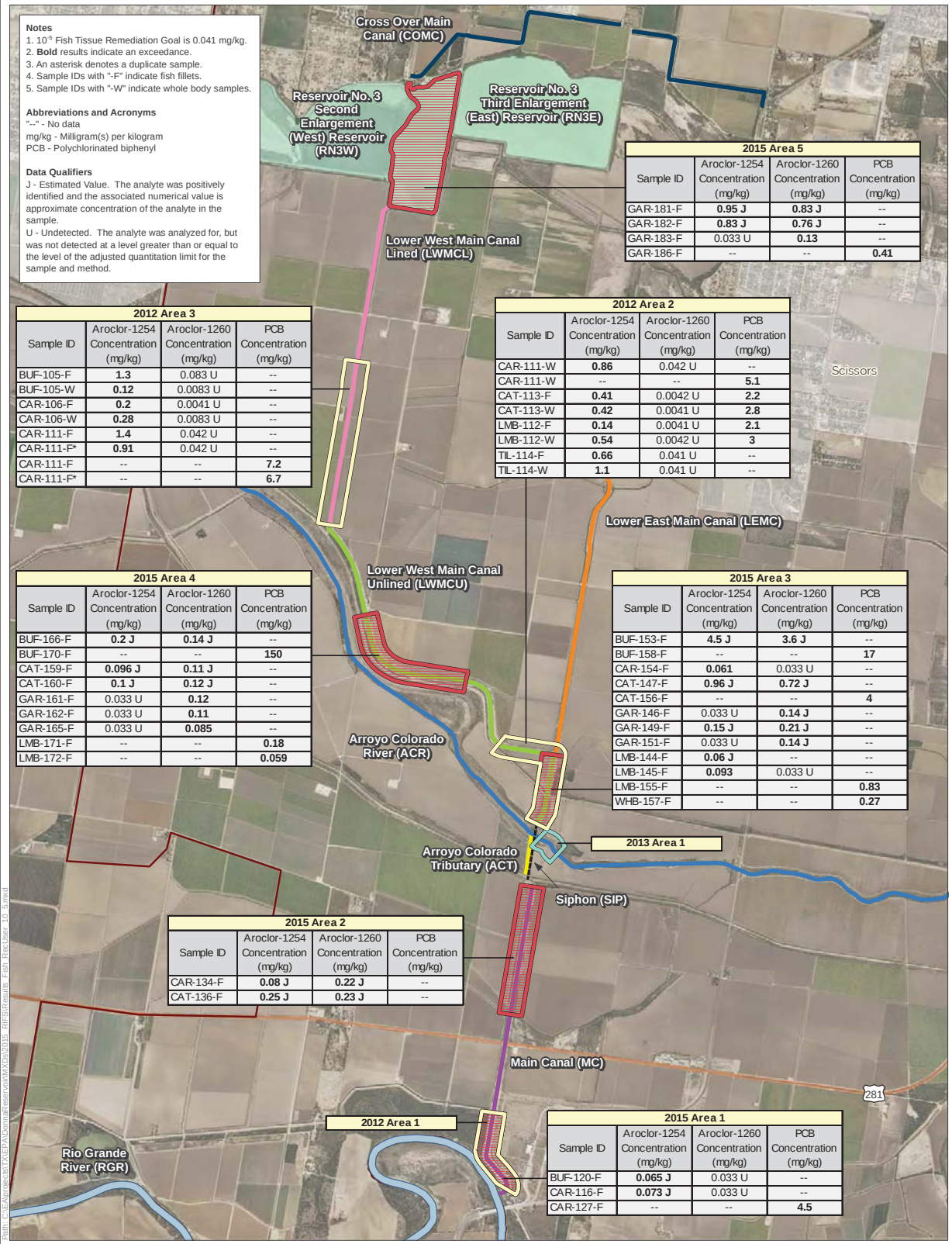
099926



Remedial Investigation/Feasibility Study
Donna Reservoir and Canal System
Donna, Hidalgo County, Texas

Figure 2-2.
Fish Samples that Exceed a Recreational User Fish Consumption Potential Remediation Goal for 10^{-4} Cancer Risk

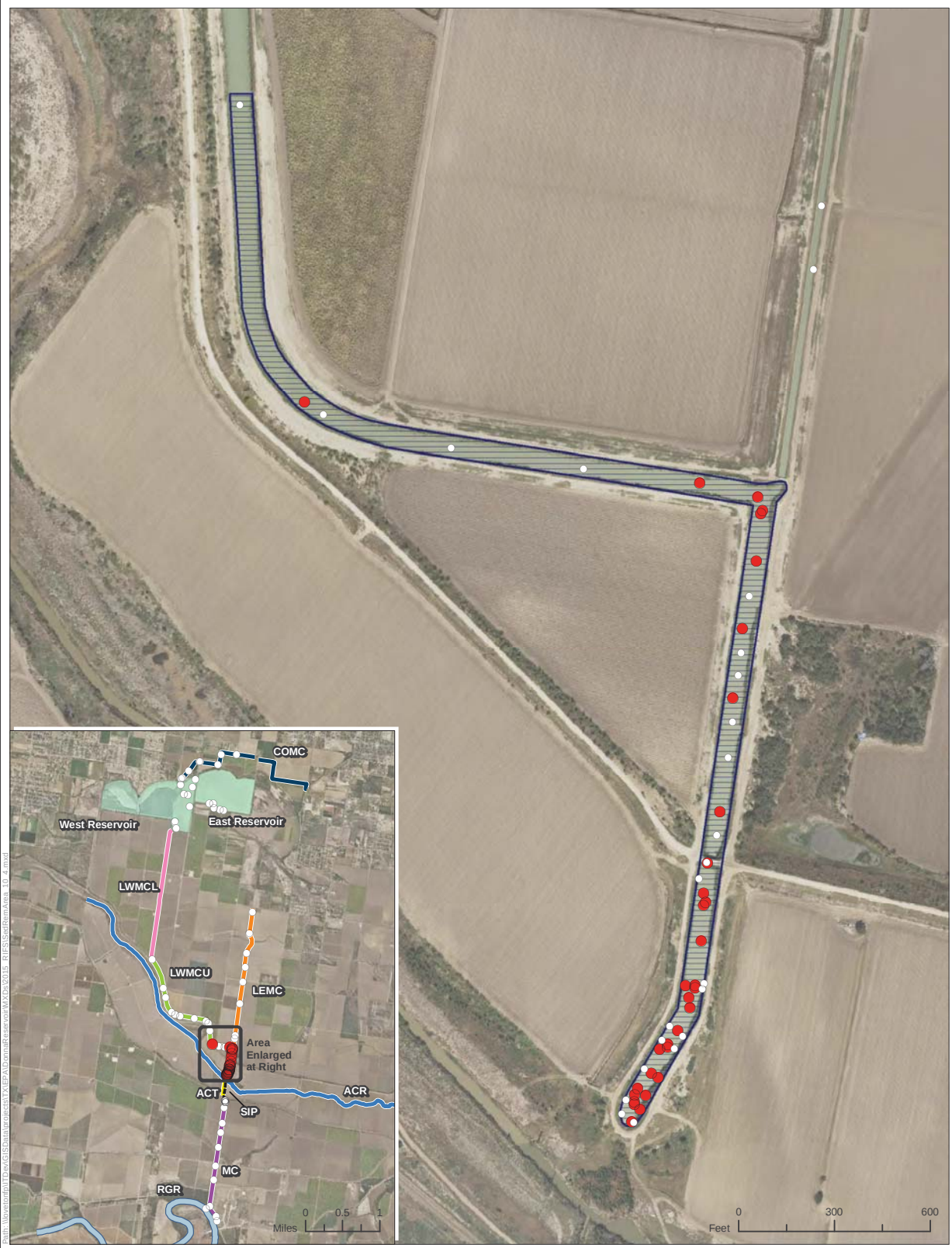
099927



Remedial Investigation/Feasibility Study
Donna Reservoir and Canal System
Donna, Hidalgo County, Texas

Figure 2-3.
Fish Samples that Exceed a Recreational User Fish Consumption Potential Remediation Goal for 10^{-5} Cancer Risk

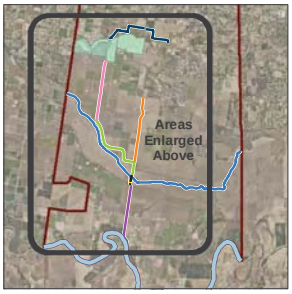
099928



Remedial Investigation/Feasibility Study
Donna Reservoir and Canal System
Donna, Hidalgo County, Texas

Figure 2-4.
Sediment Remediation Area Based on a Sediment Preliminary Remediation Goal of 0.043 mg/kg

099929



Legend

- Cross Over Main Canal
- Lower West Main Canal Lined
- Lower West Main Canal Unlined
- Lower East Main Canal
- Arroyo Colorado River
- Arroyo Colorado Tributary
- Siphon (Underground)
- Main Canal
- Rio Grande River
- Remediation Area
- Remedial Design Confirmation Area

Aroclor-1254, Aroclor-1260, or Total PCB Congener Concentrations in Sediment

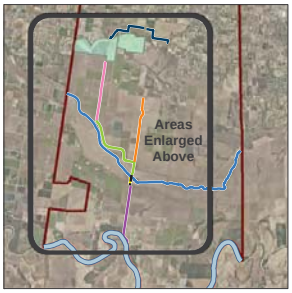
- Does not Exceed Cleanup Goal <0.004 mg/kg
- Reporting Limit Exceeds Cleanup Goal >0.004 mg/kg
- Exceeds Cleanup Goal >0.004 mg/kg

mg/kg - Milligram(s) per kilogram
PCB - Polychlorinated Biphenyl

Data Sources: Esri 2006, Texas A&M AgriLife Extension Service 2015, USGS 2014

Remedial Investigation/Feasibility Study
Donna Reservoir and Canal System
Donna, Hidalgo County, Texas

Figure 2-5.
Sediment Remediation Area Based on a Sediment Preliminary Remediation Goal of 0.004 mg/kg



Legend

- Cross Over Main Canal
- Lower West Main Canal Lined
- Lower West Main Canal Unlined
- Lower East Main Canal
- Arroyo Colorado River
- Arroyo Colorado Tributary
- Siphon (Underground)
- Main Canal
- Rio Grande River
- Remediation Area
- Remedial Design Confirmation Area

Aroclor-1254, Aroclor-1260, or Total PCB Congener Concentrations in Sediment

- Does not Exceed Cleanup Goal <0.003 mg/kg
- Reporting Limit Exceeds Cleanup Goal >0.003 mg/kg
- Exceeds Cleanup Goal >0.003 mg/kg

mg/kg - Milligram(s) per kilogram
PCB - Polychlorinated Biphenyl

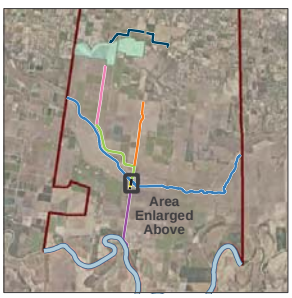
Data Sources: Esri 2006, Texas A&M AgriLife Extension Service 2015, USGS 2014

Remedial Investigation/Feasibility Study
Donna Reservoir and Canal System
Donna, Hidalgo County, Texas

Figure 2-6.
Sediment Remediation Area Based on a Sediment Preliminary Remediation Goal of 0.003 mg/kg

Path: C:\EA\projects\TX\EPA\DonnaReservoir\MXDs\2015_RIFS\SedRemArea_10_5.mxd

099931



Legend

- Lower West Main Canal Unlined (Modified)
- Main Canal (Modified)
- New Flow Control Gate
- New Siphon
- Existing Siphon

Data Sources: Esri 2006,
Texas A&M AgriLife Extension Service 2015, USGS 2014

0 100 200
Feet

Remedial Investigation/Feasibility Study
Donna Reservoir and Canal System
Donna, Hidalgo County, Texas

Figure 4-1.
Siphon Replacement

Path: C:\EA\projects\TX\EPA\DonnaReservoir\MXDs\2015_RIFS\SiphonReplacement.mxd

099932

Tables

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TABLE 2-1
EXPOSURE PARAMETERS USED IN SITE-SPECIFIC PRELIMINARY REMEDIATION GOAL CALCULATIONS

Exposure Parameters	Units	Adult	Adolescent (ages 6 to 16)	Child (ages 2 to 6)	Subsistence	References
Daily Fish Intake						
CR (Ingestion Rate)	*kilogram/meal*	0.0263	0.0196	0.0098	0.146	EPA 2000
EF (Exposure Frequency)	*meals/year*	365	365	365	365	EPA 2000
ED (Exposure Duration)	*years*	26	10	4	20	EPA 2011, 2014
BW (Body Weight)	*kilogram*	80	45	15	80	EPA 2011, 2014
AT_c (Averaging Time-cancer)	*days/year*	25,550	25,550	25,550	25,550	EPA 1989
AT_{nc} (Averaging Time-noncancer)	*days/year*	9,490	3,650	1,460	7,300	EPA 1989

Note:

U.S. Environmental Protection Agency (EPA). 1989. *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part A).* Office of Emergency and Remedial Response, EPA/540/1-89/002. December.

———. 2000. *Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume 2: Risk Assessment and Fish Consumption Limits, Third Edition* . Office of Science and Technology, Office of Water. EPA-823-B-00-008.

———. 2011. *Exposure Factors Handbook: 2011 Edition* . Office of Research and Development, EPA/600/R-090/052F. September.

———. 2014. *Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors* . Office of Solid Waste and Emergency Response, OSWER Directive 9200.1-120. February 6.

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TABLE 2-2
CALCULATIONS FOR SITE-SPECIFIC FISH TISSUE AND SEDIMENT PRELIMINARY REMEDIATION GOALS
CARCINOGENIC RISK 1 × 10^{-6}, NON-CARCINOGENIC RISK HI = 1

Receptor	Cancer: Ingestion intake variable	Non-Cancer: Ingestion intake variable
Adult	1.22E-04	3.29E-04
Adolescent	6.22E-05	4.36E-04
Child	3.73E-05	6.53E-04
Subsistence	5.21E-04	1.83E-03

Acceptable risk = 1.0E-06
Acceptable HI = 1

For Non-Cancer

Preliminary Remediation Level (mg/kg) = [Target HI x ATnc x BW] / [CR x EF x ED x (1/RfDo)]

For Cancer

Preliminary Remediation Level (mg/kg) = [Target Risk x ATc x BW] / [CR x EF x ED x (CSFo)]

Chemical of Concern	CAS No.	Oral CSFo (mg/kg-day)-1	Oral RfDo (mg/kg-day)	Preliminary Cancer Remediation Goal, Ingestion: Adult (mg/kg)	Adolescent (mg/kg)	Child (mg/kg)	Subsistence (mg/kg)	Preliminary Non-Cancer Remediation Goal, Ingestion: Adult (mg/kg)	Adolescent (mg/kg)	Child (mg/kg)	Subsistence (mg/kg)	Fish Tissue Selected Preliminary Remediation Goals[1] (C_{fish} mg/kg)
Total PCBs	11097-69-1	2.00E+00	NA	4.09E-03	8.04E-03	1.34E-02	9.59E-04	NA	NA	NA	NA	4.1E-03

Bioaccumulation Factor = BAF = Geometric Mean Fish Concentration / Geometric Mean Sediment Concentration

Sediment Preliminary Remediation Level (mg/kg) = C_{fish} (mg/kg) / BAF

Chemical of Concern	CAS No.	Geometric Mean Fish Concentration (mg/kg)	Geometric Mean Sediment Concentration (mg/kg)	BAF (mg/kg wet weight organism / mg/kg dry weight sediment)	Sediment Preliminary Remediation Goal at 10^{-6} risk (mg/kg)
Total PCBs	11097-69-1	3.70E-01	3.88E-02	9.54E+00	4.3E-04

Note:
[1] Selected Preliminary Remediation Goal not selected from the Subsistence Fisher due to the high exposures expected.

AT_c - Averaging Time-cancer
AT_{nc} - Averaging Time-noncancer
BAF - Bioaccumulation Factor
BW - Body Weight
Cfish - Preliminary Remediation Level for fish tissue
CR - Ingestion Rate
CSF_o - Cancer Slope Factor
ED - Exposure Duration
EF - Exposure Frequency
HI - Hazard Index
mg/kg - milligram per kilogram
NA - Not Applicable
PCBs - Polychlorinated Biphenyls
RfD_o - Reference Dose
Total PCBs - Either the sum of PCBs as Aroclors or the sum of PCB congeners

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TABLE 2-3
CALCULATIONS FOR SITE-SPECIFIC FISH TISSUE AND SEDIMENT PRELIMINARY REMEDIATION GOALS
CARCINOGENIC RISK 1 × 10^{-5}, NON-CARCINOGENIC RISK HI = 1

Receptor	Cancer: Ingestion intake variable	Non-Cancer: Ingestion intake variable
Adult	1.22E-04	3.29E-04
Adolescent	6.22E-05	4.36E-04
Child	3.73E-05	6.53E-04
Subsistence	5.21E-04	1.83E-03

Acceptable risk = 1.0E-05
Acceptable HI = 1

For Non-Cancer

Preliminary Remediation Level (mg/kg) = [Target HI x AT_{nc} x BW] / [CR x EF x ED x ($1/RfD_o$)]

For Cancer

Preliminary Remediation Level (mg/kg) = [Target Risk x AT_c x BW] / [CR x EF x ED x (CSF_o)]

Chemical of Concern	CAS No.	Oral: CSF_o $(mg/kg\text{-}day)^{-1}$	Oral: RfD_o (mg/kg-day)	Preliminary Cancer Remediation Goal, Ingestion: Adult (mg/kg)	Adolescent (mg/kg)	Child (mg/kg)	Subsistence (mg/kg)	Preliminary Non-Cancer Remediation Goal, Ingestion: Adult (mg/kg)	Adolescent (mg/kg)	Child (mg/kg)	Subsistence (mg/kg)	Fish Tissue Selected Preliminary Remediation Goals[1] (C_{fish} mg/kg)
Total PCBs	11097-69-1	2.00E+00	NA	4.09E-02	8.04E-02	1.34E-01	9.59E-03	NA	NA	NA	NA	4.1E-02

Bioaccumulation Factor = BAF = Geometric Mean Fish Concentration / Geometric Mean Sediment Concentration

Sediment Preliminary Remediation Level (mg/kg) = C_{fish} (mg/kg) / BAF

Chemical of Concern	CAS No.	Geometric Mean Fish Concentration (mg/kg)	Geometric Mean Sediment Concentration (mg/kg)	BAF (mg/kg wet weight organism/ mg/kg dry weight sediment)	Sediment Preliminary Remediation Goal at 10^{-5} risk (mg/kg)
Total PCBs	11097-69-1	3.70E-01	3.88E-02	9.54E+00	4.3E-03

Note:
[1] Selected Preliminary Remediation Goal not selected from the Subsistence Fisher due to the high exposures expected.

AT_c - Averaging Time-cancer
AT_{nc} - Averaging Time-noncancer
BAF - Bioaccumulation Factor
BW - Body Weight
C_{fish} - Preliminary Remediation Level for fish tissue
CR - Ingestion Rate
CSF_o - Cancer Slope Factor
ED - Exposure Duration
EF - Exposure Frequency
HI - Hazard Index
mg/kg - milligram per kilogram
NA - Not Applicable
PCBs - Polychlorinated Biphenyls
RfD_o - Reference Dose
Total PCBs - Either the sum of PCBs as Aroclors or the sum of PCB congeners

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TABLE 2-4
CALCULATIONS FOR SITE-SPECIFIC FISH TISSUE AND SEDIMENT PRELIMINARY REMEDIATION GOALS
CARCINOGENIC RISK 1 × 10^{-4}, NON-CARCINOGENIC RISK HI = 1

Receptor	Cancer: Ingestion intake variable	Non-Cancer: Ingestion intake variable
Adult	1.22E-04	3.29E-04
Adolescent	6.22E-05	4.36E-04
Child	3.73E-05	6.53E-04
Subsistence	5.21E-04	1.83E-03

Acceptable risk = 1.0E-04
Acceptable HI = 1

For Non-Cancer

Preliminary Remediation Level (mg/kg) = [Target HI x ATnc x BW] / [CR x EF x ED x (1/RfDo)]

For Cancer

Preliminary Remediation Level (mg/kg) = [Target Risk x ATc x BW] / [CR x EF x ED x (CSFo)]

Chemical of Concern	CAS No.	Oral CSFo (mg/kg-day)-1	Oral RfDo (mg/kg-day)	Preliminary Cancer Remediation Goal – Ingestion: Adult (mg/kg)	Adolescent (mg/kg)	Child (mg/kg)	Subsistence (mg/kg)	Preliminary Non-Cancer Remediation Goal – Ingestion: Adult (mg/kg)	Adolescent (mg/kg)	Child (mg/kg)	Subsistence (mg/kg)	Fish Tissue Selected Preliminary Remediation Goals[1] (C_{fish} mg/kg)
Total PCBs	11097-69-1	2.00E+00	NA	4.09E-01	8.04E-01	1.34E+00	9.59E-02	NA	NA	NA	NA	4.1E-01

Bioaccumulation Factor = BAF = Geometric Mean Fish Concentration / Geometric Mean Sediment Concentration

Sediment Preliminary Remediation Level (mg/kg) = C_{fish} (mg/kg) / BAF

Chemical of Concern	CAS No.	Geometric Mean Fish Concentration (mg/kg)	Geometric Mean Sediment Concentration (mg/kg)	BAF (mg/kg wet weight organism / mg/kg dry weight sediment)	Sediment Preliminary Remediation Goal at 10^{-4} risk (mg/kg)
Total PCBs	11097-69-1	3.70E-01	3.88E-02	9.54E+00	4.3E-02

Note:
1 Selected Preliminary Remediation Goal not selected from the Subsistence Fisher due to the high exposures expected.

