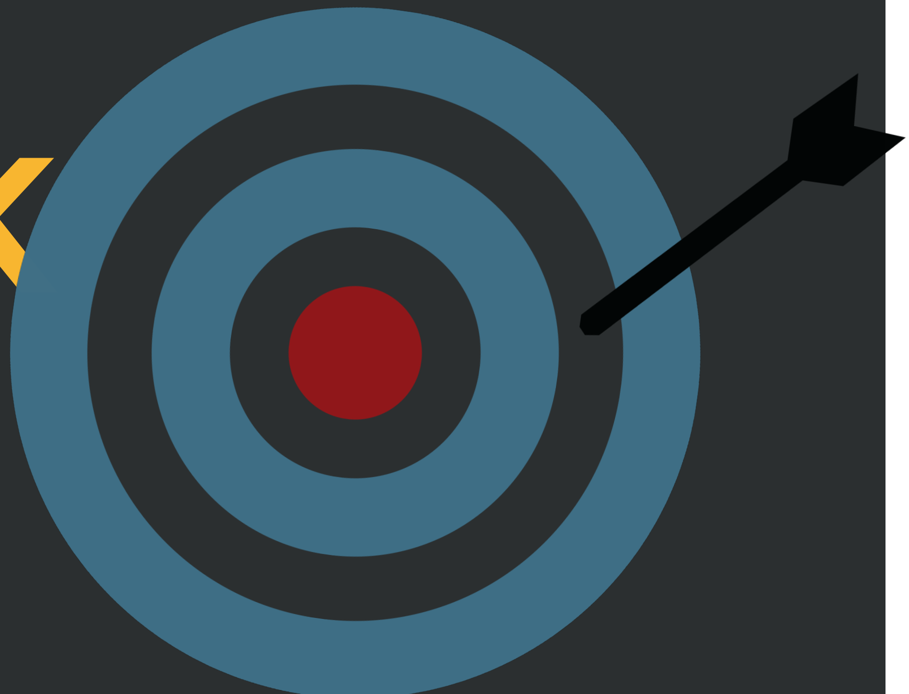
MISSING THE MARK



How Texas Pollution Cleanup Benchmarks Fail to Protect Human Health and the Environment

TEXAS CAMPAIGN FOR THE ENVIRONMENT FUND

i.

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We also thank all of the individuals, families, and organizations in Texas and beyond fighting against pollution in their communities. We dedicate this report to their efforts, and intend for it to help them raise awareness and stir responsible leaders to action.

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1 Executive Summary

Texas is home to no fewer than 5,533 polluted sites in need of some sort of cleanup.

Texas is home to no fewer than 5,533 polluted sites in need of some sort of cleanup, most of them former industrial facilities or waste dumps. Thousands of other properties have likewise had pollution on site but have not been deemed polluted enough for cleanup. Disasters like Hurricane Harvey or major storms in other parts of the state threaten to wash dangerous pollution from these properties into waterways and homes. Rapid population growth and land development also bring more Texans closer to these sites every day, with the rising demand for water making groundwater pollution an increasingly acute problem.

If Texas does not clean up the pollution sites left behind by industry and other operations, then future storms and droughts will pose even more serious threats to Texans and our environment.

Texas Cleans Up Pollution According To Our Own Guidelines

Only about 1% of identified Texas sites are under federal Superfund jurisdiction. The other 99% of polluted sites in Texas are part of state-run cleanup programs under the aegis of the Texas Risk Reduction Program (TRRP), administered by the Texas Commission on Environmental Quality (TCEQ).

Superfund, the TRRP, and similar programs in other states use quantitative benchmarks for two purposes:

1. **To determine whether sites are polluted enough to warrant cleanup, and**
2. **How much cleanup is needed to render the property safe for some other use.**

In Texas, the TCEQ has developed its own pollution cleanup benchmarks for the TRRP known as Protective Concentration Levels (PCLs). These are analogous to similar guidelines put forward by the US EPA, and the states of Louisiana, New Mexico, and Mississippi. Oklahoma and Arkansas use one of the main set of federal benchmarks for their state cleanup programs.

All agencies also allow for the development of site-specific benchmarks, but these are typically based on the same formulas used to calculate the published benchmarks that we examine in this report. In general these published benchmarks are more protective and conservative than the site-specific numbers, so if they are weak or non-protective then the vast majority of cleanups involving site-specific guidelines will be compromised.

Figure 1: US Oil Recovery Site in Houston Following Hurricane Harvey

Texas Benchmarks Tolerate Significantly More Pollution Than Other Nearby States

Texas Campaign for the Environment Fund has examined the benchmarks for more than 80 pollutants in Texas, Louisiana, New Mexico, Mississississippi, Oklahoma, Arkansas and at the federal level. We have found that **Texas benchmarks are substantially weaker than those used in other nearby states.** As a result, many sites that could be eligible for Superfund status in other states are not being remediated at all in Texas. **Sites that do undergo cleanup in Texas may still be polluted at levels that would require more cleanup in other states.**

On average, for all chemicals targeted by both Texas and the EPA, the strictest Texas benchmarks tolerate soil pollution at a rate **13.94 times greater** than the benchmarks used to score potential Superfund sites and groundwater pollution at a rate **34.78 times higher.**

Texas sites could be remediated an order of magnitude beyond the state standard and still be as polluted as sites on the Superfund National Priority List (NPL). In fact, **Texas PCLs are so weak we tolerate pollution concentrations on land designated for *residential* uses that Louisiana, Arkansas, Oklahoma, and Mississippi wouldn't even restrict to *industrial* uses.**

Deadlier Pollutants, Weaker Benchmarks

Even more concerning are the disparities between pollutants known to cause cancer and those that are not currently thought to. **It is fair to say that the more dangerous a pollutant, the less emphasis Texas puts on cleaning it up.** The differences are especially pronounced for carcinogens. The major imbalance between Texas and the various federal soil benchmarks disappears for non-carcinogenic chemicals. For non-carcinogens, Texas is actually 4.5% stronger than federal Superfund thresholds. **For carcinogens, however, Texas is 1,682% weaker.**

It is fair to say that the more dangerous a pollutant, the less emphasis Texas puts on cleaning it up.

Texas Calculations Differ From Other Agencies

Such widely divergent expectations arise because each agency uses their own distinct formulas for calculating the safe levels of these pollutants in the relevant media. Texas uses significantly different estimates for some of the factors used in these equations than those used by other agencies, and this is what gives rise to our less protective benchmarks. **Texas tolerates cancer risks 10 times higher than most of these agencies**, and **toxic hazards 10 times worse than Louisiana.** We assume that Texans are smaller on average than people in other states, that they drink less water, and that children accidentally consume less dirt. As a result we accept greater levels of pollution in our soil and water.

The principle at hand here is simple: **better data in, healthier expectations out.** By adopting more conservative factors, Texas protective levels could be safer for human health and the environment. Adjusting our cancer risk targets in particular would make an immediate difference.

Pollution Is Being Left in Flood Risk Areas

Texas Campaign for the Environment Fund, with the assistance of Air Alliance Houston, received a large amount of data from TCEQ about all of the Texas Risk Reduction Program and Superfund investigations done by the agency between 2007 and 2017. In many cases sites were designated for "No Further Action" because pollutants on site did not exceed the Texas PCLs; Louisiana, Mississippi, Oklahoma, Arkansas or other states may have cleaned up sites that Texas did not. **In fact, of the four sites recommended for inclusion in the federal Superfund program in May 2018, two of them had previously been marked "No Further Action" by TCEQ.**

Furthermore, TCE Fund found **sites that could easily flood during a natural disaster where at least half a dozen chemicals with especially weak PCLs may not be fully cleaned up.** This could wash cancer-causing, birth irregularity-associated pollutants into waterways used for recreation, drinking water, and a variety of other important uses, as well as into other homes. Preventing this contamination would require action on the part of either TCEQ through rule-making or the Texas Legislature in passing better benchmarks into law.

This report contains specific recommendations for addressing these shortcomings and improving Texas pollution cleanup programs so that they may minimize threats to the environment and human health. **We urge Texas officials to act quickly on this matter so that these changes can be accomplished before future disasters exacerbate these problems.**

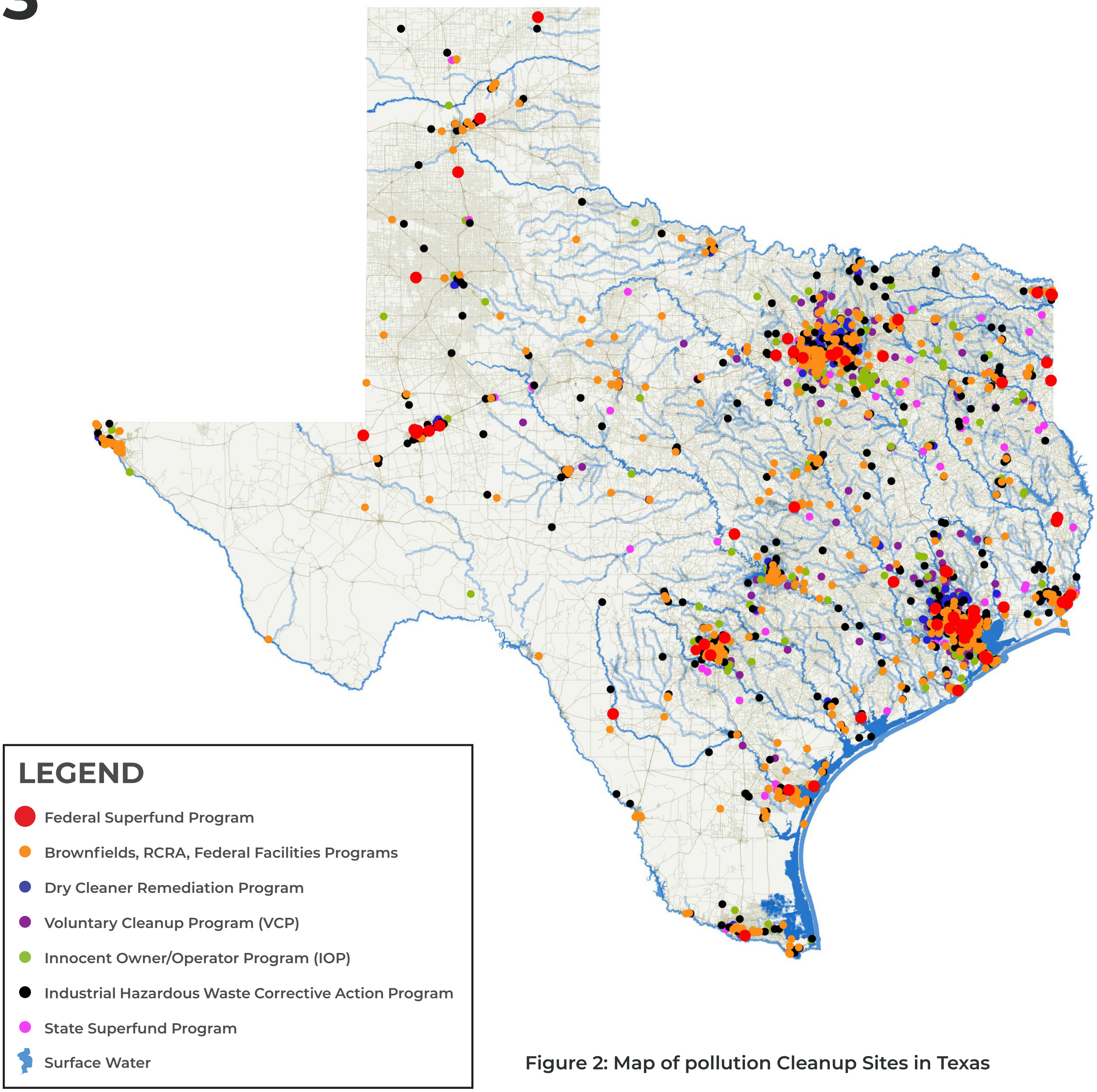


Figure 2: Map of pollution Cleanup Sites in Texas

Table 1. Texas Risk Reduction Sites

Program	VCP	IOP	DCRP	IHWCAP	SSF	PST-RP	PST-SL	Brownfields
Sites	2777	1071	298	226	101	N/A	N/A	720

Table 2. Federal Cleanup Sites in Texas

Program	Superfund NPL	RCRA Corrective Action	Federal Facilities
Sites	58	266	74

Cleanup Programs and Benchmarks in Texas and Nearby States

1.

Texas is home to thousands of polluted sites, most of them former industry or waste facilities. Hurricane Harvey and other recent natural disasters have raised serious questions among the public about what happens when polluted sites are flooded,[1] but these sites posed threats even before the storm. As residential development expands into formerly industrial and agricultural areas, the possibility of exposure to land pollution also increases. The threat of dangerous pollutants washing or drifting into Texas waterways or into people's homes only heightens the environmental impacts of disasters and intensifying land use.

One thing is clear—if Texas does not clean up the pollution sites left behind by industry and other operations, then a future of increasing storms of greater intensity will pose serious threats to Texans and our environment.

Who Cleans Up Toxic Sites in Texas?

Cleaning up sites before disasters strike must be a priority, and a more robust cleanup effort for such sites is needed across Texas. The programs to complete this task already exist. The most famous of these is the federal Superfund program, but very few sites enter this process. **As many as 5,533 sites in Texas have been identified as potentially needing some sort of cleanup**, with potentially **thousands** more uninspected or given a questionable clean bill of health. Only 58 of them are on the federal Superfund National Priority List (NPL)[2]—just about 1%.

An additional 340 sites (6%) are in other federal cleanup efforts.[3] The Resource Conservation and Recovery Act (RCRA) Corrective Action Program is responsible for 266 sites, and EPA is responsible for remediating 74 federal facilities—most of them military installations.

The other 93% of sites are most often addressed under a variety of programs authorized under the auspices of the Texas Risk Reduction Program (TRRP). Administered by the Texas Commission on Environmental Quality (TCEQ), these programs include:

- **the Voluntary Cleanup Program (VCP)—2777 sites[4]**
- **the Innocent Owner/Operator Program (IOP)—1071 sites[5]**
- **federal-funded Brownfields programs—720 sites[6]**
- **the Dry Cleaner Remediation Program (DCRP)—298 sites[7]**
- **the Industrial Hazardous Waste Corrective Action Program (IHWCAP)—226 sites[8]**
- **State Superfund (SSF)—101 sites[9]**
- **the Petroleum Storage Tank (PST) programs for dealing with fuel storage tanks. There are two programs, the Responsible Party Lead program for voluntary cleanups and the State Lead program using resources from the PST Remediation Fund.**

Generally speaking, sites enter the programs above through either regular inspection, complaints, or when required monitoring indicates there may be a problem. TCEQ staff typically performs a variety of visits and tests—**often taking years to get through backlogs**—with different pathways to different programs depending on the degree to which a site is polluted, the risks to public health, and what sort of facility caused the pollution. **Even federal programs depend upon TCEQ staff** for these inspections, though as noted, most either enter state programs or are not cleaned up at all.

Pollution Concentration Benchmarks: Bigger is Not Better

Making these decisions about whether a site qualifies for one of these programs, and then determining how much they need to be cleaned up both require quantitative benchmarks or targets for various pollutants. Sites where these chemicals are present in concentrations higher than the benchmarks may be eligible for remediation, and cleanup efforts should bring the concentration of pollutants in the affected land or water down below those target levels.

Federal law protects water and air from pollution, and while the Resource Recovery and Conservation Act (RCRA) may mandate cleanup in some instances, not all polluted lands are subject to it. Water or air pollution beyond standards set in the Clean Air, Clean Water, or Safe Drinking Water Acts is illegal in all states. Outside of RCRA, however, programs like Superfund or TRRP are cleanup/response programs. Their respective benchmarks aren't limits on the allowed levels of these pollutants, but rather measures for determining the degree to which soil or groundwater are contaminated at a site.

Throughout this report we avoid use of the term "standards" except in the case of one state which uses the term "Standard" in their benchmarks.

As for these benchmarks, they are presented as concentrations of a specific chemical in some quantity of soil or water. **The higher the concentration, the more polluted and dangerous that soil or water, so higher benchmarks are less protective.** Lower benchmarks—smaller figures—are more protective.

The higher the concentration, the more polluted and dangerous that soil or water, so higher benchmarks are less protective.

Federal Benchmarks

The federal Superfund program uses a set of benchmarks known as the Superfund Chemical Data Matrix (SCDM) for determining whether a site may or may not be eligible for the National Priority List.[10] These numbers are only used for scoring especially polluted sites, with other benchmarks used for the actual cleanup targets if they qualify.

US EPA maintains another set of benchmarks known as Regional Screening Levels (RSLs), a human health-based set of measures that are most often used for scoring similar to the SCDMs.[11] These benchmarks are also used, however, for establishing baseline Preliminary Remediation Goals (PRGs) for determining how to clean up a site.[12] Some states—including both Arkansas and Oklahoma—use these benchmarks in lieu of developing their own. There are distinct RSLs for different types of pollution and different populations that may be exposed. These include:

- **Soils on residential property (Resident Soil) where residents are expected to engage in "typical home making chores (cooking, cleaning and laundering) as well as outdoor activities." There are different subcategories for exposure to adults and to children. This and all other categories have distinct measures for cancer-causing (carcinogenic) pollutants and for those not believed to cause cancer (non-carcinogenic).**
- **Soil in workplaces (Composite Worker Soil), a measure of the likely risk and exposure to workers who may ingest and come into contact with polluted soil through outdoor maintenance at a polluted site.**
- **Resident Air, which is similar to resident soil but focuses on inhalation of pollutants.**
- **Composite Worker Air, the same as Resident Air, but for workers on a polluted site.**
- **Resident Tapwater, a measure that covers both groundwater and surface water that residents are expected to drink and bathe in. Like other residential standards they provide different measures for adults and for children.**
- **Resident Soil to Groundwater, a benchmark for concentrations of pollutants in soil that may be able to leach into groundwater.**

Furthermore, there are two different sets of RSLs for different Target Hazard Quotient (THQ) levels. THQ is a measure of likelihood of health effects from a pollutant, and the higher the THQ the more likely that concentration will cause health problems for people exposed to it. Most toxic chemicals have a known "reference dose," the largest amount of a pollutant you could eat or drink every day without noticing any negative health effects. THQ takes the benchmark concentration—the amount allowed in the contaminated soil or water—and divides it by this reference dose.

If the proposed concentration is larger than the reference dose, then the THQ will be greater than 1. If the concentration is smaller than the reference dose—that is to say, safer than even conservative health precautions—the THQ will be less than 1. EPA maintains RSL tables for THQs equivalent to 1, and another for THQs of 0.1. For acetone, for example, the strongest THQ 1 soil benchmark is 61 grams per kilogram of soil. The THQ 0.1 benchmark is 6.1 grams—ten times stronger.

For our purposes in this report we will be using the THQ 1 benchmarks for RSLs unless otherwise noted.

Figure 3: Hazard Quotient Calculation

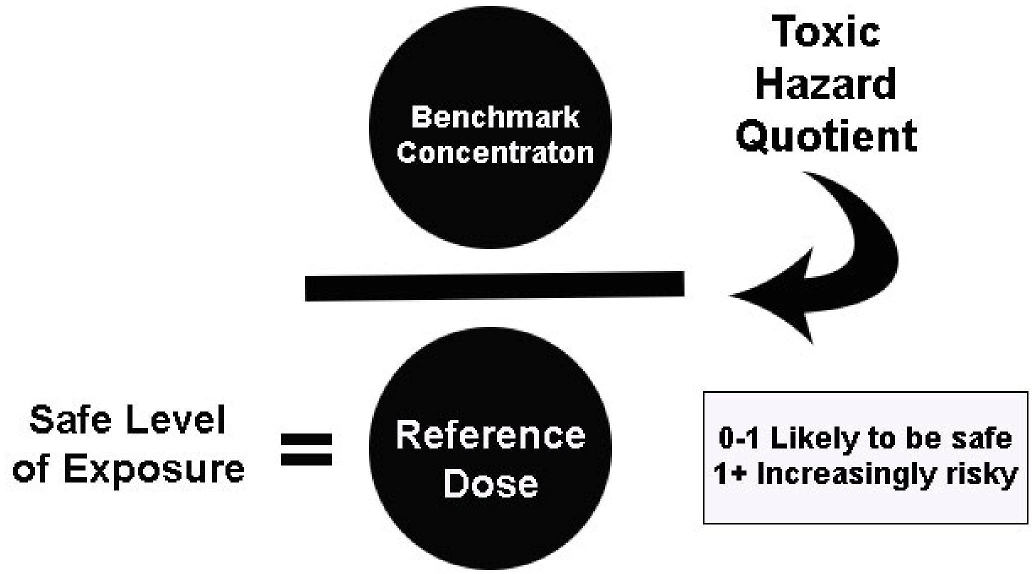


Table 3: Federal Benchmarks

Benchmark	Superfund Chemical Data Matrix (SCDM)	Regional Screening Levels (RSLs)
Purpose	Scoring Purposes Only	Scoring Purposes, Set Preliminary Remediation Goals, Used as Tier 1 Benchmark by Some States (AR, OK)
Risk Type	Cancer Risk	Carcinogenic
	Non-Cancer Risk	Non-Carcinogenic THQ =1
		Non-Carcinogenic THQ = 0.1
Water Benchmarks	Groundwater	Resident Tapwater
	Surface Water	
Soil Benchmarks	Soil	Resident Soil
		Resident Soil to Groundwater
		Composite Worker Soil
Air Benchmarks	Air	Resident Air
		Composite Worker Air
Other Benchmarks	Subsurface Intrusion	
	Radionuclide	

Texas Risk Reduction Program (TRRP) Protective Concentration Levels (PCLs)

In Texas, the TRRP has developed its own pollution cleanup benchmarks known as Protective Concentration Levels (PCLs).[13] Broadly, there are PCLs for soil and for groundwater, with each further divided between residential standards and weaker (higher) concentrations allowed at industrial or commercial sites. Sites where pollution exceeds these concentration levels may be eligible for TRRP attention.

