



“Creation of the Navajo Cleanup Standards”

Henry Haven, Geologist

Navajo EPA Leaking Storage Tank
Program

2016 Tribal Lands & Environmental Forum
Mohegan Sun Uncasville, Connecticut
August 15-18, 2016

FEB 11 2004

Introduction

Fundamental Law of the Dine'

Our Language and Traditional Beliefs

Creation stories vs Western Science

Sacred elements

Navajo Cleanup standards



I was not sure of ownership on photos or quotes if used. I credited the photos where I could. I used the images for limited use only and for presenting an idea and comparison of Navajo stories to science.



Ya'a't'eeh

Means "greetings" in the Navajo Language



Adoone'e



I am Hona'gha'ahnii (One that walks around you- mother's side)

Born for To'dich'i'i'nii (Bitter Water - father's side)

Ta'chii'nii (Red Water - maternal grandfather)

Ma'ii Deeshgiizhnii (Coyote Pass - Paternal side Nali)

Canyon DeChelly, Navajo Nation

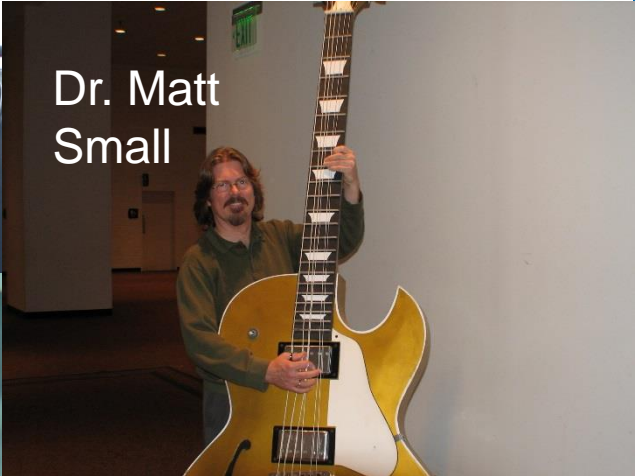
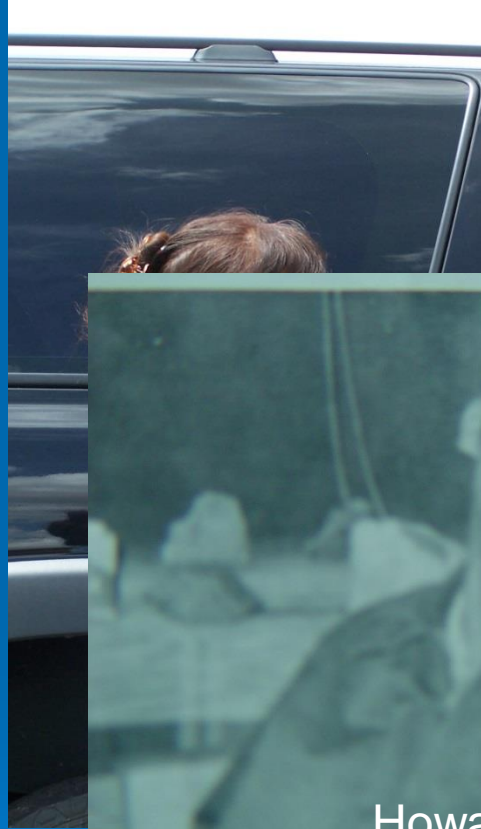
ACKNOWLEDGEMENTS

Arlene Luther



Arlene Luther

March 5, 1948-2008



NOV 26 2010



Chinle Wildcat Team 1970

My Old School House, Chinle, Arizona circa 1958





1977 Superior Oil
Drilling along the Gulf
Coast in Texas.

Smithsonian report 1855—Dr. Jonathan Letherman of the U.S. Army. Station at Fort Defiance for 3 years wrote, “Of their religion (Navajo),” he wrote, “little or nothing is known, as, indeed, all inquiries tend to show that they have none.” “The lack of tradition is a source of surprise. They have no knowledge of their origin or of the history of the tribe.” “they have frequent gatherings for dancing.” “Their singing is but a succession of grunts and is anything but agreeable.”



Navajo Nation WWII Codetalkers— a code that Japanese never broke.