ATc - Averaging Time-cancer
ATnc - Averaging Time-noncancer
BAF - Bioaccumulation Factor
BW - Body Weight
Cfish - Preliminary Remediation Level for fish tissue
CR - Ingestion Rate
CSFo - Cancer Slope Factor
ED - Exposure Duration
EF - Exposure Frequency
HI - Hazard Index
mg/kg - milligram per kilogram
NA - Not Applicable
PCBs - Polychlorinated Biphenyls
RfDo - Reference Dose
Total PCBs - Either the sum of PCBs as Aroclors or the sum of PCB congeners

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TABLE 2-5
CALCULATIONS FOR SITE-SPECIFIC FISH TISSUE AND SEDIMENT PRELIMINARY REMEDIATION GOALS
USING AROCLOR-1254

Receptor	Cancer: Ingestion intake variable	Non-Cancer: Ingestion intake variable
Adult	1.22E-04	3.29E-04
Adolescent	6.22E-05	4.36E-04
Child	3.73E-05	6.53E-04
Subsistence	5.21E-04	1.83E-03

Acceptable risk = 1.0E-04
Acceptable HI = 1

For Non-Cancer

Preliminary Remediation Level (mg/kg) = [Target HI x ATnc x BW] / [CR x EF x ED x (1/RfDo)]

For Cancer

Preliminary Remediation Level (mg/kg) = [Target Risk x ATc x BW] / [CR x EF x ED x (CSFo)]

Chemical of Concern	CAS No.	Oral: CSFo (mg/kg-day)-1	Oral: RfDo (mg/kg-day)	Preliminary Cancer Remediation Goal, Ingestion: Adult (mg/kg)	Adolescent (mg/kg)	Child (mg/kg)	Subsistence (mg/kg)	Preliminary Non-Cancer Remediation Goal, Ingestion: Adult (mg/kg)	Adolescent (mg/kg)	Child (mg/kg)	Subsistence (mg/kg)	Fish Tissue Selected Preliminary Remediation Goals[1] (C_{fish} mg/kg)
Aroclor-1254	11097-69-1	2.00E+00	2.00E-05	4.09E-01	8.04E-01	1.34E+00	9.59E-02	6.08E-02	4.59E-02	3.06E-02	1.10E-02	3.1E-02

Bioaccumulation Factor = BAF = Geometric Mean Fish Concentration / Geometric Mean Sediment Concentration

Sediment Preliminary Remediation Level (mg/kg) = C_{fish} (mg/kg) / BAF

Chemical of Concern	CAS No.	Geometric Mean Fish Concentration (mg/kg)	Geometric Mean Sediment Concentration (mg/kg)	BAF (mg/kg wet weight organism/ mg/kg dry weight sediment)	Sediment Preliminary Remediation Goal at Hazard Index = 1.0 (mg/kg)
Aroclor-1254	11097-69-1	3.70E-01	3.88E-02	9.54E+00	3.2E-03

Note:
[1] Selected Preliminary Remediation Goal not selected from the Subsistence Fisher due to the high exposures expected.

AT_c - Averaging Time-cancer
AT_{nc} - Averaging Time-noncancer
BAF - Bioaccumulation Factor
BW - Body Weight
C_{fish} - Preliminary Remediation Level for fish tissue
CR - Ingestion Rate
CSF_o - Cancer Slope Factor
ED - Exposure Duration
EF - Exposure Frequency
HI - Hazard Index
mg/kg - milligram per kilogram
PCBs - Polychlorinated Biphenyls
RfD_o - Reference Dose
Total PCBs - Either the sum of PCBs as Aroclors or the sum of PCB congeners

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TABLE 2-6

SAMPLES USED IN CALCULATION OF THE GEOMETRIC MEAN OF FISH FILLET CONCENTRATIONS, NONDETECT RESULTS VALUED AT 0.5 REPORTING LIMIT

Sample Identification	Analyte	Matrix	Result (mg/kg)
BUF-105-F	TOTAL PCB AROCLORS	Fish Fillet	1.55
BUF-153-F	TOTAL PCB AROCLORS	Fish Fillet	8.22
BUF-166-F	TOTAL PCB AROCLORS	Fish Fillet	0.46
CAR-106-F	TOTAL PCB AROCLORS	Fish Fillet	0.21
CAR-111-F	TOTAL PCB AROCLORS	Fish Fillet	1.53
CAR-150-F	TOTAL PCB AROCLORS	Fish Fillet	0.19
CAR-152-F	TOTAL PCB AROCLORS	Fish Fillet	0.15
CAR-154-F	TOTAL PCB AROCLORS	Fish Fillet	0.19
CAR-168-F	TOTAL PCB AROCLORS	Fish Fillet	0.14
CAR-169-F	TOTAL PCB AROCLORS	Fish Fillet	0.15
CAR-178-F	TOTAL PCB AROCLORS	Fish Fillet	0.15
CAR-179-F	TOTAL PCB AROCLORS	Fish Fillet	0.15
CAR-180-F	TOTAL PCB AROCLORS	Fish Fillet	0.15
CAT-113-F	TOTAL PCB AROCLORS	Fish Fillet	0.42
CAT-147-F	TOTAL PCB AROCLORS	Fish Fillet	1.79
CAT-159-F	TOTAL PCB AROCLORS	Fish Fillet	0.32
CAT-160-F	TOTAL PCB AROCLORS	Fish Fillet	0.34
DRM-167-F	TOTAL PCB AROCLORS	Fish Fillet	0.15
DRM-173-F	TOTAL PCB AROCLORS	Fish Fillet	0.15
DRM-174-F	TOTAL PCB AROCLORS	Fish Fillet	0.14
DRM-175-F	TOTAL PCB AROCLORS	Fish Fillet	0.14
GAR-146-F	TOTAL PCB AROCLORS	Fish Fillet	0.27
GAR-149-F	TOTAL PCB AROCLORS	Fish Fillet	0.48
GAR-151-F	TOTAL PCB AROCLORS	Fish Fillet	0.27
GAR-161-F	TOTAL PCB AROCLORS	Fish Fillet	0.25
GAR-162-F	TOTAL PCB AROCLORS	Fish Fillet	0.24
GAR-165-F	TOTAL PCB AROCLORS	Fish Fillet	0.22
GAR-181-F	TOTAL PCB AROCLORS	Fish Fillet	1.90
GAR-182-F	TOTAL PCB AROCLORS	Fish Fillet	1.71
GAR-183-F	TOTAL PCB AROCLORS	Fish Fillet	0.26
LMB-112-F	TOTAL PCB AROCLORS	Fish Fillet	0.15
LMB-144-F	TOTAL PCB AROCLORS	Fish Fillet	0.06
LMB-145-F	TOTAL PCB AROCLORS	Fish Fillet	0.23
LMB-163-F	TOTAL PCB AROCLORS	Fish Fillet	0.15
LMB-176-F	TOTAL PCB AROCLORS	Fish Fillet	0.15
TIL-114-F	TOTAL PCB AROCLORS	Fish Fillet	0.78
WHB-148-F	TOTAL PCB AROCLORS	Fish Fillet	0.15
WHB-164-F	TOTAL PCB AROCLORS	Fish Fillet	0.15
WHB-177-F	TOTAL PCB AROCLORS	Fish Fillet	0.15
BUF-158-F	TOTAL PCB CONGENERS	Fish Fillet	16.95
BUF-170-F	TOTAL PCB CONGENERS	Fish Fillet	151.30
CAR-111-F	TOTAL PCB CONGENERS	Fish Fillet	7.21
CAR-185-F	TOTAL PCB CONGENERS	Fish Fillet	0.01
CAT-113-F	TOTAL PCB CONGENERS	Fish Fillet	2.18
CAT-156-F	TOTAL PCB CONGENERS	Fish Fillet	4.01
DRM-184-F	TOTAL PCB CONGENERS	Fish Fillet	0.01

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TABLE 2-6

SAMPLES USED IN CALCULATION OF THE GEOMETRIC MEAN OF FISH FILLET CONCENTRATIONS, NONDETECT RESULTS VALUED AT 0.5 REPORTING LIMIT

Sample Identification	Analyte	Matrix	Result (mg/kg)
GAR-186-F	TOTAL PCB CONGENERS	Fish Fillet	0.42
LMB-112-F	TOTAL PCB CONGENERS	Fish Fillet	2.11
LMB-155-F	TOTAL PCB CONGENERS	Fish Fillet	0.85
LMB-171-F	TOTAL PCB CONGENERS	Fish Fillet	0.18
LMB-172-F	TOTAL PCB CONGENERS	Fish Fillet	0.06
WHB-157-F	TOTAL PCB CONGENERS	Fish Fillet	0.28
Geometric Mean	TOTAL PCB (ND=0.5)		0.37

Note:
Nondetect results valued at 0.5 times the reporting limit.
PCB - polychlorinated biphenyl
mg/kg - milligram per kilogram
The geometric mean fish concentration is based upon the following:

1. All fish tissue results for total PCB congeners were selected from the dataset.
2. If total PCB Congeners were not analyzed for a given fish tissue sample, then the total PCB Aroclor result was selected.
3. If both PCB Congeners and Aroclors were analyzed for a given fish tissue sample, only the total PCB congeners were selected.

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TABLE 2-7

SAMPLES USED IN CALCULATIONS OF THE GEOMETRIC MEAN OF SEDIMENT CONCENTRATIONS, NONDETECT RESULTS VALUED AT 0.5 REPORTING LIMIT

Sample Identification	Analyte	Matrix	Result (mg/kg)
LEMC-101-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.02
LEMC-102-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.05
LEMC-103-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.01
LEMC-104-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.02
LEMC-105-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.04
LEMC-106-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.05
LEMC-107-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.02
LEMC-108-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.01
LWMCU-101-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.62
LWMCU-101-SE-6-12	TOTAL PCB AROCLORS	Sediment	0.01
LWMCU-102-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.35
LWMCU-102-SE-6-12	TOTAL PCB AROCLORS	Sediment	0.12
LWMCU-103-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.10
LWMCU-103-SE-6-12	TOTAL PCB AROCLORS	Sediment	0.07
LWMCU-104-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.03
LWMCU-104-SE-6-12	TOTAL PCB AROCLORS	Sediment	0.09
LWMCU-105-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.02
LWMCU-105-SE-6-12	TOTAL PCB AROCLORS	Sediment	0.02
LWMCU-106-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.11
LWMCU-106-SE-12-20	TOTAL PCB AROCLORS	Sediment	0.19
LWMCU-106-SE-6-12	TOTAL PCB AROCLORS	Sediment	0.18
LWMCU-107-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.04
LWMCU-108-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.04
LWMCU-109-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.01
LWMCU-110-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.06
LWMCU-111-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.28
LWMCU-112-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.34
LWMCU-113-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.21
LWMCU-114-SE-0-6	TOTAL PCB AROCLORS	Sediment	1.85
LWMCU-115-SE-0-6	TOTAL PCB AROCLORS	Sediment	1.10
LWMCU-117-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.01
LWMCU-118-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.01
LWMCU-119-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.02
LWMCU-120-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.01
LWMCU-121-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.02
LWMCU-122-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.02
LWMCU-123-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.04
LWMCU-123-SE-6-12	TOTAL PCB AROCLORS	Sediment	0.07
LWMCU-124-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.02
LWMCU-125-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.03
LWMCU-126-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.02
LWMCU-127-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.02

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TABLE 2-7

SAMPLES USED IN CALCULATIONS OF THE GEOMETRIC MEAN OF SEDIMENT CONCENTRATIONS, NONDETECT RESULTS VALUED AT 0.5 REPORTING LIMIT

Sample Identification	Analyte	Matrix	Result (mg/kg)
LWMCU-128-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.01
LWMCU-129-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.22
LWMCU-130-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.12
LWMCU-130-SE-6-12	TOTAL PCB AROCLORS	Sediment	0.14
LWMCU-131-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.10
LWMCU-132-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.04
LWMCU-133-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.01
LWMCU-134-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.01
LWMCU-135-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.14
LWMCU-135-SE-6-12	TOTAL PCB AROCLORS	Sediment	0.01
LWMCU-136-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.01
LWMCU-137-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.01
LWMCU-138-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.36
LWMCU-139-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.01
LWMCU-140-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.01
LWMCU-141-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.10
LWMCU-141-SE-6-12	TOTAL PCB AROCLORS	Sediment	0.35
LWMCU-142-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.28
LWMCU-143-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.54
LWMCU-144-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.25
LWMCU-145-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.02
LWMCU-146-SE-0-6	TOTAL PCB AROCLORS	Sediment	3.93
LWMCU-147-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.23
LWMCU-148-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.02
LWMCU-149-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.04
LWMCU-149-SE-12-18	TOTAL PCB AROCLORS	Sediment	0.01
LWMCU-149-SE-6-12	TOTAL PCB AROCLORS	Sediment	0.02
LWMCU-150-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.04
LWMCU-151-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.01
LWMCU-153-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.02
LWMCU-153-SE-12-18	TOTAL PCB AROCLORS	Sediment	0.01
LWMCU-153-SE-18-23	TOTAL PCB AROCLORS	Sediment	0.01
LWMCU-153-SE-6-12	TOTAL PCB AROCLORS	Sediment	0.02
LWMCU-154-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.07
LWMCU-154-SE-12-18	TOTAL PCB AROCLORS	Sediment	0.01
LWMCU-154-SE-18-19	TOTAL PCB AROCLORS	Sediment	0.01
LWMCU-154-SE-6-12	TOTAL PCB AROCLORS	Sediment	0.01
LWMCU-155-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.03
LWMCU-155-SE-12-18	TOTAL PCB AROCLORS	Sediment	0.01
LWMCU-155-SE-6-12	TOTAL PCB AROCLORS	Sediment	0.01
LWMCU-156-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.05
LWMCU-156-SE-6-9	TOTAL PCB AROCLORS	Sediment	0.01

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TABLE 2-7

SAMPLES USED IN CALCULATIONS OF THE GEOMETRIC MEAN OF SEDIMENT CONCENTRATIONS, NONDETECT RESULTS VALUED AT 0.5 REPORTING LIMIT

Sample Identification	Analyte	Matrix	Result (mg/kg)
LWMCU-156-SE-9-11	TOTAL PCB AROCLORS	Sediment	0.01
LWMCU-157-SE-0-2	TOTAL PCB AROCLORS	Sediment	0.33
LWMCU-157-SE-2-6	TOTAL PCB AROCLORS	Sediment	0.02
LWMCU-158-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.07
LWMCU-158-SE-12-15	TOTAL PCB AROCLORS	Sediment	0.01
LWMCU-158-SE-6-12	TOTAL PCB AROCLORS	Sediment	0.01
LWMCU-159-SE-0-3	TOTAL PCB AROCLORS	Sediment	0.74
LWMCU-159-SE-3-6	TOTAL PCB AROCLORS	Sediment	0.07
LWMCU-159-SE-6-7	TOTAL PCB AROCLORS	Sediment	0.05
LWMCU-160-SE-0-6	TOTAL PCB AROCLORS	Sediment	11.39
LWMCU-160-SE-6-9	TOTAL PCB AROCLORS	Sediment	0.11
LWMCU-160-SE-9-10	TOTAL PCB AROCLORS	Sediment	0.09
LWMCU-167-SE-0-5	TOTAL PCB AROCLORS	Sediment	0.01
LWMCU-168-SE-0-3	TOTAL PCB AROCLORS	Sediment	0.01
LWMCU-170-SE-0-1	TOTAL PCB AROCLORS	Sediment	0.68
LWMCU-170-SE-1-1.5	TOTAL PCB AROCLORS	Sediment	0.44
LWMCU-171-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.11
LWMCU-172-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.19
RN3E-101-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.03
RN3E-102-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.05
RN3E-103-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.05
RN3E-104-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.04
RN3E-105-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.03
RN3W-101-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.02
RN3W-101-SE-6-12	TOTAL PCB AROCLORS	Sediment	0.01
RN3W-102-SE	TOTAL PCB AROCLORS	Sediment	0.01
RN3W-102-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.01
RN3W-103-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.01
RN3W-103-SE-6-12	TOTAL PCB AROCLORS	Sediment	0.03
RN3W-104-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.01
RN3W-105-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.01
RN3W-106-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.02
RN3W-107-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.02
RN3W-108-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.01
COMC-101-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.02
COMC-103-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.01
COMC-104-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.00
COMC-105-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.01
COMC-106-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.02
COMC-107-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.02
COMC-108-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.03
COMC-109-SE-0-6	TOTAL PCB AROCLORS	Sediment	0.01

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TABLE 2-7

SAMPLES USED IN CALCULATIONS OF THE GEOMETRIC MEAN OF SEDIMENT CONCENTRATIONS, NONDETECT RESULTS VALUED AT 0.5 REPORTING LIMIT

Sample Identification	Analyte	Matrix	Result (mg/kg)
Geometric Mean	TOTAL PCB AROCLORS	Sediment	0.039

Note:
Nondetect results valued at 0.5 the reporting limit.
PCB - polychlorinated biphenyl
mg/kg - milligram per kilogram
The geometric mean for sediment within the site is based upon the total Aroclor results for all sediment samples collected down gradient of the siphon (i.e., LEMC, LWMCU, RN3E, RN3W, and COMC).

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TABLE 2-8
DEVELOPMENT OF TOTAL POLYCHLORINATED BIPHENYL PRELIMINARY REMEDIATION GOALS IN SEDIMENT FOR WILDLIFE

Receptor	Level of Effect	Dose-based Toxicity Value (mg/kg bw-day)[1]	Dose Calculation for Piscivorous Receptors					Sediment Preliminary Remediation Goal for General Populations of Piscivorous Receptors (mg/kg dry wt.)
			Dose from Sediment (mg/kg bw-day)	Dose from Food			Total Dose (mg/kg bw-day)	
				Bioaccumulation Factor (mg/kg wet wt. fish tissue)/ (mg/kg dry wt. sediment)[2]	Fish Tissue Concentration (mg/kg wet wt.)	Dose from Fish (mg/kg bw-day)		
Belted Kingfisher (Small Piscivorous Bird)	NOAEL	0.18	0.000220	4.1	0.36	0.18	0.18	0.09
	LOAEL	1.80	0.002196	4.1	3.60	1.80	1.80	0.88
	NOAEL-LOAEL midpoint	0.990	0.001208	4.1	1.98	0.99	0.990	0.483
River Otter (Piscivorous Mammal)	NOAEL	0.01	0.000012	4.1	0.05	0.01	0.01	0.01
	LOAEL	0.10	0.000123	4.1	0.53	0.10	0.10	0.13
	NOAEL-LOAEL midpoint	0.055	0.000068	4.1	0.29	0.05	0.055	0.071

Note:

[1] NOAEL and LOAEL values for Aroclor-1248 (mammal) and Aroclor-1254 (bird) from Sample et al. 1996.
The midpoint was calculated with the following equation: midpoint = NOAEL + [(LOAEL-NOAEL)/2].

[2] The BAF was calculated with the following equation: BAF = fish tissue concentration/sediment concentration. The geometric mean total PCB congener concentration of whole body fish tissue north/downstream of the siphon (mg/kg wet wt.) was utilized for fish tissue and the geometric mean total PCB Aroclor concentration of sediment north/downstream of the siphon (mg/kg dry wt.) was utilized for sediment.

Belted Kingfisher exposure factors include the following:
- 0.15 kg body weight (average of reported mean adult breeding weights from EPA 1993)
- 0.13 kg dry wt./kg-day food ingestion rate converted assuming 75 percent prey moisture (USACHPPM 2004)
- 0.50 kg wet wt./kg-day food ingested rate from EPA (1993)
- 2 percent incidental sediment ingestion rate as total mass of diet utilized (Sample and Suter 1994)

River Otter exposure factors include the following:
- 7.99 kg body weight (average of reported adult weights from EPA 1993)
- 0.048 kg dry wt./kg-day food ingestion rate (from EPA 1993, calculated using allometric equation)
- 0.19 kg wet wt./kg-day food ingested rate converted assuming 75 percent prey moisture (USACHPPM 2004)
- 2 percent incidental sediment ingestion rate as total mass of diet utilized (Sample and Suter 1994)

BAF - bioaccumulation factor
bw - body weight
EPA - U.S. Environmental Protection Agency
LOAEL - lowest observed adverse effect level
mg/kg - milligram per kilogram
NOAEL - no observed adverse effect level
PCB - polychlorinated biphenyl
Center for Health Promotion
wt. - weight

TABLE 2-9
SAMPLES USED IN CALCULATION OF THE GEOMETRIC MEAN OF WHOLE FISH CONCENTRATIONS

Sample Identification	Analyte	Matrix	Result (mg/kg)
BF-BUF-SG2-W2	TOTAL PCB CONGENERS	Whole Fish	0.12
BF-BUF-SG3-W1	TOTAL PCB CONGENERS	Whole Fish	0.11
CAR-111-W	TOTAL PCB CONGENERS	Whole Fish	5.09
CAT-113-W	TOTAL PCB CONGENERS	Whole Fish	2.79
LMB-112-W	TOTAL PCB CONGENERS	Whole Fish	2.97
P-DRUM-SG2-W2	TOTAL PCB CONGENERS	Whole Fish	0.04
P-GAR-SG3-W1	TOTAL PCB CONGENERS	Whole Fish	0.11
SC-CAT-SG2-W4	TOTAL PCB CONGENERS	Whole Fish	0.02
SC-CAT-SG3-W4	TOTAL PCB CONGENERS	Whole Fish	0.08
BF-BUF-SG2-W1	TOTAL PCB AROCLORS	Whole Fish	0.04
BF-CARP-SG2-W1	TOTAL PCB AROCLORS	Whole Fish	0.06
BF-CARP-SG2-W2	TOTAL PCB AROCLORS	Whole Fish	0.02
BF-CARP-SG3-W1	TOTAL PCB AROCLORS	Whole Fish	0.01
BF-CARP-SG3-W2	TOTAL PCB AROCLORS	Whole Fish	0.04
BF-EEL-SG2-W1	TOTAL PCB AROCLORS	Whole Fish	0.04
BUF-105-W	TOTAL PCB AROCLORS	Whole Fish	0.12
CAR-106-W	TOTAL PCB AROCLORS	Whole Fish	0.28
P-LMB-SG2-W2	TOTAL PCB AROCLORS	Whole Fish	0.04
P-LMB-SG3-W2	TOTAL PCB AROCLORS	Whole Fish	0.07
SC-CAT-SG2-W3	TOTAL PCB AROCLORS	Whole Fish	0.06
TIL-114-W	TOTAL PCB AROCLORS	Whole Fish	1.10
Geometric Mean	TOTAL PCB (ND=0)	Whole Fish	0.12

Note:
PCB - polychlorinated biphenyl
mg/kg - milligram per kilogram
The geometric mean whole body fish concentration is based upon the following:
1. All fish whole body results for total PCB Congeners were selected from the dataset.
2. If total PCB Congeners were not analyzed for a given fish sample, than the total PCB Aroclor result was selected.
3. If both PCB Congeners and Aroclors were analyzed for a given fish sample, only the total PCB Congeners were selected.