When the cleanup begins, these concentration levels serve as pollution cleanup targets for the various programs. There are two distinct "Remedy Standards" for TRRP: Remedy Standard A requires that the polluted soil or groundwater have pollution concentrations below the applicable PCLs, while Remedy Standard B allows pollution beyond PCLs as long as "physical controls" such as caps or filters are put in place. These controls are meant to limit the "points of exposure" to the pollution, and at each of these points pollution must be below the PCLs:[14]

- **Groundwater that will be ingested**
- **Groundwater that is not intended to be ingested (Class 3 groundwater)**
- **Chemicals in the groundwater becoming airborne and inhaled (Volatilization)**
- **Groundwater that contacts surface water.**

As for soil, the pathways distinguished are:

- **Chemicals in the soil become airborne and are inhaled (Volatilization). There are distinct marks for surface soils and subsurface soils**
- **Skin ("Dermal") contact**
- **Residential soil where vegetables may be grown and consumed. There are distinct benchmarks for above ground and underground vegetables**
- **Soil exposure to groundwater**
- **A combined benchmark that takes all the above into account.**

The Texas environmental agency, TCEQ, calculates and publishes a table of more than 700 of these "Tier 1" PCLs,[15] benchmarks calculated using assumed averages for a variety of environmental factors that can affect pollution risks to people using that land or water. For the purposes of this report we have in almost all cases used the Groundwater Ingestion and Combined Soil benchmarks for comparison to other agencies, as they are typically the most protective. In all cases we compared the most protective benchmarks for the same media and risk types.

Table 4: Texas Protective Concentration Levels (PCLs)

Groundwater PCLs	Ingestion		
	Inhalation (Volatilization)		
	Class 3 Groundwater		
	Groundwater to Surface Water		
Soil PCLs	Dermal (Skin) Contact		Combined Soil PCL
	Inhalation (Volatilization)	Surface Soils	
		Subsurface Soils	
	Vegetable Consumption	Above Ground Vegetables	
		Below Ground Vegetables	
	Soil to Groundwater		
Soil Source Areas	0.5 Acres		
	30 Acres		
Risk Types	Carcinogenic		
	Non-Carcinogenic		

Other State Remediation Benchmarks

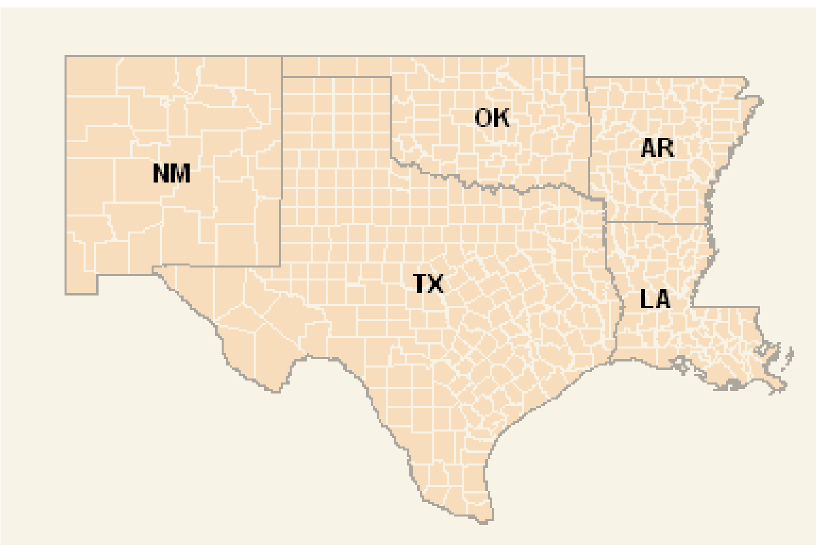
Other states have adopted their own benchmarks. Of the other states in EPA Region VI Oklahoma[16] and Arkansas,[17] as mentioned, use the federal RSLs for their programs (often modifying them on a site-specific basis), while Louisiana and New Mexico use their own benchmarks. For the purposes of this report we also wanted to examine benchmarks set by Mississippi, which neighbors Region VI.

Louisiana's analogue to the Texas cleanup program (TRRP) is called the **Risk Evaluation/Corrective Action Program (RECAP).**[18] Their primary benchmark is called the **"Screening Standard"** and features distinct benchmarks for soil and for groundwater. Screening Standards for soil are further broken down by industrial and "non-industrial" land uses with another Standard for soil benchmarks protective of groundwater.

New Mexico has both a **State Cleanup Program (SCP)**[19] and a **Voluntary Remediation Program**[20] as well as some other efforts, all of which use a set of remediation guidelines and **Screening Levels (SLs)**[21] set by the New Mexico Environment Department (NMED). They also have separate soil and water benchmarks. NMED sets soil SLs for residential and industrial uses, as well as a unique third category for construction worker protection--assuming a shorter duration of exposure than the industrial benchmark. All of the SLs for both soil and water are further broken out into measures for carcinogenic chemicals and non-carcinogenic ones.

Finally, for our purposes, Mississippi's **Voluntary Cleanup Program** and **Brownfields Program** use a set of benchmarks called the **Target Remediation Goals,**[22] also with both soil and groundwater marks. They call their industrial soil benchmarks "restricted" and their residential soil marks "unrestricted."

Figure 4: EPA Region VI



Benchmark Tiers

We referred above to PCLs as "Tier 1" because Texas has a multi-tiered system of benchmarks. All other state agencies examined for this report likewise use such a tiered system, with the benchmarks we've examined here serving as the first tier benchmarks for each program. In each case the second tier allows regulators to replace the averages with site-specific measures which reflect the real world conditions of the site in question. EPA offers a calculator for determining site-specific RSLs.

In all cases we've found these Tier 2 benchmarks use the same formulas used to calculate the Tier 1 PCLs just with those specific numbers substituted for factors calculated with default values in Tier 1. As for Texas residential and groundwater ingestion PCLs most of the factors we've found most significant do not change for Tier 2—other figures change instead, and these defaults remain.

Tier 3 benchmarks in all cases take the Tier 2 PCLs and then factor in "natural attenuation"—the reduction of pollution over time as it runs off or otherwise breaks down—or some other additional environmental factors. In Louisiana, adopting one of the lower tiers also entails additional cleanup responsibilities.

In general, responsible parties use Tier 2 or 3 benchmarks because they are more permissive, not because they are more protective. If Tier 1 benchmarks are unprotective, these tiers will be too. This is also true even in some rare instances where Tier 2 or 3 benchmarks may be stronger than Tier 1. if the Tier 1 standards are bad, then the entire system is imperiled.

2. Texas Benchmarks are Substantially Lower than Those in Other States

Texas Campaign for the Environment Fund has examined the benchmarks for more than 80 pollutants with similar types of guidelines at the federal level or in other states.[23] These chemicals include almost all of the cancer-causing pollutants targeted by Texas and other EPA Region VI states, along with polycyclic aromatic hydrocarbons (PAHs)—responsible for birth irregularities—and a variety of non-carcinogenic toxic chemicals associated with industry in Texas.

We have found that Texas benchmarks are substantially weaker than the others we have examined. Our method was simple: we simply divided the Texas benchmark concentration by each respective benchmark from other agencies. We have thus found that many sites that do undergo clean up in Texas may still be polluted at levels that would require more cleanup in nearby states.

Our method was simple: we simply divided the Texas benchmark concentration by each respective benchmark from other agencies.

The sources for each set of benchmarks can be found in Table 5 below.

Table 5: Benchmark Sources

Federal SCDM	http://bit.ly/SCDMsearch	
Federal (AR/OK) RSLs	http://bit.ly/RSLtables	
Texas PCLs	http://bit.ly/PCLtables	
Louisiana SSs	http://bit.ly/LA-SS	
Mississippi TRGs	http://bit.ly/MS-TRGs	Page 39 of linked document
New Mexico SLs	http://bit.ly/NM-SLs	Page 49 of linked document

* Note that all links are case sensitive

Benchmark Disparities Typically More than an Order of Magnitude or Worse

On average, for all chemicals targeted by both Texas and the EPA the strictest, Texas benchmarks allow soil pollution at a rate **13.94 times greater** than the benchmarks used to score potential Superfund sites. Texas tolerates groundwater pollution at a rate **34.78 times higher**.

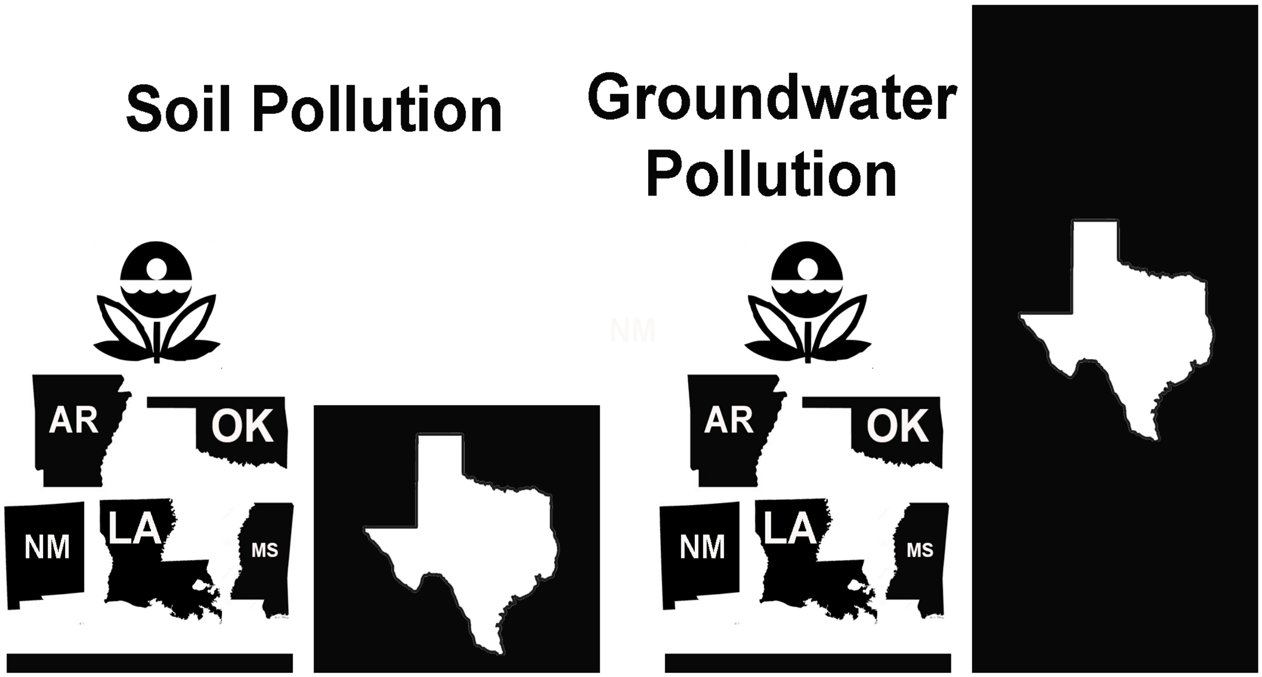
This means that a site being cleaned up under Texas guidelines could be remediated many times the state standard and it could still possibly be as polluted at sites on the Superfund National Priority List (NPL).[i]

Table 6: Texas PCLs Many Times Weaker Than Superfund Chemical Data Matrix (SCDM)—All Chemicals

Soil PCL/ SCDM	Groundwater PCL/SCDM
16.82	34.78

i The median disparity between these benchmarks is 10 times worse for groundwater and 3 times worse for soil. The disparity in *average* groundwater benchmarks are skewed by the huge disparity for a single pollutant—hexavalent chromium—which Texas allows at 1,520 times the carcinogenic groundwater benchmark for Superfund. Even without this disparity, however, Texas still allows groundwater pollution at 13 times the level considered eligible for Superfund designation.

Figure 5: Pollution Tolerated in Texas and Other States



Texas tolerates 14 times more soil pollution and 38 times more groundwater pollution than other states.

As for the benchmarks used by federal cleanup programs and the states of **Arkansas and Oklahoma** (Regional Screening Levels, RSLs), Texas guidelines compare even more unfavorably. The average residential soil benchmark in Texas is **21.95 times weaker** for the same chemical, and industrial soil benchmarks are **14.95 times weaker**.[i] The disparity is even more dramatic for groundwater—the average Texas expectation is **121.49 times weaker.**[ii]

Worst of all are the benchmarks used for soil-to-groundwater protection. These are exactly what they sound like: the benchmarks used for polluted soils that are believed to drain to groundwater. Both Texas PCLs and federal RSLs have a benchmark for this particular pathway, and TCEQ has even highlighted this benchmark in their responses to concerned citizens writing about the benchmark issue.[24] TCEQ Interim Executive Director Stephanie Bergeron Perdue wrote TCE Fund supporters in May 2018 to say that these benchmarks are "over 800 times lower than even direct contact human health-based cleanup values."

Table 7: Soil to Groundwater Benchmarks—All Chemicals

Texas PCL/Federal RSL: Residential Soil	Texas PCL/Federal RSL: Industrial Soil	Texas PCL/Federal RSL: Groundwater	Texas PCL/Federal RSL: Soil-to-GW
21.95	14.95	121.49	1367.95

Setting aside the fact that the soil-to-groundwater benchmark is rarely used and that there are common ways to avoid using it,[iii] Texas PCLs are **1,367.95 times higher than federal benchmarks** for the same pollutants,[iv] and of the 78 pollutants with benchmarks from both agencies that TCE Fund examined **only 2 had stronger PCLs** (mercury and dimethoate) than federal benchmarks. **There are at least 15 pollutants with soil-to-groundwater Texas PCLs at least 1,000 times higher than their respective federal benchmark.**[v]

There are at least 15 pollutants with soil-to-groundwater Texas PCLs at least 1,000 times higher than their respective federal benchmark.

i The median residential soil benchmark is 3.7 times weaker, and for industrial 4.34 times weaker.

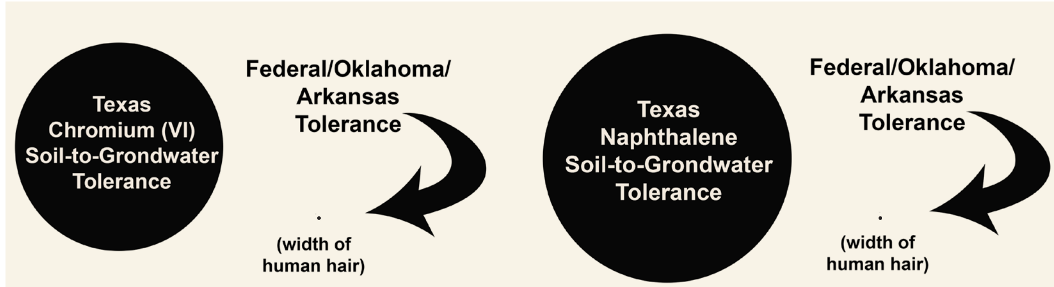
ii The median groundwater benchmark is 19.44 times weaker than the Regional Screening Levels. With hexavalent chromium removed they are on average 44.42 times weaker.

iii Namely the widespread use of "municipal settings designations" (MSDs) to restrict use of a section of groundwater by covenant, thus making it Class 3 groundwater, which has much weaker protections.

iv The overall median PCL is 96 times weaker than the soil-to-groundwater RSL. The average is skewed by Naphthalene, which Texas PCLs (16 mg/kg) allow at 29,630 times the federal benchmark (0.00054 mg/kg), and hexavalent chromium which Texas (14 mg/kg) allows at 20,896 times the federal screening level (0.00067 mg/kg). Even without these two, the average Texas benchmark is still 739 times less protective than the analogous federal number. Without these two the median disparity is still 95 times worse in Texas.

v Arsenic; benz-a-anthracene; chlordane; chloroform; cyanide; dibromo-3-chloropropane 1,2-; dichlorobenzene 1,4-; heptachlor epoxide; hexachlorobenzene; hexachlorobutadiene; hexachloroethane; hexavalent chromium; hydrazine; naphthalene; vinyl chloride.

Figure 6: Soil-to-Groundwater Benchmarks in Texas vs. Regional Screening Levels

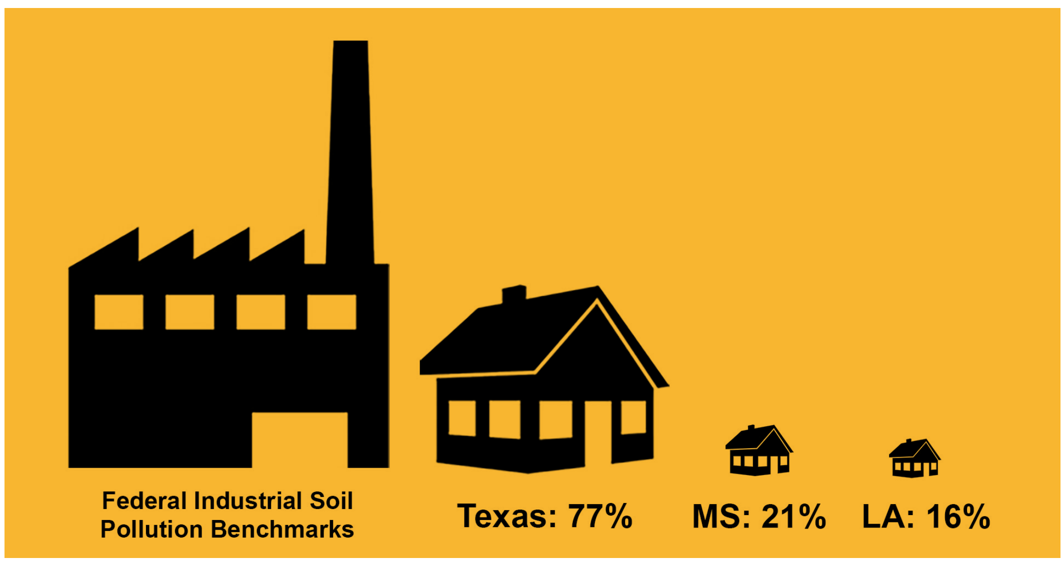


The disparity between more commonly used, non-groundwater Texas soil benchmarks and the Oklahoma/Arkansas/federal RSL benchmarks is so great that 44% of the time the federal benchmark for soils at ***industrial*** sites is stronger than even the Texas ***residential*** guideline. Even for deadly, carcinogenic pollutants such as benzene and trichloroethylene, **Texas allows family homes on sites Arkansas, Oklahoma, or EPA would consider too dangerous for industrial facilities.**

Texas allows family homes on sites Arkansas, Oklahoma, or EPA would consider too dangerous for industrial facilities.