*Navajo code talkers on Bouganville, USMC
official photo*

NAVAJO NATION LOCATION MAP

Naabeehó Bináhásdzo

Approximately 27,000
square miles

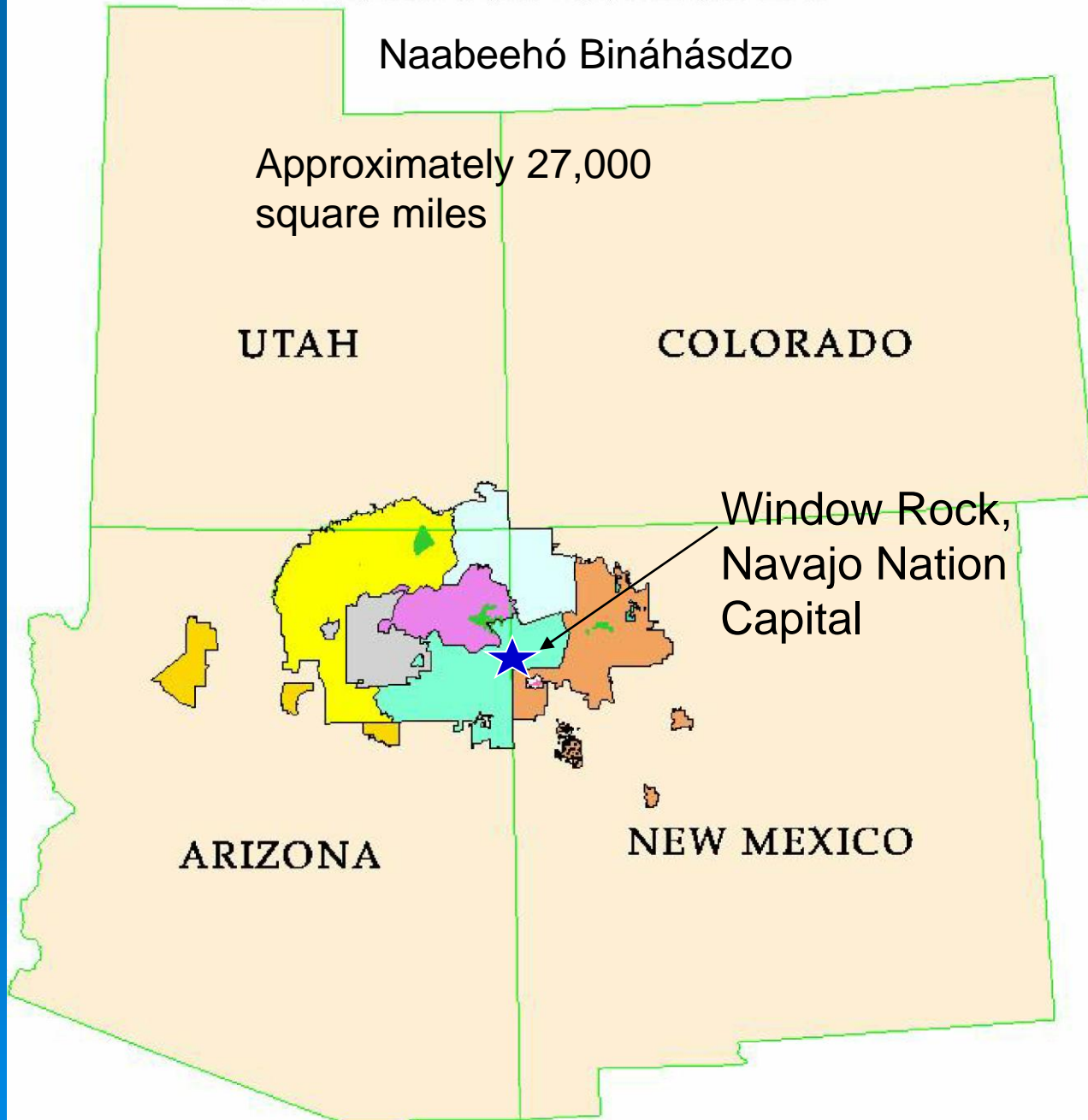
UTAH

COLORADO

Window Rock,
Navajo Nation
Capital

ARIZONA

NEW MEXICO





The Fundamental Laws of the Dine

Dine' Bi Beehaz' aanii Bitse Silei

The creation of our life. Our way of life is like an act of prayer.

