

**PROPOSED NNEPA REGULATIONS
NAVAJO NATION UNDERGROUND STORAGE TANK ACT, AS AMENDED
July 21, 2010**

STORAGE TANK CLEANUP STANDARDS

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STORAGE TANK CLEANUP STANDARDS

I. INTRODUCTION

The purpose of this introduction is to help non-Navajos understand the deep connection the Navajos have to their land, and so to understand the basis for these Cleanup Standards, which are being promulgated pursuant to the Navajo Nation Underground Storage Tank Act, 4 N.N.C. §1501 *et seq.*, as amended (NNUSTA). The land, plants, and water are extensions of the individual and are an integral part of tribal identity and tradition. The Navajo culture relies on that connection for its survival and continued well-being.

A. The Navajo Creation Story

The Navajo creation story recalls the origin of the *Diné* (meaning The People), as the Navajo call themselves, and tells of the *Diné's* emergence from three previous worlds into this, the fourth, or Glittering World, through a magic reed. The first people from the other three worlds were not like the people of today, but rather were animals, insects, or masked spirits as depicted in Navajo ceremonies. First Man (*'Altsé Hastiin*) and First Woman (*'Altsé 'Asdzáá*) were two of the beings from the First, or Black, World. First Man was made in the east from black and white clouds. First Woman was made in the west from the yellow and blue clouds. Spider Woman (*Na ashje'ii 'Asdzáá*) was also from the First World and taught Navajo women how to weave.

Once in the Glittering World, the people built a sweat house and sang the Blessing Song. They then met in the first house (*hogan*), made exactly as Talking God (*Haashch'eelti'i*) had prescribed. Inside the *hogan*, the people began to arrange their world, naming the four sacred mountains that surround their land and designating the four sacred stones that would become the boundaries of their homeland. The San Francisco Peaks (*Dook'o'osliid*), near Flagstaff, Arizona, represent the Abalone and Coral stones and mark the western religious boundary while Mt. Blanco (*Tsisnaasjini'*), in Colorado, represents the White Shell stone and is the eastern religious boundary of the Dine. Mt. Taylor (*Tsoodzil*), in New Mexico,

represents the Turquoise stone and the southern boundary while Mt. Hesperus (*Dibé Nitsaa*), Colorado, is associated with the Black Jet stone and the northern boundary.

After setting the sacred mountains where they should go, the Holy People placed the moon and sun into the sky. They began to carefully place the stars in an orderly way but Coyote, the Trickster, became impatient and flung the remaining stars into the sky. The Holy People continued to make the clouds, trees, rain, and other life necessities. When everything was as it should be, evil monsters appeared and began to kill the new Earth People. Only the birth of Ever Changing Woman (*'Asdzáá Nadleehe*) at Gobernador Knob (*Ch'óol'i'i*), New Mexico, was able to save them.

Changing Woman grew up around El Huerfano Mesa (*Dzil Na 'oodilii*) in northern New Mexico. She married the Sun and gave birth to two sons, twins, who are heroes to the Navajo people. The twins are often called Monster Slayer and Child-Born-of-Water. The twins visited their father, the Sun, who gave them weapons made of lightning bolts to fight the evil monsters. Every time the twins killed a monster, it turned to stone. The lava flows near Mt. Taylor, for example, are believed to be the blood from the death of the Monster Who Sucked in People (*Ye'itsoh*). All the angular rock formations on *Diné* lands are believed to be the bodies of monsters.

Once all the monsters were dead, the Holy People turned their attention to forming more people. First were the Tall House People (*Kiiaa aanii*). They were made of yellow and white corn. Other clans traveled to the area around the San Juan River and contributed to the tribe. Paiutes brought beautiful baskets and Pueblos shared their knowledge of farming and weaving. Other tribes included the Utes and the Apaches.

Changing Woman went to live in the Western Sea so that she could visit her husband, the Sun. Her home was made of the four sacred stones (Abalone, Turquoise, White Shell, and Black Jet). She became lonely during the day and decided to create her own people to keep her company. She made four clans from flakes of her skin: the Near Water People, Mud People, Salt Water People, and Bitter Water People. The people of those clans heard about

humans in the east who shared their heritage and wanted to go meet them. Changing Woman gave the people permission to travel east to the San Francisco Peaks. While traveling, the people came to the Hopi Mesas where they left the porcupine, which is still found there. The people then traveled towards the Chuska Mountains and on to Mt. Taylor. The people finally arrived at *Dinetah*, the *Diné* traditional homeland, and met the clans already living there.

'For there is nothing more revered nor more loved by the Navajos than the land they call *Dinehtah*.'

Raymond Friday Locke, The Book of the Navajo

B. Navajo Religion - A Sacred Way of Life and Relationship to the Land

“The traditional Navajo way contains no concept for religion as a sphere of activity separate from daily life. Navajo religion has been described as 'life itself, the land, and well-being.’ All living things - people, plants, animals, mountains, and the Earth itself - are relatives. Each being is infused with its own spirit, or “inner form,” which gives it life and purpose within an orderly and interconnected universe. The interrelatedness of all creation is recognized through daily prayer offerings and an elaborate system of ceremonies. The purpose of Navajo life is to maintain balance between the individual and the universe and to live in harmony with nature and the Creator. In order to achieve this goal, Navajos must perform their religious practices on the specific, time-honored areas which they inhabit.²

“Our offering places are sacred to us.”

Jack Hatathlie, Navajo Medicine Man

¹ Adapted from www.lapahie.com/Creation.cfm

² www.xpressweb.com/zionparkJindex3.html

“Navajo believe they have a responsibility to remain on and care for the land where they were placed by the Creator. Knowledge of sacred places carries with it the obligation to care for them through the appropriate offerings, prayers, and songs. Such ceremonies necessitate regular, sometimes daily, access to sacred places and plants.”³

“Navajo healing ceremonies are used to cope with the uncertainties and dangers that occur in the universe. They are usually performed to bring the dangerous powers under control and to restore physical and spiritual imbalances in an individual. These curative ceremonies, which can last up to nine days, must be performed in a *hogan* by a specially trained medicine person. The medicine person often uses sandpaintings and herbal remedies made from local minerals and plants to heal the patient. Plants must be collected for each individual ceremony; they cannot be gathered in advance or stored in a kit. For example a medicine person must walk to the spot where a plant is growing and tell the plant the name of the person who is sick. Each plant is addressed as an individual with offerings of corn pollen, song and prayer.”⁴

C. Cultural Considerations and the Cleanup Standards

It is imperative that contaminated Leaking Storage Tank (LST) sites be restored to pristine conditions because of the importance of the environment to religious ceremonies and to the tribe. As described above, a Navajo medicine person cannot store the materials needed for religious ceremonies and thus must have access to uncontaminated soil, plants, and water when a ceremony is to take place; access to safe, uncontaminated natural materials is essential to the continuation of traditional practices.