On a median basis the Texas residential expectations are in fact a little stronger than the federal industrial levels also used in Arkansas and Oklahoma. This is to be expected—we should have less pollution in areas slated for homes than we do for sites intended for industrial use. But even then, **Texas *residential* benchmarks are fully 77% as high as the federal *industrial* expectations**, while Louisiana's median residential benchmark is only 16%, and even Mississippi is just 21%. **Texas benchmarks are notably underwhelming and unprotective of human health and the environment.**

Figure 7: Industrial Soil Pollution Benchmarks vs. Residential Soil Pollution Benchmarks



Indeed, Texas benchmarks are generally much weaker than those of these two states in particular. Texas groundwater expectations are **22.5 weaker** than Louisiana's "Screening Standards."[i] Texas state groundwater benchmarks are **40.1 times weaker** than Mississippi's on average.[ii]

As for soil benchmarks, **Texas allows 25.74 times more pollutants in residential soils as Louisiana** on average before considering the site worthy of remediation, and **23.52 more at industrial sites**. On average **Texas tolerates 5.88 times more in our *residential* soils as Louisiana does in their *industrial* soils**.[iii] Again, Texas considers soils safe for building homes on that Louisiana wouldn't even allow for factories or warehouses. The same is true for Mississippi: **Texas residential benchmarks are 20.48 times worse than Mississippi unrestricted (residential) goals** on average, and industrial soil disparities are even worse—**33.99 times weaker here in Texas**.[6]

i Note that we are not claiming that the disparity in benchmarks between Texas and these other states necessarily implies that sites would be cleaned up in those states and not in Texas. There are other factors that go into determining eligibility for these programs besides the benchmarks. All other things equal, however, less protective benchmarks mean higher barriers for entry into these cleanup programs and less robust remedies in the end.

ii The average is skewed by the fact that Texas allows 1,090 times as much chloroform in groundwater as Mississippi. When chloroform is removed Mississippi's levels are still 17.93 more protective than the average Texas benchmark for groundwater. There is no disparity for median groundwater protections between these states because when available they all use the basic federal drinking water standards enforced by the Safe Drinking Water Act, the Maximum Contaminant Levels (MCLs). For the many chemicals that have no MCL, however, Texas is far less protective—the median groundwater expectation in Texas for chemicals without MCLs is 6.8 times as permissive as the Louisiana benchmarks, and 13.45 times Mississippi's.

iii Louisiana residential soil benchmarks are typically 8.2 times stronger, and their median industrial expectation is 6.62 times stricter. Mississippi is not quite as disparate, but Texas still allows 2.07 times as much pollution on a median basis in residential settings, and 3.27 times in industrial.

Table 8: Texas Groundwater PCLs vs. Louisiana and Mississippi—All Chemicals

Groundwater PCL/Louisiana Screening Standard	Groundwater PCL/Missisippi Groundwater Target Remediation Goals
22.5	40.1

Table 9: Texas Soil PCLs vs. Louisiana and Mississippi—All Chemicals

TX Residential/LA Residential Soil	TX Industrial/LA Industrial Soil	TX Residential/MS Residential Soil	TX Industrial/MS Industrial Soil
25.74	23.52	20.48	33.99

The typical residential benchmark in Texas is in fact a little stronger than the typical industrial expectation in Louisiana—about 10% stronger—and even better than the Mississippi's—58% stronger. Still, when compared to one another Louisiana's median residential benchmarks are **92% stronger** than Mississippi's industrial levels, and Mississippi's residential goals are **67.5% better** than Louisiana's median industrial benchmarks. **Texas allows more pollution than either state before declaring a site in need of cleanup.**

The one state in EPA's Region VI that has not mentioned much so far is New Mexico, because New Mexico benchmarks are weaker than Texas for soil contamination. As an arid area, the risk of runoff or leaching to surface and groundwater is less than in Texas and other states. Notably, however, New Mexico's benchmarks for groundwater, its major source of drinking water, are better than those in Texas.

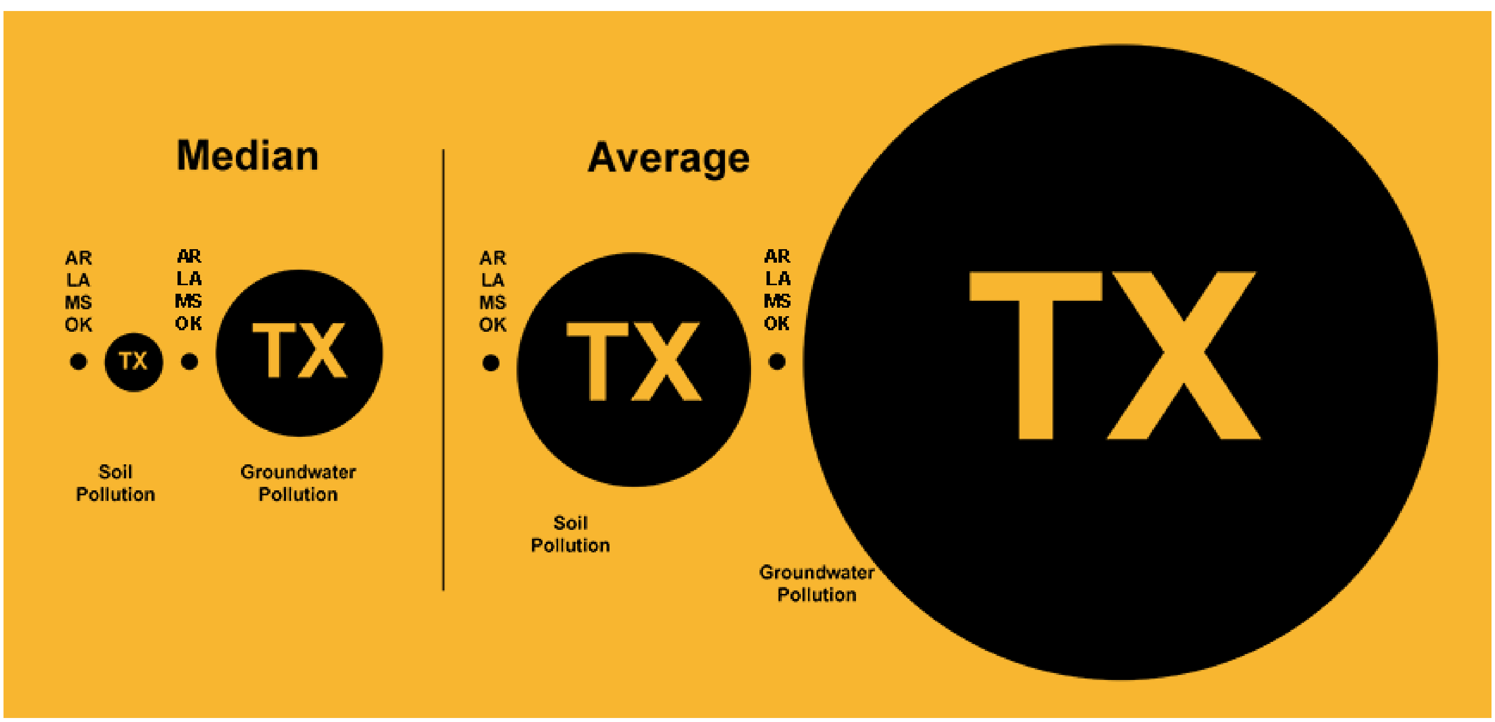
Texas remediation benchmarks allow development on lands that other states would consider threatening to human health and the environment.

Table 10: Texas PCLs vs. New Mexico—All Chemicals

TX Groundwater PCL/NM Groundwater, Average	TX Groundwater PCL/NM Groundwater, Median	TX Residential Soil PCL/NM Residential Soil, Average	TX Residential Soil PCL/NM Residential Soil, Median	TX Industrial Soil PCL/NM Industrial Soil, Average	TX Industrial Soil PCL/NM Industrial Soil, Median
17.34	2.7	3.83	0.89	1.57	0.69

Taking all of these ratios into account—from EPA and all other states we examined—the average Texas soil benchmark—both industrial and residential and crossing over to compare with the opposite standards in Arkansas, Louisiana, Mississippi, and Oklahoma—is **14.22 times weaker**. For groundwater the disparities are even worse, with an average Texas guideline **38.22 times weaker** than other state and federal benchmarks. The numbers are very clear: Texas remediation benchmarks allow development on lands that other states would consider threatening to human health and the environment.

Figure 8: Acceptable Levels of Pollution in Texas and Other States



Carcinogenic Standards are Especially Weak

Even more concerning are the disparities between pollutants known to cause cancer and those that are not thought to. **It is fair to say that the more dangerous a pollutant, the less emphasis Texas puts on cleaning it up.** Generally speaking the differences we have just seen are especially pronounced for carcinogens and less disparate for non-carcinogens. The major imbalance between Texas and the various federal soil benchmarks disappears for non-carcinogenic chemicals—Texas is actually 4.5% stronger than Superfund thresholds. **For carcinogens, however, Texas is 1,682% times weaker.**

As we will explore in the next section, the immediate cause of the distinction between cancer-causing and non-cancer-causing pollutants is the math used to develop the benchmarks. **Texas is willing to tolerate a higher incidence of cancer than other states and the federal government** in exposed populations—expressed as a "risk level" in these equations—perhaps because many of the state's most politically powerful industries are closely associated with cancer-causing pollution.

It is fair to say that the more dangerous a pollutant, the less emphasis Texas puts on cleaning it up.

Table 11: Texas PCLs, Carcinogenic vs. Non-Carcinogenic—All Chemicals

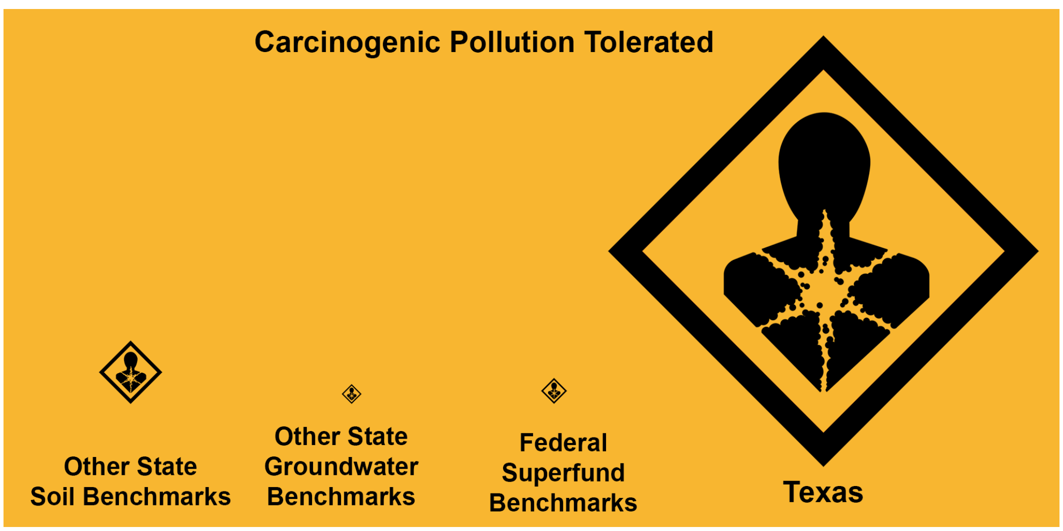
All Texas PCLs/SCDM, Carcinogens	All Texas PCLs/SCDM, Non-Carcinogens	All Texas Soil PCLs/ Carcinogen Benchmarks
16.82	0.955	6.81

Regardless of the motive for this shortcoming, we can say that **the average Texas soil benchmark for a cancer-causing pollutant is 6.81 times weaker** than the average non-carcinogenic benchmark across all agencies.[i]

One final way of quantifying this phenomenon is to compare the average disparity between Texas benchmarks and neighboring/federal benchmarks for non-carcinogens to the average disparity between benchmarks for carcinogens. Our weak benchmarks are in fact **2.61 times weaker for carcinogens** than they are for non-carcinogens in groundwater on average, and **4.17 times worse** for soil benchmarks.

Bottom line: Texas cleanup programs are less rigorous about repairing sites that may raise the risk of cancer than those without this risk.

Figure 9: Acceptable Levels of Carcinogenic Pollution in Texas and Other States



i On a median basis the typical Texas protection is 4.2 times weaker for carcinogens than for chemicals not thought to cause cancer. These disparities are skewed by three chemicals with especially disparate measures by some agencies—hexavalent chromium, chloroform, and naphthalene. When these three are removed the average Texas groundwater benchmark for carcinogens is 21.79 weaker than benchmarks used by other agencies. On a median basis our expectations are 2.13 times less protective.

How Benchmark Formulas Cause Disparities

Such widely divergent expectations raise the question of how these agencies arrive at such different benchmarks for the same chemicals. The answer is that they each use their own distinct formulas for calculating the safe levels of these pollutants in the relevant media. Most of these formulas are fairly similar, combining a variety of factors used to approximate pollution exposure and chemical-specific values to estimate the risks associated with those pollutants.

Examining Formulaic Disparities Across Agencies

The chemical-specific values are generally the same across all agencies, most often derived from:

- **the Provisional Peer-Reviewed Toxicity Values (PPRTVs) for Superfund[25]**
- **the Integrated Risk Information System (IRIS)[26]**
- **the Health Effects Assessment Summary Tables (HEAST)[27]**
- **the National Center for Environmental Assessment (NCEA)[28]**
- **the Agency for Toxic Substance and Disease Registry (ATSDR)[29]**
- **original research performed by state agencies or other approved peer-reviewed research.**

PPRTV, IRIS, HEAST and NCEA are all maintained by EPA, while ATSDR is overseen by the Centers for Disease Control (CDC). Because most agencies use the same sources the differences in benchmarks are not caused by differences in these figures. Instead the disparities between benchmarks arise from different assumption factors put into these formulas and different ways of organizing the formulas altogether.

The factors mentioned cover a variety of standard assumptions used to determine how much pollution a person living near polluted soil or groundwater would experience on a regular basis. They include factors such as:

- **Exposure Duration (the number of years a person will be exposed to the pollutant)**
- **Exposure Frequency (how many days a year a person will be exposed)**
- **Ingestion Rates for soil and water (how much soil or water someone ingests--accidentally and intentionally--in a given day)**
- **Inhalation Rates (how much air someone breathes).**

There are a number of others as well. Most of these are generally the same across agencies as well, with similar assumptions informing benchmarks in each of them. Still, Texas uses significantly different estimates for some of these figures[30] , and this is what gives rise to our less protective benchmarks.

By adopting factors similar to those in other states, Texas protective levels would be safer for human health and the environment. Simple changes could improve our expectations considerably.

Those interested in the specifics of these problems can see the information boxes in this section for details. The bottom line, however, is that Texas would see stronger, more protective PCLs if we were to:

- **Tolerate cancer risks of one in one million--like Arkansas, Oklahoma[31], Louisiana[32], and Mississippi[33]—instead of one in 100,000**

By adopting factors similar to those in other states, Texas protective levels would be safer for human health and the environment.

- **Adopt lower hazard quotients for other toxic chemicals**
- **Follow other states in our assumptions about how much water and soil people ingest and how much skin surface area they expose.**

There may be other means of improving the PCLs, but in general the Texas formulas resemble those used by other agencies. These changes are clearly the most immediately necessary for making our state remediation programs more effective.

Right now, for example, the Texas groundwater ingestion benchmark for aniline—a carcinogen—are about 13 times weaker than the strongest groundwater benchmarks used in surrounding states. This is the formula used to calculate this benchmark and the current figures used for each factor:

$$Ingestion\ PCL = \frac{(Risk\ Level) \times (Averaging\ Time\text{--}Carcinogens) \times 365\ days/year}{(Oral\ Slope\ Factor) \times (Modifying\ Factor) \times (Age\text{-}Adusted\ Ingestion\ Rate) \times (Exposure\ Frequency)}$$

$$0.16\ ml/L = \frac{10^{-5} \times 70 \times 365}{.0057 \times 1 \times 0.80 \times 350}$$

Changing the factors we outlined above—Target Risk and water ingestion rate—would change it to:

Better data in, healthier expecations out.

$$0.012\ ml/L = \frac{10^{-6} \times 70 \times 365}{.0057 \times 1 \times 1.1 \times 350}$$

This is the exact figure used by Louisiana's programs, and 0.001 milliliters per liter stronger than Superfund benchmarks and those used by the Regional Screening Levels used in Oklahoma and Arkansas. It would be only 0.0003 milliliters per liter weaker than Mississippi's benchmark.

Soil formulas are significantly more complex than those used for groundwater, but the effects should ultimately be the same: **better data in, healthier expectations out.** There are no practical changes that are going to make all Texas benchmarks stronger than all benchmarks for all chemicals in all formats—soil, water, etc.—used by other agencies, but the changes we suggest would undeniably make our land and water safer for Texas families.

For more detailed information on how these equations work, read the following informational boxes.

Risk Levels and Toxic Hazard Quotients (THQ)

Perhaps the most important difference between Texas benchmark formulas and those used in other states are the two multipliers the equations use to estimate health risks—the Risk Level for carcinogens and the Toxic Hazard Quotient (THQ) for non-carcinogens. Though calculated differently, they serve an analogous purpose in reflecting these health risks in the final equations.

What TCEQ calls the "Risk Level" and other agencies sometimes call the "Target Risk" represents the risk that a population exposed to this pollutant will develop cancer as a result of exposure to the pollution being measured. Texas uses a Risk Level of 10^{-5}, meaning that regular exposure at that level would likely cause one additional case of cancer for every 100,000 people so exposed. EPA Regional Screening Levels (used in Oklahoma and Arkansas), Louisiana, and Mississippi all use Target Risks of 10^{-6}, limiting their cancer risks to one in a million. Texas assumes cancer risks a full order of magnitude higher than other neighboring states, with the exception of New Mexico which also uses the 10^{-5} standard, and whose benchmarks are about as weak as the ones used in Texas.

As for non-carcinogens, equations use the Toxic Hazard Quotient (THQ) in lieu of the risk level or target risk, with higher THQs less safe than lower THQs. In all Texas equations THQ equals 1, which seems superfluous, as multiplying the other factors by 1 has no effect on the formula. New Mexico likewise uses a THQ of 1 helping to explain their relatively weak benchmarks. Louisiana's stricter screening standards use a THQ of 0.1 and EPA allows for both THQ 1 calculations and 0.1 marks. Mississippi, with some technical exceptions, sets a THQ of 1 as the upper boundary for their calculations, indicating that THQs below that are preferred.

Improving Texas benchmarks should entail, at the very least, improving our risk level for carcinogens to 10^{-6} and our THQ for non-carcinogens to 0.1.

Ingestion Rates and Skin Surface Areas

After these risk and hazard factors perhaps the most significant difference between Texas benchmarks and those in other states or at the federal level are assumptions made about rates of ingestion and levels of exposure to various pollutants. All formulas assume that people ingest water and (accidentally) soil and that they have a certain surface area of skin exposed to each. They assume that adults have more skin than children, that adults ingest more water than children, but that children ingest more soil than adults from playing outside, putting things in their mouths adults would not, for example.

The different levels used for each of these factors are laid out in the table below. In every case Texas uses the most permissive assumptions examined. Our benchmarks would be significantly more protective if we chose the most conservative figures for each category instead. Making these adjustments along with the changes in risk level (for carcinogens) and hazard quotient (for non-carcinogens) are the primary means of raising Texas expectations to meet those of other nearby states.

Table 12: Ingestion and Skin Area Assumptions for Benchmark Equations

	Soil Ingestion, Child (mg/day)	Water Ingestion, Child (L/day)	Water Ingestion, Adult (L/day)	Skin Area, Child (cm^2)	Skin Area, Adult (cm^2)	Skin Area, Worker (cm^2)
EPA (AR & OK)	200	0.78	2.5	2373	6032	3527
Louisiana	200	1	2	2800	5700	3300
New Mexico	200	0.78	2.5	2690	6032	3470
Texas	191	0.64	N/A	2200	4800	2500

Formula Design

Almost every benchmark formula involves fractions—one set of factors dividing into another. In all of the relevant formulas each of these above factors are used in the denominators of the equation--the bottom part of the fraction. That means that when these factors are larger the ultimate outcome—the benchmark—is smaller, or stricter. Texas using smaller factors means our resulting PCLs are larger and less protective than the benchmarks from other states. The exceptions are the risk level and the THQ which are both numerator factors. The fact that Texas uses larger figures for each of these further helps explain our less protective benchmarks.

$$PCL = \frac{RL \times ATc \times 365\ days/year}{SFo \times MF \times IRsoil.AgeAdj.res \times EF.res}$$

As an example, let's look at the formula used to calculate the groundwater carcinogenic PCL for ingestion—i.e. the benchmark for groundwater that people might drink polluted with chemicals which may cause cancer.

"RL" in the top (or numerator) of the fraction is "Risk Level." A higher number there will generate a higher PCL, so using 10^{-5} instead of 10^{-6} will result in a PCL 10 times less protective than those in other states. "ATc" is "Averaging Time" for carcinogens and is an estimate of lifespan, here Texas uses the same number as other agencies, 70.

"SF " stands for "Slope Factor, oral," which is the one chemical-specific figure in the equation. Slope factors are scientifically determined figures that represent the quantity of a substance that is likely to cause cancer in some proportion of the population. In this case it is the amount that if consumed orally would cause an increased risk of cancer.