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TABLE 2-10
DEVELOPMENT OF TOTAL POLYCHLORINATED BIPHENYL PRELIMINARY REMEDIATION GOALS IN SEDIMENT FOR WILDLIFE THREATENED AND ENDANGERED SPECIES

Level of Effect	Dose-based Toxicity Value (mg/kg bw-day)[1]	Dose Calculation								Sediment Preliminary Remediation Goal for Threatened and Endangered Wildlife (mg/kg dry wt.)
			Dose from Benthos/Fish			Dose from Plants				
		Dose from Sediment (mg/kg bw-day)	Bioaccumulation Factor (mg/kg wet wt. fish tissue)/ (mg/kg dry wt. sediment)[2]	Prey Tissue Concentration (mg/kg wet wt.)	Dose from Prey (mg/kg bw-day)	Bioaccumulation Factor (mg/kg wet wt. fish tissue)/ (mg/kg dry wt. sediment)[2]	Prey Tissue Concentration (mg/kg wet wt.)	Dose from Plants (mg/kg bw-day)	Total Dose (mg/kg bw-day)	
Belted Kingfisher, Surrogate Receptor for Interior Least Tern										
NOAEL	0.18	0.00022	4.1	0.36	0.18	--	--	--	0.18	0.088
Raccoon (benthos and vegetation), Surrogate Receptor for Coues' Rice Rat										
NOAEL	0.01	0.000000	4.5	0.10	0.01	0.008	0.000	0.00000	0.01	0.023

Note:

[1] NOAEL values for Aroclor-1248 (mammal) and Aroclor-1254 (bird) from Sample et al. 1996.

[2] The prey BAFs were calculated with the following equation: BAF = tissue concentration/sediment concentration. The geometric mean total PCB congener concentrations of tissue north/downstream of the siphon (mg/kg wet wt.) were utilized for tissue and the geometric mean total PCB Aroclor concentration of sediment north/downstream of the siphon (mg/kg dry wt.) was utilized for sediment. The total PCBs uptake factor for plants based on the log Kow for total PCBs of 6.24 and the regression for plant uptake from Travis and Arms (1988).

Belted Kingfisher exposure factors include the following:
- 0.15 kg body weight (average of reported mean adult breeding weights from EPA 1993)
- 0.13 kg dry wt./kg-day food ingestion rate converted assuming 75 percent prey moisture (USACHPPM 2004)
- 0.50 kg wet wt./kg-day food ingested rate from EPA (1993)
- 2 percent incidental sediment ingestion rate as total mass of diet utilized (Sample and Suter 1994)

Raccoon exposure factors include the following:
- 5.78 kg body weight (average of adult male and female weights given throughout year from EPA 1993)
- 0.048 kg dry wt./kg-day food ingestion rate (from EPA 1993, calculated using allometric equation)
- 0.19 kg wet wt./kg-day food ingested rate converted assuming 75 percent prey moisture (USACHPPM 2004)
- 9.4 percent incidental sediment ingestion rate as total mass of diet utilized (Beyer et al. 1994)

BAF - bioaccumulation factor
EPA - U.S. Environmental Protection Agency
mg/kg - milligram per kilogram
PCB - polychlorinated biphenyl
wt. - weight
bw - body weight
LOAEL - lowest observed adverse effect level
NOAEL - no observed adverse effect level
USACHPPM - U.S. Army Center for Health Promotion and Preventative Medicine

TABLE 2-11
SAMPLES USED IN CALCULATION OF THE GEOMETRIC MEAN OF MOLLUSK CONCENTRATIONS

Sample Identification	Analyte	Matrix	Result (mg/kg)
MOL-101-TTP-A	TOTAL PCB CONGENERS	Mollusk Tissue	0.47
MOL-102-TTP-A	TOTAL PCB CONGENERS	Mollusk Tissue	0.60
MOL-102-TTP-B	TOTAL PCB CONGENERS	Mollusk Tissue	0.04
MOL-103-TSM-A	TOTAL PCB CONGENERS	Mollusk Tissue	0.43
MOL-103-TTP-A	TOTAL PCB CONGENERS	Mollusk Tissue	0.05
MOL-104-TSM-A	TOTAL PCB CONGENERS	Mollusk Tissue	0.44
MOL-104-TSM-B	TOTAL PCB CONGENERS	Mollusk Tissue	0.04
MOL-104-TTP-A	TOTAL PCB CONGENERS	Mollusk Tissue	0.05
MOL-107-TSM-A	TOTAL PCB CONGENERS	Mollusk Tissue	1.55
MOL-107-TSM-B	TOTAL PCB CONGENERS	Mollusk Tissue	0.19
MOL-107-TTP-A	TOTAL PCB CONGENERS	Mollusk Tissue	0.07
MOL-107-TTP-B	TOTAL PCB CONGENERS	Mollusk Tissue	0.06
MOL-108-TST	TOTAL PCB CONGENERS	Mollusk Tissue	0.04
MOL-108-TTP-A	TOTAL PCB CONGENERS	Mollusk Tissue	0.60
MOL-109-TTP-A	TOTAL PCB CONGENERS	Mollusk Tissue	0.33
MOL-109-TTP-B	TOTAL PCB CONGENERS	Mollusk Tissue	0.07
MOL-105-TSM-A	TOTAL PCB CONGENERS	Mollusk Tissue	0.04
MOL-105-TTP-A	TOTAL PCB CONGENERS	Mollusk Tissue	0.35
MOL-105-TTP-B	TOTAL PCB CONGENERS	Mollusk Tissue	0.04
MOL-105-TTP-C	TOTAL PCB CONGENERS	Mollusk Tissue	0.07
MOL-106-TSM-A	TOTAL PCB CONGENERS	Mollusk Tissue	0.04
MOL-106-TTP-A	TOTAL PCB CONGENERS	Mollusk Tissue	0.04
MOL-106-TTP-B	TOTAL PCB CONGENERS	Mollusk Tissue	0.34
Geometric Mean	TOTAL PCB CONGENERS (ND=0)	Mollusk Tissue	0.13

Note:
PCB - polychlorinated biphenyl
mg/kg - milligram per kilogram

TABLE 2-12
TENTATIVE DETERMINATION OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS AND TO BE CONSIDERED ITEMS

ARAR	Citation (If Available)	Description	Applicability
Chemical Specific ARARs			
U.S. Food and Drug Administration Unavoidable Contaminants in Food for Human Consumption	21 Code of Federal Regulations Section 109.30(a)(7)	Establishes tolerances for unavoidable poisonous or deleterious substances. **The tolerance for total PCBs in the edible portion of fish and shellfish is 2 mg/kg.**	Relevant and appropriate.
Texas Risk Reduction Program Sediment Protective Concentration Levels	30 Texas Administrative Code 305.75	Establishes protective concentration levels for sediment in the state. Direct human contact sediment protective concentration levels, which address the ingestion/dermal contact with sediment pathways are available. **The sediment protective concentration level for PCBs is 2.33 mg/kg for non-carcinogenic risks and 5.48 mg/kg at a 10-5 carcinogenic risk level. However, the direct human contact protective concentration levels cannot be assumed to be protective of uptake to fish tissue and thus not protective of human exposures through the consumption of contaminated fish.**	To be considered.
Location Specific ARARs			
National Historical Preservation Act	16 United States Code Section 470 and 661 et seq. 36 Code of Federal Regulations Part 65 36 Code of Federal Regulations Part 800	Define procedures to preserve scientific, historical, and archeological data from potential destruction resulting from a change in the site terrain resulting from a federal construction project or federally licensed activity. If such artifacts are discovered during work at the site, work in the area will be stopped until data recovery and preservation activities are completed in accordance with the Act and regulations.	Applicable if scientific, historical, and archeological data is discovered during the project.
Executive Order 11988 Floodplains Management	40 Code of Federal Regulations Part 6 Appendix A 40 Code of Federal Regulations Section 6.302	Requires federal agencies to evaluate the potential affects of actions they may take in a floodplain to avoid adverse impacts in a floodplain.	Applicable because the site lies within a 100-year floodplain.
Endangered Species Act of 1973	16 United States Code Section 1531 et seq. 50 Code of Federal Regulations Sections 222-228	Federal agencies must confirm any action that is federally authorized, funded, or implemented by the agency is not probable to adversely affect the continued existence of any threatened or endangered species. The agency must ensure that the critical habitat is not destroyed or negatively modified.	Applicable if threatened or endangered species are found onsite.
Migratory Bird Treaty Act	16 United States Code Section 703 et seq.	Federal responsibility for the protection of the international migratory bird resource and requires continued consultation with the U.S. Fish and Wildlife Service during remedial design and remedial action activities to ensure that the cleanup of the site does not unnecessarily impact migratory birds. Specific mitigative measures may be identified for compliance with this requirement.	Applicable if the remedy may impact migratory birds.
International Boundary and Water Commission United States and Mexico	United States Section	Approval must be received from the U.S. International Boundary and Water Commission prior to commencement of construction of any facility which passes over, under or within the floodplain of the international reaches of the Rio Grande and Colorado Rivers. The U.S. International Boundary and Water Commission retains right of approval on all improvements which are to pass over, under or through the walls, levees, improved channel or floodways of U.S. International Boundary and Water Commission Flood Control Projects, including the Rio Grande.	Applicable because the site lies within the boundaries of the International Boundary and Water Commission.
Texas Parks and Wildlife Department	31 Texas Administrative Code Sections 65.171-65.176	Requirements for any species of wildlife listed in Texas as threatened or endangered, living or dead, including parts.	Applicable if threatened or endangered species are found onsite.

TABLE 2-12
TENTATIVE DETERMINATION OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS AND TO BE CONSIDERED ITEMS

ARAR	Citation (If Available)	Description	Applicability
Action Specific ARARs			
Disposal			
Toxic Substances Control Act	40 Code of Federal Regulations 761	Disposal of polychlorinated biphenyls.	Applicable if disposal of media containing polychlorinated biphenyls is required.
Resource Conservation and Recovery Act	40 Code of Federal Regulations 260, 261, 262, 263, 264, 268, 270, 271, 272, 370	General hazardous waste management including identification, generation, transportation, disposal of waste; permitting, monitoring, and reporting requirements; authorizations and recognition of state hazardous waste programs; chemical release reporting.	Applicable if transportation and disposal of hazardous waste as defined by Resource Conservation and Recovery Act (listed or characteristic) is required.
Procedures of Planning and Implementing Off-site Response Actions	40 Code of Federal Regulations 300.400	Hazardous waste generated from CERCLA cleanups must go to RCRA permitted treatment, storage, and disposal facilities that are in compliance with RCRA and state rules, and that do not have releases to the environment.	Applicable if hazardous waste is generated during remedial activities.
Waste Classification	30 Texas Administrative Code Section 335.505 30 Texas Administrative Code Section 335.508	Provides procedure for implementation of Texas waste notification system and establishes standards for classification of industrial solid waste managed in Texas, including Class 1, Class 2, and Class 3 wastes.	Applicable if waste is generated during remedial activities.
Remediation Activities			
Permits and Enforcement Comprehensive Environmental Response, Compensation, and Liability Act	CERCLA 121e	This section of CERCLA states that "no federal, state, or local permit shall be required for any portion of a CERCLA remedial action that is conducted on the site of the facility being remediated." This includes exemption from the RCRA permitting process. Note that the substantive requirements of the regulations must still be met.	Applicable if a remedial action is conducted at the site, because the site is subject to CERCLA.
Clean Water Act	33 United States Code Section 1251 et seq. Section 404 National Pollution Discharge Elimination System	Dredging, backfill, or infill materials or activities within waters and wetlands of the United States	Applicable if remedial activities impact waters of the United States.
Spill Prevention and Control	30 Texas Administrative Code Chapter 327	Defines reportable quantities in the event of a spill or release to environment, notification requirements, and actions required.	Applicable if a release or spill to the environment occurs during remedial activities.
Worker Health and Safety For Remedial Actions	40 Code of Federal Regulations 300.150 29 Code of Federal Regulations 1910.120	Requires assurance of the health and safety of workers during the remedial action.	Applicable if remedial activities are conducted at the site.
Fish and Wildlife Coordination Act	16 United States Code Section 662	When modifications to a stream or other water body are proposed or approved by any United States agency, such agency shall review with the U.S. Fish and Wildlife Service, Department of the Interior, and with the head of the agency overseeing the wildlife resources of the site.	Applicable if remedial activities occur in streams or the canal system.
Water Discharge			
National Pollutant Discharge Elimination System	40 Code of Federal Regulations 122 40 Code of Federal Regulations 125	Provides conditions that must be incorporated into National Pollutant Discharge Elimination System permits. Applicable to discharge of storm water from the site.	Applicable if remedial activities are conducted at the site.
Texas Pollutant Discharge Elimination System - Construction General Permit	TXR150000	General permit to discharge water from construction activities.	Applicable if construction activities are performed during the remedial action.

Notes:
ARAR - Applicable or relevant and appropriate requirements
CERCLA - Comprehensive Environmental Response, Compensation and Liabilities Act
PCB - Polychlorinated biphenyls
RCRA - Resource Conservation and Recovery Act
TBC - To be considered
µg/L - micrograms per liter
mg/kg - milligrams per kilogram

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TABLE 2-13

SUMMARY OF ANALYTICAL REPORTING LIMITS AND OTHER ITEMS FOR CONSIDERATION DURING SELECTION OF SEDIMENT PRELIMINARY REMEDIATION GOALS

Analysis	Value	Method	Description
Total PCBs	0.000002	CBC01.2	EPA CLP RI Lowest Reporting Limit (all samples)
Total PCBs	0.00002	CBC01.2	EPA CLP RI Arithmetic Mean of Reporting Limits (all samples)
Total PCBs	0.000021	--	Lowest Upgradient PCB Congener Concentration (Main Canal and Rio Grande River Samples)
Total PCBs	0.000055	CBC01.2	EPA CLP RI Highest Reporting Limit (all samples)
Total PCBs	0.000209	Method 1668	TestAmerica Inc. Achievable Reporting Limit
Aroclor-1254	0.00041	Method 8082 (SW-846) Low Level	TestAmerica Inc. RI Lowest Reporting Limit (nondetect samples)
Total PCBs	0.000418	HRSM01.2	EPA CLP Achievable Reporting Limit
Aroclor-1254	0.00083	Method 8082 (SW-846) Low Level	TestAmerica Inc. Achievable Reporting Limit
Aroclor-1254	0.001	SOM01.2	EPA CLP RI Lowest Reporting Limit (nondetect samples)
Total PCBs	0.0012	--	Average Upgradient PCB Congener Concentration (Main Canal and Rio Grande River Samples)
Total PCBs	0.003	--	Human Health Calculated Risk-Based PRG, Aroclor-1254 Non-Cancer HI=1
Total PCBs	0.004	--	Human Health Calculated Risk-Based PRG, PCB Cancer Risk 10^{-5}
Aroclor-1254	0.0043	Method 8082 (SW-846) Low Level	TestAmerica Inc. RI Arithmetic Mean of Reporting Limits (nondetect samples)
Total PCBs	0.0077	--	Highest Upgradient PCB Congener Concentration (Main Canal and Rio Grande River Samples)
Aroclor-1254	0.014	Method 8082 (SW-846) Low Level	TestAmerica Inc. RI Highest Reporting Limit (nondetect samples)
Total PCBs	0.023	--	Small Piscivorous Mammal NOAEL (T&E species)[a]
Aroclor-1254	0.0271	SOM01.2	EPA Region 6 RI Reporting Limit (nondetect sample)
Aroclor-1254	0.0291	SOM01.2	EPA CLP RI Arithmetic Mean of Reporting Limits (nondetect samples)
Aroclor-1254	0.033	SOM02.3	EPA CLP Achievable Reporting Limit for Routine Analysis
Total PCBs	0.043	--	Human Health Calculated Risk-Based PRG, PCB Cancer Risk 10^{-4}
Total PCBs	0.06	--	Benthic Invertebrate Threshold Effect Concentration (T&E species)
Total PCBs	0.071	--	Small Piscivorous Mammal NOAEL-LOAEL Midpoint (general population)
Aroclor-1254	0.076	SOM01.2	EPA CLP RI Highest Reporting Limit (nondetect samples)
Total PCBs	0.088	--	Small and Large Piscivorous Birds NOAEL (T&E species)
Total PCBs	0.483	--	Small Piscivorous Birds NOAEL-LOAEL Midpoint (general population)
Total PCBs	0.68	--	Benthic Invertebrate Probable Effect Concentration (general population)

Note:

[a] Goal applicable to reservoir only based on evaluation of habitat as discussed in Section 2.3.3, note reservoir concentrations do not exceed 0.023 mg/kg and thus already meet this goal.

CLP - Contract Laboratory Program
EPA - U.S. Environmental Protection Agency
HI - hazard index
LOAEL - lowest observed adverse effects level
NOAEL - no observed adverse effects level
PCB - polychlorinated biphenyl
PRG - preliminary remediation goal
RI - Remedial Investigation
T&E - threatened and endangered
Total PCBs - Either the sum of PCBs as Aroclors or the sum of PCB congeners

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TABLE 3-1
REMEDIAL TECHNOLOGY SCREENING FOR THE SIPHON

General Response Action	Technology	Process Option	Effectiveness	Implementability	Cost[1]	Status
Containment	Physical Barrier	Slipline Siphon	Will address relevant RAOs if performed in conjunction with certain sediment alternatives.	Implementable	Moderate	**Retained**
		Geopolymer Liner	Will address relevant RAOs if performed in conjunction with certain sediment alternatives.	Implementable, but requires confined space entry and dry environment	High	Not retained due to implementability
Replacement	Construction	Replace Siphon	Will address relevant RAOs if performed in conjunction with certain sediment alternatives.	Implementable	High	**Retained**

Note:
[1] Cost estimates are relative within each general response action
NCP - National Contingency Plan
RAO - remedial action objective

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TABLE 3-2
REMEDIAL TECHNOLOGY SCREENING FOR SEDIMENT

General Response Action	Technology	Process Option	Effectiveness	Implementability	Cost[1]	Status
Monitored Natural Recovery	Un-Enhanced Natural Processes	Long-term Monitoring	Will not address RAOs.	Implementable	Low	**Retained in reservoir but not retained in canal.**
Containment	Engineered Barrier	Not Applicable	Not effective in the canal. Anticipated to address relevant RAOs if performed in conjunction with certain siphon alternatives in the reservoir.	Implementable	High	**Retained in reservoir but not retained in canal.**
Treatment	*In Situ* Solidification/ Stabilization	*In Situ* Treatment	Will address relevant RAOs if performed in conjunction with certain siphon alternatives.	Implementable, but challenging.	High	Not retained due to challenges with implementation.
Removal	Dredging and Disposal	Off-Site Disposal	Will address relevant RAOs if performed in conjunction with certain siphon alternatives.	Implementable	High	**Retained**
		On-Site Disposal	Will address relevant RAOs if performed in conjunction with certain siphon alternatives.	Implementable, but requires purchasing land.	High	Not retained due to the requirement to purchase land.
Replacement	Construction	Replace Canal	Will address relevant RAOs if performed in conjunction with certain siphon alternatives.	Implementable, but requires purchasing land.	High	Not retained due to the requirement to purchase land.