Traditional gathering places are present throughout the *Dinetah* and are not commonly divulged to anyone or may vary as the ceremony dictates. This leads to a need for protection of all land, plants, animals, water, and air, as any area can or may be used for religious purposes.

³ www.xpressweb.com/zionparkJindex3.html

⁴ www.xpreweb.com/zionpark/index3_0html

The Navajo Nation takes the lead in the protection of its environment and its people. In 1995, the Navajo Nation Council passed a resolution establishing the Navajo Nation Environmental Protection Agency (NNEPA) as an independent agency and enacted the Navajo Nation Environmental Policy Act, which set the tone for the tribe's holistic approach to the protection of the land and the people, *see* 4 N.N.C. §§ 901-906. The Navajo Nation has since enacted a number of environmental laws, of which the Navajo Nation Underground Storage Tank Act (4 N.N.C. §§ 1501-1575) is an example, demonstrating the Navajo Nation's commitment to environmental protection within the boundaries of the Dinétah.⁵

It is with these facts in mind that the Navajo Nation Storage Tank Program began the process of developing cleanup standards for sites that have been jeopardized by petroleum product spills. Groundwater is generally shallow (an average of 20 feet below the surface; Henry Haven, Jr., Pers. Comm.) and often reaches the surface at sacred seeps and springs. Although most drinking water wells tap into deeper aquifers, many people on the reservation use those seeps and springs for irrigation, daily household chores and, in some cases, as their sole source of drinking water. Animals, both wild and domestic, also need the shallow water-bearing units as drinking water. The possibility of bioaccumulation of toxic compounds in both plants and animals was also considered in the assignment of cleanup levels. Research in the area of bioaccumulation has shown that certain compounds are a cause for concern for human health when contaminated plants and animals are consumed. The Navajo Nation does not have zoning regulations and thus any area can be used for residential purposes.

⁵ The U.S Environmental Protection Agency (USEPA) Administrator William Ruckelshaus issued an Indian Policy in 1984 that recognizes the authority of tribal governments to make their own environmental policies and set their own environmental standards (<http://www.epa.gov/tribal/pdf/indian-policy-84.pdf>). Succeeding USEPA Administrators have reaffirmed USEPA's partnership with Indian tribes, including in September 2004 in commemoration of the twentieth anniversary of USEPA's Indian Policy (<http://www.epa.gov/tribal/pdf/indian-policy-leavitt-pr.pdf>).

Nearly 50% of petroleum storage tank sites identified so far on the Navajo Nation are suspected to have LUSTs with contamination affecting both soil and water. At most of these LUST sites, the shallow groundwater is in direct contact with contaminated soil (Henry Haven, Jr., Pers. Comm.) This fact was taken into account in the cleanup standards proposed for soil. It is the NNEPA Storage Tank Program's position that the most stringent cleanup levels be used to protect both the soil and the groundwater. The most stringent soil cleanup levels are those calculated using a dilution-attenuation factor (DAF) of unity (1). A DAF of 1 assumes direct contact with the edge of the mixing zone and is an appropriate representation of most field conditions encountered at Navajo Nation sites. These recommended values are protective of both the soil and the groundwater. Due to the arid climate present on the Navajo Nation, surface water is often related to shallow groundwater and should be afforded the same level of protection.

II. REPORTING PETROLEUM PRODUCT RELEASES OR SUSPECTED RELEASES

Pursuant to the NNUSTA, as amended, any suspected or known release of a regulated substance must be reported to the NNEPA within 24 hours. 4 N.N.C. § 1544. The only exception to this requirement is a release known to be less than 25 gallons that can be cleaned up completely within 24 hours of the release. If the cleanup cannot be accomplished within 24 hours, the owner/operator must notify the NNEPA and the USEPA (as stated in the federal regulations) within the 24-hour time-frame.

A. Suspected Releases

If there is reason to assume a release has occurred, the NNEPA must be notified within 24 hours. A release may be suspected if one or more of the following conditions are present:

- Stained soil.
- Soil with petroleum odor.

- Elevated readings of field monitoring instruments.
- Failure of any method of release detection.
- Presence of known contamination on a down gradient property, with no obvious reason to suspect a release on that property and no obvious other source.

B. Confirming Releases

The owner/operator must confirm within seven days if a suspected release is an actual release. Once a release is confirmed the NNEPA and the USEPA must be notified within 24 hours. If a release is confirmed, the date that the release was initially suspected becomes the official release date for all regulatory deadlines pertaining to that release.

Methods of confirming releases include:

- Laboratory analyses of suspect soil and/or water.
- Discovery of free product outside the tank.
- Two consecutive failures of tank tightness tests and/or line tightness tests.

To report a release, call (928) 871-7993 or fax (928) 871-7996. The reporting party will be supplied with a NNEPA LUST Spill Report Form which must be filled out and returned within 14 days.

If a situation exists that may impact the immediate health and safety of the community, immediately call the Navajo Nation Department of Emergency Management at (928) 871-6892, the Navajo Nation Superfund Program, and then the Navajo Nation Storage Tank Program and the USEPA.

C. Initial Response to a Confirmed Release

Initial actions at a site with a confirmed release should include, but are not limited to:

- Removal of contaminated soil and disposal at an authorized facility.
- Enhancement and stimulation of bioactivity by addition of approved bioactivity enhancement treatment(s). This treatment is required not only at tank pulls but in any areas within the site where contaminated soil is encountered.

III. ANALYTICAL REQUIREMENTS

A. Contaminants of Concern

For the purpose of the Navajo Nation Storage Tank Program, Contaminants Of Concern (COCs) are substances contained within a regulated storage tank system that have been released into environmental media. LUST site characterization should include analyses for BTEX (Benzene, Toluene, Ethylbenzene, and Ortho-, Meta-, and Para-Xylenes), PAHs (Polycyclic Aromatic Hydrocarbons), MTBE (Methyl-Tert-Butyl Ether) and TPH (total petroleum hydrocarbons). In some cases, based on site history, analyses for metals, lead scavengers, solvents/chlorinated solvents, and fuel additives should also be conducted. Commonly encountered COCs at LUST sites include:

• BTEX

BTEX analysis is especially important at sites with gasoline releases. Benzene is an indicator chemical for carcinogenic effects of low-molecular weight hydrocarbons. BTEX is volatile and biodegradable under conditions where oxygen and certain microbes are present. Research is ongoing to determine the biodegradability of BTEX under anaerobic conditions. All samples collected must be analyzed for BTEX using USEPA methods 8021B or 8260B. USEPA method 8260B is especially appropriate in cases where waste oil is/was present. USEPA sample preparation method 5035 should be used for soil analyses containing low levels (0.5-200 ug/kg) of BTEX.