All of the other figures have defined numbers associated with them, though some of them can be replaced with different, site-specific figures for Tier 2 PCLs. "MF" is "Modifying Factor" which is equal to 1 in all cases except arsenic, making it otherwise meaningless to the outcomes of the formula. In the case of arsenic MF is 0.1, which by making the entire denominator (bottom of the fraction) smaller makes the final PCL higher and thus weaker.

This is supposed to reflect that some forms of arsenic cannot be absorbed by our bodies when ingested, but the results are groundwater PCLs for arsenic that are fully 119 times weaker than Superfund benchmarks and 117 times worse than the figures used in Oklahoma and Arkansas.

The other factors are what we have outlined above: “EF.res” is “Exposure Frequency, residential” and “IRw.AgeAdj.res” is “Age Adjusted Water Ingestion Rate.” Texas uses the same residential Exposure Frequency as other agencies—350—but remember that our water ingestion rate is smaller than other agencies. Because this smaller figure is in the denominator, it makes the final PCL larger and less protective. Numerator figures such as Risk Level (or in non-carcinogenic case Hazard Quotients, which are likewise in the numerator) are made larger, while denominator figures such as Ingestion Rate and Exposure Frequency are made smaller. The result are weaker standards than those of other nearby states.

Where Texas is Better

Not all Texas factors are worse than other agencies we explored. Exceptions include the “adherence factor,” used to approximate how much dirt actually sticks to the skin. All other agencies examined for this report use adult adherence factors of 0.07; Texas uses 0.1. This number is used in the denominator of the relevant equations, so Texas’ larger adherence factor creates slightly more protective PCLs than they otherwise would. Also Texas assumes an adult “Exposure Duration” of 30 years while New Mexico and EPA assume one of 26 years and Louisiana 24 years. This is also used mostly as a denominator factor, so this makes Texas benchmarks a little more protective than they would be if we used the EPA or Louisiana numbers.

Averaging Time, we’ll recall, is used in the numerator of most equations so smaller figures are more protective. Texas and Louisiana both use a smaller number than EPA and New Mexico--70 for the former agencies, 80 for the latter. Besides these few exceptions, however, Texas formulas as currently designed will deliver less protective standards.

What Are These Pollutants?

4.

Texas Campaign for the Environment Fund, with the assistance of Air Alliance Houston received a large amount of data from TCEQ about all of the Texas Risk Reduction Program and Superfund investigations done by the agency between 2007 and 2017. TCEQ staff visited no fewer than 818 sites, most designated for "No Further Action" (NFA), indicating that no remedy was necessary. In many cases these NFA sites were left unremediated because pollutants on site did not exceed the Texas benchmarks--the Protective Concentration Levels (PCLs)—meaning there are sites that Louisiana, Mississippi, Oklahoma, Arkansas or other states may have cleaned up that Texas did not.

Below we examine six chemicals out of dozens with Texas benchmarks that are especially weak when compared to other states. For each the disparity between other agency benchmarks and Texas PCLs is significantly worse than average; these are some of the chemicals with the weakest PCLs in Texas. They each have also been reported as "chemicals of concern" at multiple polluted sites in Texas between 2007 and 2017. A look at their health impacts and roles in the consumer economy demonstrate the necessity of improving our expectations for cleaning them up.

We want to be clear: TCE Fund is making no claims about the safety of these sites besides the fact that TCEQ determined that these chemicals of concern were present—or potentially present—and they ultimately left the chemicals in place. *In many instances it is unclear how much pollution was present or how much remained after their responses. More research is needed on how sites are inspected and addressed by cleanup programs.*

There are sites that Louisiana, Mississippi, Oklahoma, Arkansas or other states may have cleaned up that Texas did not.

Acetone

Acetone is derived from propylene, which is a byproduct of oil and gas refining. Acetone is used as a solvent in many industrial operations, especially in the production of synthetic fibers and plastics, and as a precursor for chemicals used in the production of acrylic plastics such as Plexiglas.[34]

TX Sites Reporting this Pollutant:

15

TX vs. Superfund Water Benchmarks	TX vs. Superfund Soil Benchmarks	TX vs. All Other Soil Benchmarks	TX vs. All Other GW Benchmarks
2.2	0.84	41.7	52

Some sites where acetone was detected and not remediated include:

- **Medina Lakes Groundwater Plume:** A groundwater plume only 335 feet from the shoreline of a lake on the Medina River in Lakehills, TX (Bandera County) where **acetone and at least nine other dangerous pollutants were found with no known source** (though a nearby illegal dump is mentioned in the inspection report) in 2011 and 2012. "No chemicals of concern were detected above [Texas] PCLs in any of the environmental media sampled and analyzed." The site was designated "No Further Action" in 2015.

- **Kelso Water Systems Inc.:** A private well serving at least 200 people in a trailer park a quarter of a mile outside of Lubbock with a series of regulatory violations drawing water near domesticated animal pens. Chemicals including acetone as well as arsenic, barium, chromium, copper, lead, nickel, selenium, zinc, nitrate, tetrachloroethene, bromoform, bromodichloromethane, chloroform, dibromochloromethane, and methylene chloride, were detected in the water there, **though they do not indicate at what level or whether they exceeded PCLs**. Regardless, the site was listed as "No Further Action."

- **Martine Springs-Slaughter Creek Groundwater Plume:** A spring on Slaughter Creek in South Austin that fed surface water used for bottled drinking water that tested positive for acetone in 2012, but TCEQ determined it was a "non-detect" because the pollution may have come from cross contamination or some other element of the environment. If TCEQ did further testing after this they do not indicate it in the reports available to TCE Fund. Texas acetone PCLs are more than 7 times weaker than EPA guidelines used in Oklahoma and Arkansas, more than 16 times Mississippi Target Remediation Goals, and 100 times higher than Louisiana Screening Standards. **This is to say that it is possible that a water source for bottled water in Texas could have acetone pollution at concentrations Oklahoma, Arkansas, Louisiana, and Mississippi would consider in need of remediation.**

Figure 10: Medina River site

Figure 11: Martine Springs-Slaughter Creek site

Arsenic

TX Sites Reporting this Pollutant:

60

A well-known toxin, arsenic was historically used in a variety of agricultural pesticides, with only cotton farming using it today in the United States.[35] Texas is the nation's largest cotton producer, growing more than a quarter of the nation's total crop—the most valuable legal cash crop in the United States. Arsenic is also used as an additive in animal feeds, especially chicken feed, to promote weight gain and prevent some diseases. Poultry is a multi-billion dollar industry in Texas.

TX vs. Superfund Water Benchmarks	TX vs. Superfund Soil Benchmarks	TX vs. All Other Soil Benchmarks	TX vs. All Other GW Benchmarks
119.6	31.7	26.4	40.9

Sites with potential arsenic pollution include:

- **J&J Plastics Company:** A one-time plastics manufacturer in Turney, Texas (Cherokee County) that had such high levels of soil pollution on site in 1987 that **EPA insisted that local firefighters not put out a blaze there for fear of increasing toxic air emissions**. The next indication of any inspection came 27 years later, in 2014. The site had since been turned into a home with large gardens on site, and TCEQ found arsenic soil concentrations up to 3.65 times the residential PCL, which would be more than 205 times the Mississippi benchmark. Despite this, the site was designated "No Further Action" because the polluted soils were located "away from the residence," and because "the general topography of the site runoff is to the northern section of the property, away from the residence on site." Concentrations nearest the house were "below respective PCLs," but no data is provided—they may very well be above those allowed in other states.

- **Braxdale Aviation:** A former private runway used by aerial pesticide applicators in Crystal City, Texas (Zavala County) was determined to be a threat of "medium" seriousness by EPA in 1987 and 1988. Some 20 years later the runway had been converted into a home and a farm, and TCEQ scored the site for possible inclusion in the State Superfund. The site's score qualified it for inclusion. No other actions are noted until 2015 when further inspection "detected concentrations of arsenic in all onsite and off-site samples exceeded respective SCDM concentrations" but "less than their respective PCLs and three times background concentrations." **The site is on the banks of the Nueces River, making it a potential flood risk as well.** Despite being as polluted as a federal Superfund site the property was designated "No Further Action."`

Figure 12: Braxdale Aviation site

The site is on the banks of the Nueces River, making it a potential flood risk as well.

- **American Rice Grower's Co-Op:** A rice grower's co-op in Liberty, Texas (Liberty County) was found in 2014 to have arsenic "slightly" above residential PCLs, but "as the site is a commercial property the concentrations of the chemicals of concern (COC) did not exceed the Commercial/Industrial criteria as detailed in TRRP." Still, this is an instance where Texas' stricter residential benchmarks are actually far weaker than other states' industrial levels, with the mark "slightly" exceeded here 2 times the Louisiana industrial benchmark, 6.28 times Mississippi's and 8 times that used in Oklahoma or Arkansas. **This site might be barred from even industrial use in surrounding states, but they can operate with no cleanup in Texas.**

Benzene

Benzene is a key component of crude oil and one of the most basic—and therefore common—petrochemicals. It is an aromatic hydrocarbon, a class of chemicals responsible for birth irregularities, and it is also carcinogenic.[36] Besides its ubiquity in the petrochemical industry, it is also an important additive in gasoline to increase octane and reduce engine knocking.

TX Sites Reporting this Pollutant:

23

TX vs. Superfund Water Benchmarks	TX vs. Superfund Soil Benchmarks	TX vs. All Other Soil Benchmarks	TX vs. All Other GW Benchmarks
3.6	5.8	35.9	3.1

Sites with benzene as a key pollutant include:

- **Former Delroc Oil Refinery:** The Woodwind Lakes subdivision in Northwest Houston built on the site of a former oil field, with 32 houses built on the site of a one-time refinery. EPA asked TCEQ to inspect the site in 2006 by testing specifically for benzene along with other pollutants. The site inspection report says that "although observed releases were observed in soils, none pose a threat to the community," without ever specifying which chemicals were found in what concentrations. **Shallow groundwater samples tested positive for benzene, ethylbenzene, and several other dangerous pollutants**, but because the groundwater is not believed to migrate to deeper aquifers **TCEQ decided not to remediate the site**.

- **Delfasco Forge Division:** A former metal forging and fabricating business in Grand Prairie, tested positive for benzene and a variety of other pollutants in its groundwater in 2002. The property owner self-reported in 2005 that there was pollution on site still, "however the extent of soil and groundwater contamination was not delineated as per Texas Risk Reduction Program (TRRP) Protective Concentration Levels (PCLs)." Soil levels tested in 2011 showed contamination below Superfund benchmarks, but more specific numbers are not indicated, and these benzene benchmarks are still eight times higher Louisiana

Screening Standards, Mississippi Target Remediation Goals, or benchmarks used in Oklahoma and Louisiana. Because the area is not on well water TCEQ decided not to clean up the site, but seven years later EPA nominated the site for the Superfund National Priority List. **Texas expectations allowed the site to stay polluted despite the EPA determining it is polluted enough for the nation's highest cleanup priority list.**

- **Gardner Flyers:** A former pesticides and fertilizer crop dusting company in Mercedes, Texas (Hidalgo County) was identified in 1993 as "an inactive facility with insufficient data for screening purposes," and exactly one year later it was referred for inspection by staff of the TCEQ's predecessor agency (the Texas Natural Resource Conservation Commission). Soil samples were taken five years later and found benzene exceeded the "reporting limit" along with a variety of other pollutants. Fourteen years later in 2013 **inspectors gave the site a hazard score which qualified for the State Superfund program**. The next year they performed further tests—but did not test for benzene. The soil samples showed significant pesticide contamination, but TCEQ determined "the site does not pose an imminent threat to public health and safety or the environment," and designated it for **"No Further Action."**

Chloroform

TX Sites Reporting this Pollutant:

8

Chloroform is a precursor to the chemical known commercially as Teflon. It is used in both consumer products and industrial applications as a lubricant. It is also used as a solvent and in pesticides.[37]

TX vs. Superfund Water Benchmarks	TX vs. Superfund Soil Benchmarks	TX vs. All Other Soil Benchmarks	TX vs. All Other GW Benchmarks
119.6	31.7	26.4	40.9

Sites reporting chloroform as a chemical of concern include:

- **Coiling Technologies Inc. Public Water System:** A manufacturing facility near Jersey Village (Harris County) operating over groundwater that serves 76 people. They found carbon tetrachloride pollution in their groundwater during routine testing starting in 2011. Further testing in 2014 found both this pollutant and chloroform, the latter at concentrations below Texas PCLs, but very close to federal Superfund levels. **The samples exceeded federal benchmarks and Mississippi goals by an order of magnitude, and some samples exceeded New Mexico's benchmarks.** Because the samples cleared Texas' expectations, however, the site was designated "No Further Action."

- **Mont Belvieu Groundwater Plume:** Groundwater testing at site of a manufactured home retailer in Baytown in 2015 tested positive for chloroform and a variety of other chemicals, possibly from an adjacent petroleum-related business. TCEQ determined that chloroform was present below PCLs, but at least one other chemical was more than twice the Texas benchmark. This raises concerns that chloroform (which was not given a specific concentration in reports) might have exceeded other guidelines. Two further rounds of testing the next year found multiple instances of volatile organic compounds, semi-volatile organic compounds, and polycyclic aromatic hydrocarbons in the samples, though they did not report whether chloroform was among them. Because they did not exceed PCLs or Superfund values the site was designated **"No Further Action."**

- The Medina Lake Groundwater Plume we noted as being potentially affected by acetone pollution was also polluted with chloroform.

Texas expectations allowed the site to stay polluted despite the EPA determining it is polluted enough for the nation's highestcleanup priority list.

Benzo(a)pyrene

TX Sites Reporting this Pollutant:

11

Benzo(a)pyrene (or BaP) is another polycyclic aromatic hydrocarbon (PAH), as well as a carcinogen. Like many other PAHs it is produced when organic matter—wood, coal, fossil fuels—are incompletely burned, and since industrial processes are not 100% efficient, it is widely produced in heavy industry across Texas.[38]

TX vs. Superfund Water Benchmarks	TX vs. Superfund Soil Benchmarks	TX vs. All Other Soil Benchmarks	TX vs. All Other GW Benchmarks
119.6	31.7	26.4	40.9

Sites with BaP as a chemical of concern include:

- **Hi-Chem Inc; Houston Intermediate Chemicals:** A former chemical company in the town of Alvin (Brazoria County) where EPA executed an emergency removal of 400 toxic waste drums In 1992 and 1993. The Texas Water Commission (a predecessor of TCEQ) found later in 1993 that not all contaminated soils had been removed. Prior to the drum removal 15 hazardous substances (including benzo(a)pyrene) were detected on site. **This is especially concerning at the site is on the banks of a bayou and could easily flood in a natural disaster.** Some 20 years later TCEQ screened the site, testing for 33 chemicals including BaP. "These chemicals were detected by the soil and groundwater analysis but were at levels below the [Texas] Residential PCLs," which are of course much weaker than standards in other states. By clearing this low bar the site was declared in need of "No Further Action."

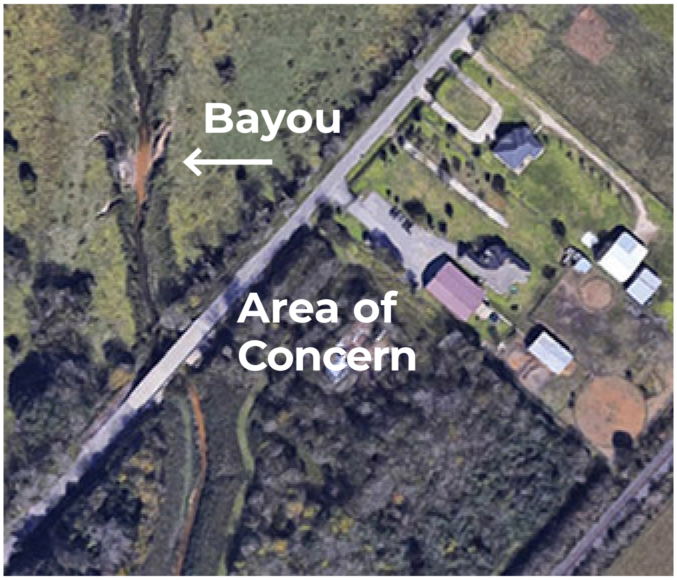


Figure 13: Hi-Chem Inc. site

- **Battery Recyclers of Houston:** A former battery recycler and secondary lead smelter in Pearland (Brazoria County) was found eligible for state Superfund screening in 2013, at which point TCEQ found BaP at levels over PCL benchmarks in soils on site—at least 41 times Superfund benchmarks. Despite this, TCEQ declared it an "active" site and because the Texas Risk Reduction Program only deals with inactive sites, it is ineligible for remediation. This "active" designation comes despite no apparent buildings on the site and the same TCEQ report says "battery recycling operations are no longer conducted" there. **Furthermore, despite saying that no "critical pathways" were impacted, the site is on the banks of a creek, and TCE Fund research found that the site was partially underwater following Hurricane Harvey, as shown below.** Despite this, TCEQ designated the site for "No Further Action." As a result this site was not part of TCEQ's inventory of polluted sites potentially affected by Hurricane Harvey, and there is no information about any spread of pollution caused by the storm at this stie.

TCE Fund research found that the site was partially underwater following Hurricane Harvey.

Figure 14: Battery Recyclers of Houston (Pearland) site

- **Tom's Custom Spraying:** A former herbicide applicator business in Canyon, Texas (Randall County), south of Amarillo. The operation experienced a spill of atrazine—a widely used herbicide banned for use in Europe and associated with hormonal disruption—in 1971 on an area of soil later used for agriculture. They also buried used chemical drums on site. State inspectors performed a preliminary assessment/site inspection in 1988, and the site was referred for sampling inspection in 1992. The sampling was performed eight years later, and **a variety of pollutants exceeded PCLs**. Two years later it was determined in need of further evaluation, which was performed three years later, in 2005. Again, **pollutants were found above PCLs**, and TCEQ tested it again 10 years later in 2015. The area where the company operated was devoid of vegetation, though the surrounding areas were all used for agriculture. **BaP was found at concentrations above federal Superfund levels, but below PCLs and so the site was designated for "No Further Action."** That is to say, that a site with the same level of BaP could potentially be a Superfund site in some other state, but gets an effective clean bill of health in Texas.

Bromodichloromethane

TX Sites Reporting this Pollutant:

6

Believed to be a carcinogen, bromodichloromethane has been used historically as a flame retardant, and is still used as a solvent for fats and waxes. It can also occur as a byproduct in drinking water when chlorine is used to kill bacteria, itself a potentially harmful practice.[39]

TX vs. Superfund Water Benchmarks	TX vs. Superfund Soil Benchmarks	TX vs. All Other Soil Benchmarks	TX vs. All Other GW Benchmarks
12.5	8.9	142.4	38.1

Sites with bromodichloromethane as a chemical of concern include:

- **River City Metal Finishing:** A defunct industrial site in San Antonio the **EPA recently named a Superfund National Priority List site, but which TCEQ previously designated for "No Further Action."** An injunction from a district court ordered the site closed and all drums and vats removed in 2012. Reports of discolored liquids running off the site prompted a TCEQ investigation in 2013 and they found that the court order had been ignored. Four months later TCEQ removed the vats and drums, and bromodichlormethane was found at "elevated levels." However, because they were below Texas PCLs it was designated for "No Further Action." It took another four years for the site to enter the Superfund process upon EPA concern regarding the Edwards Aquifer, which the site may impact.

The site has not been cleaned up even with groundwater still serving 76 people.

- **Coiling Technologies Inc.,** the manufacturing facility near Jersey Village that found elevated levels of chloroform found bromodichlormethane at levels above Superfund benchmarks. **These levels are higher than the expectations used in Oklahoma, Arkansas, and Mississippi by an order of magnitude.** Because bromodichloromethane was "not a target [chemical of concern]" this exceedance was not considered relevant, and **the site has not been cleaned up even with groundwater still serving 76 people.**

There are hundreds of other pollutants produced in Texas, and the state's processes for determining safe levels of exposure to them are similarly flawed. Communities across the state may have sites like the ones listed above, declared safe but still potentially polluted. Floods like those caused by Harvey or even conventional storms every year in many parts of the state threaten to carry these pollutants into waterways, onto sensitive land, and even into people's homes. Furthermore, as water resources become scarcer over time polluted groundwater reduces options for communities and property owners.

Texas needs to take action to strengthen its benchmarks as soon as possible.