Note:
[1] Cost estimates are relative within each general response action
NCP - National Contingency Plan

TABLE 4-1
SUMMARY OF REMEDIAL ALTERNATIVE COSTS BY REMEDY COMPONENT

Alternative	Component	Cost[1]
Alternative 1: No Further Action	No cost associated with this alternative	
Alternative 2: Limited Action	Engineering Controls	$ 8,000
	Community Involvement and Engineering Controls	$ 1,630,000
	Total Cost	**$ 1,640,000**
Alternative 3: Slipline Siphon, Canal Dredging, and Fish Removals	*Remedy Component SI-A*	
	Slipline Siphon	$ 3,800,000
	Post Remediation Site Monitoring	$ 450,000
	Remedy Component SE-A	
	Dredging of Canal Sediment with Off-Site Disposal	$ 7,600,000
	Fish Removal	$ 3,010,000
	Post Remediation Site Monitoring (fish and sediment)	$ 560,000
	Community Involvement and Engineering Controls	$ 140,000
	Total Cost	**$ 15,600,000**
Alternative 4: Slipline Siphon, Canal Dredging, and Reservoir Monitored Natural Recovery	*Remedy Component SI-A*	
	Slipline Siphon	$ 3,800,000
	Post Remediation Site Monitoring	$ 450,000
	Remedy Component SE-B	
	Dredging of Canal Sediments with Off-Site Disposal	$ 27,240,000
	Fish Removal	$ 3,010,000
	Monitored Natural Recovery	$ 3,230,000
	Community Involvement and Engineering Controls	$ 180,000
	Total Cost	**$ 37,900,000**
Alternative 5: Slipline Siphon, Canal Dredging, and Reservoir Dredging with Sand Layer	*Remedy Component SI-A*	
	Slipline Siphon	$ 3,800,000
	Post Remediation Site Monitoring	$ 450,000
	Remedy Component SE-C	
	Dredging of Canal and Reservoir Sediments with Off-Site	$ 159,200,000
	Fish Removal	$ 3,010,000
	Post Remediation Site Monitoring	$ 410,000
	Community Involvement and Engineering Controls	$ 140,000
	Total Cost	**$ 167,000,000**
Alternative 6: Replace Siphon, Canal Dredging, and Fish Removals	*Remedy Component SI-B*	
	Replace Siphon	$ 8,100,000
	Remedy Component SE-A	
	Dredging of Canal Sediment with Off-Site Disposal	$ 7,600,000
	Fish Removal	$ 3,010,000
	Post Remediation Site Monitoring	$ 560,000
	Community Involvement and Engineering Controls	$ 140,000
	Total Cost	**$ 19,400,000**

TABLE 4-1
SUMMARY OF REMEDIAL ALTERNATIVE COSTS BY REMEDY COMPONENT

Alternative	Component	Cost[1]
Alternative 7: Replace Siphon, Canal Dredging, and Reservoir Monitored Natural Recovery	*Remedy Component SI-B*	
	Replace Siphon	$ 8,100,000
	Remedy Component SE-B	
	Dredging of Canal Sediments with Off-Site Disposal	$ 27,240,000
	Fish Removal	$ 3,010,000
	Monitored Natural Recovery	$ 3,230,000
	Community Involvement and Engineering Controls	$ 180,000
	Total Cost	**$ 41,800,000**
Alternative 8: Replace Siphon, Canal Dredging, and Reservoir Dredging with Sand Layer	*Remedy Component SI-B*	
	Replace Siphon	$ 8,100,000
	Remedy Component SE-C	
	Dredging of Canal and Reservoir Sediments with Off-Site	$ 159,200,000
	Fish Removal	$ 3,010,000
	Post Remediation Site Monitoring	$ 410,000
	Community Involvement and Engineering Controls	$ 140,000
	Total Cost	**$ 170,900,000**

Notes:
[1]Costs and totals subject to rounding error

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TABLE 5-1
SCREENING OF REMEDIAL ALTERNATIVES

Remedial Alternative	Effectiveness	Implementability	Cost	Status
Alternative 1: No Further Action	Not Effective	Implementable	None	Retained
Alternative 2: Limited Action	Effective for protection of human health, if institutional controls, engineering controls, and community involvement are successful. Not effective for ecological receptors.	Implementable	Low	Retained
Alternative 3: Slipline Siphon, Canal Dredging, and Fish Removals	Effective	Implementable	Low	Retained
Alternative 4: Slipline Siphon, Canal Dredging, and Reservoir Monitored Natural Recovery	Effective	May not be implementable	Medium	Not Retained
Alternative 5: Slipline Siphon, Canal Dredging, and Reservoir Dredging with Sand Layer	Effective	May not be implementable	High	Not Retained
Alternative 6: Replace Siphon, Canal Dredging, and Fish Removals	Effective	Implementable	Low	Retained
Alternative 7: Replace Siphon, Canal Dredging, and Reservoir Monitored Natural Recovery	Effective	May not be implementable	Medium	Not Retained
Alternative 8: Replace Siphon, Canal Dredging, and Reservoir Dredging with Sand Layer	Effective	May not be implementable	High	Not Retained

TABLE 7-1
COMPARISON OF ALTERNATIVES

	(1) Overall Protection of Human Health and the Environment	(2) Compliance with ARARs	(3) Long-Term Effectiveness and Permanence	(4) Reduction of Toxicity, Mobility, or Volume through Treatment	(5) Short-Term Effectiveness	(6) Implementability	(7) Cost (Present Value)
Alternative 1 No Further Action	Is not protective of human health or the environment. Will not meet remedial active objectives.	Will not meet ARARs. The U.S. Food and Drug Administration tolerance level for total PCBs in the edible portion of fish and shellfish is 2 mg/kg and is an ARAR.	Does not provide long-term effectiveness or permanence.	Does not reduce toxicity, mobility, or volume of contamination.	No short-term risk associated with this alternative.	Implementable.	$ -
Alternative 2 Limited Action	Engineering controls in the form of signs and community involvement would only warn the public of the dangers of fish consumption. Low overall protection to human health. This alternatives does not address protection to the environment and will not meet the ecological remedial action objective.	Is anticipated to meet ARARs assuming community involvement, engineering controls, and aquatic life ban are effective.	Alternative 2 would not provide long-term effectiveness and permanence since the siphon would continue to release source contamination that would be deposited in sediments. The ecological receptors interacting with the sediments would continue to bioaccumulate the contaminants deposited in the sediments. The long-term effectiveness and permanence of Alternative 2 is low because the source material would continue to deposit contaminants in the downstream sediments until the contaminants in the source material is depleted.	Alternative 2 does not reduce the toxicity, mobility, or volume of contamination in the siphon or the sediment through treatment.	The only short-term risk in Alternative 2 is the carbon footprint associated with installation of signs and travel for the community involvement representatives.	Alternative 2 is highly implementable as no construction is required.	$ 1,640,000
Alternative 3 Slipline Siphon and Canal Dredging	High overall protection of human health and the environment. The slipline in the siphon would act as a barrier between the source of contamination and migration pathways. The canal would be dredged to remove sediment concentrations above 0.043 mg/kg total PCBs, this will reduce the risk to benthic invertebrates. Reductions in fish tissue and mollusk PCB concentrations will occur naturally once the sources of contamination are contained (slipling of the siphon) or removed (dredging of sediments), this will reduce the risk to humans, piscivorous birds and mammals, and aquatic carnivorous mammals. While reductions in fish tissue will occur naturally, annual fish removals would reduce unacceptable risk to human receptors faster than if no fish removals occur.	It is anticipated that Alternative 3 would meet ARARs, specifically the U.S. Food and Drug Administration PCB fish tolerance level.	Alternative 3 provides long-term effectiveness and permanence. The installation of the slipline would satisfy the criteria of long-term effectiveness because the slipline would act as a permanently installed barrier and prevent contaminant migration out of the source material. Sediment dredging and annual fish removals would eliminate residual contamination from the system. Barring a catastrophic failure of the slipline, Alternative 3 provides long-term effectiveness and permanence.	Alternative 3 does not reduce the toxicity, mobility, or volume of contamination through treatment. Although the slipline would reduce the mobility through the means of a barrier and sediment dredging would reduce volume by removing material from the site, these methods are not considered treatment.	Short term risks are elevated in Alternative 3. The community is affected by an increase in traffic caused by the transportation of equipment and material. Additionally, dust may be produced during construction and transportation activities, but can be mitigated through standard construction practices. Environmental impacts associated with construction around the siphon include the effects of diverting/dewatering the Arroyo Colorado and the siphon. Environmental impacts associated with dredging the canal and fish removal include reducing the population of benthic organisms and fish. Although silt curtains would be used, dredging the canal would also disturb sediment which could increase exposure to downstream ecological receptors. Additionally, air emissions from heavy equipment and vehicles would contribute to negative impacts to the environment. The sustainability GREM score for this alternative was 6.9. The estimated construction time for this alternative is approximately 7 months.	The feasibility of implementing Alternative 3 is dependent on which season construction takes place. During periods of high water demand, sliplining may be more difficult to implement because water would be pumped at a higher flowrate to bypass the siphon. A higher flowrate in the canal would increase the level of suspended sediment when the material is disturbed during dredging. Implementing fish removal is feasible because this field activity in these areas have been previously performed. Equipment and specialists are available for all components of Alternative 3. If construction activity takes place during periods of low water demand, implementability of Alternative 3 is much higher. Coordination with the irrigation district would be necessary prior to remedial action.	$15,600,000
Alternative 6 Replace Siphon and Canal Dredging	High overall protection of human health and the environment. Replacing the siphon would eliminate the migration pathway from source material by bypassing the source of contamination. The canal would be dredged to remove sediment concentrations above 0.043 mg/kg total PCBs, this will reduce the risk to benthic invertebrates. Reductions in fish tissue and mollusk PCB concentrations will occur naturally once the sources of contamination are removed, this will reduce the risk to humans, piscivorous birds and mammals, and aquatic carnivorous mammals. While reductions in fish tissue will occur naturally, annual fish removals would reduce unacceptable risk to human receptors faster than if no fish removals occur. Alternative 6 is protective of human health and the environment.	It is anticipated that Alternative 6 would meet ARARs, specifically the U.S. Food and Drug Administration PCB fish tolerance level.	Alternative 6 provides long-term effectiveness and permanence. The installation of a new siphon would satisfy the criteria of long-term effectiveness because the pathway of contaminated material to ecological and human receptors is eliminated. Sediment dredging and annual fish removals would eliminate the residual contamination from the system. Alternative 6 provides long-term effectiveness and permanence.	Alternative 6 does not reduce the toxicity, mobility, or volume of contamination through treatment. Although the new siphon would reduce the mobility by bypassing the source, the existing siphon would remain in place. Sediment dredging would reduce volume by removing material from the site. These methods are not considered treatment.	Short term risks are elevated in Alternative 6. The community is affected by an increase in traffic caused by the transportation of equipment and material. Additionally, dust may be produced during construction and transportation activities, but can be mitigated through standard construction practices. Environmental impacts associated with the construction of the new siphon include the effects of diverting/dewatering the Arroyo Colorado. Environmental impacts associated with dredging the canal and fish removal include reducing the population of benthic organisms and fish. Although silt curtains would be used, dredging the canal would also disturb sediment which could increase exposure to downstream ecological receptors. Additionally, air emissions from heavy equipment and vehicles would contribute to negative impacts to the environment. The sustainability GREM score for this alternative was 5.9. The estimated construction time for this alternative is approximately 9 months.	The feasibility of implementing Alternative 6 is dependent on which season construction takes place. During periods of high water demand, construction may be more difficult when installing the new weir and transitioning water flow to the new siphon. The new siphon would also require property access or land purchase in the areas where the new siphon and canal segments would be installed. A higher flowrate in the canal would increase the level of suspended sediment when the material is disturbed during dredging. Implementing fish removal is feasible because this field activity in these areas have been previously performed. Equipment and specialists are available for all components of Alternative 6. If construction activity takes place during periods of low water demand, implementability of Alternative 6 is much higher. Coordination with the irrigation district would be necessary prior to construction.	$19,400,000

Note:
ARAR - Applicable Relevant or Appropriate Requirement
GREM - Green Remediation Evaluation Matrix
mg/kg - milligrams per kilogram
NA - Not Applicable
PCB - Polychlorinated biphenyl

Appendix A
Detailed Cost Estimates

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TECHNOLOGY	LOCATION	MEDIUM	Estimated Cost to Implement	$1,640,000
Limited Action Alternative 2	Donna Reservoir and Canal System Donna, TX	NA	Construction Time:	- month
			Operation Time:	- years
			Community Involvement:	20 years

Description	Data Source (Means[1] or Other)	Quantities: Quantity Amount	Quantity Unit	Cost Breakdown (if available): Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Material Unit Cost	Material Total Cost	Combined Unit Costs: Unit Cost	Option Total Cost
REMEDIAL ACTION		**TOTAL CAPITAL COST (totals rounded to nearest thousand)**									**$8,000**
Engineering Controls											**$5,945**
Sign Installation											
Mobilization	Professional Estimate	1	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,650.00	$1,650
Sign, aluminum, reflectorized, 30" by 30" and 10' steel posts, upright, bolted	1014 5320 0300/1014 5320 1500	20	ea	$ 28	$ 561	$ 16	$ 315	$ 170.91	$ 3,418	$ -	$4,295
System Contingency											**$1,486**
25% of Total Construction Activities										$5,945	$1,486
Professional/Technical Services[2]											**$594**
10% of Construction + Contingency for Project Management										$ 5,945	$594
NA of Construction (not including disposal) + Contingency for Remedial Design											
NA of Construction (not including disposal) + Contingency for Construction Management											
LIFETIME COMMUNITY INVOLVEMENT AND ENGINEERING CONTROLS										**ANNUAL LTM COST**	**$131,000**
										LIFETIME LTM (NPV)	**$1,630,000**
Community Involvement and Engineering Controls											**$119,226**
Mobilization/demobilization	Professional estimate	12	events	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,650.00	$19,800
Per diem	GSA + Tax	72	days	$ -	$ -	$ -	$ -	$ -	$ -	$ 166.00	$11,952
Community outreach event (2 representatives)	Professional estimate	12	events	$ 7,200	$ 86,400	$ -	$ -	$ -	$ -	$ -	$86,400
Sign Replacement	1014 5320 0300/1014 5320 1500	5	ea	$ 28	$ 140	$ 16	$ 79	$ 170.91	$ 855	$ -	$1,074
Professional/Technical Services[2]											**$11,923**
10% of Activities for Project Management										$119,226	$11,923
Lifetime Long Term Monitoring (Net Present Value)[2]											**$1,627,423**
Community Involvement and Engineering Controls		1	NPV							$1,627,423	$1,627,423
30 Community Involvement											
7% Discount Factor (per EPA guidance)											
TOTAL ESTIMATED NPV TECHNOLOGY COST (Capital + Lifetime O&M + Community Involvement and Engineering Controls)											**$1,640,000**

Assumptions:

General

Working condition is Safety Level: **D**
Weighted Average of city cost index **96.8%**
Costs are loaded with mark-up **10%**
Labor productivity: **82%**; Equipment productivity **100%**
(not applicable for costs derived from vendor quotes).

During Excavation

Approximate hourly wage — Community Outreach Representative **$120.00**

Notes

ea Each
NA Not Applicable
O&M Operation and maintenance

1 Source is The Gordian Group, RS Means Online (2016), McAllen, TX, unless otherwise cited
2 Source of factor: "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study," US EPA (July 200(

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TECHNOLOGY	LOCATION	MEDIUM	Estimated Cost to Implement	$4,200,000
Slipline Siphon **Alternative Component SI-A**	**Donna Reservoir and Canal System** **Donna, TX**	**Siphon**	**Construction Time:** 2 months **Operation Time:** - years **Post Remediation Monitoring** - years	

		Quantities		Cost Breakdown (if available)						Combined Unit Costs	
Description	Data Source (Means[1] or Other)	Quantity Amount	Quantity Unit	Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Material Unit Cost	Material Total Cost	Unit Cost	Option Total Cost
REMEDIAL ACTION		**TOTAL CAPITAL COST (totals rounded to nearest thousand)**									**$3,770,000**
Construction Activities											**$2,403,588**
Temporary Facilities and Site Maintenance											
Command facility 40' combo with 15' office	Mobile Mini, Inc.	2	month	$ -	$ -	$ -	$ -	$ -	$ -	$ 506.00	$1,012
Office equipment rental average	0152 1340 0100	2	month	$ -	$ -	$ -	$ -	$ 219	$ 438	$ -	$438
Land lease	USDA	2	month	$ -	$ -	$ -	$ -	$ -	$ -	$ 33.46	$67
Command facility mobilization/demobilization	Mobile Mini, Inc.	2	month	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,914.00	$3,828
Clearing & grubbing, light trees, to 6" diameter	3111 1010 0020	1	acre	$ 2,206	$ 2,206	$ 1,807	$ 1,807	$ -	$ -	$ -	$4,013
Rough grade, 20,100-25,000 SF	3122 1320 0210	1	ea	$ 576	$ 576	$ 550	$ 550	$ -	$ -	$ -	$1,127
Temporary, roads, gravel fill, 4" gravel depth	0155 2350 0050	2,500	SY	$ 2	$ 5,228	$ 1	$ 1,385	$ 4	$ 10,145	$ -	$16,757
Fencing	United Site Services	2	month	$ -	$ -	$ -	$ -	$ -	$ -	$ 550.00	$1,100
Generator	United Rentals	2	month	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,922.60	$7,845
Lighting	United Rentals	2	month	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,663.20	$3,326
Toilet, portable chemical (2 toilets)	0154 3340 6410	2	month	$ -	$ -	$ -	$ -	$ -	$ -	$ 400.67	$801
Rubbish handling, dumpster, 10 CY, 3 ton capacity, one dump per week	0241 1919 0700	8	weeks	$ -	$ -	$ -	$ -	$ 511	$ 4,090	$ -	$4,090
Site security (24 hours a day) (2 guards)	0156 3250 0100	2,880	hr	$ 49.58	$ 142,782	$ -	$ -	$ -	$ -	$ -	$142,782
Excavation and Backfill											
Pre- and post-construction topographical survey	0221 1309 0100	1.84	acre	$ 4,240	$ 7,787	$ 158	$ 289	$ 132	$ 242	$ -	$8,318
Per diem construction crew	GSA + Tax	14	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 830.00	$11,620
Per diem truck drivers	GSA + Tax	14	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 830.00	$11,620
Clearing brush by hand	3113 1310 0100	1.84	acre	$ 2,857	$ 5,246	$ -	$ -	$ -	$ -	$ -	$5,246
Erosion control, silt fence, install and maintain, remove, 3' high	3125 1416 1000	4,000	LF	$ 1	$ 3,481	$ 0.14	$ 554	$ 1	$ 2,386	$ -	$6,420
Excavating trench, 6' to 10' deep, 1-1/2 CY excavator	3123 1613 0610	4,741	BCY	$ 1.35	$ 6,404	$ 1.85	$ 8,786	$ -	$ -	$ -	$15,189
Rent truck, dump, 3 axle, 16 ton or 12 CY payload (2 trucks)	0154 3320 5300/0131 1320 0160	2	week	$ 3,961	$ 7,923	$ -	$ -	$ -	$ -	$ 2,273.17	$12,469
Demolition, concrete water piping, 108"-144" diameter	0241 1338 0400	500	LF	$ 40.73	$ 20,366	$ 28.05	$ 14,027	$ -	$ -	$ -	$34,393
Hazardous waste transportation to disposal site, up to 18 tons, maximum	0281 2010 1200	30	load	$ -	$ -	$ -	$ -	$ -	$ -	$ 936.32	$28,090
Hazardous waste disposal, dumpsite disposal charge, maximum	0281 2010 6020	431	Ton	$ -	$ -	$ -	$ -	$ -	$ -	$ 383.01	$165,077
Backfill trench, F.E. Loader, 2-1/4 CY Bucket, 100' haul (2 loaders)	3123 1613 3090	5,926	LCY	$ 2.12	$ 12,546	$ 1.85	$ 10,982	$ -	$ -	$ -	$23,528
Sheepsfoot roller, 6" lifts, 3 passes	3123 2323 5620	4,741	ECY	$ 0.36	$ 1,724	$ 1.05	$ 4,999	$ -	$ -	$ -	$6,723
Rent and operate water truck, off highway, 6,000 gallon capacity	0154 3340 6950	2	week	$ -	$ -	$ -	$ -	$ -	$ -	$ 9,630.10	$19,260
Engineering oversight	Professional estimate	14	day	$ 1,200	$ 16,800	$ -	$ -	$ -	$ -	$ -	$16,800
Sliplining											
Per diem	GSA	14	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 803.00	$11,242
Siphon interior surveying	Sea View Systems, Inc.	1	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 67,760.00	$67,760
Cofferdam at siphon entrance and exit	Lincoln Park FS[2]	100	LF	$ -	$ -	$ -	$ -	$ -	$ -	$ 325.23	$32,523
Dewatering pump, 16 HP, 4" trash pump, gas (3 pumps)	Sunbelt Rentals	2	week	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,006.50	$2,013
55 gallon steel drums for fish disposal	Dallas Steel Drums, Inc.	3	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 54.18	$163
Bypass pumps, 375 HP diesel, (6 pumps)	Baker Corp/0131 1320 0160	2	week	$ 5,942	$ 11,884	$ -	$ -	$ -	$ -	$ 49,055.60	$109,996
Pump fuel costs	Baker Corp	14	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,603.20	$106,445
Installation material, 96" reline pipe to 20' joint lengths	Hobas Pipe	1,600	LF	$ -	$ -	$ -	$ -	$ -	$ -	$ 528.00	$844,800
Shotcrete, up to 35 CY per hour, grout annular space	0337 1360 0100	900	CY	$ 7	$ 6,336	$ 2	$ 2,118	$ 145	$ 130,852	$ -	$139,306
Installation of slipline equipment and labor	Hobas Pipe	14	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,500.00	$77,000
Engineering oversight	Professional est	14	day	$ 1,200	$ 16,800	$ -	$ -	$ -	$ -	$ -	$16,800
Rent and operate water truck, off highway, 6,000 gallon capacity	0154 3340 6950	2	week	$ -	$ -	$ -	$ -	$ -	$ -	$ 9,630.10	$19,260
Bypass Arroyo Colorado											
Per diem	GSA + Tax	21	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,992.00	$41,832
Cofferdam including mobilization and temporary sheeting, shore driven	3152 1610 0020/professional estimate	6,000	SF	$ 7	$ 44,732	$ 9	$ 51,378	$ 36	$ 216,250	$ -	$312,360
Dewatering systems, drainage trench 2' wide, 3' deep with backhoe loader	3123 1920 0100	140	CY	$ 6	$ 831	$ 3	$ 410	$ -	$ -	$ -	$1,241
Pumping 8 hr., 20 LF suction 100 LF discharge, 6 inch centrifugal (2 pump)	3123 1920 1100	21	day	$ 633	$ 13,289	$ 767	$ 16,101	$ -	$ -	$ -	$29,390
Excavating bypass, 1 CY hydraulic excavator	3123 1613 0120	2,400	BCY	$ 2	$ 4,894	$ 2	$ 5,266	$ -	$ -	$ -	$10,160
Silt curtain (100'x7')	Granite Environmental, Inc.	3	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,427.69	$7,283