- **PAHs**

PAHs can be somewhat recalcitrant to biodegradation and their ultimate fate in biodegradation has greater uncertainty. Benzo(a)pyrene is especially important as an indicator chemical for cancer effects of heavier petroleum hydrocarbon fractions such as those found in diesel. If there is reason to believe that the spill involves petroleum products in the higher TPH fractions or if TPH levels in soil or water are above the clean up levels samples will be analyzed for benzo(a) pyrene and/or other PAHs listed in Tables 4 and 5 using USEPA methods 8270C or 8310.

- **MTBE**

MTBE has been used to boost octane ratings in gasoline and to improve gas combustion. Unless site history and material usage records support the absence of MTBE, analyses of samples at gasoline storage facilities should include MTBE as an analyte during at least the initial sampling. Research into the health effects of MTBE are ongoing. MTBE is not readily biodegraded and thus persists in the environment. Analyses for MTBE should be conducted using USEPA method 8260B.

- **TBA**

Tert-butyl alcohol (TBA) is a breakdown product of MTBE as well as a potential impurity in the manufacture of MTBE. TBA has also been used as an additive to petroleum products. TBA is very mobile in groundwater and is not readily biodegraded. Analyses for TBA should be conducted if there is reason to suspect that TBA or MTBE were/are in use at the site. Analyses for TBA should be conducted using USEPA method 8260B.

- **Lead and Other Metals**

In addition to lead, a number of metals can be associated with petroleum product storage sites. Those metals include arsenic, barium, cadmium, chromium, mercury, selenium, and

silver. Metals can pose a health risk to humans and threaten the environment because they tend to bioaccumulate and may persist in the body for extended periods of time, causing long-term health concerns. High concentrations of metals are often associated with sites storing waste oil. Analyses for lead should be conducted at sites known or suspected to have stored leaded gasoline or in cases where the stored product is unknown. Analysis for other metals should be conducted if the site has stored or is storing waste oil, or the product is unknown, or if there is reason to believe the site may contain levels of those metals in excess of federal or NNEPA allowable contaminant levels. Analyses for metals (except mercury) should be conducted using USEPA methods 60106 or 6020. Mercury testing is achieved by using USEPA method 7470A for water and USEPA method 7471A for soil.

- **Lead Scavengers**

Leaded gasoline fuels contain additives known as organolead compounds. These lead compounds (i.e. tetraethyllead, tetramethyllead, trimethyllead, and others) require the presence of lead scavengers to prevent engine deposits of the lead oxide combustion product. Lead scavenger compounds include ethylene dibromide (EDB) and ethylene dichloride (EDC, also known as 1,2 DCA). EDB is resistant to chemical and biological degradation, causing it to be persistent. Due to the chemical and physical properties of EDB, it volatilizes quickly within the vadose zone, dissolves quickly into the aqueous phase in the saturated zone of the subsurface, or remains in the free product when present. EDC (1, 2 DCA) readily migrates to groundwater and is very persistent. Therefore any site where the release cannot be documented to have occurred after the phase-out period of leaded fuels for automobiles should be analyzed for lead scavengers. Analyses for the lead scavengers should be performed using USEPA methods 8260B or 504.1.

- **Solvents/Chlorinated Solvents**

Petroleum solvents contain volatile organic compounds (VOCs) of concern for inhalation pathways, BTEX, and PAHs. Petroleum solvents do not usually contain sufficient

quantities of BTEX and PAHs to allow measurement in water and soil samples. At sites where tanks are known or suspected to have contained petroleum solvents, sampling and analysis for those compounds should be conducted. If the initial analysis does not detect the target analytes (BTEX and PAHs) and the site is known to have stored solvents, measurement may be based on the total volatile petroleum hydrocarbons (TVPH) procedure, which quantifies all chromatographic peaks between 2-methyl pentane and 1,2,4-trimethylbenzene. The accepted analytical method is USEPA method 80 15B.

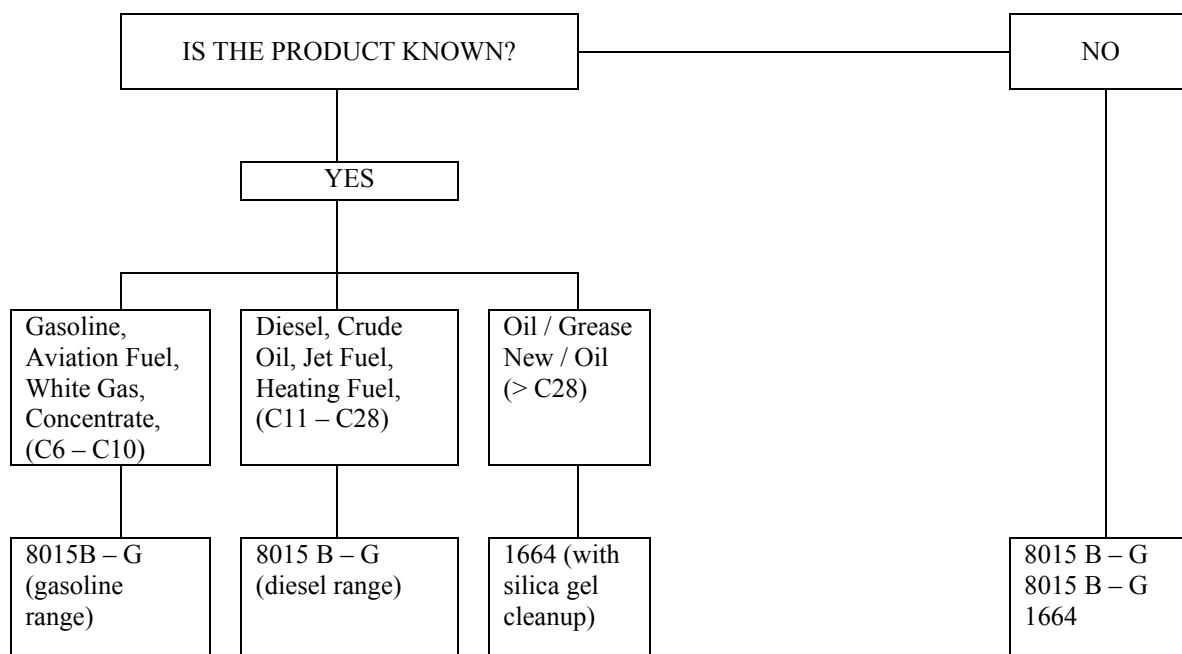
The most common chlorinated solvents are perchloroethene (aka tetrachloroethene, PCE), trichloroethene (TCE), dichloroethene (DCE), vinyl chloride (YC), trichloroethane (TCA), and dichloroethane (DCA)) (Wiedemeier et al., 1999). These compounds may be present at sites that were used for automobile repairs (garages). Sites that have a known history of such use must include sampling for chlorinated solvents as part of the initial sampling regimen. USEPA recommended methods for analysis of chlorinated solvents are 80218 (GC-PID) and 82608.