Solutions

There are essentially two paths to rectifying these flawed benchmarks: legislation or rule-making. The Texas Legislature could consider and pass legislation that would establish new expectations for these benchmarks in Texas law. Even before then, however, TCEQ could open a rulemaking process to change the relevant equations and shift PCLs to more protective levels. The PCLs are laid out in Chapter 350 of Title 30 of the Texas Administrative Code, Subchapter D. TCEQ should begin exploring relevant improvements to these rules immediately.

Members of the Legislature are key to this process, as TCEQ officials are sensitive to their wishes. They could also support relevant legislation or even pursue both paths simultaneously, ensuring that state regulators understand the seriousness of this issue in light of recent disasters.

Within these two possible paths to change—rulemaking or legislation—we have identified two basic strategies for improving our protections. The simplest would be to adopt EPA Regional Screening Levels as the Tier 1 benchmarks for the Texas Risk Reduction Program, as Oklahoma and Arkansas have already done.

The second strategy would be to maintain Texas' independent PCL benchmarks but to adjust the equations in the ways outlined earlier in this report, adopting for each figure the most protective estimates used by neighboring states:

- **Set Risk Levels for carcinogens similar to those used by neighboring states--one in a million as opposed to one in 100,000 (10^{-6}, not 10^{-5})**
- **Hazard Quotients should be set at 0.1**
- **Child ingestion rates for soil should be set at 200 mg/day, the figure used in Louisiana, Mississippi, Arkansas, and Oklahoma**
- **Child ingestion rate for water of 1 L/day, the figure used in Louisiana**
- **Adult ingestion rate for water of 2.5 L/day, used in Mississippi, Oklahoma, and Arkansas**
- **Age-adjusted ingestion rate for water of 1.1 L/day, the figure used in Louisiana**
- **Child dermal surface area of 2800 cm^2, used in Louisiana**
- **Worker dermal surface area of 3527 cm^2, the figure used in Oklahoma and Arkansas**
- **Adult dermal surface area of 6032 cm^2, used in New Mexico, Oklahoma, and Arkansas**

This would give Texas the opportunity to maintain its independence while ensuring that our communities are safe.

Cleaning up polluted sites is a waste of energy and resources if they are still polluted and dangerous when we are done with them.

Conclusion

The combination of robust industry and increasingly serious disasters poses serious threats to the long-term health of Texans. We don't have to accept this, however, if we are willing to clean up the messes our good fortune has left behind.

Cleaning up polluted sites is a waste of energy and resources if they are still polluted and dangerous when we are done with them. We need standards that reflect the value we put on the lives of our loved ones and the land and water of Texas.

The good news is that there are specific changes we can make and clear paths for adopting them--if only there is the will to do so. Other states such as Louisiana, Mississippi, Oklahoma, and Arkansas have found it possible to adopt higher expectations and still have strong industries, and while there are plenty of polluted sites still in those places, Texas can learn from them and do better.

We urge our elected and appointed officials to take this step up and to lead before it is once again too late.

6.

Appendix I: Glossary of Terms

Acetone: A colorless, volatile, flammable organic solvent produced during oil and gas refining. It is an irritant and inhalation may lead to liver damage.[40]

Adherence factor: The amount of solid material that adheres to the skin per unit of surface area (usually square centimeters).[41] Used as a factor in calculating dermal (skin) exposure PCLs and similar benchmarks from other agencies.

Agency for Toxic Substance and Disease Registry (ATSDR): A federal public health agency within the Centers for Disease Control which responds to and protects people from harmful chemical exposures.[42] (https://www.atsdr.cdc.gov/)

Arsenic: A naturally occurring element with organic and inorganic forms. Inorganic arsenic compounds are mainly used to preserve wood. Copper chromated arsenic (CCA) is used to make "pressure-treated" lumber. Organic arsenic compounds are used as pesticides, primarily on cotton plants. Some organic arsenic compounds are used as additives in animal feed. Arsenic is a fatal toxin in large doses, and chronic exposure can cause fatigue, abnormal heart rhythm, blood-vessel damage resulting in bruising, and impaired nerve function, as well as cancer.[43]

Averaging Time: The period over which exposure to a pollutant is averaged, usually an estimation of a lifetime in years so that the final benchmark represents a concentration safe for regular exposure over the course of a person's lifetime.

Benzene: A toxic, volatile, flammable liquid hydrocarbon byproduct of coal distillation. Benzene is used as an industrial solvent in paints, varnishes, lacquer thinners, gasoline, etc. Benzene causes central nervous system damage acutely and bone marrow damage chronically and is carcinogenic. It was formerly used as parasiticide.[44]

Benzo(a)pyrene: A crystalline, aromatic hydrocarbon found in gasoline and diesel exhaust, cigarette smoke, coal tar and coal tar pitch, charcoal-broiled foods and certain other foods, amino acids, fatty acids and carbohydrate pyrolysis products, soot smoke, creosote oil, petroleum asphalt and shale oils. It is a potent mutagen and carcinogen.[45]

Bromodichloromethane: A colorless, liquid halogenated hydrocarbon used in the synthesis of chemicals lso found as a by-product in chlorinated water. It is reasonably anticipated to be a human carcinogen.[46]

Brownfield: A property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant. EPA's Brownfields Program provides grants to support revitalization efforts by funding environmental assessment, cleanup, and job training activities.[47]

Carcinogen: A chemical of concern which causes an increased incidence of cancer, or substantially decreases the time to develop cancer, in animals or humans.[48]

CERCLA: The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly known as Superfund. This law created a tax on the chemical and petroleum industries and provided broad Federal authority to respond directly to releases or threatened releases of hazardous substances that may endanger public health or the environment. It also provided for liability of persons responsible for releases of hazardous waste at these sites. The tax expired in 1995 and the program's trust fund ran out of money in 2006.[49]

Chloroform: A colorless, volatile, liquid with an ether-like odor. Formerly used as an inhaled anesthetic during surgery, the primary use of chloroform today is in industry, where it is used as a solvent and in the production of the refrigerant freon. Acute chloroform toxicity results in impaired liver function, cardiac arrhythmia, nausea and central nervous system dysfunction. As a byproduct of water chlorination, chloroform may be present in small amounts in chlorinated water.[50]

Class 3 Groundwater: Class 3 groundwater resources are not considered usable as drinking water and are not subject to groundwater ingestion PCLs.[51]

Chemical of Concern (COC): Any chemical that has the potential to adversely affect the environment or human health due to its concentration, distribution, and mode of toxicity and suspected to be present at a particular polluted site.[52]

Combined Soil PCL: TCEQ's benchmark that combines the benchmarks for ingestion, dermal contact, inhalation of volatile and particulate emissions, and ingestion of aboveground and below-ground vegetables with chemicals of concern in soil.

Composite Worker Air: EPA's air pollution benchmark based on protecting a full-time employee working on-site who spends most of the workday conducting maintenance activities indoors. The composite worker is assumed to be exposed to contaminants by inhaling ambient air.[53]

Composite Worker Soil: A soil pollution benchmark based on protecting a a full-time employee working on-site where the soil is polluted and who spends most of the workday conducting maintenance activities outdoors. The activities for this worker (e.g., moderate digging, landscaping) typically involve on-site exposure to surface soils. The composite worker is expected to have an elevated soil ingestion rate and is assumed to be exposed to contaminants through incidental ingestion of soil, skin contact with soil, inhalation of volatiles and fugitive dust.[54]

Denominator: The bottom number in a fraction which divides into the numerator (top number). Larger denominators make for smaller final figures.

Dermal Surface Area: The amount of skin an average person has exposed to environmental factors.

Dry Cleaner Remediation Program (DCRP): Part of the TRRP, DCRP establishes a prioritization list of dry cleaner sites and administers the Dry Cleaning Facility Release Fund to assist with remediation of contamination caused by dry cleaning solvents.[55] (https://www.tceq.texas.gov/remediation/dry_cleaners)

Exposure Duration: Length of time over which contact with a contaminant lasts[56] usually a lifetime, 24 to 30 years for adults, 6 years for children, or shorter periods for workers.

Hazard Ranking System: A scoring system used by EPA to assess the relative threat associated with actual or potential releases of hazardous substances at sites. The HRS is the primary way of determining whether a site is to be included on the Superfund National Priorities List (NPL).[57]

Health Effects Assessment Summary Tables (HEAST): An EPA document annually updated to provide the most current comprehensive listing of provisional risk assessment information relative to oral and inhalation routes of exposure for chemicals.[58]

Hexavalent Chromium: Also written as Chromium (VI), it is usually produced by an industrial process, and is known to cause cancer. In addition, it targets the respiratory system, kidneys, liver, skin and eyes. Chromium metal is added to alloy steel to increase hardenability and corrosion resistance. Hexavalent chromium compounds may be used as pigments in dyes, paints, inks, and plastics. It also may be used as an anticorrosive agent added to paints, primers, and other surface coatings. The Chromium (VI) compound chromic acid is used to electroplate chromium onto metal parts to provide a decorative or protective coating.[59]

Industrial/Commercial Soil: TCEQ's benchmarks for soil at property with an Industrial/Commercial land use designation from TCEQ. TCEQ defines this land use as:

"Any real property or portions of a property not used for human habitation or for other purposes with a similar potential for human exposure as defined for residential land. Examples of commercial/industrial land use include manufacturing; industrial research and development; utilities; commercial warehouse operations; lumber yards; retail gas stations; auto service stations; auto dealerships; equipment repair and service stations; professional offices (lawyers, architects, engineers, real estate, insurance, etc.); medical/dental offices and clinics (not including hospitals); financial institutions; office buildings; any retail business whose principal activity is the sale of food or merchandise; personal service establishments (health clubs, barber/beauty salons, mortuaries, photographic studios, etc.); churches (not including churches providing day care or school services other than during normal worship services); motels/hotels (not including those which allow residence); agricultural lands; and portions of government-owned land (local, state, or federal) that have commercial/industrial activities occurring."[60]

Industrial Hazardous Waste Corrective Action Program (IHWCAP): Part of the TRRP, IHWCAP administers the cleanup of sites contaminated from industrial and municipal hazardous and industrial nonhazardous wastes. Sites with pollution not caused by these regulated forms of waste go into other programs.[61] (https://www.tceq.texas.gov/remediation/corrective_action/ihwca.html)

Ingestion Rate: The rate at which a chemical is consumed orally, either intentionally through drinking contaminated water and eating contaminated foods, or incidentally through dust or volatile chemicals getting into a person's mouth.

Innocent Owner/Operator Program (IOP): Part of the TRRP, a program for owners or operators of properties contaminated as a result of a release or migration of contaminants from a source or sources not located on the property, and who did not cause or contribute to the source or sources of contamination.[62] (https://www.tceq.texas.gov/remediation/iop/iop.html)

Integrated Risk Information System (IRIS): EPA's program for identifying and characterizing chemicals found in the environment, the agency's preferred source of toxicity information. The main source for reference doses and slope factors.[63] (https://www.epa.gov/iris)

Louisiana Department of Environmental Quality (LDEQ): Louisiana's state environmental agency. (http://deq.louisiana.gov/)

Management Options: Tiers of benchmarks used by RECAP to manage "areas of concern." Management Option 1 is typically equal to the Screening Standard, and they likewise represent constituent concentrations in soil or water that are protective of human health and the environment. Management Option 2 provides for the development of soil and groundwater benchmarks using site-specific data. Management Option 3 also provides for the development of site-specific benchmarks, but in general requires additional site evaluation, a more extensive exposure assessment, and the application of more sophisticated models.[64]

Maximum Contaminant Level (MCL): The highest level of a contaminant that is allowed in drinking water under the federal Safe Drinking Water Act.

Maximum Contaminant Level Goal (MCLG): The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety and are non-enforceable public health goals.[65] For many chemicals the MCLG is set at zero.

Mississippi Department of Environmental Quality (MDEQ): Mississippi's state environmental agency. (https://www.mdeq.ms.gov/)

Mississippi Brownfields Voluntary Cleanup and Redevelopment Program: MDEQ's main remediation program.

Mutagen: A chemical or other substance which can cause genetic mutation, which may result in birth irregularities or congenital health problems.

National Center for Environmental Assessment (NCEA): EPA's national resource center for human health and ecological risk assessment. NCEA conducts risk assessments, carries out research to improve the state-of-the-science of risk assessment, and provides guidance and support to risk assessors. IRIS is maintained by NCEA.[66] (https://www.epa.gov/aboutepa/about-national-center-environmental-assessment-ncea)

National Priority List (NPL): The list of sites of national priority among the known releases or threatened releases of hazardous substances, pollutants, or contaminants throughout the United States and its territories.[67] The term "Superfund site" usually refers to a site on the NPL.

New Mexico Environment Department (NMED): New Mexico's state environmental agency. (https://www.env.nm.gov/)

No Further Action (NFA): The TCEQ designation when all necessary response actions at an affected property have been taken,[68] there was no release of pollution in the first place, or no remedy is needed because any pollution is present at concentrations less than the critical PCLs.[69]

Numerator: The top number in a fraction, the number the divided into the numerator (the top number). Larger numerators make for larger final figures.

Petroleum Storage Tank (PST) Responsible Party Lead: Part of the TRRP, this program supervises the cleanup of spills from regulated storage tanks led by the parties responsible for the spill. The program records and evaluates all reported incidents of releases of petroleum and other hazardous substances from underground and above-ground storage tanks.[70] (https://www.tceq.texas.gov/remediation/pst_rp)

Petroleum Storage Tank (PST) State Lead: Same as PST Responsible Party Lead, but used when responsible parties (RPs) are either unwilling or financially unable to conduct the necessary corrective actions at LPST sites. Its primary source of funding is the PST Remediation Fund.[71] (https://www.tceq.texas.gov/remediation/pst_sl)

Polyaromatic Hydrocarbons (PAHs): A group of over 100 different chemicals formed during the incomplete burning of coal, oil and gas, garbage, or other organic substances like tobacco or charbroiled meat. PAHs are found in coal tar, crude oil, creosote, and roofing tar, and some are manufactured for use in medicines or to make dyes, plastics, and pesticides. Many PAHs are carcinogens, and they may be associated with reproductive health problems including birth irregularities.[72]

Preliminary Remediation Goals (PRGs): As part of the Superfund remediation process, PRGs provide remedial design staff with long-term targets to use during analysis and selection of remediation alternatives. Ultimately they should help the site comply with applicable or relevant and appropriate requirements (ARARs), concentration limits set by other environmental regulations, or with risk assessments, often involving the use of Regional Screening Levels.[73]

Protective Concentration Levels (PCLs): The primary pollution benchmark used by the Texas Risk Reduction Program, set by rule by the Texas Commission on Environmental Quality. They define it as:

"The concentration of a chemical of concern which can remain within the source medium (soil or groundwater) and not result in levels which exceed the applicable human health risk-based exposure limit or ecological protective concentration level at the point of exposure for that exposure pathway."[74]

Essentially the concentration not believed to cause risks to human health or the environment.

Provisional Peer Reviewed Toxicity Values (PPRTVs): The second tier of human health toxicity values for the EPA Superfund and Resource Conservation and Recovery Act (RCRA) hazardous waste programs (second to EPA's Integrated Risk Information System [IRIS]). PPRTVs have been developed specifically for EPA's Superfund program and have not undergone the multi-program review and consensus required for toxicity values to be placed in IRIS.[75]

RECAP: See Risk Evaluation/Corrective Action Program (RECAP).

Reference Concentration (RfC): a scientifically-calculated estimate of how much of a chemical the human population (including sensitive subgroups) can be continually exposed to that is likely to be without a significant risk of negative health effects during a lifetime.[76]

Regional Screening Levels (RSLs): An EPA benchmark which provides comparison values for residential and commercial/industrial exposures to soil, air, and tapwater (drinking water). RSLs are calculated using the latest toxicity values, default exposure assumptions and physical and chemical properties.[77]

Resident Air: EPA's air pollution benchmark based on protecting a person who spends most, if not all, of the day at home. Their activities involve typical home making chores (cooking, cleaning and laundering) as well as outdoor activities. The resident is assumed to be exposed to contaminants through breathing ambient air.

Resident Soil: Same as resident air, but considers exposure through incidental ingestion of soil, skin contact with soil, inhalation of volatiles and fugitive dust.

Resident Soil to Groundwater: An EPA benchmark for concentrations in soil that have the potential to contaminate groundwater above risk based screening levels or MCLs.[78]

Resident Tapwater: EPA's water pollution benchmark for chemicals in water that are delivered into a residence from sources such as groundwater or surface water. Activities such as showering, laundering, and dish washing are taken into account in calculating this benchmark.[79]

Residential Soil: TCEQ's benchmarks for soil at a site designated for residential land use. TCEQ defines this land use as "Property used for dwellings such as single family houses and multi-family apartments, children's homes, nursing homes, and residential portions of government-owned lands (local, state, or federal). Because of the similarity of exposure potential and the sensitive nature of the potentially exposed population, day care facilities, educational facilities, hospitals, and parks (local, state, or federal) shall also be considered residential."[80]

Resource Conservation and Recovery Act (RCRA): A federal law granting EPA the authority to control hazardous waste from the "cradle-to-grave." This includes the generation, transportation, treatment, storage, and disposal of hazardous waste. RCRA also set forth a framework for the management of non-hazardous solid wastes.[81] It also includes a federal remediation program.

Restricted/Unrestricted: MDEQ's designations for industrial (restricted) and residential (unrestricted) land uses.[82]

Risk Evaluation/Corrective Action Program (RECAP): LDEQ's program for for cleanup activities and addressing risks to human health and the environment posed by the release of chemical constituents to the environment.[83] (http://deq.louisiana.gov/page/recap)

Risk Level: The probability of developing cancer or other tumors due to continuous lifetime exposure to a single carcinogen. This term is used by TCEQ; other agencies sometimes use "Target Risk"

Screening Levels (SLs): See Regional Screening Levels (RSLs)

Screening Standard: LDEQ's benchmark for pollution concentrations that are protective of human health and the environment.[84] The primary benchmark used for RECAP, and analogous to TCEQ PCLs.

Slope Factor: An estimate of the increased cancer risk from oral exposure to a dose of 1 mg/kg-day for a lifetime.[85]

Source Area: The the portion of an environmental medium (soil or groundwater) with pollution concentrations that are leaching, dissolving or emitting to a point where it can be exposed to people or the environment. Tier 1 soil PCLs are calculated for 0.5-acre and 30-acre source area sizes. If other factors are held constant, the larger the source area, the higher the pollution concentration that is delivered to those exposed.[86]

State Cleanup Program: NMED's non-voluntary remediation program, it administers those portions of New Mexico law that require the cleanup of contaminated soil, soil vapor, and groundwater to protect human health and the environment. The regulations require corrective actions to mitigate any damage caused by an unauthorized discharge, and investigation and abatement of subsurface contamination in order to attain groundwater standards.[87] (https://www.env.nm.gov/gwqb/ros-scp/)

State Superfund (SSF): Texas equivalent of the federal Superfund program and part of the TRRP, it addresses facilities that may constitute an imminent and substantial endangerment to public health and safety or the environment due to a release or threatened release of hazardous substances.[88] Most states do not have state Superfunds, and Texas is the only state examined in this report with one. (https://www.tceq.texas.gov/remediation/superfund/statesf)

Superfund: See CERCLA, but often refers in particular to its long-term remedial response actions, that permanently and significantly reduce the dangers associated with releases or threats of releases of hazardous substances that are serious, but not immediately life threatening. These actions can be conducted only at sites listed on EPA's National Priorities List.[89]

Superfund Chemical Data Matrix (SCDM): A source for factor values and screening concentration benchmarks used to evaluate potential National Priorities List (NPL) sites with the Hazard Ranking System (HRS). As a screening tool, the HRS and SCDM are used for quickly assessing sites at the screening stage and data used to perform this task may not be applicable for other site specific purposes.[90]

Superfund Site Discovery and Assessment Program (SSDAP): TCEQ's program for evaluating facilities for potential remediation under the state Superfund program. Immediate response actions may be taken during the evaluation process to protect human health and the environment, if warranted.[91]

Target Remediation Goals: MDEQ's benchmark pollution concentrations which have been determined to be protective of human health and the environment for restricted use and unrestricted use of a site.[92]

Target Risk: See "Risk Level."