EA Engineering, Science, and Technology, Inc., PBC

TECHNOLOGY	LOCATION	MEDIUM	Estimated Cost to Implement	$4,200,000
Slipline Siphon **Alternative Component SI-A**	**Donna Reservoir and Canal System** **Donna, TX**	**Siphon**	**Construction Time:** 2 months **Operation Time:** - years **Post Remediation Monitoring** - years	

Description	Data Source (Means[1] or Other)	Quantities: Quantity Amount	Quantities: Quantity Unit	Cost Breakdown (if available): Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Material Unit Cost	Material Total Cost	Combined Unit Costs: Unit Cost	Option Total Cost
Backfill, 2-1/2 CY front end loader, 300' haul	3123 2317 0190	3,000	LCY	$ 1	$ 3,156	$ 3	$ 10,193	$ -	$ -	$ -	$13,349
Rough grade 75,100-100,000 SF	3122 1320 0280	1	ea	$ 2,232	$ 2,232	$ 2,131	$ 2,131	$ -	$ -	$ -	$4,363
Site Restoration											
Rough grade 75,100-100,000 SF	3122 1320 0280	1	ea	$ 2,232	$ 2,232	$ 2,131	$ 2,131	$ -	$ -	$ -	$4,363
Seeding, hydro or air seeding, with mulch and fertilizer	3292 1914 5400	300	MSF	$ 15	$ 4,368	$ 9	$ 2,799	$ 44	$ 13,135	$ -	$20,302
Mobilization and Demobilization											**$119,961**
5% of Total Costs of Site Work										$2,399,226	$119,961
System Contingency											**$629,797**
25% of Total Construction Activities										$2,519,187	$629,797
Professional/Technical Services[3]											**$598,307**
5% of Construction + Contingency for Project Management										$ 3,148,984	$157,449
8% of Construction + Contingency for Remedial Design										$ 3,148,984	$251,919
6% of Construction + Contingency for Construction Management										$ 3,148,984	$188,939
OPERATION AND MAINTENANCE									**ANNUAL O&M COST**		**$ -**
									LIFETIME O&M (NPV)		**$ -**
NO LONG TERM O&M REQUIRED											
LONG TERM MONITORING									**ANNUAL LTM COST**		**$ 109,000**
									LIFETIME LTM (NPV)		**$ 445,000**
Monitoring, Sampling, Testing and Analysis											**$103,450**
Post Remediation Site Monitoring - Sediment Sampling (annually for 5 years)											
Mobilization/demobilization	Professional est	1	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 8,360.00	$8,360
Per diem	GSA + Tax	5	days	$ -	$ -	$ -	$ -	$ -	$ -	$ 664.00	$3,320
Forklift variable reach, 6,000 lbs	United Rentals	1	week	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,989.90	$1,990
17' Tracker boat with 40hp motor and trailer	EA Engineering	5	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 255.96	$1,280
Sampling labor (4 samplers)	Professional est	5	day	$ 4,800	$ 24,000	$ -	$ -	$ -	$ -	$ -	$24,000
Sampling equipment, supplies, and shipping	Professional est	1	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,500.00	$5,500
Sediment analysis - PCB Congeners	Test America Laboratories	50	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,100.00	$55,000
Reporting	Professional est	40	hr	$ 100	$ 4,000	$ -	$ -	$ -	$ -	$ -	$4,000
Professional/Technical Services[3]											**$5,172**
5% of Total Sampling Activities for Project Management										$103,450	$5,172.49
Lifetime Long Term Monitoring (Net Present Value)[3]											**$445,372**
Post Remediation Site Monitoring - Sediment Sampling (annually for 5 years)		1	NPV							$445,372	$445,372
7% Discount Factor (per EPA guidance)											
TOTAL ESTIMATED NPV TECHNOLOGY COST (Capital + Lifetime O&M + Post Remediation Monitoring)											**$4,200,000**

EA Engineering, Science, and Technology, Inc., PBC

TECHNOLOGY	LOCATION	MEDIUM	Estimated Cost to Implement	$4,200,000
Slipline Siphon **Alternative Component SI-A**	**Donna Reservoir and Canal System** **Donna, TX**	**Siphon**	**Construction Time:** 2 months **Operation Time:** - years **Post Remediation Monitoring** - years	

		Quantities		Cost Breakdown (if available)						Combined Unit Costs	
Description	Data Source (Means[1] or Other)	Quantity Amount	Quantity Unit	Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Material Unit Cost	Material Total Cost	Unit Cost	Option Total Cost
Assumptions:											
General											
Working condition is Safety Level:		D	(Labor productivity: 82% ; Equipment productivity: 100%)								
Weighted Average of city cost index		96.8%	(not applicable for costs derived from vendor quotes).								
Costs are loaded with mark-up		10%									
Inflation		3%	per year	6%	for 2 years	13%	for 4 years	34%	for 10 years		
Sales Tax		8.25%									
During Excavation and Backfill											
Density of soil		1.6	ton/CY								
Workers work week consists of		6	days /week	1	rigs						
Loose cubic yard to in-place cubic yard ratio		1.25	LCY/BCY								
		1	mobilization/demobilizations per excavator					$664	per diem per rig		
During Slipline Installation											
Workers work week consists of		6	days /week	1	rigs						
		1	mobilization/demobilizations per excavator					$664	per diem per rig		
Approximate hourly wage											
Standard work day		12	hrs								
Approximate hourly wage	Junior Engineer	$100.00									
	Construction Manager	$140.00									
Lab Cost											
PCB Congeners - Sediment		$1,000									

Notes

BCY	In-place cubic yard	gal	Gallon	LF	Linear foot
CY	Cubic yard	hrs	Hours	O&M	Operation and maintenance
ea	Each	HP	Horse power	SF	Square foot
ECY	Embankment cubic yards	H&S	Health and Safety	SY	Square yard
ft	Foot	LCY	Loose cubic yard		

1 Source is The Gordian Group, RS Means Online (2016), McAllen, TX, unless otherwise cite
2 Source: "Lincoln Park/Milwaukee River Channel Sediments Site, Phase II Feasibility Study/Remedial Design", EA Engineering (201
3 Source of factor: "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study," US EPA (July 200

EA Engineering, Science, and Technology, Inc., PBC

TECHNOLOGY	LOCATION	MEDIUM	Estimated Cost to Implement	$8,100,000
Replace Siphon Alternative Component SI-B	Donna Reservoir and Canal System Donna, TX	Siphon	Construction Time:	4 months
			Operation Time:	- years
			Post Remediation Monitoring	- years

		Quantities		Cost Breakdown (if available)						Combined Unit Costs	
Description	Data Source (Means[1] or Other)	Quantity Amount	Quantity Unit	Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Material Unit Cost	Material Total Cost	Unit Cost	Option Total Cost
REMEDIAL ACTION		**TOTAL CAPITAL COST (totals rounded to nearest thousand)**									**$8,100,000**
Construction Activities											**$5,185,422**
Temporary Facilities and Site Maintenance											
Command facility 40' combo with 15' office	Mobile Mini, Inc.	4	month	$ -	$ -	$ -	$ -	$ -	$ -	$ 506.00	$2,024
Office equipment rental average	0152 1340 0100	4	month	$ -	$ -	$ -	$ -	$ 219	$ 877	$ -	$877
Land lease	USDA	4	month	$ -	$ -	$ -	$ -	$ -	$ -	$ 33.46	$134
Command facility mobilization/demobilization	Mobile Mini, Inc.	1	lump sum	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,914.00	$1,914
Clearing & grubbing, light trees, to 6" diameter	3111 1010 0020	1	acre	$ 2,206	$ 2,206	$ 1,807	$ 1,807	$ -	$ -	$ -	$4,013
Rough grade, 20,100-25,000 SF	3122 1320 0210	1	ea	$ 576	$ 576	$ 550	$ 550	$ -	$ -	$ -	$1,127
Temporary, roads, gravel fill, 4" gravel depth	0155 2350 0050	2,500	SY	$ 2	$ 5,228	$ 1	$ 1,385	$ 4	$ 10,145	$ -	$16,757
Fencing	United Site Services	4	month	$ -	$ -	$ -	$ -	$ -	$ -	$ 550.00	$2,200
Generator	United Rentals	4	month	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,922.60	$15,690
Lighting	United Rentals	4	month	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,663.20	$6,653
Toilet, portable chemical (2 toilets)	0154 3340 6410	4	month	$ -	$ -	$ -	$ -	$ -	$ -	$ 427.90	$1,712
Rubbish handling, dumpster, 10 CY, 3 ton capacity, one dump per week	0241 1919 0700	16	weeks	$ -	$ -	$ -	$ -	$ 511	$ 8,180	$ -	$8,180
Site security (24 hours a day) (2 guards)	0156 3250 0100	5,760	hr	$ 49.58	$ 285,565	$ -	$ -	$ -	$ -	$ -	$285,565
Excavation, Installation and Backfill											
Pre- and post-construction topographical survey	0221 1309 0100	3.67	acre	$ 4,240	$ 15,575	$ 158	$ 579	$ 132	$ 483	$ -	$16,636
Per diem	GSA + Tax	84	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,992.00	$167,328
Clearing brush by hand	3113 1310 0100	1.84	acre	$ 2,857	$ 5,246	$ -	$ -	$ -	$ -	$ -	$5,246
Erosion control, silt fence, install and maintain, remove, 3' high	3125 1416 1000	5,000	LF	$ 1	$ 4,351	$ 0.14	$ 692	$ 1	$ 2,982	$ -	$8,026
Rent and operate water truck, off highway, 6,000 gallon capacity	0154 3340 6950	12	week	$ -	$ -	$ -	$ -	$ -	$ -	$ 9,630.10	$115,561
108" diameter pipe, prestressed concrete	Layne Christensen Company	1,600	LF	$ -	$ -	$ -	$ -	$ -	$ -	$ 770.00	$1,232,000
Excavation, installation, backfill, compaction labor	Layne Christensen Company	1,600	LF	$ -	$ -	$ -	$ -	$ -	$ -	$ 220.00	$352,000
Engineering oversight	Professional est	84	day	$ 768	$ 64,512	$ -	$ -	$ -	$ -	$ -	$64,512
Bypass Arroyo Colorado											
Per diem	GSA + Tax	21	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,992.00	$41,832
Cofferdam including mobilization and temporary sheeting, shore driven	3152 1610 0020/professional estimate	6,000	SF	$ 7	$ 44,732	$ 9	$ 51,378	$ 36.042	$ 216,250	$ -	$312,360
Dewatering systems, drainage trench 2' wide, 3' deep with backhoe loader	3123 1920 0100	140	CY	$ 6	$ 831	$ 3	$ 410	$ -	$ -	$ -	$1,241
Pumping 8 hr., 20 LF suction 100 LF discharge, 6 inch centrifugal (2 pump)	3123 1920 1100	21	day	$ 633	$ 13,289	$ 767	$ 16,101	$ -	$ -	$ -	$29,390
Excavating bypass, 1 CY hydraulic excavator	3123 1613 0120	2,400	BCY	$ 2	$ 4,894	$ 2	$ 5,266	$ -	$ -	$ -	$10,160
Silt curtain (100'x7')	Granite Environmental, Inc	3	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,427.69	$7,283
Sampling analysis - PCB as Aroclors	TestAmerica, Inc.	20	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 180.40	$3,608
Sampling equipment and supplies	Professional est	1	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,200.00	$2,200
Backfill, 2-1/2 CY front end loader, 300' haul	3123 2317 0190	3,000	LCY	$ 1	$ 3,156	$ 3	$ 10,193	$ -	$ -	$ -	$13,349
Rough grade 75,100-100,000 SF	3122 1320 0280	1	ea	$ 2,232	$ 2,232	$ 2,131	$ 2,131	$ -	$ -	$ -	$4,363
Modified Canal Segments											
Per diem	GSA + Tax	35	days	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,490.00	$87,150
Rough grade 75,100-100,000 SF	3122 1320 0280	2	ea	$ 2,232	$ 4,464	$ 2,131	$ 4,262	$ -	$ -	$ -	$8,725
Excavation, hydraulic, crawler mtd, 1-1/2 CY	3123 1642 0250	5,000	BCY	$ 0.82	$ 4,091	$ 1.11	$ 5,538	$ -	$ -	$ -	$9,630
Selective demolition, concrete	0305 0510 0050	800	CY	$ 49.54	$ 39,631	$ 10.30	$ 8,239	$ -	$ -	$ -	$47,870
Cast-in place retaining walls, w/ vertical face, 33 deg embankment, 10' high	3232 1310 2600	600	LF	$ 569.52	$ 341,712	$ 73.36	$ 44,017	$ 402	$ 241,491	$ -	$627,221
Slip form concrete canal lining, unreinforced, 8"thick	3213 1328 0120	3,667	SY	$ 0.78	$ 2,857	$ 0.87	$ 3,202	$ 37	$ 137,229	$ -	$143,289
Cofferdam at siphon entrance and exit	Lincoln Park FS[2]	100	LF	$ -	$ -	$ -	$ -	$ -	$ -	$ 325.23	$32,523
Bypass pumps, 375 HP diesel, (6 pumps)	Baker Corp/0131 1320 0160	2	week	$ -	$ -	$ -	$ -	$ -	$ -	$ 49,055.60	$98,111
Pump fuel costs	Baker Corp	14	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,603.20	$106,445
Knife Gate, handwheel operator, 20" diameter	3520 1669 0170	6	ea	$ 396.79	$ 2,381	$ 388.41	$ 2,330	$ 13,371	$ 80,223	$ -	$84,934
Prestressed concrete pipe, 150 PSI, 12" diameter	3311 1310 3000	600	LF	$ 8.65	$ 5,190	$ 4.21	$ 2,524	$ 64	$ 38,508	$ -	$46,223
Weir replacement (flow control gate)	Layne Christensen Company	1	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 385,000.00	$385,000

EA Engineering, Science, and Technology, Inc., PBC

TECHNOLOGY	LOCATION	MEDIUM	Estimated Cost to Implement	$8,100,000
Replace Siphon Alternative Component SI-B	Donna Reservoir and Canal System Donna, TX	Siphon	Construction Time:	4 months
			Operation Time:	- years
			Post Remediation Monitoring	- years

Description	Data Source (Means[1] or Other)	Quantities: Quantity Amount	Quantities: Quantity Unit	Cost Breakdown (if available): Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Material Unit Cost	Material Total Cost	Combined Unit Costs	Option Total Cost
Existing Siphon Sealing											
Total cost to complete	Inquip Associates, Inc	1	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 770,000.00	$770,000
Site Restoration											
Rough grade 75,100-100,000 SF	3122 1320 0280	1	ea	$ 2,232	$ 2,232	$ 2,131	$ 2,131	$ -	$ -	$ -	$4,363
Seeding, hydro or air seeding, with mulch and fertilizer	3292 1914 5400	300	MSF	$ 15	$ 4,368	$ 9	$ 2,799	$ 44	$ 13,135	$ -	$20,302
Mobilization and Demobilization											**$259,053**
5% of Total Costs of Site Work										$5,181,060	$259,053
System Contingency											**$1,360,028**
25% of Total Construction Activities										$5,440,113	$1,360,028
Professional/Technical Services[3]											**$1,292,027**
5% of Construction + Contingency for Project Management										$ 6,800,141	$340,007
8% of Construction + Contingency for Remedial Design										$ 6,800,141	$544,011
6% of Construction + Contingency for Construction Management										$ 6,800,141	$408,008

OPERATION AND MAINTENANCE	**ANNUAL O&M COST**	**$ -**
	LIFETIME O&M (NPV)	**$ -**
NO LONG TERM O&M REQUIRED		
LONG TERM MONITORING	**ANNUAL LTM COST**	**$ -**
	LIFETIME LTM (NPV)	**$ -**
NO LONG TERM MONITORING REQUIRED		
TOTAL ESTIMATED NPV TECHNOLOGY COST (Capital + Lifetime O&M + Post Remediation Monitoring)		**$8,100,000**

Assumptions:

General

Working condition is Safety Level:	D	(Labor productivity:	82%	;	Equipment productivity	100%	)	
Weighted Average of city cost index	96.8%	(not applicable for costs derived from vendor quotes).						
Costs are loaded with mark-up	10%							
Inflation	3%	per year	6%	for 2 years	13%	for 4 years	34%	for 10 years
Sales Tax	8.25%							

During Excavation and Backfill

Density of Soil	1.6	ton/CY			
Workers work week consists of	6	days /week	1	rigs	
Loose cubic yard to in-place cubic yard ratio	1.25	LCY/BCY			
	1	mobilization/demobilizations per excavator			$664 per diem per rig

During Cap Installation

Workers work week consists of	6	days /week	1	rigs	
	1	mobilization/demobilizations per excavator			$664 per diem per rig

Approximate hourly wage

Standard work day		12	hrs
Approximate hourly wage	Field Engineer	$100.00	

Notes

BCY	In-place cubic yard	gal	Gallon	LF	Linear foot
CY	Cubic yard	hrs	Hours	MSF	thousand square feet
ea	Each	HP	horse power	O&M	Operation and maintenance
ECY	Embankment cubic yards	H&S	Health and Safety	SF	Square foot
ft	Foot	LCY	Loose cubic yard	SY	Square yard

1 Source is The Gordian Group, RS Means Online (2016), McAllen, TX, unless otherwise cited
2 Source: "Lincoln Park/Milwaukee River Channel Sediments Site, Phase II Feasibility Study/Remedial Design", EA Engineering (2013)
3 Source of factor: "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study," US EPA (July 2000)

EA Engineering, Science, and Technology, Inc., PBC

TECHNOLOGY	LOCATION	MEDIUM	Estimated Cost to Implement	$11,300,000
Dredging of Canal Sediment with Off-Site Disposal Alternative Component SE-A	Donna Reservoir and Canal System Donna, TX	Sediment	Construction Time:	5 months
			Operation Time:	5 years
			Post Remediation Monitoring	20 years