- **TPH**

Total Petroleum Hydrocarbons (TPH) may contain many PAHs which have toxic and carcinogenic properties. TPH is a mixture of several hydrocarbon compounds that vary depending on several factors, including the composition of the crude oil the mixture came from, the amount of refinement, the fraction under consideration (i.e., gasoline, diesel, oil and grease), and the amount of weathering the mixture has undergone. TPH values are used as indicators that potentially high levels of other COCs are present at the site. The 500 ppm level for soil proposed in this document is a nuisance standard rather than a health-based level. At the 500 ppm level the soil is visibly contaminated and has a strong "petroleum" odor. All soil samples must be analyzed for TPH. If TPH analytical values are above the target levels in Tables 4 or 5 for diesel or higher fractions, analysis for the PAHs must be conducted. If the soil is in contact with groundwater, the analyses for PAHs must be conducted for soil TPH levels above 100 ppm. In no case can TPH levels in groundwater exceed the values in Table 4 (Water Cleanup Standards).

Analytical methods for TPH vary with the fraction under consideration. The following flow chart provides a guideline for determining which USEPA method is appropriate, based on the nature of the released product:

Flow Chart for Analytical Methods



• Free Product

Free product is defined as a mobile regulated substance that is present as an NAPL (nonaqueous phase liquid, i.e., not dissolved in water). At sites where free product is present, the NNEPA must be notified within 24 hours of discovery. Free product must be removed to the full extent practicable and in a manner that minimizes the spread of contamination. The type, thickness, and total volume of free product must be recorded. All free product must be disposed of and treated in compliance with applicable regulations.

B. Sampling Requirements

Depending on the nature of the released material, the NNEPA requires that sampling of water and soil at new sites include some or all of the common COCs listed above. Table 1 can be used to determine which COCs should be included in the initial sampling:

Table 1. Initial Site Sampling Requirements¹									
Product	BTEX	PAHs	MTBE	TBA	EDB, EDC	Lead	Metals	Solvents	TPH²
Unknown	X	X	X	X	X	X	X	X	X
Gasoline	X		X	X					X
Leaded Gasoline	X		X	X	X	X			X
Diesel or similar products	X	X							X
Waste Oil		X				X	X	X	X

1. This table is a guide only. Based on site conditions the sampling requirements may change.

2. Soil only

Once analytical results for the initial sampling have been received and reviewed by NNEPA, the owner/operator must contact NNEPA to determine if any other sampling may be required.

C. Approved Analytical Methods

Tables 2 and 3 (attached as Appendix B) may be used as guides to determine the analytical method(s) and associated requirements most appropriate for sampling at a site. Table 2 pertains to sampling and analysis for water while Table 3 pertains to sampling and analysis for soil. It is always recommended that laboratory-supplied containers and preservatives be

used when sampling.

IV. ADJUSTING CLEANUP STANDARDS FOR TRADITIONAL AND CULTURAL VALUES

The values in Tables 4 and 5 (attached as Appendix C) are based on values previously published by the USEPA, the State of New Mexico, the State of California, or calculated specifically for this document based on those previously published values. It is important to recognize that the values in Tables 4 and 5 are cleanup STANDARDS, not remediation goals. In view of cultural and traditional values, the NNEPA Storage Tank Program does not endorse a tiered approach to remediation and believes that promulgating a single value for each contaminant for each medium best serves the Navajo Nation. Site-specific cleanup goals may be allowed at some sites on a case-by-case basis. The petition process for such variances is detailed below.

For the water cleanup standards, federal Maximum Contaminant Levels (MCLs) were used where available. For COCs without federal MCLs, research was conducted into other tribal water quality standards approved by USEPA Region 9 to find precedents for water cleanup standards. The Navajo Nation has USEPA-approved surface water quality standards, as does the Hualapai Tribe. Both of these programs chose to use standards based on USEPA's National Recommended Water Quality Criteria (NRWQC) for Human Health for Consumption of Water and Organisms. These programs used the NRWQC levels from the 1999 edition (USEPA, 1999). Although a newer version of the NRWQC is available, NNEPA's Storage Tank Program uses the 1999 NRWQC levels so as to promote consistency across Navajo lands. The Hoopa Valley tribe of California has a USEPA-approved Water Quality Control Plan (2002) with standards based on USEPA Region 9's Preliminary Remediation Goals (PRGs) and the State of California Toxics Rule, which in some cases are more stringent than the NRWQC levels. For COCs not included in either the MCLs or the NRWQC, surrounding four-corner states, USEPA Region 9 PRGs (USEPA, 2004a), and the State of California were researched and the lowest value for the given COC was chosen for the cleanup standards. The exception is the value for MTBE,

which is from the USEPA Region 3 Risk-Based Concentrations (RBCs) table (US EPA, 2004b).

Soil cleanup standards were adopted as follows: Once the water cleanup standards were chosen, the soil cleanup levels were calculated using Equation 10 of the USEPA Soil Screening Guidance: User's Guide (SSG) (USEPA, 1996a). The dilution/attenuation factor (DAF) was assumed to be unity (i.e., DAF = 1). Values for K_{oc} and H' were obtained from Appendix C of the SSG (exceptions are described below).