Texas Commission on Environmental Quality (TCEQ): The state environmental agency for Texas, which "strives to protect our state's public health and natural resources consistent with sustainable economic development."[93] (https://www.tceq.texas.gov/)

Texas Risk Reduction Program (TRRP): A comprehensive program that addresses the investigation of contaminated sites, establishes reasonable standards for notice, provides flexibility in calculating site-specific cleanup levels, and sets forth appropriate response actions to address the environmental contamination. The program is charged with providing "a consistent corrective action process directed toward protection of human health and the environment balanced with the economic welfare of the citizens of this state."[94] (https://www.tceq.texas.gov/remediation/trrp/trrp.html)

Tier 1, 2, 3 PCLs: Tier 1 PCLs are established using equations and input parameters set in the rule resulting in non-unique or "generic" PCLs for each pollutant for each exposure pathway. Tier 2 PCLs are established using equations set in rule and guidance, but allow for use of site-specific input parameters. Tier 3 covers any evaluation method that deviates from the prescribed requirements of Tiers 1 and 2, and allows user-defined PCL equations and input variables. Tier 3 provides the greatest amount of site specific considerations, and accommodates both equivalent and higher degrees of sophistication. Therefore, the PCL values are likely to be higher numeric values under Tier 3 than those established under Tier 1 or 2.[95]

TNRCC: The Texas Natural Resources Conservation Commission, the immediate predecessor to TCEQ.

Toxic Hazard Quotient (THQ): The ratio of the level of exposure to a non-carcinogenic chemical to the reference dose for the same chemical over a similar period of time. A THQ of 1 is therefore equivalent to the reference dose, THQs higher than 1 pose greater risks to human health, and those below 1 are more protective.

TWC: The Texas Water Commission, a predecessor agency to TNRCC and thus to TCEQ.

Remedy Standard A: Under TRRP, a pollution cleanup remedy in which all surface and subsurface soil, groundwater, and other environmental media must be removed and/or decontaminated to yield ollution concentrations less than applicable PCLs. Physical controls are not allowed as a response action under Remedy Standard A.[96]

Remedy Standard B: Under TRRP, a cleanup remedy which allows physical control measures to prevent exposure to pollution at concentrations above the PCLs in addition to removal and/or decontaminationare allowed. At any point where exposure is expected, however, concentrations must be below PCLs.[97]

Volatilization: The process of converting a chemical substance from a liquid or solid state to a gaseous or vapor state.[98]

Voluntary Cleanup Program (VCP): Part of the TRRP, VCP provides administrative, technical, and legal incentives to encourage the cleanup of contaminated sites in Texas. Since all non-responsible parties, including future lenders and landowners, receive protection from liability to the state of Texas for cleanup of sites under the VCP, most of the constraints for completing real estate transactions at those sites are eliminated once a VCP certificate of completion is issued.[99] (https://www.tceq.texas.gov/remediation/vcp/vcp.html)

Voluntary Remediation Program: NMED's primary remediation program, it provides incentives for the voluntary remediation of contaminated properties and encourages their redevelopment. Participants who successfully complete the program receive site closure documentation from NMED and liability protection for lenders and future purchasers.[100] (https://www.env.nm.gov/gwqb/ros-vrp/)

Appendix II: Data Tables and Benchmark Comparisons

Texas Campaign for the Environment Fund has examined the benchmarks for more than 80 pollutants with similar types of guidelines at the federal level or in other states. The following tables include the data inputs referenced throughout this report. Some tables provide raw benchmark data in ml/L or mg/Kg while others compare one set of benchmarks with another. Use this page as a guide to the following seven data tables on pages 32-38.

Groundwater Benchmark Tables

Appendix II Table 1: GROUNDWATER BENCHMARKS (ml/L)

Appendix II Table 2: GROUNDWATER BENCHMARKS COMPARISON

Appendix II Table 3: GROUNDWATER BENCHMARKS COMPARISON ANALYSIS

Soil Benchmark Tables

Appendix II Table 4: SOIL BENCHMARKS (mg/Kg)

Appendix II Table 5: SOIL BENCHMARKS COMPARISON

Appendix II Table 6: SOIL BENCHMARKS COMPARISON ANALYSIS

Soil to Groundwater Comparison Table

Appendix II Table 7: SOIL TO GROUNDWATER BENCHMARKS COMPARISON (ml/L)

Appendix II Table 1: GROUNDWATER BENCHMARKS (ml/L)	TCEQ Strictest PCL	Category	EPA SCDM Carcinogenic	EPA SCDM Non-Carcinogenic	EPA Maximum Contaminant Level	EPA Maximum Contaminant Level Goal	EPA Regional Screening Level (RSL)	Louisiana DEQ Screening Standard (SS)	Louisiana DEQ Mgmt Option 1 (MO1)	New Mexico ED Tap Water Screening Level	Mississippi DEQ Target Remediation Goal (TRG)
Acetone	22.0000000	Ing Non Carc		10.0000000			1.4000000	0.1000000	0.6100000	14.1000000	0.6080000
Acrylamide	0.0018000	Ing Carc	0.0000500	0.0400000		0.0000000	0.0000500				0.0000149
Alachlor	0.0020000	Ing Carc	0.0013000	0.2000000	0.0020000	0.0000000	0.0011000			0.0001370	0.0020000
Aldrin	0.0000540	Ing Carc	0.0000045	0.0006000			0.0000009	0.0019000	0.0019000	0.0000020	0.0000039
Aniline	0.1600000	Ing Carc	0.0130000	0.1000000			0.0130000	0.0120000	0.0120000		0.0117000
Anthracene	7.3000000	Ing Non Carc	6.0000000	6.0000000			1.8000000	0.0430000	1.8000000	1.7200000	0.0434000
Antimony	0.0060000	Ing Non Carc		0.0060000	0.0060000	0.0060000	0.0007800	0.0060000	0.0060000	0.0072600	0.0060000
Arsenic	0.0061000	Ing Carc	0.0000510	0.0060000	0.0100000	0.0000000	0.0000520	0.0100000	0.0100000	0.0008550	0.0500000
Atrazine	0.0030000	Ing Carc	0.0003300	0.7000000	0.0030000	0.0030000	0.0003000			0.0033900	0.0030000
Azinphos-methyl (guthion)	0.0370000	Ing Non Carc					0.0056000				0.0000000
Barium	2.0000000	Ing Non Carc		2.0000000	2.0000000	2.0000000	0.3800000	2.0000000	2.0000000	3.2800000	2.0000000
Benz-a-anthracene	0.0091000	Ing Carc	0.0002000				0.0000300	0.0078000	0.0078000	0.0001200	0.0000917
Benzene	0.0050000	Ing Carc	0.0014000	0.0800000	0.0050000	0.0000000	0.0004600	0.0050000	0.0050000	0.0045500	0.0050000
Benzidine	0.0000040	Ing Carc	0.0000001	0.0600000			0.0000001			0.0000011	0.0000003
Benzo-a-pyrene	0.0002000	Ing Carc	0.0000200	0.0060000	0.0002000	0.0000000	0.0000250	0.0002000	0.0002000	0.0002510	0.0002000
Benzo-k-fluoranthene	0.0910000	Ing Carc	0.0020000				0.0025000	0.0025000	0.0025000	0.0034300	0.0009170
Bis (2-ethyl-hexyl) phthalate	0.0060000	Ing Carc	0.0055000	0.4000000			0.0056000	0.0060000	0.0060000	0.0556000	0.0060000
Bromodichloromethane	0.0150000	Ing Carc	0.0012000	0.4000000		0.0000000	0.0001300	0.1000000	0.1000000	0.0013400	0.0001680
Cadmium	0.0050000	Ing Non Carc	0.0100000	0.0100000	0.0050000	0.0050000	0.0009200	0.0050000	0.0050000	0.0062400	0.0050000
Carbaryl	2.4000000	Ing Non Carc					0.1800000				3.6500000
Carbon tetrachloride	0.0050000	Ing Carc	0.0010000	0.0800000	0.0050000	0.0000000	0.0004600	0.0050000	0.0050000	0.0045500	0.0050000
Chlordane (technical)	0.0020000	Ing Carc	0.0002200	0.0100000	0.0020000	0.0000000	0.0000200	0.0020000	0.0020000	0.0004480	0.0020000
Chlordane, cis- (alpha chlordane)	0.0026000	Ing Carc	0.0002200	0.0100000							
Chlordane, trans- (gamma chordane)	0.0026000	Ing Carc	0.0002200	0.0100000							
Chloroform	0.2400000	Ing Carc	0.0025000	0.2000000		0.0700000	0.0002200	0.1000000	0.1000000	0.0022900	0.0001550
Chlorothalonil (carc)	0.0830000	Ing Carc					0.0220000				0.0000000
Chromium (VI)	0.0760000	Ing Non Carc	0.0000500	0.0600000	0.1000000	0.1000000	0.0000350	0.1000000	0.1000000	0.0005010	0.1000000
Chrysene	0.9100000	Ing Carc	0.0200000				0.0250000	0.0016000	0.0091000	0.0343000	0.0091700
Cumene	2.4000000	Ing Non Carc		2.0000000			0.0450000			0.4470000	0.6790000
Cyanide	0.2000000	Ing Non Carc		0.0100000	0.2000000	0.2000000	0.0015000	0.2000000	0.2000000	0.0014600	0.2000000
DDD	0.0001659	Ing Carc	0.0003200				0.0000320	0.0002800	0.0002800	0.0003170	0.0002790
DDE	0.0027000	Ing Carc	0.0002200				0.0000460	0.0002000	0.0002000	0.0004620	0.0001970
DDT	0.0027000	Ing Carc	0.0002200	0.0100000			0.0002300	0.0003000	0.0003000	0.0022900	0.0001970
Diazinon	0.0220000	Ing Non Carc					0.0010000				0.0329000
Dibenz-a,h-anthracene	0.0002000	Ing Carc	0.0000200				0.0000250	0.0025000	0.0025000	0.0000343	0.0000092
Dibenzofuran	0.0980000	Ing Non Carc		0.0200000			0.0007900	0.0100000	0.0240000		0.0243000
Dibromo-3-chloropropane, 1,2-	0.0002000	Ing Carc	0.0000300	0.0040000	0.0002000	0.0000000	0.0000003	0.0002000	0.0002000	0.0000033	0.0002000
Dichlorobenzene, 1,4-	0.0380000	Ing Carc	0.0140000	1.0000000	0.0750000	0.0750000	0.0300000	0.0750000	0.0750000	0.0048200	0.0750000
Dichloroethane, 1,2-	0.0050000	Ing Carc	0.0008500	0.1000000	0.0050000	0.0000000	0.0001700	0.0050000	0.0050000	0.0017100	0.0050000
Dichloropropane, 1,2-	0.0050000	Ing Carc	0.0021000	0.8000000	0.0050000	0.0000000	0.0008500	0.0050000	0.0050000	0.0043800	0.0050000
Dichloropropene, 1,3- (mixed isomers)	0.0091000	Ing Carc	0.0007000	0.6000000			0.0004700	0.0050000	0.0050000	0.0047100	0.0000842
Dieldrin	0.0000570	Ing Carc	0.0000048	0.0010000			0.0000018	0.0025000	0.0025000	0.0000175	0.0000042
Dimethoate	0.0049000	Ing Non Carc					0.0044000				0.0000000
Dioxane 1,4-	0.0091000	Ing Carc	0.0007000	0.6000000			0.0004600			0.0045900	0.0060900
Diphenylamine	0.6100000	Ing Non Carc					0.1300000				0.9130000
Diphenylhydrazine, 1,2-	0.0011000	Ing Carc	0.0000900				0.0000780			0.0007800	0.0000837
Fluoranthene (Benzo(j,k) fluorene)	0.9800000	Ing Non Carc	0.8000000	0.8000000			0.0800000	0.1500000	1.5000000	0.8020000	1.4600000
Fluorene	0.9800000	Ing Non Carc	0.8000000	0.8000000			0.0290000	0.0240000	0.2400000	0.2880000	0.2430000
Glyphosate	0.7000000	Ing Non Carc			0.7000000	0.7000000	0.2000000			2.0100000	0.0000000
Heptachlor epoxide	0.0001000	Ing Carc	0.0000085	0.0002600	0.0002000	0.0000000	0.0000014	0.0002000	0.0002000		0.0002000
Hexachlorobenzene	0.0005700	Ing Carc	0.0000480	0.0100000	0.0010000	0.0000000	0.0000098	0.0010000	0.0010000	0.0000976	0.0010000
Hexachlorobutadiene	0.0120000	Ing Carc	0.0009900	0.0200000			0.0001400	0.0007300	0.0008500	0.0013900	0.0008590
Hexachlorocyclohexane, alpha (alpha-BHC)	0.0001400	Ing Carc	0.0000120	0.1000000			0.0000072	0.0000300	0.0000300		
Hexachlorocyclohexane, gamma (lindane; gamma-BHC)	0.0002000	Ing Carc	0.0000700	0.0060000	0.0002000	0.0002000	0.0000420	0.0002000	0.0002000		
Hexachloroethane	0.0170000	Ing Non Carc	0.0010000	0.0100000			0.0003300	0.0100000	0.0100000	0.0032800	0.0047800
Hydrazine	0.0003000	Ing Carc	0.0000200	0.0100000							0.0000223
Malathion	0.4900000	Ing Non Carc					0.0390000				0.7300000
Mercury (pH = 6.8)	0.0020000	Ing Non Carc		0.0020000	0.0020000	0.0020000	0.0000630	0.0020000	0.0020000	0.0019600	0.0020000
Mercury (pH = 4.9)	0.0020000	Ing Non Carc		0.0020000	0.0020000	0.0020000	0.0000630	0.0020000	0.0020000	0.0019600	0.0020000
Methoxychlor	0.0400000	Ing Non Carc		0.0400000	0.0400000	0.0400000	0.0037000	0.0400000	0.0400000		0.0400000
Methyl parathion	0.0061000	Ing Non Carc		0.0050000			0.0004500			0.1060000	0.0091300
Methylene chloride (dichloromethane)	0.0050000	Ing Non Carc	0.0100000	0.1000000	0.0050000	0.0000000	0.0110000	0.0050000	0.0050000	0.1180000	0.0050000
MTBE (methyl tert-butyl ether)	0.2400000	Ing Non Carc	0.0430000				0.0140000	0.0200000	0.0200000	0.1430000	0.0400000
Naphthalene	0.4900000	Ing Non Carc	0.4000000	0.4000000			0.0001700	0.0100000	0.0100000	0.0016500	0.0062000
Nickel and compounds	0.4900000	Ing Non Carc	0.4000000	0.4000000			0.0220000	0.0730000	0.7300000	0.3720000	0.7300000
Nitrosodiphenylamine	0.1900000	Ing Carc	0.0150000				0.0120000	0.0140000	0.0140000	0.1220000	0.0137000
Pentachlorophenol (PCP)	0.0023000	Ing Carc	0.0001000	0.1000000	0.0010000	0.0000000	0.0000410	0.0010000	0.0010000	0.0004130	0.0010000
Phenanthrene	0.7300000	Ing Non Carc						0.1800000	1.8000000	0.1700000	1.1000000
Polychlorinated biphenyls (PCBs)	0.0004600	Ing Carc	0.0000300	0.0004000	0.0005000	0.0000000	0.0000026	0.0005000	0.0005000		0.0005000
Pyrene	0.7300000	Ing Non Carc	0.6000000	0.6000000			0.0120000	0.0180000	0.1800000	0.1170000	0.1830000
Selenium	0.0500000	Ing Non Carc		0.0500000	0.0500000	0.0500000	0.0100000	0.0500000	0.0500000	0.0987000	0.0500000
Styrene	0.1000000	Ing Non Carc		0.1000000	0.1000000	0.1000000	0.1200000	0.1000000	0.1000000	1.2100000	0.1000000
Tetrachloroethane, 1,1,2,2-	0.0046000	Ing Carc	0.0003000	0.4000000			0.0000760	0.0005000	0.0005000	0.0007570	0.0000527
Tetrachloroethylene	0.0050000	Ing Carc	0.0370000	0.1000000	0.0050000	0.0000000	0.0110000	0.0050000	0.0050000		
Toxaphene	0.0008300	Ing Carc	0.0000700	0.0400000	0.0030000	0.0000000	0.0000710	0.0030000	0.0030000	1.0900000	0.0030000
Trichlorobenzene, 1,2,4-	0.0310000	Ing Carc	0.0026000	0.2000000	0.0700000	0.0700000	0.0012000	0.0700000	0.0700000	0.0115000	0.0700000
Trichloroethane, 1,1,2-	0.0050000	Ing Carc	0.0013000	0.0800000	0.0050000	0.0030000	0.0002800	0.0050000	0.0050000	8.0000000	0.0050000
Trichloroethylene	0.0050000	Ing Non Carc	0.0011000	0.0100000	0.0050000	0.0000000	0.0004900			0.0025900	
Trichlorophenol, 2,4,6-	0.0240000	Ing Non Carc	0.0070000	0.0200000			0.0041000	0.0100000	0.0100000	0.0411000	0.0060900
Trichloropropane, 1,2,3-	0.0000300	Ing Non Carc	0.0000008	0.0800000			0.0000008			0.0000084	0.0000062
Trifluralin	0.1200000	Ing Non Carc	0.0100000	0.1500000			0.0026000				
Vinyl chloride	0.0006100	Ing Non Carc	0.0000210	0.0600000	0.0020000	0.0000000	0.0000190	0.0020000	0.0020000	0.0003240	0.0020000