		Quantities		Cost Breakdown (if available)						Combined Unit Costs	
Description	Data Source (Means[1] or Other)	Quantity Amount	Quantity Unit	Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Material Unit Cost	Material Total Cost	Unit Cost	Option Total Cost
REMEDIAL ACTION - CONSTRUCTION		**TOTAL CAPITAL COST (totals rounded to nearest thousand)**									**$7,580,000**
Construction Activities											**$5,332,903**
Temporary Facilities and Site Maintenance											
Command facility 40' combo with 15' office	Mobile Mini, Inc.	5	month	$ -	$ -	$ -	$ -	$ -	$ -	$ 506.00	$2,530
Office equipment rental average	0152 1340 0100	5	month	$ -	$ -	$ -	$ -	$ 219	$ 1,096	$ -	$1,096
Land lease	USDA	5	month	$ -	$ -	$ -	$ -	$ -	$ -	$ 33.46	$167
Clearing & grubbing, heavy trees, to 12" diameter	3111 1010 0200	1	acre	$ 3,139	$ 3,139	$ 2,589	$ 2,589	$ -	$ -	$ -	$5,729
Rough grade 35,100-40,000 SF	3122 1320 0240	1	ea	$ 893	$ 893	$ 858	$ 858	$ -	$ -	$ -	$1,750
Temporary, roads, gravel fill, 4" gravel depth	0155 2350 0050	4,000	SY	$ 2	$ 8,365	$ 1	$ 2,215	$ 4	$ 16,231	$ -	$26,811
Fencing	United Site Services	5	month	$ -	$ -	$ -	$ -	$ -	$ -	$ 687.50	$3,438
Generator	United Rentals	5	month	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,922.60	$19,613
Lighting	United Rentals	5	month	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,663.20	$8,316
Toilet, portable chemical (2 toilets)	0154 3340 6410	5	month	$ -	$ -	$ -	$ -	$ -	$ -	$ 427.90	$2,140
Rubbish handling, dumpster, 10 CY, 3 ton capacity, one dump per week	0241 1919 0700	21	weeks	$ -	$ -	$ -	$ -	$ 511	$ 10,736	$ -	$10,736
Temporary bridge rental	Mabey	21	weeks	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,034	$21,714
Concrete caissons for marine const., 80 to 150 ton capacity, 22" diameter, 10' deep	3163 2616 0400	120	VLF	$ 63	$ 7,561	$ 26	$ 3,166	$ 27	$ 3,288	$ -	$14,015
Temporary bridge installation	0131 1320 0160	1	week	$ 11,884	$ 11,884	$ -	$ -	$ -	$ -	$ -	$11,884
Gravel for road maintenance, 3" thick	Stone and Soil, Inc	134,580	SF	$ -	$ -	$ -	$ -	$ -	$ -	$ 0.41	$54,829
Gravel freight	Stone and Soil, Inc	62	load	$ -	$ -	$ -	$ -	$ -	$ -	$ 220.00	$13,713
Excavator diesel hydraulic crawler mounted 1-1/2 CY capacity	0154 3320 0200	6	week	$ 4,066	$ 24,396	$ 3,110	$ 18,657	$ -	$ -	$ -	$43,053
Site security (24 hours a day) (2 guards)	0156 3250 0100	7,200	hr	$ 49.58	$ 356,956	$ -	$ -	$ -	$ -	$ -	$356,956
Excavation											
Per diem construction crew	GSA + Tax	100	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,328.00	$132,800
Clearing brush by hand	3113 1310 0100	3	acre	$ 2,857	$ 8,825	$ -	$ -	$ -	$ -	$ -	$8,825
Excavating, clamshell, 1 CY; for wet excavation	3123 1642 0550; 3123 1642 4200	19,979	BCY	$ 2.91	$ 58,128	$ 4.78	$ 95,543	$ -	$ -	$ -	$153,672
Excavator attachment, grapple	0154 3320 0345	15	week	$ -	$ -	$ -	$ -	$ -	$ -	$ 646.29	$9,694
Front end loader, 4WD, 2.5-3.5 CY 145HP	0154 3320 4710/0131 1320 0160	15	week	$ 1,981	$ 29,711	$ -	$ -	$ -	$ -	$ 1,392.88	$50,604
Rent truck, dump, 4 axle, 25 ton payload	0154 3320 5310/0131 1320 0160	15	week	$ 1,981	$ 29,711	$ -	$ -	$ -	$ -	$ 1,654.74	$54,532
Silt curtain (100' x 7')	Granite Environmental, Inc.	20	each	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,427.69	$48,554
Levee stabilization, loading and spreading, common earth, shovel, 1-1/2 CY bucket	3123 2315 4010	554	BCY	$ 0.71	$ 396	$ 1.27	$ 702	$ 39	$ 21,783	$ -	$22,881
Rent and operate water truck, off highway, 6,000 gallon capacity	0154 3340 6950	15	week	$ -	$ -	$ -	$ -	$ -	$ -	$ 9,630.10	$144,452
Engineering oversight	Professional est	50	day	$ 1,200	$ 60,000	$ -	$ -	$ -	$ -	$ -	$60,000
Disposal of Sediment											
Mobilization/demobilization of water tight boxes	USA Environmental, LP	20	load	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,100.00	$22,000
Per diem truck drivers	GSA + Tax	79	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,660.00	$130,590
Transportation of sediment	USA Environmental, LP	1,573	load	$ -	$ -	$ -	$ -	$ -	$ -	$ 550.00	$865,354
Liners	USA Environmental, LP	1,573	load	$ -	$ -	$ -	$ -	$ -	$ -	$ 33.00	$51,921
Box rental, 20 boxes	USA Environmental, LP	2,000	box days	$ -	$ -	$ -	$ -	$ -	$ -	$ 13.20	$26,400
Disposal of sediment, includes stabilization	USA Environmental, LP	28,321	ton	$ -	$ -	$ -	$ -	$ -	$ -	$ 77.00	$2,180,692
Washout of boxes	USA Environmental, LP	20	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 234.03	$4,681
Fractionation tank, 20,000 gallon capacity; for sediment dewatering	Baker Corp, Inc.	100	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 46.20	$4,620
Trash pump, for sediment dewatering	Sunbelt Rentals/0131 1320 0160	4	month	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,067.00	$4,268
Excavator diesel hydraulic crawler mounted, 1-1/2 CY	0154 3320 0200/0131 1320 0160	4	month	$ 7,923	$ 31,692	$ -	$ -	$ -	$ -	$ 9,248.69	$68,687
Cement, Portland, type I/II, trucked in bulk, 94 lb bags	0305 1330 0250	42,180	ea	$ -	$ -	$ -	$ -	$ 14	$ 596,589	$ -	$596,589
Confirmation Sampling											
Per diem	GSA + Tax	5	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 498.00	$2,490
Forklift variable reach, 6,000 lbs	United Rentals	1	week	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,989.90	$1,990
17' Tracker boat with 40hp motor and trailer	Professional est	1	week	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,200	$1,200

TECHNOLOGY	LOCATION	MEDIUM	Estimated Cost to Implement	$11,300,000
Dredging of Canal Sediment with Off-Site Disposal Alternative Component SE-A	Donna Reservoir and Canal System Donna, TX	Sediment	Construction Time:	5 months
			Operation Time:	5 years
			Post Remediation Monitoring	20 years

		Quantities		Cost Breakdown (if available)						Combined Unit Costs	
Description	Data Source (Means[1] or Other)	Quantity Amount	Quantity Unit	Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Material Unit Cost	Material Total Cost	Unit Cost	Option Total Cost
Sampling labor (3 samplers)	Professional est	5	day	$ 3,000	$ 15,000	$ -	$ -	$ -	$ -	$ -	$15,000
Sampling equipment, supplies, and shipping	Professional est	1	each	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,720	$5,720
Sediment analysis - PCBs as Aroclors	TestAmerica Inc.	50	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 180	$9,020
Reporting	Professional est	40	hr	$100	$ 4,000	$ -	$ -	$ -	$ -	$ -	$4,000
Engineering Controls											
Sign, aluminum, reflectorized, 30" by 30" and 10' steel posts, upright, bolted	1014 5320 0300/1014 5320 1500	20	ea	$ 28	$ 561	$ 16	$ 315	$ 170.91	$ 3,418	$ -	$4,295
Site Restoration											
Rip-rap & rock lining	3137 1310 0200	415	SY	$ 49	$ 20,402	$ 15	$ 6,334	$ 46	$ 18,997	$ -	$45,733
Rough grade 50,100-75,000 SF	3122 1320 0270	1	ea	$ 1,610	$ 1,610	$ 1,537	$ 1,537	$ -	$ -	$ -	$3,148
Mobilization and Demobilization											**$266,645**
5% of Total Costs of Site Work										$5,332,903	$266,645
System Contingency											**$1,399,100**
25% of Total Construction Activities										$5,596,400	$1,399,100
Professional/Technical Services[2]											**$577,325**
5% of Construction (not including disposal) + Contingency for Project Management										$ 3,038,551	$151,928
8% of Construction (not including disposal) + Contingency for Remedial Design										$ 3,038,551	$243,084
6% of Construction (not including disposal) + Contingency for Construction Management										$ 3,038,551	$182,313
REMEDIAL ACTION - FISH REMOVAL									**ANNUAL COST**		**$ 733,000**
									TOTAL COST (NPV)		**$ 3,010,000**
Residual Contamination Removal											**$558,391**
Annual Electrofishing and Fish Removal (for 5 years)											
Mobilization/demobilization	Professional est	2	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,730.00	$9,460
Per diem	GSA + Tax	35	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 830.00	$29,050
Forklift variable reach, 6,000 lbs	United Rentals	2	months	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,828.58	$9,657
17' Tracker boat with 40hp motor and trailer	EA Engineering	35	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 230	$8,050
Regular DC shocker for electrofishing	EA Engineering	35	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 260	$9,100
Removal activities (5 person team)	Professional est	35	day	$ 6,000	$ 210,000	$ -	$ -	$ -	$ -	$ -	$210,000
55 gallon steel drums	Dallas Steel Drums, Inc.	500	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 54	$27,088
Hazardous waste transportation to disposal site	0281 2010 1260	500	mile	$ -	$ -	$ -	$ -	$ -	$ -	$ 47	$23,408
Hazardous waste pickup and disposal	0281 2010 1100	500	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 221	$110,748
Low Water Removal Actions (for 5 years)											
Mobilization/demobilization	Professional est	2	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,730.00	$9,460
Per diem	GSA + Tax	10	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 664.00	$6,640
Forklift variable reach, 6,000 lbs	United Rentals	2	week	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,989.90	$3,980
17' Tracker boat with 40hp motor and trailer	EA Engineering	10	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 230	$2,300
Cast Net	Bett's Super Pro Cast Net	1	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 264.00	$264
Seine Netting (43 lb test)	The Fish Net Company	1	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 211	$211
Removal activities (4 person team)	Professional est	10	day	$ 4,800	$ 48,000	$ -	$ -	$ -	$ -	$ -	$48,000
55 gallon steel drums	Dallas Steel Drums, Inc.	100	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 54	$5,418
Hazardous waste transportation to disposal site	0281 2010 1260	500	mile	$ -	$ -	$ -	$ -	$ -	$ -	$ 47	$23,408
Hazardous waste pickup and disposal	0281 2010 1100	100	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 221	$22,150
System Contingency											**$139,598**
25% of Remedial Action - Fish Removals										$558,391	$139,597.76

TECHNOLOGY	LOCATION	MEDIUM	Estimated Cost to Implement	$11,300,000
Dredging of Canal Sediment with Off-Site Disposal Alternative Component SE-A	Donna Reservoir and Canal System Donna, TX	Sediment	Construction Time:	5 months
			Operation Time:	5 years
			Post Remediation Monitoring	20 years

Description	Data Source (Means[1] or Other)	Quantities: Quantity Amount	Quantities: Quantity Unit	Cost Breakdown (if available): Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Material Unit Cost	Material Total Cost	Combined Unit Costs: Unit Cost	Option Total Cost
Professional/Technical Services[2]											**$34,899**
5% of Remedial Action - Fish Removals + Contingency for Project Management										$ 697,989	$ 34,899
Lifetime Remedial Action - Fish Removals (Net Present Value)[2]											**$ 3,005,445**
Annual Remedial Action - Fish Removals Net Present Value											$ 3,005,445
5 **Years of Operation**											
7% **Discount Factor (per EPA guidance)**											
LONG TERM MONITORING, COMMUNITY INVOLVEMENT AND ENGINEERING CONTROLS										**ANNUAL LTM COST**	**$88,000**
										LIFETIME LTM (NPV)	**$700,000**
Monitoring, Sampling, Testing and Analysis - Fish											**$73,270**
Post Remediation Site Monitoring - Fish Tissue Sampling (at years 1, 2, 3, 4, 5, 7, and 9)											
Mobilization/demobilization	Professional est	1	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 8,360.00	$8,360
Per diem	GSA + Tax	5	days	$ -	$ -	$ -	$ -	$ -	$ -	$ 664.00	$3,320
Forklift variable reach, 6,000 lbs	United Rentals	1	week	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,989.90	$1,990
17' Tracker boat with 40hp motor and trailer	EA Engineering	5	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 255.96	$1,280
Regular DC shocker for electrofishing	EA Engineering	5	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 255.96	$1,280
Sampling labor (4 samplers)	Professional est	5	day	$ 4,800	$ 24,000	$ -	$ -	$ -	$ -	$ -	$24,000
Sampling equipment, supplies, and shipping	Professional est	1	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,500.00	$5,500
Fish tissue analysis - PCBs as Aroclors	Test America Laboratories	100	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 235.40	$23,540
Reporting	Professional est	40	hr	$ 100	$ 4,000	$ -	$ -	$ -	$ -	$ -	$4,000
Monitoring, Sampling, Testing and Analysis - Sediment											**$189,039**
Post Remediation Site Monitoring - Sediment Sampling (at year 4)											
Mobilization/demobilization	Professional est	1	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 8,360.00	$8,360
Per diem	GSA + Tax	10	days	$ -	$ -	$ -	$ -	$ -	$ -	$ 664.00	$6,640
Forklift variable reach, 6,000 lbs	United Rentals	2	week	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,989.90	$3,980
17' Tracker boat with 40hp motor and trailer	EA Engineering	10	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 255.96	$2,560
Sampling labor (4 samplers)	Professional est	10	day	$ 4,800	$ 48,000	$ -	$ -	$ -	$ -	$ -	$48,000
Sampling equipment, supplies, and shipping	Professional est	1	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,500.00	$5,500
Sediment analysis - PCB Congeners	Test America Laboratories	100	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,100.00	$110,000
Reporting	Professional est	40	hr	$ 100	$ 4,000	$ -	$ -	$ -	$ -	$ -	$4,000
Community Involvement											**$9,846**
Mobilization/demobilization	Professional est	1	events	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,650.00	$1,650
Per diem	GSA + Tax	6	days	$ -	$ -	$ -	$ -	$ -	$ -	$ 166.00	$996
Community outreach event (2 representatives)	Professional est	1	events	$ 7,200	$ 7,200	$ -	$ -	$ -	$ -	$ -	$7,200
Engineering Controls											**$1,074**
Sign Replacement	1014 5320 0300/1014 5320 1500	5	ea	$ 28	$ 140	$ 16	$ 79	$ 170.91	$ 855	$ -	$1,074
Professional/Technical Services[2]											**$4,209**
5% of Total Sampling Activities for Project Management										$84,189	$4,209
Lifetime Long Term Monitoring (Net Present Value)[2]											**$698,868**
Monitoring, Sampling, Testing and Analysis - Fish		1	NPV							$405,197	$405,197
Monitoring, Sampling, Testing and Analysis - Sediment		1	NPV							$151,428	$151,428
Community Involvement		1	NPV							$134,325	$134,325
Engineering Controls		1	NPV							$7,918	$7,918
10 Long-Term Sampling											

TECHNOLOGY	LOCATION	MEDIUM	Estimated Cost to Implement	$11,300,000
Dredging of Canal Sediment with Off-Site Disposal Alternative Component SE-A	Donna Reservoir and Canal System Donna, TX	Sediment	Construction Time:	5 months
			Operation Time:	5 years
			Post Remediation Monitoring	20 years

			Quantities		Cost Breakdown (if available)							
	Description	Data Source (Means[1] or Other)	Quantity Amount	Quantity Unit	Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Material Unit Cost	Material Total Cost	Combined Unit Costs: Unit Cost	Option Total Cost
10	Community Involvement and Engineering Controls											
7%	Discount Factor (per EPA guidance)											

TOTAL ESTIMATED NPV TECHNOLOGY COST **$11,300,000**

Assumptions:

General

Working condition is Safety Level:	D	Labor productivity:	82%	,	Equipment productivity:	100%		
Weighted Average of city cost index	96.8%	(not applicable for costs derived from vendor quotes).						
Costs are loaded with mark-up	10%							
Inflation	3%	per year	6%	for 2 years	13%	for 4 years	34%	for 10 years
Sales Tax	8.25%							

During Excavation

Density of Sediment	1.4	ton/CY					
Workers work week consists of	6	days /week	1	rigs			
	1	mobilization/demobilizations per excavator			$664	per diem per rig	
Length of canal segment for excavation	4,486	feet					
Approximate width of canal	55.5	feet					
Approximate depth of excavation	2.17	feet					

Disposal

Approximate quantity of concrete for stabilization	7%	by weight
Disposal rate	20	loads/day

Annual Fish Sampling

Sampling to be conducted	1	time per year
Fish Tissue Samples	35	sample
Quality Control Samples	2	# of MS/MSDs to collect
Duplicate	3	# of duplicates to collect
Long Term Monitoring Reports	40	hours per report (1 report per event)
Standard work day	12	hrs
Approximate hourly wage — Junior Engineer	$100.00	
Construction Manager	$140.00	
Community Outreach Representative	$120.00	

Lab Costs

Sediment	
PCB Congeners	$1,000.00
Fish Tissue[3]	
PCB as Aroclors	$214.00

Notes

BCY	In-place cubic yard	H&S	Health and Safety
CY	Cubic yard	LCY	Loose cubic yard
ea	Each	LF	Linear foot
ft	Foot	SF	Square foot
gal	Gallon	SY	Square yard
hrs	Hours	VLF	Vertical linear foot
HP	horse power		

1 Source is The Gordian Group, RS Means Online (2016), McAllen, TX, unless otherwise cited
2 Source of factor: "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study," US EPA (July 2000a)
3 Fish tissue analyses include cost for lipids and filleting

EA Engineering, Science, and Technology, Inc., PBC

TECHNOLOGY	LOCATION	MEDIUM	Estimated Cost to Implement	$33,700,000
Dredging of Canal Sediment with Off-Site Disposal and Reservoir Monitored Natural Recovery Alternative Component SE-B	Donna Reservoir and Canal System Donna, TX	Sediment	Construction Time: 13 months Operation Time: 5 years Post Remediation Monitoring 20 years	

Description	Data Source (Means[1] or Other)	Quantities: Quantity Amount	Quantity Unit	Cost Breakdown (if available): Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Material Unit Cost	Material Total Cost	Combined Unit Costs: Unit Cost	Option Total Cost
REMEDIAL ACTION - CONSTRUCTION		**TOTAL CAPITAL COST (totals rounded to nearest thousand)**									**$27,240,000**
Pre-Design											**$682,268**
Reservoir and Canal Baseline Sampling											
Mobilization/demobilization	Professional est	1	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 13,200.00	$13,200
Per diem	GSA + Tax	21	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 996.00	$20,916
Forklift variable reach, 6,000 lbs	United Rentals	3	weeks	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,989.90	$5,970
Vibra-corer-PVL Technologies and Consumables	PVL Technologies, Inc.	13	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 495.00	$6,435
17' Tracker boat with 40hp motor and trailer	Professional est	13	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 255.96	$3,327
Sampling labor (6 samplers)	Professional est	21	day	$ 7,200	$ 151,200	$ -	$ -	$ -	$ -	$ -	$151,200
Sampling equipment, supplies, and shipping	Professional est	1	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 11,220.00	$11,220
Sediment analysis - PCB Congeners	TestAmerica Inc.	420	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,100.00	$462,000
Reporting	Professional est	80	hr	$ 100	$ 8,000	$ -	$ -	$ -	$ -	$ -	$8,000
Construction Activities											**$18,900,051**
Temporary Facilities and Site Maintenance											
Command facility 40' combo with 15' office	Mobile Mini, Inc.	12	month	$ -	$ -	$ -	$ -	$ -	$ -	$ 506.00	$6,072
Office equipment rental average	0152 1340 0100	12	month	$ -	$ -	$ -	$ -	$ 219	$ 2,630	$ -	$2,630
Land lease	USDA	12	month	$ -	$ -	$ -	$ -	$ -	$ -	$ 33.46	$402
Clearing & grubbing, heavy trees, to 12" diameter	3111 1010 0200	1	acre	$ 3,139	$ 3,139	$ 2,589	$ 2,589	$ -	$ -	$ -	$5,729
Rough grade 35,100-40,000 SF	3122 1320 0240	1	ea	$ 893	$ 893	$ 858	$ 858	$ -	$ -	$ -	$1,750
Temporary, roads, gravel fill, 4" gravel depth	0155 2350 0050	4,000	SY	$ 2	$ 8,365	$ 1	$ 2,215	$ 4	$ 16,231	$ -	$26,811
Fencing	United Site Services	12	month	$ -	$ -	$ -	$ -	$ -	$ -	$ 687.50	$8,250
Generator	United Rentals	12	month	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,922.60	$47,071
Lighting	United Rentals	12	month	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,663.20	$19,958
Toilet, portable chemical (2 toilets)	0154 3340 6410	12	month	$ -	$ -	$ -	$ -	$ -	$ -	$ 427.90	$5,135
Rubbish handling, dumpster, 10 CY, 3 ton capacity, one dump per week	0241 1919 0700	56	weeks	$ -	$ -	$ -	$ -	$ 511	$ 28,629	$ -	$28,629
Temporary bridge rental	Mabey	21	weeks	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,034	$21,714
Concrete caissons for marine const., 80 to 150 ton capacity, 22" diameter, 10' deep	3163 2616 0400	120	VLF	$ 63	$ 7,561	$ 26	$ 3,166	$ 27	$ 3,288	$ -	$14,015
Temporary bridge installation	0131 1320 0160	1	week	$ 11,884	$ 11,884	$ -	$ -	$ -	$ -	$ -	$11,884
Gravel for road maintenance, 3" thick	Stone and Soil, Inc	365,130	SF	$ -	$ -	$ -	$ -	$ -	$ -	$ 0.41	$148,757
Gravel freight	Stone and Soil, Inc	170	load	$ -	$ -	$ -	$ -	$ -	$ -	$ 220	$37,400
Excavator diesel hydraulic crawler mounted 1-1/2 CY capacity	0154 3320 0200	14	weeks	$ 4,066	$ 56,925	$ 3,110	$ 43,533	$ -	$ -	$ -	$100,458
Site security (24 hours a day) (2 guards)	0156 3250 0100	17,520	hr	$ 49.58	$ 868,592	$ -	$ -	$ -	$ -	$ -	$868,592
Excavation (Unlined)											
Per diem construction crew	GSA + Tax	330	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,328.00	$438,240
Per diem truck drivers	GSA + Tax	330	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,660.00	$547,800
Clearing brush by hand	3113 1310 0100	8	acre	$ 2,857	$ 23,944	$ -	$ -	$ -	$ -	$ -	$23,944
Excavating, clamshell, 1 CY; for wet excavation	3123 1642 0550; 3123 1642 4200	54,206	BCY	$ 2.91	$ 157,709	$ 4.78	$ 259,219	$ -	$ -	$ -	$416,928
Excavator attachment, grapple	0154 3320 0345	48	week	$ -	$ -	$ -	$ -	$ -	$ -	$ 646.29	$31,022
Front end loader, 4WD, 2.5-3.5 CY 145HP	0154 3320 4710/0131 1320 0160	48	week	$ 1,981	$ 95,076	$ -	$ -	$ -	$ -	$ 1,392.88	$161,934
Rent truck, dump, 4 axle, 25 ton payload	0154 3320 5310/0131 1320 0160	48	week	$ 1,981	$ 95,076	$ -	$ -	$ -	$ -	$ 1,654.74	$174,504
Silt curtain (100' x 7')	Granite Environmental, Inc.	30	each	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,427.69	$72,831
Levee stabilization, loading and spreading, common earth, shovel, 1-1/2 CY bucket	3123 2315 4010	3,568	BCY	$ 0.71	$ 2,549	$ 1.27	$ 4,522	$ 39	$ 140,340	$ -	$147,411
Rent and operate water truck, off highway, 6,000 gallon capacity	0154 3340 6950	48	week	$ -	$ -	$ -	$ -	$ -	$ -	$ 9,630.10	$462,245
Engineering oversight	Professional est	200	day	$ 1,200	$ 240,000	$ -	$ -	$ -	$ -	$ -	$240,000
Excavation (Lined)											
Mobilization/demobilization equipment hauled 40-ton capacity	0154 3650 1500	2	each	$ 292	$ 584	$ 405	$ 809	$ -	$ -	$ -	$1,393
Per diem construction crew	GSA + Tax	175	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,328.00	$232,400
Clearing brush by hand	3113 1310 0100	12	acre	$ 2,857	$ 32,913	$ -	$ -	$ -	$ -	$ -	$32,913
Excavating, backhoe, 1 CY; for wet excavation	3123 1642 0200; 3123 1642 4200	17,195	BCY	$ 2.00	$ 34,393	$ 2.30	$ 39,557	$ -	$ -	$ -	$73,950
Front end loader, 4WD, 2.5-3.5 CY 145HP	0154 3320 4710/0131 1320 0160	20	week	$ 1,981	$ 39,615	$ -	$ -	$ -	$ -	$ 1,392.88	$67,472
Rent truck, dump, 4 axle, 25 ton payload	0154 3320 5310/0131 1320 0160	20	week	$ 1,981	$ 39,615	$ -	$ -	$ -	$ -	$ 1,654.74	$72,710
Vacuum truck, hazardous material, 5000 gallons	0154 3340 7625/0131 1320 0160	5	week	$ 3,961.50	$ 19,807	$ -	$ -	$ -	$ -	$ 1,426.06	$26,938