“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*

2004 Monument Valley, Utah

The Navajo Creation Story

Voices of memories from the beginning
of time.....



IN THE BEGINNING...jini

One who grew up in
the middle of the
universe -

The first world was small, a floating island
in mist and water in the middle of four seas.

Our creator (Ya'alnii'
nee'yani) blew air into
the earth and added
layers of clay to make it
bigger for us.

Science--

Around 200 million years ago
(Jurassic Time) there existed
one large supercontinent called
Pangaea



Science - The most abundant element in the earth's crust is oxygen. Oxygen makes up 46.8% of the earth's crust. Gravity pulls dust into tiny rocks and over millions of years gravity pulls these rocks to form planets...

The Navajo creation stories from our elders tell us emergence (Hajiinei) and progression through different worlds of the people.

Navajo origin stories begin with a First World of darkness (Nihodilhil). From this Dark World the Dine began a journey of emergence into the world of the present

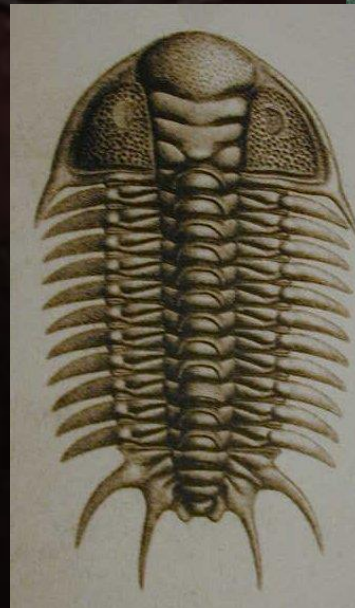
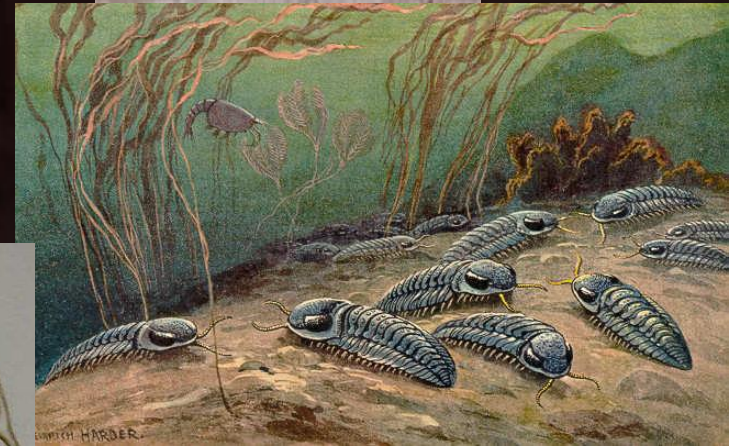
The first world was the “dark world” inhabited by insects.