Appendix II Table 2: GROUNDWATER BENCHMARKS COMPARISON	TCEQ/EPA SCDM	TCEQ/EPA RSL	TCEQ/Louisana MO1	TCEQ/Louisana SS	TCEQ/Mississippi TRG	TCEQ/New Mexico SL	Average Disparity
Acetone	2.2000000	15.7142857	36.0655738	220.0000000	36.1842105	1.560283688	51.95405895
Acrylamide	36.0000000	36.0000000			120.8100000		64.27
Alachlor	1.5384615	1.8181818			1.0000000	14.59854015	4.738795875
Aldrin	12.0000000	58.6956522	0.0284211	0.0284211	13.7100000	27.27272727	18.62253692
Aniline	12.3076923	12.3076923	13.3333333	13.3333333	13.6752137		12.9914530
Anthracene	1.2166667	4.0555556	4.0555556	169.7674419	168.2000000	4.244186047	58.58990095
Antimony	1.0000000	7.6923077	1.0000000	1.0000000	1.0000000	0.826446281	2.086458997
Arsenic	119.6078431	117.3076923	0.6100000	0.6100000	0.1200000	7.134502924	40.89833972
Atrazine	9.0909091	10.0000000			1.0000000	0.8849557522	5.243966211
Azinphos-methyl (guthion)		6.6071429					6.6071429
Barium	1.0000000	5.2631579	1.0000000	1.0000000	1.0000000	0.6097560976	1.645485666
Benz-a-anthracene	45.5000000	303.3333333	1.1666667	1.1666667	99.2400000	75.83333333	87.70666666
Benzene	3.5714286	10.8695652	1.0000000	1.0000000	1.0000000	1.098901099	3.089982483
Benzidine	40.0000000	36.3636364			13.7500000	3.669724771	23.44584028
Benzo-a-pyrene	10.0000000	8.0000000	1.0000000	1.0000000	1.0000000	0.796812749	3.632802125
Benzo-k-fluoranthene	45.5000000	36.4000000	36.4000000	36.4000000	99.2400000	26.53061224	46.74510204
Bis (2-ethyl-hexyl) phthalate	1.0909091	1.0714286	1.0000000	1.0000000	1.0000000	0.1079136691	0.8783752282
Bromodichloromethane	12.5000000	115.3846154	0.1500000	0.1500000	89.2900000	11.19402985	38.11144088
Cadmium	0.5000000	5.4347826	1.0000000	1.0000000	1.0000000	0.8012820513	1.622677442
Carbaryl		13.3333333			0.6575342		6.99543375
Carbon tetrachloride	5.0000000	10.8695652	1.0000000	1.0000000	1.0000000	1.098901099	3.328077716
Chlordane (technical)	9.0909091	100.0000000	1.0000000	1.0000000	1.0000000	4.464285714	19.4258658
Chlordane, cis- (alpha chlordane)	11.8181818						11.81818182
Chlordane, trans- (gamma chordane)	11.8181818						11.81818182
Chloroform	96.0000000	1090.9090910	2.4000000	2.4000000	1548.3900000	104.8034934	474.1504307
Chlorothalonil (carc)		3.7727273					3.7727273
Chromium (VI)	1520.0000000	2171.4285710	0.7600000	0.7600000	0.7600000	151.6966068	640.900863
Chrysene	45.5000000	36.4000000	100.0000000	568.7500000	99.2400000	26.53061224	146.070102
Cumene	1.2000000	53.3333333			3.5346097	5.369127517	15.85926763
Cyanide	20.0000000	133.3333333	1.0000000	1.0000000	1.0000000	136.9863014	48.88660578
DDD	0.5184375	5.1843750	0.5925000	0.5925000	0.5946237	0.5233438486	1.3342967
DDE	12.2727273	58.6956522	13.5000000	13.5000000	13.7100000	5.844155844	19.58708921
DDT	12.2727273	11.7391304	9.0000000	9.0000000	13.7100000	1.179039301	9.483482834
Diazinon		22.0000000			0.6686930		11.3343465
Dibenz-a,h-anthracene	10.0000000	8.0000000	0.0800000	0.0800000	21.8100000	5.83090379	7.633483965
Dibenzofuran	4.9000000	124.0506329	4.0833333	9.8000000	4.0329218		29.3733776
Dibromo-3-chloropropane, 1,2-	6.6666667	606.0606061	1.0000000	1.0000000	1.0000000	59.88023952	112.6012521
Dichlorobenzene, 1,4-	2.7142857	1.2666667	0.5066667	0.5066667	0.5100000	7.883817427	2.231350524
Dichloroethane, 1,2-	5.8823529	29.4117647	1.0000000	1.0000000	1.0000000	2.923976608	6.869682368
Dichloropropane, 1,2-	2.3809524	5.8823529	1.0000000	1.0000000	1.0000000	1.141552511	2.067476302
Dichloropropene, 1,3- (mixed isomers)	13.0000000	19.3617021	1.8200000	1.8200000	108.0800000	1.932059448	24.33562693
Dieldrin	11.8750000	31.6666667	0.0228000	0.0228000	13.6000000	3.257142857	10.07406825
Dimethoate		1.1136364					1.1136364
Dioxane 1,4-	13.0000000	19.7826087			1.4900000	1.982570806	9.063794877
Diphenylamine		4.6923077			0.6681271		2.6802174
Diphenylhydrazine, 1,2-	12.2222222	14.1025641			13.1400000	1.41025641	10.21876068
Fluoranthene (Benzo(j,k) fluorene)	1.2250000	12.2500000	0.6533333	0.6533333	0.6700000	1.221945137	2.778935301
Fluorene	1.2250000	33.7931035	4.0833333	40.8333333	4.0300000	3.402777778	14.56125798
Glyphosate		3.5000000				0.3482587065	1.924129353
Heptachlor epoxide	11.7647059	71.4285714	0.5000000	0.5000000	0.5000000		16.93865546
Hexachlorobenzene	11.8750000	58.1632653	0.5700000	0.5700000	0.5700000	5.840163934	12.93140487
Hexachlorobutadiene	12.1212121	85.7142857	14.1176471	16.4383562	13.9700000	8.633093525	25.16576576
Hexachlorocyclohexane, alpha (alpha-BHC)	11.6666667	19.4444444	4.6666667	4.6666667			10.11111111
Hexachlorocyclohexane, gamma (lindane; gamma-BHC)	2.8571429	4.7619048	1.0000000	1.0000000			2.404761925
Hexachloroethane	17.0000000	51.5151515	1.7000000	1.7000000	3.5600000	5.182926829	13.44301306
Hydrazine	15.0000000				13.4500000		14.225
Malathion		12.5641026			0.6712329		6.61766775
Mercury (pH = 6.8)	1.0000000	31.7460317	1.0000000	1.0000000	1.0000000	1.020408163	6.127739977
Mercury (pH = 4.9)	1.0000000	31.7460317	1.0000000	1.0000000	1.0000000	1.020408163	6.127739977
Methoxychlor	1.0000000	10.8108108	1.0000000	1.0000000	1.0000000		2.96216216
Methyl parathion	1.2200000	13.5555556			0.6681271	0.05754716981	3.875307467
Methylene chloride (dichloromethane)	0.5000000	0.4545455	1.0000000	1.0000000	1.0000000	0.04237288136	0.6661530636
MTBE (methyl tert-butyl ether)	5.5813953	17.1428571	12.0000000	12.0000000	6.0000000	1.678321678	9.067095695
Naphthalene	1.2250000	2882.3529412	49.0000000	49.0000000	79.0322581	296.969697	559.5966494
Nickel and compounds	1.2250000	22.2727273	0.6712329	0.6712329	0.6700000	1.317204301	4.471232887
Nitrosodiphenylamine	12.6666667	15.8333333	13.5714286	13.5714286	13.8700000	1.557377049	11.84503903
Pentachlorophenol (PCP)	23.0000000	56.0975610	2.3000000	2.3000000	2.3000000	5.569007264	15.26109471
Phenanthrene			0.4055556	0.4055556	0.6636364	4.294117647	1.442216312
Polychlorinated biphenyls (PCBs)	15.3333333	176.9230769	0.9200000	0.9200000	0.9200000		39.00328205
Pyrene	1.2166667	60.8333333	4.0555556	40.5555556	3.9900000	6.239316239	19.4817379
Selenium	1.0000000	5.0000000	1.0000000	1.0000000	1.0000000	0.506585613	1.584430935
Styrene	1.0000000	0.8333333	1.0000000	1.0000000	1.0000000	0.0826446281	0.8193296547
Tetrachloroethane, 1,1,2,2-	15.3333333	60.5263158	9.2000000	9.2000000	87.2900000	6.07661823	31.27104456
Tetrachloroethylene	0.1351351	0.4545455	1.0000000	1.0000000			0.64742015
Toxaphene	11.8571429	11.6901409	0.2766667	0.2766667	0.2800000	0.0007614678899	4.063563085
Trichlorobenzene, 1,2,4-	11.9230769	25.8333333	0.4428571	0.4428571	0.4400000	2.695652174	6.962962785
Trichloroethane, 1,1,2-	3.8461538	17.8571429	1.0000000	1.0000000	1.0000000	0.000625	4.117320283
Trichloroethylene	4.5454545	10.2040816				1.930501931	5.560012677
Trichlorophenol, 2,4,6-	3.4285714	5.8536585	2.4000000	2.4000000	3.9400000	0.5839416058	3.101028595
Trichloropropane, 1,2,3-	36.1445783	40.0000000			4.8200000	3.592814371	21.13934817
Trifluralin	12.0000000	46.1538462					29.07692308
Vinyl chloride	29.0476191	32.1052632	0.3050000	0.3050000	0.3100000	1.882716049	10.65926638

Appendix II Table 3: GROUNDWATER BENCHMARKS COMPARISON ANALYSIS	TCEQ/EPA SCDM	TCEQ/EPA RSL	TCEQ/Louisana MO1	TCEQ/Louisiana SS	TCEQ/Mississippi TRG	TCEQ/New Mexico SL	Average Disparity
Averages	34.77660763	121.491102	7.506550929	22.50127907	40.1021317	17.34055221	38.21187639
Average Without Chromium (VI), Naphlthalene, and Chloroform	12.995667	44.42153804			17.92748666	8.841431181	
Median	10	19.44444444	1	1	1	2.695652174	
Median Without MCLs	12	20.89130435	4.055555556	6.833333334	13.45	3.669724771	
Non-Carcinogenic Average	78.21766667	203.1896554	5.938603861	28.49718172	12.56405403	30.92874502	
Non-C Average Without Chromium (VI) and Naphthalene	2.334385967	24.44341689				9.439366478	
Non-Carcinogenic Median	1.216666684	12.94871795	1	1	1	1.269574719	
Non-C Median Without Chromium (VI) and Naphthalene	1.216666667	12.4070513				1.12117665	
Carcinogenic Average	18.38375517	74.25481578	8.233160546	19.72269004	55.06847826	10.8699842	
Carcinogenic Average Without Chloroform		53.92173028			21.88355556	8.578923002	
Carcinogenic Median	11.875	29.4117647	1	1	3.75	3.424978614	
Carcinogenic Median Without Chloroform		19.7826087			1.0000000	3.257142857	
Carc/Non Carc Average	0.2350332853	0.3654458473	1.386379819	0.6920926509	4.383018262	0.3514524821	
Adjusted Carcinogenic/Non-Carcinogenic Avg	7.875199486	3.037824709	1.386379819	0.6920926509	1.741759109	0.9088452093	
Carc/Non Carc Median	9.760273838	2.27140361	1	1	3.75	2.697736937	
Adj C/NC Median	9.76027397	1.594464972			1	2.905111212	
C/NC Avg Ratio	1.235570391						
Adjusted C/NC Avg Ratio	2.607016831						
C/NC Median ratio	3.413235731						
Adjusted C/NC Median Ratio	2.870947788						

Appendix II Table 4: SOIL BENCHMARKS (mg/Kg)	TCEQ Residential PCL	TCEQ Industrial PCL	EPA SCDM Carcinogenic	EPA SCDM Non-Carcinogenic	EPA Residential Soil RSL (THQ 1)	EPA industrial Soil RSL (THQ 1)	EPA Residential Soil RSL (THQ 0.1)	EPA industrial Soil RSL (THQ 0.1)	Louisiana DEQ Non-Industrial	Louisiana DEQ Industrial	Mississippi DEQ Restricted (Industrial)	Mississippi DEQ Unrestricted (Residential)	New Mexico ED Residential	New Mexico ED Industrial/ Occupational
Acetone	59,000.00	290,000.00		70,000.00	61,000.00	670,000.00	6,100.00	67,000.00	170	1,400.00	104,000.00	7,820.00	66,300.00	959,000.00
Acrylamide	5.7	15	0.3	100	0.24	4.6	0.24	4.6			1.27	0.142		
Alachlor	59	240	12	700	9.7	41	9.7	41			71.5	7.98	95.10	458.00
Aldrin	0.05	0.97	0.04	2	0.039	0.18	0.039	0.18	0.028	0.13	0.337	0.0376	0.31	1.50
Aniline	59	93	120	500	95	400	44	400	2.4	17	1000	112		
Anthracene	18,000.00	190000		20000	18000	230000	1800	23000	2200	48000	613000	23500	17,400.00	253,000.00
Antimony	15	310		30	31	470	3.1	47	3.1	82	81.7	31.3	31.30	519.00
Arsenic (inorganic)	24	200	0.77	30	0.68	3	0.68	3	12	12	3.82	0.426	7.07	35.90
Atrazine	21	86	3	2700	2.4	10	2.4	10			25.8	2.88	23.20	112.00
Azinphos-methyl (guthion)	100	1,000.00			190	2,500.00	19	250						
Barium	8,100.00	120,000.00		10,000.00	15,000.00	220,000.00	1,500.00	22,000.00	550	14,000.00	14,300.00	5,480.00	15,600.00	255,000.00
Benz-a-anthracene	41	170	1		1.1	21	1.1	21	0.62	2.9	7.84	0.875	1.53	32.30
Benzene	69	130	12	300	1.2	5.1	1.2	5.1	1.5	3.1	1.36	0.887	17.70	86.50
Benzidine	0.01	0.033	0.00066	200	0.00053	0.01	0.00053	0.01			0.0249	0.00278	0.01	0.11
Benzo-a-pyrene	4.1	17	0.1	20	0.11	2.1	0.11	2.1	0.33	0.33	0.784	0.0875	1.12	23.60
Benzo-k-fluoranthene	420	1700	10		11	210	11	210	6.2	29	78.4	8.75	15.30	323.00
Bis (2-ethyl-hexyl) phthalate	43	560	49	1000	39	160	39	160	35	170	409	45.6	380.00	1,830.00
Bromodichloromethane	98	460	11	1000	0.29	1.3	0.29	1.3	1.8	4.2	1.89	1.24	6.14	29.90
Cadmium	51	770		30	71	980	7.1	98	3.9	100	1020	39.1	85,900.00	417,000.00
Carbaryl	6,700.00	68,000.00			6,300.00	82,000.00	630	8,200.00			20,400.00	7,820.00		
Carbon tetrachloride	23	46	9	300	0.65	2.9	0.65	2.9	0.18	1.1	0.569	0.371	10.60	52.10
Chlordane (technical)	5.9	64	1.9	30	1.7	7.7	1.7	7.7	1.6	10	12.3	1.82	17.70	89.00
Chlordane, cis- (alpha chlordane)	13	54	1.9	30										
Chlordane, trans- (gamma chordane)	7.3	51	1.9	30										
Chloroform	8	13	22	700	0.32	1.4	0.32	1.4	0.044	0.3	0.478	0.312	5.85	28.40
Chromium (VI)	120	1000	0.3	200	0.3	6.3	0.3	6.3	23	610	381	227	3.05	72.10
Chrysene	4,100.00	17000	100		110	2100	110	2100	62	290	784	87.5	153.00	3,230.00
Cumene	3,000.00	6,300.00		7,000.00	1,900.00	9,900.00	190	990			9.43	9.43	2,350.00	14,100.00
Cyanide	45	280		40	23	150	2.3	15	150	3,600.00	4,080.00	1,560.00	11.10	62.80
DDD	14	100	2.8		1.9	9.6	0.19	2.5	2.4	16	23.8	2.66	22.20	107.00
DDE	10	73	2		2	9.3	2	9.3	1.7	11	16.8	1.88	15.70	75.50
DDT	5.4	68	2	30	1.9	8.5	1.9	8.5	1.7	12	16.8	1.88	18.70	95.00
Diazinon	21	43			44	570	4.4	57			1,840.00	70.4		
Dibenz-a,h-anthracene	4	17	0.1		0.11	2.1	0.11	2.1	0.33	0.33	0.784	0.0875	0.15	3.23
Dibenzofuran	270	2,700.00		70	73	1,000.00	7.3	100	29	150	8,180.00	313		
Dibromo-3-chloropropane, 1,2-	0.08	0.14	0.1	10	0.0053	0.064	0.0053	0.064	0.18	1.6	0.0999	0.0999	0.09	1.17
Dichlorobenzene, 1,4-	250	1200	120	5000	2.6	11	2.6	11	6.7	16	238	26.6	1,290.00	6,730.00
Dichloroethane, 1,2-	30	110	7.6	400	0.46	2	0.46	2	0.82	1.8	116	116	8.25	40.30
Dichloropropane, 1,2-	31	44	18	3000	2.5	11	1.6	6.6	0.69	1.8	0.445	0.445	17.60	86.10
Dichloropropene, 1,3- (mixed isomers)	26	61	6	2000	1.8	8.2	1.8	8.2	3.1	10	0.352	0.352	29.10	146.00
Dieldrin	0.15	1.1	0.043	3	0.034	0.14	0.034	0.14	0.03	0.15	0.358	0.0399	0.33	1.60
Dimethoate	13	140			140	1,800.00	14	180						
Dioxane 1,4-	37	100	6	2000	5.3	24	5.3	24			520	58.1	53.30	257.00
Diphenylamine	1,700.00	17,000.00			6,300.00	82,000.00	630	8,200.00			5,100.00	1,960.00		
Diphenylhydrazine, 1,2-	5.4	20	0.8		0.68	2.9	0.68	2.9			7.15	0.798	6.66	32.10
Fluoranthene (Benzo(j,k) fluroene)	2,300.00	25000		3000	2400	30000	240	3000	220	2900	81700	3130	2,320.00	33,700.00
Fluorene	2,300.00	25000		3000	2400	30000	240	3000	280	5400	81700	3130	2,320.00	33,700.00
Glyphosate	6,700.00	68,000.00			6,300.00	82,000.00	630	8,200.00					6,160.00	91,600.00
Heptachlor epoxide	0.24	1.9	0.076	1	0.07	0.33	0.07	0.33	0.053	0.26	0.629	0.0702		
Hexachlorobenzene	1	6.9	0.43	60	0.21	0.96	0.21	0.96	0.34	2	1.65	0.399	3.33	16.00
Hexachlorobutadiene	12	23	8.9	70	1.2	5.3	1.2	5.3	0.82	8.6	0.135	0.0882		
Hexachlorocyclohexane, alpha (alpha-BHC)	0.25	2.9	0.11	600	0.086	0.36	0.086	0.36	0.082	0.44				
Hexachlorocyclohexane, gamma (lindane; gamma-BHC)	1.1	18	0.63	20	0.57	2.5	0.57	2.5	0.39	2				
Hexachloroethane	46	420	10	50	1.8	8	1.8	8	5.2	68	93.3	45.6	133.00	641.00
Hydrazine	0.21	0.38	0.2	70	0.23	1.1	0.23	1.1			1.91	0.213		
Malathion	96	140			1,300.00	16,000.00	130	1,600.00			4,080.00	1,560.00		
Mercury (pH = 6.8)	5.5	11		12	11	46	1.1	4.6	2.3	61	61.3	10	23.60	111.00
Mercury (pH = 4.9)	2.1	3.3		12	11	46	1.1	4.6	2.3	61	61.3	10		
Methomyl	1,700.00	17,000.00			1,600.00	21,000.00	160	2,100.00					1,540.00	22,900.00
Methoxychlor	270	3,400.00		300	320	4,100.00	32	410	30	430	1,020.00	391		
Methyl parathion	17	170		19	16	210	1.6	21			408	19.6		
Methylene chloride (dichloromethane)	1,500.00	8600	70	400	57	1000	35	320	19	44	21.9	14.3	766.00	14,400.00
MTBE (methyl tert-butyl ether)	590	1100	380		47	210	47	210	650	4700	8740	3910		
Naphthalene	120	190		1000	3.8	17	3.8	17	6.2	43	247	194	1,160.00	16,800.00
Nickel and compounds	840	8600		1000	820	11000	82	1100	160	4100	4080	1560	595,000.00	2,890,000
Nitrosodiphenylamine	570	1900	140		110	470	110	470	90	400	1170	130	1,090.00	5,240.00
Pentachlorophenol	0.73	32	1	300	1	4	1	4	2.8	9.7	23.8	2.66	9.85	44.50
Phenanthrene	1,700.00	19,000.00							2,100.00	43,000.00	61,300.00	2,350.00	1,740.00	25,300.00
Polychlorinated biphenyls (PCBs)	1.1	7.1	0.3	1	0.23	0.94	0.23	0.94	0.11	0.9	10	1		
Pyrene	1,700.00	19000		2000	1800	23000	180	2300	230	5600	61300	2350	1,740.00	25,300.00
Selenium	310	4,900.00		300	390	5,800.00	39	580	39	1,000.00	1,020.00	391	391.00	6,490.00
Styrene	4,300.00	7,800.00		10,000.00	6,000.00	35,000.00	600	3,500.00	500	1,700.00	384	384	7,230.00	50,900.00
Tetrachloroethane, 1,1,2,2-	30	140	3	1000	0.6	2.7	0.6	2.7	0.81	2	1	0.656	7.93	39.10
Tetrachloroethylene	420	770	330	400	24	100	8.1	39	8.3	35				
Toxaphene	1.2	17	0.63	100	0.49	2.1	0.49	2.1	0.44	2.2	5.2	0.581	4.84	23.30
Trichlorobenzene, 1,2,4-	70	110	23	700	24	110	5.8	26	66	1200	824	782	240.00	1,250.00
Trichloroethane, 1,1,2-	10	19	12	300	1.1	5	0.15	0.63	1.9	4.3	1.67	1.09	18.60	91.30
Trichloroethylene	11	21	8.8	30	0.94	6	0.41	1.9					15.40	111.00
Trichlorophenol, 2,4,6-	67	680	63	70	49	210	6.3	82	40	170	314	58.1	484.00	2,330.00
Trichloropropane, 1,2,3-	0.2	0.95	0.0051	300	0.0051	0.11	0.0051	0.11			0.818	0.0912	0.05	1.21
Trifluralin	270	2500	90	580	90	420	59	420						
Vinyl chloride	3.4	13	0.094	200	0.059	1.7	0.059	1.7	0.24	0.79	0.939	0.426	0.74	28.30