Equation 10 (Soil Screening Level Partitioning Equation for Migration to Groundwater) is as follows:

$$SLS(mg/kg) = C_w \left[K_d + \frac{(\theta_w + \theta_a H')}{P_b} \right]$$

Where:

- C_w is the target soil leachate concentration (mg/L). Chemical-dependent, based on target water concentration.
- K_d is the soil-water partition coefficient (L/kg). K_d is calculated by multiplying K_{oc} by f_{oc} (organics). Chemical-dependent.
- K_{oc} is the soil organic carbon/water partition coefficient (L/kg). Chemical- dependent, found in the tables included in the SSG.
- f_{oc} is the fraction organic carbon in soil (g/g). Default value is 0.002 (2%).
- θ_w is the water-filled soil porosity (L_{water}/L_{soil}). Default value is 0.3.
- θ_a is the air-filled soil porosity (L_{air}/L_{soil}). It is equal to $n - \theta_w$. The calculated default value is 0.13.
- n is the soil porosity (L_{pore}/L_{soil}). It is equivalent to $1 - (P_b/P_s)$. The calculated default value is 0.43.
- P_b is the dry soil bulk density (kg/L). Default value is 1.5.
- P_s is the soil particle density (kg/L). Default value is 2.65.
- H' is the dimensionless Henry's Law constant.

Default values from the Equation 10 table were used for the calculations. The value for C_w was the standard water cleanup established for Table 3. θ_a and n were back-calculated from the default values in the Equation 10 table.

Phenanthrene and TBA are not listed in the SSG Tables. Values for K_{oc} and H' were found by searching the USEPA Superfund Chemical Data Matrix (SCDM) (USEPA, 2004d) for phenanthrene and obtained from Zogorski et al. (1999) for TBA.

V. CLEANUP STANDARDS

The ultimate goal of environmental cleanup on the Navajo Nation is to reduce contaminants to undetectable or background levels. However, physical, technical, economic, and time limitations often make this goal difficult to achieve. In consideration of these limitations, Tables 4 and 5 list the cleanup levels to be achieved at all LUST sites on the Navajo Nation. The COCs included in the tables are those commonly found at LUST sites but are not the only potential contaminants at such sites. On a site-by-site basis, the NNEPA may require testing and analysis for additional compounds based on either need for additional information (i.e., product released is unknown) or if waste oil is suspected or known to be present, since this can present additional concerns about metal and/or solvent/chlorinated solvent contamination.

Some of the cleanup standards are below the detection level (DL) for their associated analytical methods. In such cases, the DL for the analytical method is the cleanup standard. As the DL improves for each method, or new methods are developed, the new DL becomes the cleanup standard, until such point that the cleanup standard and the DL are equal.

Cleanup standards for both water and soil as proposed in this document are based on research and data available at the time this document was prepared. The NNEPA reserves the right to change or modify the standards as new research and data becomes available. Revisions will be made pursuant to the rulemaking procedures set forth in the NNEPA

Uniform Rules.

A. Water

The cleanup standards for surface and groundwater are set at the limits set forth in Table 4, except that for those contaminants of concern not listed in Table 4 site-specific levels should be developed and submitted to the NNEPA for review and approval. The owner/operator may submit a request for a variance from the cleanup limits in Table 4 through a petition process (described below) if it can be scientifically and technically demonstrated that the cleanup standards cannot be achieved at the LUST site due to site-specific considerations.

B. Soil

The cleanup standards for soil are set at the limits set forth in Table 5, except that for those contaminants of concern not listed in Table 5, site-specific levels should be developed and submitted to the NNEPA for review and approval. The soil site-specific levels developed shall, in no case, cause (1) the contaminants of concern levels for contaminants in surface and groundwater to exceed the cleanup levels in Table 4; (2) groundwater to have an observable petroleum sheen or film using either the product interface probe method or visual measurement using a product thickness bailer; or (3) surface water to have an observable petroleum sheen or film. These restrictions also apply to residual NAPL in soil. The TPH cleanup values in Table 5 have been promulgated based on the best data available at the time this document was prepared. TPH research is ongoing and the NNEPA reserves the right to change the TPH cleanup requirements as new data are made available, pursuant to NNEPA's rulemaking procedures.

VI. POINT OF COMPLIANCE

Due to the nature of the relationship between the Navajo people and the natural resources on the Navajo Nation, it is appropriate to set the point of compliance (POC) at LUST sites

at the source area and/or the point of highest COC concentrations as determined during site assessment activities.

VII. LUST SITE CLOSURE (NO FURTHER ACTION)

When water and soil have been remediated to, or demonstrated to be at levels below, all known site COC clean up levels at the POC, the NNEPA may issue a No Further Action (NFA) letter for the site. This letter does not release the owner/operator from liability should site conditions change and/or future risks resulting from the release become apparent.

If remediation to cleanup standards cannot be achieved at the site for any or all COCs, in any or all media, the owner/operator may request a variance through the petition process. In this case, a partial site closure may be granted for those COCs that have been remediated to the cleanup standards.

At sites where monitored natural attenuation (MNA) is the NNEPA-approved remediation method, an NFA letter cannot be issued until the cleanup level has been achieved since MNA implies an ongoing periodic monitoring plan is in place.

VIII. PETITIONS FOR VARIANCES FROM CLEAN UP STANDARDS

The following are the procedures for requesting a petition for a variance from the cleanup standards proposed in this document. Note that under the Navajo Nation UST Act, 4 N.N.C. § 1542(13), as amended, the NNEPA is authorized to act independently from all other tribal departments and enforce against all equally; thus any petition for a variance at a site owned by the Navajo Nation is also subject to the procedures outlined below.

The owner/operator may request a meeting with NNEPA Storage Tank Program staff during which the owner/operator may present scientifically and technically defensible data to support the claim that the site cannot be remediated to the cleanup standards

promulgated by the NNEPA Storage Tank Program. The owner/operator is responsible for providing all documents and data in support of that claim. NNEPA staff will review the data and may either request additional data or approve or deny the request based on the evidence provided by the owner/operator. In general, a demonstration of technical intractability will be required before a variance is granted. The decision of the NNEPA staff will be considered equivalent to an initial order under Uniform Rules § 304, and the owner/operator may request a hearing on the decision pursuant to Uniform Rules § 305, which will trigger the hearing procedures in Uniform Rules Subpart 3(C) and the judicial review provision of Uniform Rules § 332.

Cases where the alternative cleanup levels are in conflict with the requirements of other agencies should be referred to the affected agency for review under the processes required by that agency.