099969

TECHNOLOGY	LOCATION	MEDIUM	Estimated Cost to Implement	$33,700,000
Dredging of Canal Sediment with Off-Site Disposal and Reservoir Monitored Natural Recovery Alternative Component SE-B	**Donna Reservoir and Canal System Donna, TX**	**Sediment**	**Construction Time:**	**13 months**
			Operation Time:	**5 years**
			Post Remediation Monitoring	**20 years**

		Quantities		Cost Breakdown (if available)						Combined Unit Costs	
Description	Data Source (Means[1] or Other)	Quantity Amount	Quantity Unit	Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Material Unit Cost	Material Total Cost	Unit Cost	Option Total Cost
Disposal of Canal Sediment											
Mobilization/demobilization of water tight boxes	USA Environmental, LP	20	load	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,100.00	$22,000
Per diem truck drivers	GSA + Tax	281	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,660.00	$466,693
Transportation of sediment	USA Environmental, LP	5,623	load	$ -	$ -	$ -	$ -	$ -	$ -	$ 550.00	$3,092,545
Liners	USA Environmental, LP	5,623	load	$ -	$ -	$ -	$ -	$ -	$ -	$ 33.00	$185,553
Box rental, 20 boxes	USA Environmental, LP	7,200	box days	$ -	$ -	$ -	$ -	$ -	$ -	$ 13.20	$95,040
Disposal of sediment, includes stabilization	USA Environmental, LP	101,211	ton	$ -	$ -	$ -	$ -	$ -	$ -	$ 77.00	$7,793,213
Washout of boxes	USA Environmental, LP	20	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 234.03	$4,681
Fractionation tank, 20,000 gallon capacity; for sediment dewatering	Baker Corp, Inc.	330	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 46.20	$15,246
Trash pump, for sediment dewatering	Sunbelt Rentals/0131 1320 0160	11	month	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,067.00	$11,737
Excavator diesel hydraulic crawler mounted, 1-1/2 CY	0154 3320 0200/0131 1320 0160	11	month	$ 7,923	$ 87,153	$ -	$ -	$ -	$ -	$ 9,248.69	$188,889
Cement, Portland, type I/II, trucked in bulk, 94 lb bags	0305 1330 0250	150,739	ea	$ -	$ -	$ -	$ -	$ 14	$ 2,132,052	$ -	$2,132,052
Confirmation Sampling											
Per diem	GSA + Tax	15	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 830.00	$12,450
Forklift variable reach, 6,000 lbs	United Rentals	3	week	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,989.90	$5,970
17' Tracker boat with 40hp motor and trailer	Professional est	3	week	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,200	$3,600
Sampling labor (3 samplers)	Professional est	15	day	$ 3,000	$ 45,000	$ -	$ -	$ -	$ -	$ -	$45,000
Sampling equipment, supplies, and shipping	Professional est	1	each	$ -	$ -	$ -	$ -	$ -	$ -	$ 6,600	$6,600
Sediment analysis - PCB Congeners	TestAmerica Inc.	120	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,100.00	$132,000
Reporting	Professional est	40	hr	$100	$ 4,000	$ -	$ -	$ -	$ -	$ -	$4,000
Engineering Controls											
Sign, aluminum, reflectorized, 30" by 30" and 10' steel posts, upright, bolted	1014 5320 0300/1014 5320 1500	20	ea	$ 28	$ 561	$ 16	$ 315	$ 171	$ 3,418	$ -	$4,295
Site Restoration											
Rip-rap & rock lining	3137 1310 0200	415	SY	$ 49	$ 20,402	$ 15	$ 6,334	$ 46	$ 18,997	$ -	$45,733
Rough grade 75,100-100,000 SF	3122 1320 0280	12	ea	$ 2,188	$ 26,258	$ 2,217	$ 26,605	$ -	$ -	$ -	$52,863
Mobilization and Demobilization											**$945,003**
5% of Total Costs of Site Work										$18,900,051	$945,003
System Contingency											**$4,790,696**
25% of Total Construction Activities										$19,162,785	$4,790,696
Professional/Technical Services[2]											**$1,922,033**
5% of Construction (not including disposal) + Contingency for Project Management										$ 11,306,076	$565,304
6% of Construction (not including disposal) + Contingency for Remedial Design										$ 11,306,076	$678,365
6% of Construction (not including disposal) + Contingency for Construction Management										$ 11,306,076	$678,365
REMEDIAL ACTION - FISH REMOVAL										**ANNUAL COST**	**$ 733,000**
										TOTAL COST (NPV)	**$ 3,010,000**
Residual Contamination Removal											**$558,391**
Annual Electrofishing and Fish Removal (for 5 years)											
Mobilization/demobilization	Professional est	2	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,730.00	$9,460
Per diem	GSA + Tax	35	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 830.00	$29,050
Forklift variable reach, 6,000 lbs	United Rentals	2	months	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,828.58	$9,657
17' Tracker boat with 40hp motor and trailer	EA Engineering	35	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 230	$8,050
Regular DC shocker for electrofishing	EA Engineering	35	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 260	$9,100
Removal activities (5 person team)	Professional est	35	day	$ 6,000	$ 210,000	$ -	$ -	$ -	$ -	$ -	$210,000
55 gallon steel drums	Dallas Steel Drums, Inc.	500	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 54	$27,088
Hazardous waste transportation to disposal site	0281 2010 1260	500	mile	$ -	$ -	$ -	$ -	$ -	$ -	$ 47	$23,408
Hazardous waste pickup and disposal	0281 2010 1100	500	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 221	$110,748
Low Water Removal Actions (for 5 years)											
Mobilization/demobilization	Professional est	2	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,730.00	$9,460
Per diem	GSA + Tax	10	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 664.00	$6,640
Forklift variable reach, 6,000 lbs	United Rentals	2	week	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,989.90	$3,980

TECHNOLOGY	LOCATION	MEDIUM	Estimated Cost to Implement	$33,700,000
Dredging of Canal Sediment with Off-Site Disposal and Reservoir Monitored Natural Recovery Alternative Component SE-B	Donna Reservoir and Canal System Donna, TX	Sediment	Construction Time: 13 months Operation Time: 5 years Post Remediation Monitoring 20 years	

Description	Data Source (Means[1] or Other)	Quantities: Quantity Amount	Quantity Unit	Cost Breakdown (if available): Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Material Unit Cost	Material Total Cost	Combined Unit Costs: Unit Cost	Option Total Cost
17' Tracker boat with 40hp motor and trailer	EA Engineering	10	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 230	$2,300
Cast Net	Bett's Super Pro Cast Net	1	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 264.00	$264
Seine Netting (43 lb test)	The Fish Net Company	1	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 211.48	$211
Removal activities (4 person team)	Professional est	10	day	$ 4,800	$ 48,000	$ -	$ -	$ -	$ -	$ -	$48,000
55 gallon steel drums	Dallas Steel Drums, Inc.	100	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 54	$5,418
Hazardous waste transportation to disposal site	0281 2010 1260	500	mile	$ -	$ -	$ -	$ -	$ -	$ -	$ 47	$23,408
Hazardous waste pickup and disposal	0281 2010 1100	100	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 221	$22,150
System Contingency											**$139,598**
25% of Remedial Action - Fish Removals										$558,391	$139,597.76
Professional/Technical Services[2]											**$34,899**
5% of Remedial Action - Fish Removals + Contingency for Project Management										$ 697,989	$ 34,899
Lifetime Remedial Action - Fish Removals (Net Present Value)[2]											**$ 3,005,445**
Annual Remedial Action - Fish Removals Net Present Value											$ 3,005,445
5 **Years of Operation**											
7% **Discount Factor (per EPA guidance)**											
LONG TERM MONITORING, COMMUNITY INVOLVEMENT AND ENGINEERING CONTROLS										**ANNUAL LTM COST** **LIFETIME LTM (NPV)**	**$643,000** **$3,420,000**
Monitoring, Sampling, Testing and Analysis											**$601,529**
Post Remediation Site Monitoring - Biennial Fish Tissue Sampling (for 20 years)											
Mobilization/demobilization	Professional est	1	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 8,360.00	$8,360
Per diem	GSA + Tax	10	days	$ -	$ -	$ -	$ -	$ -	$ -	$ 664.00	$6,640
Forklift variable reach, 6,000 lbs	United Rentals	2	week	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,989.90	$3,980
17' Tracker boat with 40hp motor and trailer	EA Engineering	10	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 255.96	$2,560
Regular DC shocker for electrofishing	EA Engineering	5	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 255.96	$1,280
Sampling labor (4 samplers)	Professional est	10	day	$ 4,800	$ 48,000	$ -	$ -	$ -	$ -	$ -	$48,000
Sampling equipment and supplies	Professional est	1	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,200.00	$2,200
Fish tissue analysis - PCBs as Aroclors	Test America Laboratories	100	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 235.40	$23,540
Reporting	Professional est	40	hr	$ 100	$ 4,000	$ -	$ -	$ -	$ -	$ -	$4,000
Monitored Natural Recovery Reservoir Monitoring - Biennial Sediment Sampling (for 20 years)											
Mobilization/demobilization	Professional est	1	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 13,200.00	$13,200
Per diem	GSA + Tax	13	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 996.00	$12,948
Forklift variable reach, 6,000 lbs	United Rentals	2	weeks	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,989.90	$3,980
Vibra-corer-PVL Technologies and Consumables	PVL Technologies, Inc.	13	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 495.00	$6,435
17' Tracker boat with 40hp motor and trailer	Professional est	13	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 255.96	$3,327
Sampling labor (6 samplers)	Professional est	13	day	$ 7,200	$ 93,600	$ -	$ -	$ -	$ -	$ -	$93,600
Sampling equipment, supplies, and shipping	Professional est	1	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,480.00	$7,480
Sediment analysis - PCB Congeners	TestAmerica Inc.	320	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,100.00	$352,000
Reporting	Professional est	80	hr	$ 100	$ 8,000	$ -	$ -	$ -	$ -	$ -	$8,000
Community Involvement											**$9,846**
Mobilization/demobilization	Professional est	1	events	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,650.00	$1,650
Per diem	GSA + Tax	6	days	$ -	$ -	$ -	$ -	$ -	$ -	$ 166.00	$996
Community outreach event (2 representatives)	Professional est	1	events	$ 7,200	$ 7,200	$ -	$ -	$ -	$ -	$ -	$7,200
Engineering Controls											**$1,074**
Sign Replacement	1014 5320 0300/1014 5320 1500	5	ea	$ 28	$ 140	$ 16	$ 79	$ 170.910	$ 855	$ -	$1,074
Professional/Technical Services[2]											**$30,622**
5% of Total Sampling Activities for Project Management										$612,449	$30,622
Lifetime Long Term Monitoring (Net Present Value)[2]											**$3,415,664**

TECHNOLOGY	LOCATION	MEDIUM	Estimated Cost to Implement	$33,700,000
Dredging of Canal Sediment with Off-Site Disposal and Reservoir Monitored Natural Recovery Alternative Component SE-B	**Donna Reservoir and Canal System Donna, TX**	**Sediment**	**Construction Time:** 13 months **Operation Time:** 5 years **Post Remediation Monitoring** 20 years	

Description	Data Source (Means[1] or Other)	Quantities: Quantity Amount	Quantities: Quantity Unit	Cost Breakdown (if available): Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Material Unit Cost	Material Total Cost	Combined Unit Costs: Unit Cost	Combined Unit Costs: Option Total Cost
Monitoring, Sampling, Testing and Analysis		1	NPV							$3,232,484	$3,232,484
Community Involvement		1	NPV							$171,237	$171,237
Engineering Controls		1	NPV							$11,943	$11,943
20	Years of Monitoring										
7%	Discount Factor (per EPA guidance)										

TOTAL ESTIMATED NPV TECHNOLOGY COST **$33,700,000**

Assumptions:

General

Working condition is Safety Level:	D	(Labor productivity:	82%	;	Equipment productivity	100%	)	
Weighted Average of city cost index	96.8%	(not applicable for costs derived from vendor quotes).						
Costs are loaded with mark-up	10%							
Inflation	3%	per year	6%	for 2 years	13%	for 4 years	34%	for 10 years
Sales Tax	8.25%							

During Excavation

Density of Sediment	1.4	ton/CY			
Workers work week consists of	6	days /week	1	rigs	
	1	mobilization/demobilizations per excavator			
			$664	per diem per rig	
Length of unlined canal segment for excavation	12,171	feet			
Length of lined canal segment for excavation	16,730	feet			
Approximate width of canal	55.5	feet			
Approximate depth of excavation of unlined canal segment	2.17	feet			
Approximate depth of excavation of lined canal segment	0.5	feet			

Disposal

Approximate quantity of concrete for stabilization	7%	by weight
Disposal rate	20	CY/day

Annual Fish Sampling

Sampling to be conducted		1	time per year
Fish Tissue Samples		35	sample
Quality Control Samples		2	# of MS/MSDs to collect
Duplicate		3	# of duplicates to collect
Long Term Monitoring Reports		40	hours per report (1 report per event)
Standard work day		12	hrs
Approximate hourly wage	Junior Engineer	$100.00	
	Construction Manager	$140.00	
	Community Outreach Representative	$120.00	

Lab Costs

Sediment	
PCB Congeners	$1,000.00
Fish Tissue[3]	
PCBs as Aroclors	$214.00

Notes

BCY	In-place cubic yard	H&S	Health and Safety
CY	Cubic yard	LCY	Loose cubic yard
ea	Each	LF	Linear foot
ft	Foot	SF	Square foot
gal	Gallon	SY	Square yard
hrs	Hours		
HP	horse power		

1 Source is The Gordian Group, RS Means Online (2016), McAllen, TX, unless otherwise cited
2 Source of factor: "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study," US EPA (July 2000a)
3 Fish tissue analyses include cost for lipids and filletin

EA Engineering, Science, and Technology, Inc., PBC

TECHNOLOGY	LOCATION	MEDIUM	Estimated Cost to Implement	$162,800,000
Dredging of Canal Sediment with Off-Site Disposal and Reservoir Dredging with Sand Layer Alternative Component SE-C	Donna Reservoir and Canal System Donna, TX	Sediment	Construction Time: 49 months Operation Time: 5 years Post Remediation Monitoring 10 years	

		Quantities		Cost Breakdown (if available)						Combined Unit Costs	
Description	Data Source (Means[1] or Other)	Quantity Amount	Quantity Unit	Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Material Unit Cost	Material Total Cost	Unit Cost	Option Total Cost
REMEDIAL ACTION - CONSTRUCTION		**TOTAL CAPITAL COST (totals rounded to nearest thousand)**									**$159,200,000**
Pre-Design											**$682,268**
Reservoir and Canal Baseline Sampling											
Mobilization/demobilization	Professional est	1	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 13,200.00	$13,200
Per diem	GSA + Tax	21	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 996.00	$20,916
Forklift variable reach, 6,000 lbs	United Rentals	3	weeks	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,989.90	$5,970
Vibra-corer-PVL Technologies and Consumables	PVL Technologies, Inc.	13	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 495.00	$6,435
17' Tracker boat with 40hp motor and trailer	Professional est	13	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 255.96	$3,327
Sampling labor (6 samplers)	Professional est	21	day	$ 7,200	$ 151,200	$ -	$ -	$ -	$ -	$ -	$151,200
Sampling equipment, supplies, and shipping	Professional est	1	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 11,220.00	$11,220
Sediment analysis - PCB Congeners	TestAmerica Inc.	420	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,100.00	$462,000
Reporting	Professional est	80	hr	$ 100	$ 8,000	$ -	$ -	$ -	$ -	$ -	$8,000
Construction Activities											**$110,420,718**
Temporary Facilities and Site Maintenance											
Command facility 40' combo with 15' office	Mobile Mini, Inc.	49	month	$ -	$ -	$ -	$ -	$ -	$ -	$ 506.00	$24,794
Office equipment rental average	0152 1340 0100	49	month	$ -	$ -	$ -	$ -	$ 219	$ 10,740	$ -	$10,740
Land lease	USDA	49	month	$ -	$ -	$ -	$ -	$ -	$ -	$ 535.33	$26,231
Clearing & grubbing, heavy trees, to 12" diameter	3111 1010 0200	1	acre	$ 3,139	$ 3,139	$ 2,589	$ 2,589	$ -	$ -	$ -	$5,729
Rough grade 35,100-40,000 SF	3122 1320 0240	1	ea	$ 893	$ 893	$ 858	$ 858	$ -	$ -	$ -	$1,750
Temporary, roads, gravel fill, 4" gravel depth	0155 2350 0050	4,000	SY	$ 2	$ 8,365	$ 1	$ 2,215	$ 4	$ 16,231	$ -	$26,811
Fencing	United Site Services	49	month	$ -	$ -	$ -	$ -	$ -	$ -	$ 687.50	$33,688
Generator	United Rentals	49	month	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,922.60	$192,207
Lighting	United Rentals	49	month	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,663.20	$81,497
Toilet, portable chemical (2 toilets)	0154 3340 6410	49	month	$ -	$ -	$ -	$ -	$ -	$ -	$ 427.90	$20,967
Rubbish handling, dumpster, 10 CY, 3 ton capacity, one dump per week	0241 1919 0700	210	weeks	$ -	$ -	$ -	$ -	$ 511	$ 107,358	$ -	$107,358
Temporary bridge rental	Mabey	21	weeks	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,034.00	$21,714
Concrete caissons for marine const., 80 to 150 ton capacity, 22" diameter, 10' deep	3163 2616 0400	120	VLF	$ 63	$ 7,561	$ 26	$ 3,166	$ 27	$ 3,288	$ -	$14,015
Temporary bridge installation	0131 1320 0160	1	week	$ 11,884	$ 11,884	$ -	$ -	$ -	$ -	$ -	$11,884
Gravel for road maintenance, 3" thick	Stone and Soil, Inc	365,130	SF	$ -	$ -	$ -	$ -	$ -	$ -	$ 0.41	$148,757
Gravel freight	Stone and Soil, Inc	170	load	$ -	$ -	$ -	$ -	$ -	$ -	$ 220.00	$37,400
Excavator diesel hydraulic crawler mounted 1-1/2 CY capacity	0154 3320 0200	1	weeks	$ 4,066	$ 4,066	$ 3,110	$ 3,110	$ -	$ -	$ -	$7,176
Site security (24 hours a day) (2 guards)	0156 3250 0100	70,560	hr	$ 49.58	$ 3,498,166	$ -	$ -	$ -	$ -	$ -	$3,498,166
Excavation (Unlined)											
Per diem construction crew	GSA + Tax	330	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,328.00	$438,240
Per diem truck drivers	GSA + Tax	330	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,660.00	$547,800
Clearing brush by hand	3113 1310 0100	8	acre	$ 2,857	$ 23,944	$ -	$ -	$ -	$ -	$ -	$23,944
Excavating, clamshell, 1 CY; for wet excavation	3123 1642 0550; 3123 1642 4200	54,206	BCY	$ 2.91	$ 157,709	$ 4.78	$ 259,219	$ -	$ -	$ -	$416,928
Excavator attachment, grapple	0154 3320 0345	48	week	$ -	$ -	$ -	$ -	$ -	$ -	$ 646.29	$31,022
Front end loader, 4WD, 2.5-3.5 CY 145HP	0154 3320 4710/0131 1320 0160	48	week	$ 1,981	$ 95,076	$ -	$ -	$ -	$ -	$ 1,392.88	$161,934
Rent truck, dump, 4 axle, 25 ton payload	0154 3320 5310/0131 1320 0160	48	week	$ 1,981	$ 95,076	$ -	$ -	$ -	$ -	$ 1,654.74	$174,504
Silt curtain (100' x 7')	Granite Environmental, Inc.	30	each	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,427.69	$72,831
Levee stabilization, loading and spreading, common earth, shovel, 1-1/2 CY bucket	3123 2315 4010	3,568	BCY	$ 0.71	$ 2,549	$ 1.27	$ 4,522	$ 39	$ 140,340	$ -	$147,411
Rent and operate water truck, off highway, 6,000 gallon capacity	0154 3340 6950	48	week	$ -	$ -	$ -	$ -	$ -	$ -	$ 9,630.10	$462,245
Engineering oversight	Professional est	200	day	$ 1,200	$ 240,000	$ -	$ -	$ -	$ -	$ -	$240,000
Excavation (Lined)											
Mobilization/demobilization equipment hauled 40-ton capacity	0154 3650 1500	2	each	$ 292	$ 584	$ 405	$ 809	$ -	$ -	$ -	$1,393
Per diem construction crew	GSA + Tax	175	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,328.00	$232,400
Clearing brush by hand	3113 1310 0100	12	acre	$ 2,857	$ 32,913	$ -	$ -	$ -	$ -	$ -	$32,913
Excavating, backhoe, 1 CY; for wet excavation	3123 1642 0200; 3123 1642 4200	17,195	BCY	$ 2.00	$ 34,393	$ 2.30	$ 39,557	$ -	$ -	$ -	$73,950
Front end loader, 4WD, 2.5-3.5 CY 145HP	0154 3320 4710/0131 1320 0160	20	week	$ 1,981	$ 39,615	$ -	$ -	$ -	$ -	$ 1,392.88	$67,472
Rent truck, dump, 4 axle, 25 ton payload	0154 3320 5310/0131 1320 0160	20	week	$ 1,981	$ 39,615	$ -	$ -	$ -	$ -	$ 1,654.74	$72,710
Vacuum truck, hazardous material, 5000 gallons	0154 3340 7625/0131 1320 0160	5	week	$ 3,961.50	$ 19,807	$ -	$ -	$ -	$ -	$ 1,426.06	$26,938