Appendix II Table 5: SOIL BENCHMARKS COMPARISON(	TCEQ/SCDM	TCEQ/EPA Residential Soil (THQ 1)	TCEQ Residential/ EPA Indiustrial Soil (THQ 1)	TCEQ Industrial/ EPA Industrial (THQ 1)	TCEQ/EPA Residential Soil (THQ 0.1)	TCEQ Residential/ EPA Industrial Soil (THQ 0.1)	TCEQ Industrial/ EPA Industrial (THQ 0.1)	TCEQ Residential/ Louisiana Residential	TCEQ Residential/ Louisiana Industrial	TCEQ Industrial/ Louisiana Industrial	TCEQ Residential/ Mississippi Residentail	TCEQ Residential/ Mississippi Industrial	TCEQ Industrial/ Mississippi Industrial	TCEQ Residential/ New Mexico Residential	TCEQ Industrial/ New Mexico Industrial	Average Disparity
Acetone	0.84	0.97	0.09	0.43	9.67	0.88	4.33	347.06	42.14	207.14	7.54	0.57	2.79	0.890	0.302	41.709
Acrylamide	19	23.75	1.24	3.26	23.75	1.24	3.26				40.14	4.49	11.81			13.194
Alachlor	4.92	6.08	1.44	5.85	6.08	1.44	5.85				7.39	0.83	3.36	0.620	0.524	3.699
Aldrin	1.25	1.28	0.28	5.39	1.28	0.28	5.39	1.79	0.38	7.46	1.33	0.15	2.88	0.161	0.647	1.996
Aniline	0.49	0.62	0.15	0.23	1.34	0.15	0.23	24.58	3.47	5.47	0.53	0.06	0.09			2.878
Anthracene		1	0.08	0.83	10	0.78	8.26	8.18	0.38	3.96	0.77	0.03	0.31	1.034	0.751	2.597
Antimony	0.5	0.48	0.03	0.66	4.84	0.32	6.6	4.84	0.18	3.78	0.48	0.18	3.79	0.479	0.597	1.850
Arsenic (inorganic)	31.17	35.29	8	66.67	35.29	8	66.67	2	2	16.67	56.34	6.28	52.36	3.395	5.571	26.380
Atrazine	7	8.75	2.1	8.6	8.75	2.1	8.6				7.29	0.81	3.33	0.905	0.768	4.917
Azinphos-methyl (guthion)		0.53	0.04	0.4	5.26	0.4	4									1.772
Barium	0.81	0.54	0.04	0.55	5.4	0.37	5.45	14.73	0.58	8.57	1.48	0.57	8.39	0.519	0.471	3.231
Benz-a-anthracene	41	37.27	1.95	8.1	37.27	1.95	8.1	66.13	14.14	58.62	46.86	5.23	21.68	26.797	5.263	25.357
Benzene	5.75	57.5	13.53	25.49	57.5	13.53	25.49	46	22.26	41.94	77.79	50.74	95.59	3.898	1.503	35.901
Benzidine	19.7	24.53	1.3	3.3	24.53	1.3	3.3				4.68	0.52	1.33	2.510	0.295	7.274
Benzo-a-pyrene	41	37.27	1.95	8.1	37.27	1.95	8.1	12.42	12.42	51.52	46.86	5.23	21.68	3.661	0.720	19.343
Benzo-k-fluoranthene	42	38.18	2	8.1	38.18	2	8.1	67.74	14.48	58.62	48.00	5.36	21.68	27.451	5.263	25.811
Bis (2-ethyl-hexyl) phthalate	0.88	1.1	0.27	3.5	1.1	0.27	3.5	1.23	0.25	3.29	0.94	0.11	1.37	0.113	0.306	1.215
Bromodichloromethane	8.91	337.93	75.38	353.85	337.93	75.38	353.85	54.44	23.33	109.52	79.03	51.85	243.39	15.961	15.385	142.409
Cadmium		0.72	0.05	0.79	7.18	0.52	7.86	13.08	0.51	7.7	1.30	0.05	0.75	0.001	0.002	2.894
Carbaryl		1.06	0.08	0.83	10.63	0.82	8.29				0.86	0.33	3.33			2.914
Carbon tetrachloride	2.56	35.38	7.93	15.86	35.38	7.93	15.86	127.78	20.91	41.82	61.99	40.42	80.84	2.170	0.883	33.181
Chlordane (technical)	3.11	3.47	0.77	8.31	3.47	0.77	8.31	3.69	0.59	6.4	3.24	0.48	5.20	0.333	0.719	3.258
Chlordane, cis- (alpha chlordane)	6.84															6.840
Chlordane, trans- (gamma chordane)	3.84															3.840
Chloroform	0.36	25	5.71	9.29	25	5.71	9.29	181.82	26.67	43.33	25.64	16.74	27.20	1.368	0.458	26.906
Chromium (VI)	400	400	19.05	158.73	400	19.05	158.73	5.22	0.2	1.64	0.53	0.31	2.62	39.344	13.870	107.953
Chrysene	41	37.27	1.95	8.1	37.27	1.95	8.1	66.13	14.14	58.62	46.86	5.23	21.68	26.797	5.263	25.357
Cumene	0.43	1.58	0.3	0.64	15.79	3.03	6.36				318.13	318.13	668.08	1.277	0.447	111.183
Cyanide	1.13	1.96	0.3	1.87	19.57	3	18.67	0.3	0.01	0.08	0.03	0.01	0.07	4.054	4.459	3.701
DDD	5	7.37	1.46	10.42	73.68	5.6	40	5.83	0.88	6.25	5.26	0.59	4.20	0.631	0.935	11.207
DDE	5	5	1.08	7.85	5	1.08	7.85	5.88	0.91	6.64	5.32	0.6	4.35	0.637	0.967	3.877
DDT	2.7	2.84	0.64	8	2.84	0.64	8	3.18	0.45	5.67	2.87	0.32	4.05	0.289	0.716	2.880
Diazinon		0.48	0.04	0.08	4.77	0.37	0.75				0.30	0.01	0.02			0.758
Dibenz-a,h-anthracene	40	36.36	1.9	8.1	36.36	1.9	8.1	12.12	12.12	51.52	45.71	5.1	21.68	26.144	5.263	20.826
Dibenzofuran	3.86	3.7	0.27	2.7	36.99	2.7	27	9.31	1.8	18	0.86	0.03	0.33			8.273
Dibromo-3-chloropropane, 1,2-	0.8	15.09	1.25	2.19	15.09	1.25	2.19	0.44	0.05	0.09	0.80	0.8	1.40	0.940	0.120	2.833
Dichlorobenzene, 1,4-	2.08	96.15	22.73	109.09	96.15	22.73	109.09	37.31	15.63	75	9.40	1.05	5.04	0.194	0.178	40.122
Dichloroethane, 1,2-	3.95	65.22	15	55	65.22	15	55	36.59	16.67	61.11	0.26	0.26	0.95	3.636	2.730	26.440
Dichloropropane, 1,2-	1.72	12.4	2.82	4	19.38	4.7	6.67	44.93	17.22	24.44	69.66	69.66	98.88	1.761	0.511	25.250
Dichloropropene, 1,3- (mixed isomers)	4.33	14.44	3.17	7.44	14.44	3.17	7.44	8.39	2.6	6.1	73.86	73.86	173.30	0.893	0.418	26.257
Dieldrin	3.49	4.41	1.07	7.86	4.41	1.07	7.86	5	1	7.33	3.76	0.42	3.07	0.450	0.688	3.459
Dimethoate		0.09	0.01	0.08	0.93	0.07	0.78									0.327
Dioxane 1,4-	6.17	6.98	1.54	4.17	6.98	1.54	4.17				0.64	0.07	0.19	0.694	0.389	2.794
Diphenylamine		0.27	0.02	0.21	2.7	0.21	2.07				0.87	0.33	3.33			1.112
Diphenylhydrazine, 1,2-	6.75	7.94	1.86	6.9	7.94	1.86	6.9				6.77	0.76	2.80	0.811	0.623	4.326
Fluoranthene (Benzo(j,k) fluroene)		0.96	0.08	0.83	9.58	0.77	8.33	10.45	0.79	8.62	0.73	0.03	0.31	0.991	0.742	3.087
Fluorene		0.96	0.08	0.83	9.58	0.77	8.33	8.21	0.43	4.63	0.73	0.03	0.31	0.991	0.742	2.616
Glyphosate		1.06	0.08	0.83	10.63	0.82	8.29							1.088	0.742	2.943
Heptachlor epoxide	3.16	3.43	0.73	5.76	3.43	0.73	5.76	4.53	0.92	7.31	3.42	0.38	3.02			3.275
Hexachlorobenzene	2.33	4.76	1.04	7.19	4.76	1.04	7.19	2.94	0.5	3.45	2.51	0.61	4.18	0.300	0.431	2.882
Hexachlorobutadiene	1.35	10	2.26	4.34	10	2.26	4.34	14.63	1.4	2.67	136.05	88.89	170.37			34.505
Hexachlorocyclohexane, alpha (alpha-BHC)	2.27	2.91	0.69	8.06	2.91	0.69	8.06	3.05	0.57	6.59						3.580
Hexachlorocyclohexane, gamma (lindane; gamma-BHC)	1.75	1.93	0.44	7.2	1.93	0.44	7.2	2.82	0.55	9						3.326
Hexachloroethane	4.6	25.56	5.75	52.5	25.56	5.75	52.5	8.85	0.68	6.18	1.01	0.49	4.50	0.346	0.655	12.995
Hydrazine	1.05	0.91	0.19	0.35	0.91	0.19	0.35				0.99	0.11	0.20			0.524
Malathion		0.07	0.01	0.01	0.74	0.06	0.09				0.06	0.02	0.03			0.121
Mercury (pH = 6.8)	0.46	0.5	0.12	0.24	5	1.2	2.39	2.39	0.09	0.18	0.55	0.09	0.18	0.233	0.099	0.915
Mercury (pH = 4.9)	0.18	0.19	0.05	0.07	1.91	0.46	0.72	0.91	0.03	0.05	0.21	0.03	0.05			0.374
Methomyl		1.06	0.08	0.81	10.63	0.81	8.1							1.104	0.742	2.917
Methoxychlor	0.9	0.84	0.07	0.83	8.44	0.66	8.29	9	0.63	7.91	0.69	0.26	3.33			3.219
Methyl parathion	0.89	1.06	0.08	0.81	10.63	0.81	8.1				0.87	0.04	0.42			2.371
Methylene chloride (dichloromethane)	21.43	26.32	1.5	8.6	42.86	4.69	26.88	78.95	34.09	195.45	104.90	68.49	392.69	1.958	0.597	67.294
MTBE (methyl tert-butyl ether)	1.55	12.55	2.81	5.24	12.55	2.81	5.24	0.91	0.13	0.23	0.15	0.07	0.13			3.413
Naphthalene		31.58	7.06	11.18	31.58	7.06	11.18	19.35	2.79	4.42	0.62	0.49	0.77	0.103	0.011	9.157
Nickel and compounds		1.02	0.08	0.78	10.24	0.76	7.82	5.25	0.2	2.1	0.54	0.21	2.11	0.001	0.003	2.222
Nitrosodiphenylamine	4.07	5.18	1.21	4.04	5.18	1.21	4.04	6.33	1.43	4.75	4.38	0.49	1.62	0.523	0.363	2.988
Pentachlorophenol	0.73	0.73	0.18	8	0.73	0.18	8	0.26	0.08	3.3	0.27	0.03	1.34	0.074	0.719	1.642
Phenanthrene								0.81	0.04	0.44	0.72	0.03	0.31	0.977	0.751	0.510
Polychlorinated biphenyls (PCBs)	3.67	4.78	1.17	7.55	4.78	1.17	7.55	10	1.22	7.89	1.10	0.11	0.71			3.977
Pyrene		0.94	0.07	0.83	9.44	0.74	8.26	7.39	0.3	3.39	0.72	0.03	0.31	0.977	0.751	2.439
Selenium	1.03	0.79	0.05	0.84	7.95	0.53	8.45	7.95	0.31	4.9	0.79	0.3	4.80	0.793	0.755	2.683
Styrene	0.43	0.72	0.12	0.22	7.17	1.23	2.23	8.6	2.53	4.59	11.20	11.2	20.31	0.595	0.153	4.753
Tetrachloroethane, 1,1,2,2-	10	50	11.11	51.85	50	11.11	51.85	37.04	15	70	45.73	30	140.00	3.783	3.581	38.737
Tetrachloroethylene	1.27	17.5	4.2	7.7	51.85	10.77	19.74	50.6	12	22						19.763
Toxaphene	1.9	2.45	0.57	8.1	2.45	0.57	8.1	2.73	0.55	7.73	2.07	0.23	3.27	0.248	0.730	2.779
Trichlorobenzene, 1,2,4-	3.04	2.92	0.64	1	12.07	2.69	4.23	1.06	0.06	0.09	0.09	0.08	0.13	0.292	0.088	1.899
Trichloroethane, 1,1,2-	0.83	9.09	2	3.8	66.67	15.87	30.16	5.26	2.33	4.42	9.17	5.99	11.38	0.538	0.208	11.181
Trichloroethylene	1.25	11.7	1.83	3.5	26.83	5.79	11.05							0.714	0.189	6.984
Trichlorophenol, 2,4,6-	1.06	1.37	0.32	3.24	10.63	0.82	8.29	1.68	0.39	4	1.15	0.21	2.17	0.138	0.292	2.384
Trichloropropane, 1,2,3-	39.22	39.22	1.82	8.64	39.22	1.82	8.64				2.19	0.24	1.16	3.922	0.785	12.240
Trifluralin	3	3	0.64	5.95	4.58	0.64	5.95									3.394
Vinyl chloride	36.17	57.63	2	7.65	57.63	2	7.65	14.17	4.3	16.46	7.98	3.62	13.84	4.588	0.459	15.744

Appendix II Table 6:
SOIL BENCHMARKS COMPARISON ANALYSIS

Appendix II Table 6: SOIL BENCHMARKS COMPARISON ANALYSIS	TCEQ/SCDM	TCEQ/EPA Residential Soil (THQ 1)	TCEQ Residential/ EPA Indiustrial Soil (THQ 1)	TCEQ Industrial/ EPA Industrial (THQ 1)	TCEQ/EPA Residential Soil (THQ 0.1)	TCEQ Residential/ EPA Indiustrial Soil (THQ 0.1)	TCEQ Industrial/ EPA Industrial (THQ 0.1)	TCEQ Residential/ Louisiana Residential	TCEQ Residential/ Louisiana Industrial	TCEQ Industrial/ Louisiana Industrial	TCEQ Residential/ Mississippi Residentail	TCEQ Residential/ Mississippi Industrial	TCEQ Industrial/ Mississippi Industrial	TCEQ Residential/ New Mexico Residential	TCEQ Industrial/ New Mexico Industrial	Average Disparity
Average	13.9383	21.9486	3.1899	14.9518	27.3881	3.9105	18.3262	25.7377	5.8785	23.5175	20.4787	12.4137	33.9880	3.8322	1.5693	14.2212
Median	3.0200	3.7000	0.7700	4.3400	10.0000	1.2100	8.0000	8.1950	0.8950	6.6150	2.0654	0.4200	3.2692	0.8935	0.6875	3.5197
Non-Carcinogenic Average	0.9550	2.0419	0.3474	1.0807	9.8981	1.1167	7.0741	26.5450	2.9856	16.1367	14.6275	13.8750	30.1843	0.8949	0.6956	
Non-Carcinogenic Median	0.8250	0.9400	0.0800	0.7900	9.4400	0.7700	7.8600	8.1950	0.4050	4.5050	0.7348	0.0700	0.5875	5.1217	1.9529	
Carcinogenic Average	16.8235	32.2848	4.6658	22.1540	36.4694	5.3612	24.1687	25.3917	7.1183	26.6807	23.4665	11.6674	35.9304	5.1217	1.9529	
Carcinogenic Median	3.7550	10.8500	1.6800	7.7750	14.7650	1.9250	8.0300	7.3600	1.4150	7.3950	5.2632	0.6100	4.1818	0.8935	0.6875	
Carc Avg/Non-Carc Avg	17.6162	15.8115	13.4303	20.4989	3.6845	4.8010	3.4165	0.9566	2.3843	1.6534	1.6043	0.8409	1.1904	5.7233	2.8076	
C/NC Avg Ratio for Similar Benchmarks	6.8148															
Carc Median/Non-Carc Median	4.5515	11.5426	21.0000	9.8418	1.5641	2.5000	1.0216	0.8981	3.4938	1.6415	7.1625	8.7143	7.1186	0.1744	0.3520	
C/NC Med Ratio for Similar Benchmarks	4.1699															

Appendix II Table 7: SOIL TO GROUNDWATER BENCHMARKS COMPARISON (ml/L)	Texas PCL	EPA Regional Screening Level (RSL)	PCL/RSL
Acetone	21.0000	2.9000	7.2414
Acrylamide	0.0018	0.0000	163.6364
Alachlor	0.0095	0.0009	10.9195
Aldrin	0.0510	0.0002	340.0000
Aniline	0.1800	0.0046	39.1304
Anthracene	3400.0000	58.0000	58.6207
Antimony	2.7000	0.2700	10.0000
Arsenic	2.5000	0.0015	1666.6667
Atrazine	0.0120	0.0002	60.0000
Azinphos-methyl (guthion)	0.2200	0.0170	12.9412
Barium	220.0000	160.0000	1.3750
Benz-a-anthracene	65.0000	0.0110	5909.0909
Benzene	0.0130	0.0002	56.5217
Benzidine	0.0000	0.0000	19.6429
Benzo-a-pyrene	3.8000	0.0290	131.0345
Benzo-k-fluoranthene	2200.0000	2.9000	758.6207
Bis (2-ethyl-hexyl) phthalate	82.0000	1.3000	63.0769
Bromodichloromethane	0.0330	0.0000	891.8919
Cadmium	0.7500	0.3800	1.9737
Carbaryl	14.0000	1.7000	8.2353
Carbon tetrachloride	0.0310	0.0002	172.2222
Chlordane (technical)	4.8000	0.0027	1777.7778
Chloroform	0.5100	0.0001	8360.6557
chlorothalonil (carc)	4.1000	0.0500	82.0000
Chromium (VI)	14.0000	0.0007	20895.5224
Chrysene	5600.0000	9.1000	615.3846
Cumene	170.0000	0.7400	229.7297
Cyanide	20.0000	0.0150	1333.3333
DDD	6.5000	0.0075	866.6667
DDE	5.9000	0.0110	536.3636
DDT	7.4000	0.0770	96.1039
Diazinon	0.0790	0.0650	1.2154
Dibenz-a,h-anthracene	7.6000	0.0960	79.1667
Dibenzofuran	17.0000	0.1500	113.3333
Dibromo-3-chloropropane, 1,2-	0.0009	0.0000	6214.2857
Dichlorobenzene, 1,4-	1.1000	0.0005	2391.3043
Dichloroethane, 1,2-	0.0069	0.0000	143.7500
Dichloropropane, 1,2-	0.0110	0.0003	39.2857
Dichloropropene, 1,3- (mixed isomers)	0.0200	0.0002	117.6471
Dieldrin	0.0240	0.0001	338.0282
Dimethoate	0.0051	0.0099	0.5152
Dioxane 1,4-	0.0088	0.0001	93.6170
Diphenylamine	4.8000	2.3000	2.0870
Diphenylhydrazine, 1,2-	0.0160	0.0003	64.0000
Fluoranthene (Benzo(j,k) fluorene)	960.0000	89.0000	10.7865
Fluorene	150.0000	5.5000	27.2727
Glyphosate	15.0000	3.1000	4.8387
Heptachlor epoxide	0.0290	0.0000	1035.7143
Hexachlorobenzene	0.5600	0.0001	4666.6667
Hexachlorobutadiene	1.6000	0.0003	5925.9259
Hexachlorocyclohexane, alpha (alpha-BHC)	0.0040	0.0000	95.2381
Hexachlorocyclohexane, gamma (lindane; gamma-BHC)	0.0046	0.0002	19.1667
Hexachloroethane	0.6400	0.0002	3200.0000
Hydrazine	0.0003	0.0000	1318.1818
Malathion	3.3000	0.1000	33.0000
Mercurcy (pH = 6.8)	0.0039	0.0330	0.1182
Methoxychlor	62.0000	2.0000	31.0000
Methyl parathion	0.0850	0.0074	11.4865
Methylene chloride (dichloromethane)	0.0065	0.0013	5.0000
MTBE (methyl tert-butyl ether)	0.3100	0.0032	96.8750
Naphthalene	16.0000	0.0005	29629.6296
Nickel and compounds	79.0000	32.0000	2.4688
Nitrosodiphenylamine	1.4000	0.0670	20.8955
Pentachlorophenol (PCP)	0.0092	0.0001	161.4035
Polychlorinated biphenyls (PCBs)	5.3000	0.0068	779.4118
Pyrene	560.0000	13.0000	43.0769
Selenium	1.1000	0.2600	4.2308
Styrene	1.6000	1.3000	1.2308
Tetrachloroethane, 1,1,2,2-	0.0120	0.0000	400.0000
Tetrachloroethylene	0.0250	0.0023	10.8696
Toxaphene	5.8000	0.0110	527.2727
Trichlorobenzene, 1,2,4-	2.4000	0.0034	705.8824
Trichloroethane, 1,1,2-	0.0100	0.0001	112.3596
Trichloroethylene	0.0170	0.0002	94.4444
Trichlorophenol, 2,4,6-	0.0870	0.0040	21.7500
Trichloropropane, 1,2,3-	0.0003	0.0000	843.7500
Trifluralin	33.0000	0.0840	392.8571
Vinyl chloride	0.0110	0.0000	1692.3077
		Average	1367.9452
		Median	95.6710

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