At a minimum, the owner/operator must provide documents which describe the following in writing:

- Reason and justification for waiver request.
- Proposed site-specific cleanup standards with justifications, including but not limited to a demonstration that the site-specific cleanup standards are compatible with current and future land use and the cultural and traditional significance of the site.
- A complete report of all remedial activities at the site to date.
- Tabulated results of all monitoring data at the site (including soil, water, and air data).
- A site conceptual model that includes all data from site characterization activities to date.
- Concentration vs. time plots of all groundwater monitoring data, if available.
- Statistical evaluation of concentration reduction trends for all COCs identified at the site, if available.
- Evaluation of other remediation alternatives and the alternatives selected for the site.
- Estimated timeframe to reach new cleanup standards.
- An Implementation and Monitoring Plan.

- Institutional or engineering controls proposed along with an Implementation and Monitoring Plan for the controls, if used.
- Demonstration that the alternative cleanup standards are achievable and do not create a present or future hazard to human health and the environment or cause undue damage to the property and have been approved by all other affected agencies.

IX. MONITORED NATURAL ATTENUATION

Natural attenuation, also referred to as intrinsic remediation, intrinsic bioremediation, passive remediation, natural biodegradation, etc., is defined as the "reduction in mass or concentration of a compound in groundwater over time or distance from the source of constituents of concern due to naturally occurring physical, chemical, and biological processes, such as biodegradation, dispersion, dilution, sorption, and volatilization" (ASTM, 1998). Natural attenuation occurs to some degree at all sites.

Monitored Natural Attenuation is the process by which natural attenuation is monitored over time to ensure that attenuation is occurring and will produce the desired reduction in contamination without the need of other remediation methods. NNEPA will not consider MNA as an acceptable clean-up method unless contamination levels are within 10% of the values of the relevant clean-up standards. In such cases, MNA must be augmented by one or more bioremediation techniques. In addition, as with all other remediation methods, MNA must be shown to be able to meet remediation goals within a reasonable amount of time and be comparable to other remediation methods in efficacy and economy. MNA may be appropriate as a stand-alone remediation method at marginal sites where the COC levels are low. It may also be useful to consider MNA at the edge of active remediation areas where contaminant levels have reached low levels due to ongoing remediation.

NNEPA may consider MNA as an alternative remediation method, on a site-by-site basis, if the decision process found in the ASTM (1998) Standard Guide, Section 6, has been followed. This process includes but is not limited to:

- A record of initial response activities to prevent further contamination.

- A site characterization report that provides information used to determine if MNA is a viable remedial alternative method either by itself or in conjunction with other method(s), including sources, pathways, and receptors. As part of the site characterization activities, a site conceptual model should be developed to gain insight into the groundwater depth, flow direction and velocity, three-dimensional distribution of the COCs, the surface and subsurface geology, source areas, and migration pathways. This conceptual model should be updated as new analytical and hydrogeological data are made available.
- A determination of the COCs present at the site.
- A determination of the remedial goals for the site.
- An evaluation of the plume status (shrinking, stable, or expanding) as a primary line of evidence that natural attenuation is occurring.
- Gathering of secondary lines of evidence of natural attenuation such as estimates of natural attenuation rates, geochemical data used as indicators of natural attenuation (dissolved oxygen, pH, temperature, conductivity, redox potential, nitrate, sulfate, etc.), solute transport modeling, and/or microbiological studies.
- A comparison of the estimated MNA performance to the remediation goals.
- A comparison of MNA to other remedial options.
- An evaluation as to whether MNA can achieve the remediation goals within an acceptable timeframe.
- A cost comparison of MNA to other methods.
- A well defined implementation and monitoring plan, including considerations for institutional and engineering controls, if needed.

Refer to ASTM Guide E 1943-98 for more complete details.

X. REFERENCES

American Society for Testing and Materials (ASTM), 1998, Standard Guide for Remediation of Groundwater by Natural Attenuation at Petroleum Release Sites: ASTM Publication E 1943-98.

Arizona Revised Statutes Title 49, Chapter 6 (Underground Storage Tank Regulation).

Arizona Administrative Code Title 18, Chapter 12 (Department of Environmental Quality Underground Storage Tanks).

Kelly, W.R., Herman, J.S., and Mills, A.L., 1997, The geochemical effects of benzene, toluene, and xylene (BTX) biodegradation: Applied Geochemistry, vol. 12, pp. 291-303.

Locke, R.F., 2001, The Book of the Navajo: 6th Edition, Mankind Publishing Company, Los Angeles.

State of Arizona Release Reporting and Corrective Action Guidance (2002). Arizona Department of Environmental Quality Underground Storage Tank Program.

State of New Mexico Guidelines for Corrective Action (2000), New Mexico Environment Department Underground Storage Tank Bureau.

USEPA, 004a, Region 9 PRGs Table.

RL:www.epa.gov/region9/wasteisfund/prglfilesi04prgtable.pdf

USEPA, 2004b, Region 3 RBCs Table.

URL: www.epa.gov/reg3hwmd/risk/humanlrbc/rbc1004.pdf

USEPA, 2004c, Groundwater Oxygenate Cleanup Levels for LUST Sites.

URL: www.epa.gov/swerustl/mtbe/oxytable.pdf

USEPA, 2004d, Superfund Chemical Data Matrix (SCDM).

URL: www.epa.gov/superfund/sites/npl/hrsres/tools/scdm.htm

USEPA, 1999, National Recommended Water Quality Criteria-Correction. Office of Water.