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EA Engineering, Science, and Technology, Inc., PBC

TECHNOLOGY	LOCATION	MEDIUM	Estimated Cost to Implement	$162,800,000
Dredging of Canal Sediment with Off-Site Disposal and Reservoir Dredging with Sand Layer Alternative Component SE-C	Donna Reservoir and Canal System Donna, TX	Sediment	Construction Time: 49 months Operation Time: 5 years Post Remediation Monitoring 10 years	

		Quantities		Cost Breakdown (if available)						Combined Unit Costs	
Description	Data Source (Means[1] or Other)	Quantity Amount	Quantity Unit	Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Material Unit Cost	Material Total Cost	Unit Cost	Option Total Cost
Disposal of Canal Sediment											
Mobilization/demobilization of water tight boxes	USA Environmental, LP	20	load	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,100.00	$22,000
Per diem truck drivers	GSA + Tax	281	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,660.00	$466,693
Transportation of sediment	USA Environmental, LP	5,623	load	$ -	$ -	$ -	$ -	$ -	$ -	$ 550.00	$3,092,545
Liners	USA Environmental, LP	5,623	load	$ -	$ -	$ -	$ -	$ -	$ -	$ 33.00	$185,553
Box rental, 20 boxes	USA Environmental, LP	7,200	box days	$ -	$ -	$ -	$ -	$ -	$ -	$ 13.20	$95,040
Disposal of sediment, includes stabilization	USA Environmental, LP	101,211	ton	$ -	$ -	$ -	$ -	$ -	$ -	$ 77.00	$7,793,213
Washout of boxes	USA Environmental, LP	20	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 234.03	$4,681
Fractionation tank, 20,000 gallon capacity; for sediment dewatering	Baker Corp, Inc.	330	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 46.20	$15,246
Trash pump, for sediment dewatering	Sunbelt Rentals/0131 1320 0160	11	month	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,067.00	$11,737
Excavator diesel hydraulic crawler mounted, 1-1/2 CY	0154 3320 0200/0131 1320 0160	11	month	$ 7,923	$ 87,153	$ -	$ -	$ -	$ -	$ 9,248.69	$188,889
Cement, Portland, type I/II, trucked in bulk, 94 lb bags	0305 1330 0250	150,739	ea	$ -	$ -	$ -	$ -	$ 14	$ 2,132,052	$ -	$2,132,052
Reservoir											
Mobilization/demobilization	Terra Contracting Services, LLC	1	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 825,000.00	$825,000
Site staging area preparation	Terra Contracting Services, LLC	1	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 220,000.00	$220,000
Per diem	GSA + Tax	200	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 166.00	$33,200
Debris Removal	Terra Contracting Services, LLC	1	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,500.00	$5,500
Crane crew, daily use, 40-ton truck-mounted hydraulic crane	0154 1950 0300	365	days	$ 334	$ 122,057	$ 1,403.22	$ 512,173	$ -	$ -	$ -	$634,230
Hydraulic Dredging	Terra Contracting Services, LLC	282,333	BCY	$ -	$ -	$ -	$ -	$ -	$ -	$ 49.50	$13,975,500
Material dewatering and handling (Geotubes®)	Terra Contracting Services, LLC	282,333	CY	$ -	$ -	$ -	$ -	$ -	$ -	$ 27.50	$7,764,167
Water treatment	Terra Contracting Services, LLC	12	month	$ -	$ -	$ -	$ -	$ -	$ -	$ 220,000.00	$2,640,000
Sand cover w/ installation	Terra Contracting Services, LLC	282,333	CY	$ -	$ -	$ -	$ -	$ -	$ -	$ 38.50	$10,869,833
Engineering oversight	Professional est	200	day	$ 1,200	$ 240,000	$ -	$ -	$ -	$ -	$ -	$240,000
Disposal of Reservoir Sediment											
Mobilization/demobilization of water tight boxes	USA Environmental, LP	20	load	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,100.00	$22,000
Per diem truck drivers	GSA + Tax	1,112	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,660.00	$1,845,401
Transportation of sediment	USA Environmental, LP	22,234	load	$ -	$ -	$ -	$ -	$ -	$ -	$ 550.00	$12,228,563
Liners	USA Environmental, LP	22,234	load	$ -	$ -	$ -	$ -	$ -	$ -	$ 33.00	$733,714
Box rental, 20 boxes	USA Environmental, LP	22,234	box days	$ -	$ -	$ -	$ -	$ -	$ -	$ 13.20	$293,486
Disposal of sediment, includes stabilization	USA Environmental, LP	400,208	ton	$ -	$ -	$ -	$ -	$ -	$ -	$ 77.00	$30,815,978
Washout of boxes	USA Environmental, LP	20	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 234.03	$4,681
Excavator diesel hydraulic crawler mounted, 1-1/2 CY	0154 3320 0200/0131 1320 0160	37.06	month	$ 7,923	$ 293,597	$ -	$ -	$ -	$ -	$ 9,248.69	$636,318
Cement, Portland, type I/II, trucked in bulk, 94 lb bags	0305 1330 0250	340,602	ea	$ -	$ -	$ -	$ -	$ 14	$ 4,817,470	$ -	$4,817,470
Confirmation Sampling											
Per diem	GSA + Tax	15	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 830.00	$12,450
Forklift variable reach, 6,000 lbs	United Rentals	3	week	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,989.90	$5,970
17' Tracker boat with 40hp motor and trailer	Professional est	3	week	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,200	$3,600
Sampling labor (3 samplers)	Professional est	15	day	$ 3,000	$ 45,000	$ -	$ -	$ -	$ -	$ -	$45,000
Sampling equipment, supplies, and shipping	Professional est	1	each	$ -	$ -	$ -	$ -	$ -	$ -	$ 6,600	$6,600
Sediment analysis - PCB Congeners	TestAmerica Inc.	120	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,100.00	$132,000
Reporting	Professional est	40	hr	$100	$ 4,000	$ -	$ -	$ -	$ -	$ -	$4,000
Engineering Controls											
Sign, aluminum, reflectorized, 30" by 30" and 10' steel posts, upright, bolted	1014 5320 0300/1014 5320 1500	20	ea	$ 28	$ 561	$ 16	$ 315	$ 171	$ 3,418	$ -	$4,295
Site Restoration											
Rip-rap & rock lining	3137 1310 0200	415	SY	$ 49	$ 20,402	$ 15	$ 6,334	$ 46	$ 18,997	$ -	$45,733
Rough grade 75,100-100,000 SF	3122 1320 0280	12	ea	$ 2,188	$ 26,258	$ 2,217	$ 26,605	$ -	$ -	$ -	$52,863
Mobilization and Demobilization											**$5,521,036**
5% of Total Costs of Site Work										$110,420,718	$5,521,036
System Contingency											**$28,972,223**
25% of Total Construction Activities										$115,888,891	$28,972,223
Professional/Technical Services[2]											**$13,631,738**
5% of Construction (not including disposal costs) + Contingency for Project Management										$ 80,186,693	$4,009,335

TECHNOLOGY	LOCATION	MEDIUM	Estimated Cost to Implement	$162,800,000
Dredging of Canal Sediment with Off-Site Disposal and Reservoir Dredging with Sand Layer Alternative Component SE-C	Donna Reservoir and Canal System Donna, TX	Sediment	Construction Time: 49 months Operation Time: 5 years Post Remediation Monitoring 10 years	

Description	Data Source (Means[1] or Other)	Quantities: Quantity Amount	Quantity Unit	Cost Breakdown (if available): Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Material Unit Cost	Material Total Cost	Combined Unit Costs: Unit Cost	Option Total Cost
6% of Construction (not including disposal costs) + Contingency for Remedial Design										$ 80,186,693	$4,811,202
6% of Construction (not including disposal costs) + Contingency for Construction Management										$ 80,186,693	$4,811,202
REMEDIAL ACTION - FISH REMOVAL									**ANNUAL COST**		**$ 733,000**
									TOTAL COST (NPV)		**$ 3,010,000**
Residual Contamination Removal											**$558,391**
Annual Electrofishing and Fish Removal (for 5 years)											
Mobilization/demobilization	Professional est	2	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,730.00	$9,460
Per diem	GSA + Tax	35	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 830.00	$29,050
Forklift variable reach, 6,000 lbs	United Rentals	2	months	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,828.58	$9,657
17' Tracker boat with 40hp motor and trailer	EA Engineering	35	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 230	$8,050
Regular DC shocker for electrofishing	EA Engineering	35	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 260	$9,100
Removal activities (5 person team)	Professional est	35	day	$ 6,000	$ 210,000	$ -	$ -	$ -	$ -	$ -	$210,000
55 gallon steel drums	Dallas Steel Drums, Inc.	500	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 54	$27,088
Hazardous waste transportation to disposal site	0281 2010 1260	500	mile	$ -	$ -	$ -	$ -	$ -	$ -	$ 47	$23,408
Hazardous waste pickup and disposal	0281 2010 1100	500	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 221	$110,748
Low Water Removal Actions (for 5 years)											
Mobilization/demobilization	Professional est	2	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,730.00	$9,460
Per diem	GSA + Tax	10	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 664.00	$6,640
Forklift variable reach, 6,000 lbs	United Rentals	2	week	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,989.90	$3,980
17' Tracker boat with 40hp motor and trailer	EA Engineering	10	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 230	$2,300
Cast Net	Bett's Super Pro Cast Net	1	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 264.00	$264
Seine Netting (43 lb test)	The Fish Net Company	1	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 211	$211
Removal activities (4 person team)	Professional est	10	day	$ 4,800	$ 48,000	$ -	$ -	$ -	$ -	$ -	$48,000
55 gallon steel drums	Dallas Steel Drums, Inc.	100	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 54	$5,418
Hazardous waste transportation to disposal site	0281 2010 1260	500	mile	$ -	$ -	$ -	$ -	$ -	$ -	$ 47	$23,408
Hazardous waste pickup and disposal	0281 2010 1100	100	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 221	$22,150
System Contingency											**$139,598**
25% of Remedial Action - Fish Removals										$558,391	$139,597.76
Professional/Technical Services[2]											**$34,899**
5% of Remedial Action - Fish Removals + Contingency for Project Management										$ 697,989	$ 34,899
Lifetime Remedial Action - Fish Removals (Net Present Value)[2]											**$ 3,005,445**
Annual Remedial Action - Fish Removals Net Present Value											$ 3,005,445
5 **Years of Operation**											
7% **Discount Factor (per EPA guidance)**											
LONG TERM MONITORING, COMMUNITY INVOLVEMENT AND ENGINEERING CONTROLS									**ANNUAL LTM COST**		**$87,000**
									LIFETIME LTM (NPV)		**$550,000**
Monitoring, Sampling, Testing and Analysis - Fish											**$73,270**
Post Remediation Site Monitoring - Biennial Fish Tissue Sampling (for 10 years)											
Mobilization/demobilization	Professional est	1	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 8,360.00	$8,360
Per diem	GSA + Tax	5	days	$ -	$ -	$ -	$ -	$ -	$ -	$ 664.00	$3,320
Forklift variable reach, 6,000 lbs	United Rentals	1	week	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,989.90	$1,990
17' Tracker boat with 40hp motor and trailer	EA Engineering	5	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 255.96	$1,280
Regular DC shocker for electrofishing	EA Engineering	5	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 255.96	$1,280
Sampling labor (4 samplers)	Professional est	5	day	$ 4,800	$ 24,000	$ -	$ -	$ -	$ -	$ -	$24,000
Sampling equipment, supplies, and shipping	Professional est	1	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,500.00	$5,500
Fish tissue analysis - PCBs as Aroclors	Test America Laboratories	100	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 235.40	$23,540
Reporting	Professional est	40	hr	$ 100	$ 4,000	$ -	$ -	$ -	$ -	$ -	$4,000

EA Engineering, Science, and Technology, Inc., PBC

TECHNOLOGY	LOCATION	MEDIUM	Estimated Cost to Implement	$162,800,000
Dredging of Canal Sediment with Off-Site Disposal and Reservoir Dredging with Sand Layer Alternative Component SE-C	Donna Reservoir and Canal System Donna, TX	Sediment	Construction Time: 49 months Operation Time: 5 years Post Remediation Monitoring 10 years	

Description	Data Source (Means[1] or Other)	Quantities: Quantity Amount	Quantity Unit	Cost Breakdown (if available): Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Material Unit Cost	Material Total Cost	Combined Unit Costs: Unit Cost	Option Total Cost
Monitoring, Sampling, Testing and Analysis - Sediment											**$189,039**
Post Remediation Site Monitoring - Sediment Sampling (at year 4)											
Mobilization/demobilization	Professional est	1	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 8,360.00	$8,360
Per diem	GSA + Tax	10	days	$ -	$ -	$ -	$ -	$ -	$ -	$ 664.00	$6,640
Forklift variable reach, 6,000 lbs	United Rentals	2	week	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,989.90	$3,980
17' Tracker boat with 40hp motor and trailer	EA Engineering	10	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 255.96	$2,560
Sampling labor (4 samplers)	Professional est	10	day	$ 4,800	$ 48,000	$ -	$ -	$ -	$ -	$ -	$48,000
Sampling equipment, supplies, and shipping	Professional est	1	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,500.00	$5,500
Fish tissue analysis - PCBs Congeners	Test America Laboratories	100	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,100.00	$110,000
Reporting	Professional est	40	hr	$ 100	$ 4,000	$ -	$ -	$ -	$ -	$ -	$4,000
Community Involvement and Engineering Controls											**$9,846**
Mobilization/demobilization	Professional est	1	events	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,650.00	$1,650
Per diem	GSA + Tax	6	days	$ -	$ -	$ -	$ -	$ -	$ -	$ 166.00	$996
Community outreach event (2 representatives)	Professional est	1	events	$ 7,200	$ 7,200	$ -	$ -	$ -	$ -	$ -	$7,200
Community Involvement and Engineering Controls											**$1,074**
Sign, aluminum, reflectorized, 30" by 30" and 10' steel posts, upright, bolted	1014 5320 0300/1014 5320 1500	5	ea	$ 28	$ 140	$ 16	$ 79	$ 171	$ 855	$ -	$1,074
Professional/Technical Services[2]											**$4,156**
5% of Total Sampling Activities for Project Management										$83,116	$4,156
Lifetime Long Term Monitoring (Net Present Value)[3]											**$554,707**
Monitoring, Sampling, Testing and Analysis - Fish		1	NPV							$261,036	$261,036
Monitoring, Sampling, Testing and Analysis - Sediment		1	NPV							$151,428	$151,428
Community Involvement		1	NPV							$134,325	$134,325
Engineering Controls		1	NPV							$7,918	$7,918
10 Years of Monitoring											
7% Discount Factor (per EPA guidance)											

TOTAL ESTIMATED NPV TECHNOLOGY COST **$162,800,000**

Assumptions:

General

Working condition is Safety Level:	D	(Labor productivity	82%	; Equipment productivity	100%	)
Weighted Average of city cost index	96.8%	(not applicable for costs derived from vendor quotes).				
Costs are loaded with mark-up	10%					
Inflation	3%	per year	6%	for 2 years	13%	for 4 years
	34%	for 10 years				
Sales Tax	8.25%					

During Excavation

Density of Sediment	1.4	ton/CY				
Workers work week consists of	6	days /week	1	rigs		
	1	mobilization/demobilizations per excavator			$664	per diem per rig
Length of unlined canal segment for excavation	12,171	feet				
Length of lined canal segment for excavation	16,730	feet				
Approximate width of canal	55.5	feet				
Approximate depth of excavation of unlined canal segment	2.17	feet				
Approximate depth of excavation of lined canal segment	0.5	feet				

Disposal

Approximate quantity of concrete for stabilization of canal sediment	7%	by weight
Approximate quantity of concrete for stabilization of reservoir sediment	4%	by weight
Disposal rate	20	loads/day

Annual Fish Sampling

Sampling to be conducted	1	time per year

EA Engineering, Science, and Technology, Inc., PBC

TECHNOLOGY	LOCATION	MEDIUM	Estimated Cost to Implement	$162,800,000
Dredging of Canal Sediment with Off-Site Disposal and Reservoir Dredging with Sand Layer **Alternative Component SE-C**	**Donna Reservoir and Canal System** **Donna, TX**	**Sediment**	**Construction Time:** 49 months **Operation Time:** 5 years **Post Remediation Monitoring** 10 years	

		Quantities		Cost Breakdown (if available)						Combined Unit Costs	
Description	Data Source (Means[1] or Other)	Quantity Amount	Quantity Unit	Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Material Unit Cost	Material Total Cost	Unit Cost	Option Total Cost
Fish Tissue Samples		35	sample								
Quality Control Samples		2	# of MS/MSDs to collect								
Duplicate		3	# of duplicates to collect								
Long Term Monitoring Reports		40	hours per report (1 report per event)								
Standard work day		12	hrs								
Approximate hourly wage	Junior Engineer	$100.00									
	Construction manager	$140.00									
	Community Outreach Representative	$120.00									
Lab Costs											
Sediment											
PCB Congeners		$1,000.00									
Fish Tissue											
PCBs as Aroclors		$214.00									

Notes

BCY	In-place cubic yard	gal	Gallon	LCY	Loose cubic yard
CY	Cubic yard	hrs	Hours	LF	Linear foot
ea	Each	HP	Horse Power	SF	Square foot
ft	Foot	H&S	Health and Safety	SY	Square yard

1 Source is The Gordian Group, RS Means Online (2016), McAllen, TX, unless otherwise cited
2 Source of factor: "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study," US EPA (July 2000a)
3 Fish tissue analyses include cost for lipids and filletin

Appendix B
Green Remediation Evaluation Matrix

EA Engineering, Science, and Technology, Inc., PBC

TABLE B-1

GREEN REMEDIATION EVALUATION MATRIX FOR REMEDIAL ALTERNATIVES

Stressors	Affected Media	Mechanism/Effect	Yes/No	Score[1] Alt. 3	Score[1] Alt. 6
Substance Release/Production					
Airborne NOx & SOx	Air	Acid rain and photochemical smog	Yes	6	5
Chloro-fluorocarbon vapors	Air	Ozone depletion	No		
Greenhouse gas emissions	Air	Atmospheric warming	Yes	6	5
Airborne particulates/toxic vapors/gases/water vapor	Air	General air pollution/toxic air/humidity increase	Yes	6	5
Liquid waste production	Water	Water toxicity/sediment toxicity/sediment	Yes	7	7
Solid waste production	Land	Land use/toxicity	Yes	8	5
Thermal Releases					
Warm water	Water	Habitat warming	No		
Warm vapor	Air	Atmospheric humidity	No		
Physical Disturbances/Disruptions					
Soil structure disruption	Land	Habitat destruction/ soil infertility	Yes	7	5
Noise/Odor/Vibration/Aesthetics	General environment	Nuisance and safety	Yes	6	5
Traffic	Land; general environment	Nuisance and safety	Yes	7	6
Land Stagnation	Land; general environment	Remediation time; cleanup efficiency; re-development	Yes	7	6
Resource Depletion/Gain					
Petroleum (energy)	Subsurface	Consumption	Yes	7	6
Mineral	Subsurface	Consumption	Yes	8	8
Construction materials (soil/concrete/plastic)	Land	Consumption/reuse	Yes	7	6
Land & space	Land	Impoundment/reuse	Yes	7	6
Surface water & groundwater	Water, land (subsidence)	Impoundment/ sequester/reuse	Yes	8	8
Biology resources (plants/trees/animals /microorganisms)	Air, water, land/forest, subsurface	Species disappearance/diversity reduction regenerative ability reduction	Yes	7	6
			Average	6.9	5.9

Note:
[1] On a scale of 1-10, with 10 representing the least impact
Alt. 3 - Slipline Siphon and Canal Dredging
Alt. 6 - Replace Siphon and Canal Dredging
Scores are intended to provide a qualitative comparison between alternatives for a single media type and are not meant to be compared between different media.