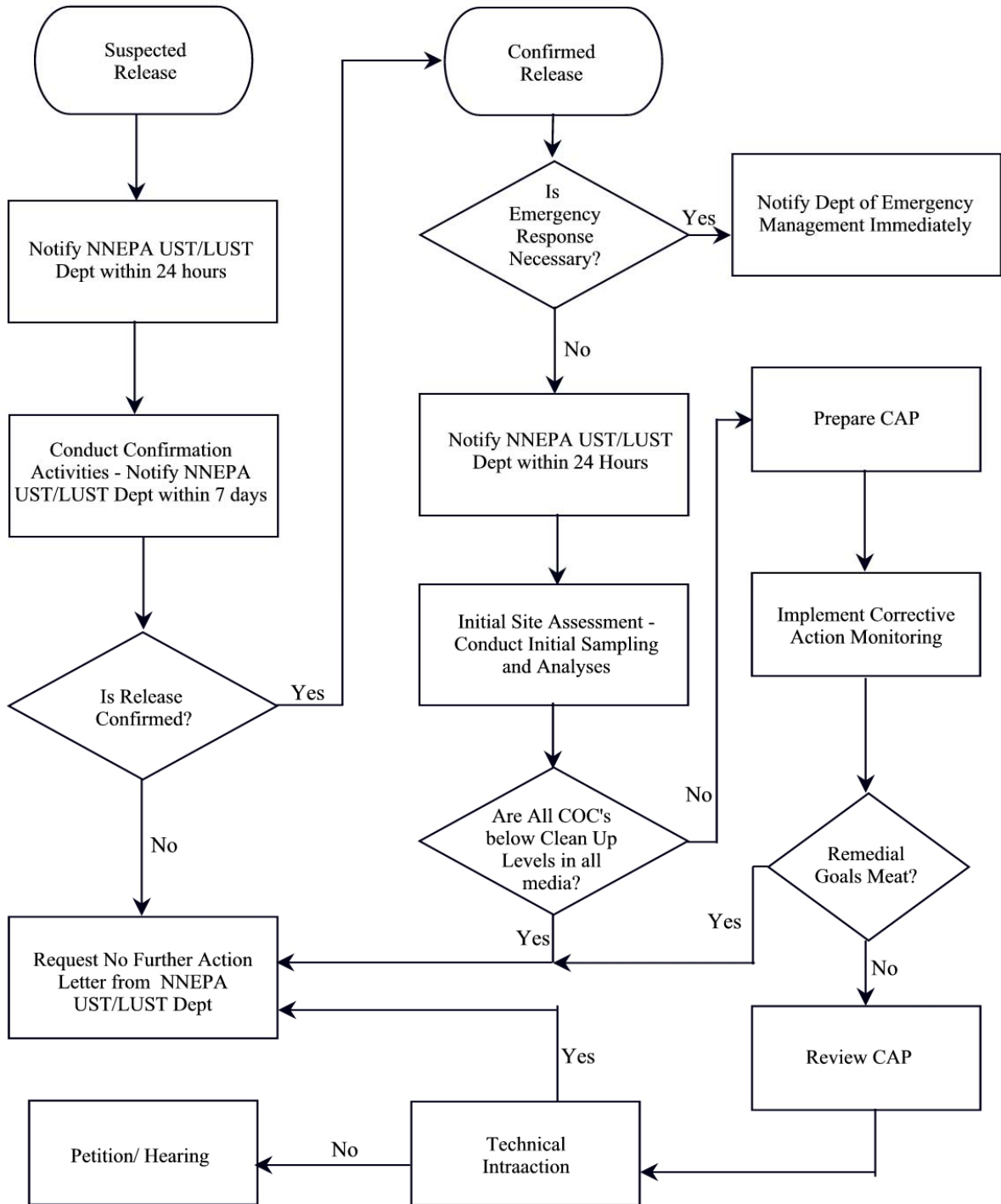
USEPA, 1996a, Soil Screening Guidance: User's Guide. EPA1540/R-96/0 18. Office of Solid Waste and Emergency Response Publication 9355.4-23.

USEPA, 1996b, Soil Screening Guidance: Technical Background Document. PA1540/R95/128. Office of Solid Waste and Emergency Response Publication.

Wiedemeier, T.H., Rifai, H.8., Newell, C.J., and Wilson, J.T., 1999, Natural Attenuation of Fuels and Chlorinated Solvents in the Subsurface. John Wiley and Sons, Inc., New York, pp.617.

Zogorski, J.8., Morduchowitz, A., Baehr, A.L., Bauman, B.J., Conrad, D.L., Drew, R.T., Korte, N.E., Lapham, W.W., Pankow, J.F., and Washington, E.R., 1999, Fuel Oxygenates and Water Quality. US EPA Office of Transportation and Air Quality, Fuels and Fuel Additives website. URL: www.epa.gov/otaq/regs/fuels/ostp-2.pdf

Appendix A
 NNEPA Leaking UST Process Flowchart



APPENDIX B

Analytical method	Chemical Group	Container	Preservative	Minimum Sample ³	Maximum Holding Time
8021B	BTEX, MTBE, TBA, Lead Scavengers	G-TLS	HCl to pH<2 4°C	2x40 ml.	14 days 7 days if pH>2
8260B ^{1,2}	BTEX, MTBE, TBA, Lead Scavengers	G-TLS	H ₂ SO ₄ or HCl or NaHSO ₄ to pH<2, 0.1% trisodium phosphate to pH>10. 4°C	2x40 ml.	14 days 7 days if pH>2
8270C	PAHs	G-TLC (amber)	4°C	1000ML.	7 days until extraction and 40 days after extraction
8310	PAHs	G-TLC (amber)	4°C	1000ml.	7 days until extraction and 40 days after extraction
6010B	metals (except mercury)	P, G	HNO ₃ to pH<2 4°C	500 ml.	6 months
6020	metals (except mercury)	P, G	HNO ₃ to pH<2 4°C	500 ml.	6 months
7470	Mercury	P, G	H ₂ SO ₄ or HCl to pH < 2, 4° C	500 ml	28 days
8015	Solvents	G – TLC	H ₂ SO ₄ or HCl to pH<2, 4° C	1000 ml	48 hours
1664	TPH	G – TLC	H ₂ SO ₄ or HCl to pH<2, 4° C	1000 ml	28 days

1. BTEX, MTBE, and TBA can be analyzed from a single sample provided that the sample is not preserved with acid.
2. Preservation of MTBE samples with HCl to prevent biodegradation may cause hydrolysis. As a result, trisodium phosphate 12 hydrate is preferred for MTBE sample preservation. This works out to 0.4 g/40 ml VOA vial to increase the pH to pH>10. Dry granular powder added to vial in lab. Do not be concerned about potential blue floc.
3. This minimum sampling does not include various quality control samples.

G– TLS = Glass with Teflon (pTFE)lined septum
 G- TLC = Glass with Teflon (PTFE) lined cap
 G- TLC (amber) = Amber glass with Teflon (PTFE) lined cap
 G = Glass
 P = Polyethylene
 PTFE = Teflon

Analytical method	Chemical Group	Container	Preservative	Minimum Sample³	Maximum Holding Time
8021B	BTEX, MTBE, TBA, Lead Scavengers	G-TLS	HCl to pH<2 4°C	2x40 ml.	14 days 7 days if pH>2
8260B ^{1,2}	BTEX, MTBE, TBA, Lead Scavengers	G-TLS	H ₂ SO ₄ or HCl or NaHSO ₄ to pH<2, 0.1% trisodium phosphate to pH>10. 4°C	2x40 ml.	14 days 7 days if pH>2
8270C	PAHs	G-TLC (amber)	4°C	1000ML.	7 days until extraction and 40 days after extraction
8310	PAHs	G-TLC (amber)	4°C	1000ml.	7 days until extraction and 40 days after extraction
6010B	metals (except mercury)	P, G	HNO ₃ to pH<2 4°C	500 ml.	6 months
6020	metals (except mercury)	P, G	HNO ₃ to pH<2 4°C	500 ml.	6 months
7471A	Mercury	P, G	HNO ₃ to pH<2	500 ml	28 days
8015	Solvents, TPH	G – TLC	H ₂ SO ₄ or HCl to pH<2, 4° C	1000 ml	48 hours
1664	TPH	G – TLC	H ₂ SO ₄ or HCl to pH<2, 4° C	1000 ml	28 days

1. BTEX, MTBE, and TBA can be analyzed from a single sample provided that the sample is not preserved with acid.
2. Preservation of MTBE samples with HCl to prevent biodegradation may cause hydrolysis. As a result, trisodium phosphate 12 hydrate is preferred for MTBE sample preservation. This works out to 0.4 g/40 ml VOA vial to increase the pH to pH>10. Dry granular powder added to vial in lab. Do not be concerned about potential blue floc.
3. This minimum sampling does not include various quality control samples.

G– TLS = Glass with Teflon (pTFE)lined septum
G- TLC = Glass with Teflon (PTFE) lined cap
G- TLC (amber) = Amber glass with Teflon (PTFE) lined cap
G = Glass
P = Polyethylene
PTFE = Teflon

APPENDIX C

Table 4. Water Clean Up Standards					
	CAS Num	EPA Weight of Evidence Class	Water Clean Up Standard**(ug/l)	Source	EPA Method
BTEX					
Benzene	71-43-2	A	5	Federal Drinking water MCL	8021B
toluene	108-88-3	D	1000	Federal Drinking water MCL	
Ethylbenzene	100-41-4	D	700	Federal Drinking water MCL	
Xylenes (total)	1330-20-7	D	1000	Federal Drinking water MCL	
PAH					
Acenaphthene	83-32-9	NA*	670	National Recommended Water Quality Criteria	8270C 8310
Anthracene	120-12-7	D	8300	National Recommended Water Quality Criteria	
Benz(a)anthracene	56-55-3	B2	0.0028	National Recommended Water Quality Criteria	
Benzo(a)pyrene	50-32-8	B2	0.2	Federal Drinking water MCL	
Benzo(b)fluoranthene	205-99-2	B2	0.0028	National Recommended Water Quality Criteria	
Benzo(k)fluoranthene	207-08-9	B2	0.0028	National Recommended Water Quality Criteria	
Chrysene	218-01-9	B2	0.0028	National Recommended Water Quality Criteria	
Dibenzo(a,h)anthracene	53-70-3	B2	0.0028 (0.03)	National Recommended Water Quality Criteria	
Fluoranthene	208-44-0	D	300	National Recommended Water Quality Criteria	
Fluorine	86-73-7	D	1300	National Recommended Water Quality Criteria	
Indeno(1,2,3,-c,d)pyrene	193-39-5	B2	0.0028	National Recommended Water Quality Criteria	
Naphthalene	91-20-3	C	6.2	EPA Region 9 Tap Water PRGs "Cal Modified"	
Phenanthrene	85-01-8	D	6.2	State of New Mexico	
Pyrene	129-00-0	D	960	National Recommended Water Quality Criteria	
Lead	7439-923-1	B2	15	Federal Drinking water MCL	
Additives					
MTBE	1634-04-4	NA	2.6 (5)	EPA Region 3 Tap Water RBCs	8260B
TBA	75-65-0	B2	12	State of California	
EDB	106-93-4	B2	0.05	Federal Drinking water MCL	
EDC OR 1, 2 DCA	107-06-2	B2	5	Federal Drinking water MCL	

* Not Assigned

** Analytical method detection limit is in parentheses after clean up standard

MCL = Maximum Contaminant Levels

Table 4. Soil Clean Up Standards					
	CAS Num	EPA Weight of Evidence Class	Soil Clean Up Standard+ (mg/kg)	Source	Source EPA Method
TEX					
Benzene	71-43-2	A	0.002 (0.5)	Calculated (see text)	8021B 8260B
toluene	108-88-3	D	0.6	Calculated (see text)	
Ethylbenzene	100-41-4	D	0.7	Calculated (see text)	
Xylenes (total)	1330-20-7	D	7	Calculated (see text)	
PAH					
Acenaphthene	83-32-9	NA*	10	Calculated (see text)	8270C 8310
Anthracene	120-12-7	D	490	Calculated (see text)	
Benz(a)anthracene	56-55-3	B2	0.002	Calculated (see text)	
Benzo(a)pyrene	50-32-8	B2	0.4	Calculated (see text)	
Benzo(b)fluoranthene	205-99-2	B2	0.007	Calculated (see text)	
Benzo(k)fluoranthene	207-08-9	B2	0.007	Calculated (see text)	
Chrysene	218-01-9	B2	0.002	Calculated (see text)	
Dibenzo(a,h)anthracene	53-70-3	B2	0.02	Calculated (see text)	
Fluoranthene	208-44-0	D	64	Calculated (see text)	
Fluorine	86-73-7	D	36	Calculated (see text)	
Indeno(1,2,3,-c,d)pyrene	193-39-5	B2	0.02	Calculated (see text)	
Naphthalene	91-20-3	C	0.02	Calculated (see text)	
Phenanthrene	85-01-8	D	0.3	Calculated (see text)	
Pyrene	129-00-0	D	200	Calculated (see text)	
TPH					
Gasoline			500		8015B – G 8015 B – G 1664
Diesel			500		
Waste Oil			500		
Lead	7439-923-1	B2		State of New Mexico	6010B, 6020
Additives					
MTBE	1634-04-4	NA		Calculated (see text)	8260B
TBA	75-65-0	B2		Calculated (see text)	
EDB	106-93-4	B2		Calculated (see text)	
EDC OR 1, 2 DCA	107-06-2	B2		Calculated (see text)	

* Not Assigned

+ The soil standards are based on values protective of groundwater and where calculated using NNEPA LUST target water concentrations and a DAF of 1.

** The estimated analytical method detection limit is in parentheses after the clean up standards. Due to variations in instruments and laboratory practices, Detection Levels may vary somewhat.