SCIENCE---

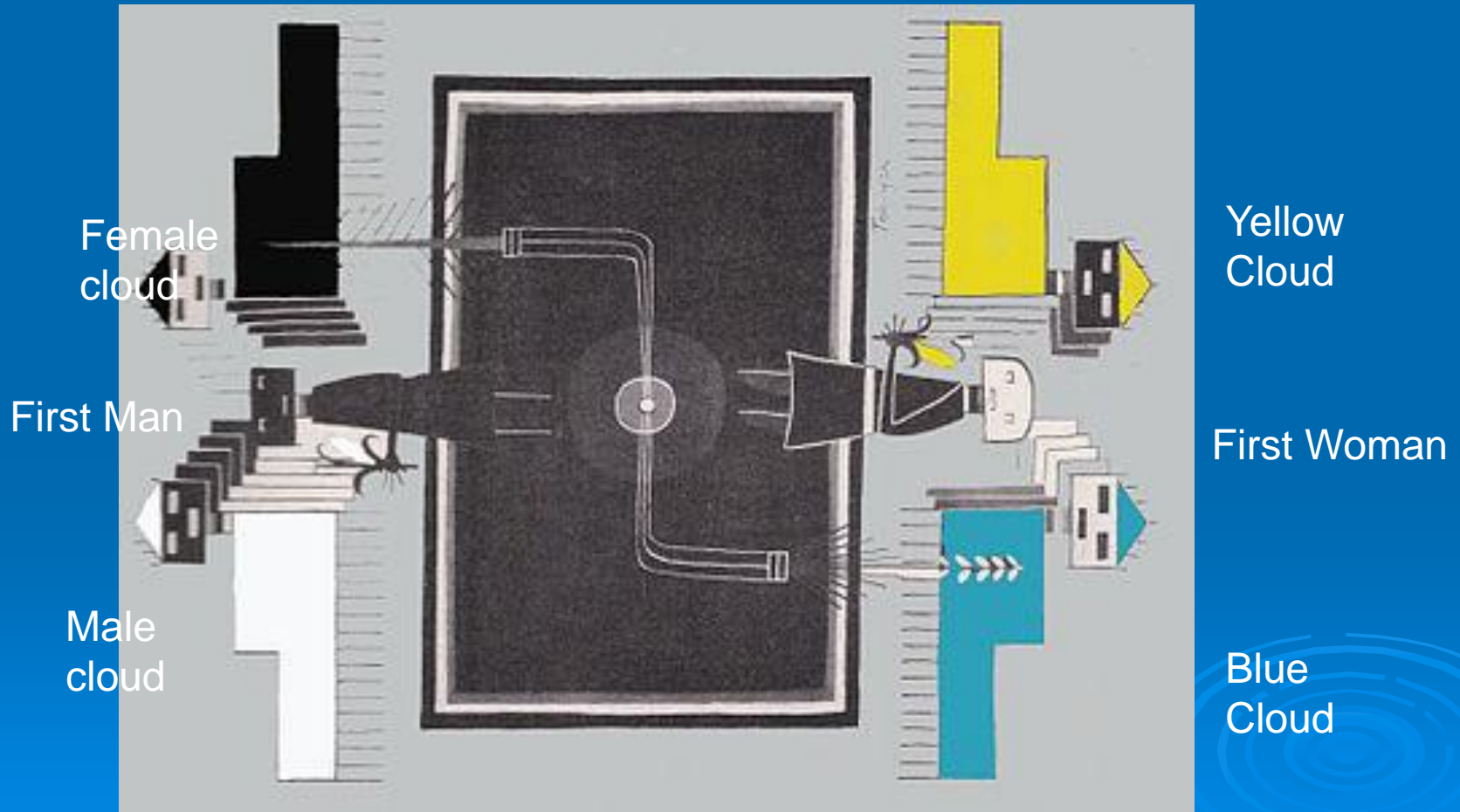
Trilobites – early Cambrian 526 million years ago roaming the oceans. Mass Extinction end of Permian period 250 million years ago



sect



The inhabitants of the **first world** were Diyin Dine é, Coyote, mist beings and various insect people. The supernatural beings First Woman and First Man came into existence here and met for the first time after seeing each other's fire. First Man burned a quartz crystal for a fire and the First woman burned a turquoise crystal.

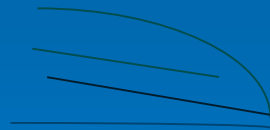


SCIENCE: Quartz crystals have piezoelectric properties, meaning that they are capable of changing a mechanical force into electricity, or an electric current into a mechanical force. A slice, or wafer, of quartz crystal will generate an electric current when it is subjected to pressure. Everyday uses such as acting as the ignition source for [cigarette lighters](#) and push-start [propane barbecues](#) .



First Man and First Women were created from ears of white and yellow corn by the holy people.

The east wind blew between the two buckskins and gave them life. This is how life began.



East
Wind



Did Life First Develop in a Mica Sandwich at the Bottom of a Primordial Sea?

News story originally written on December 4, 2007

Earth's first life form may have developed between the layers of a chunk of mica sitting like a multilayered sandwich in primordial waters, according to a new hypothesis.

The mica hypothesis, which was developed by Helen Hansma of the National Science Foundation (NSF), proposes that the compartments between layers of mica -- a common mineral that cleaves into smooth sheets -- could have provided the shelter and protection needed for molecules to organize into cells.



The four sacred elements were created in the first world or the natural laws.

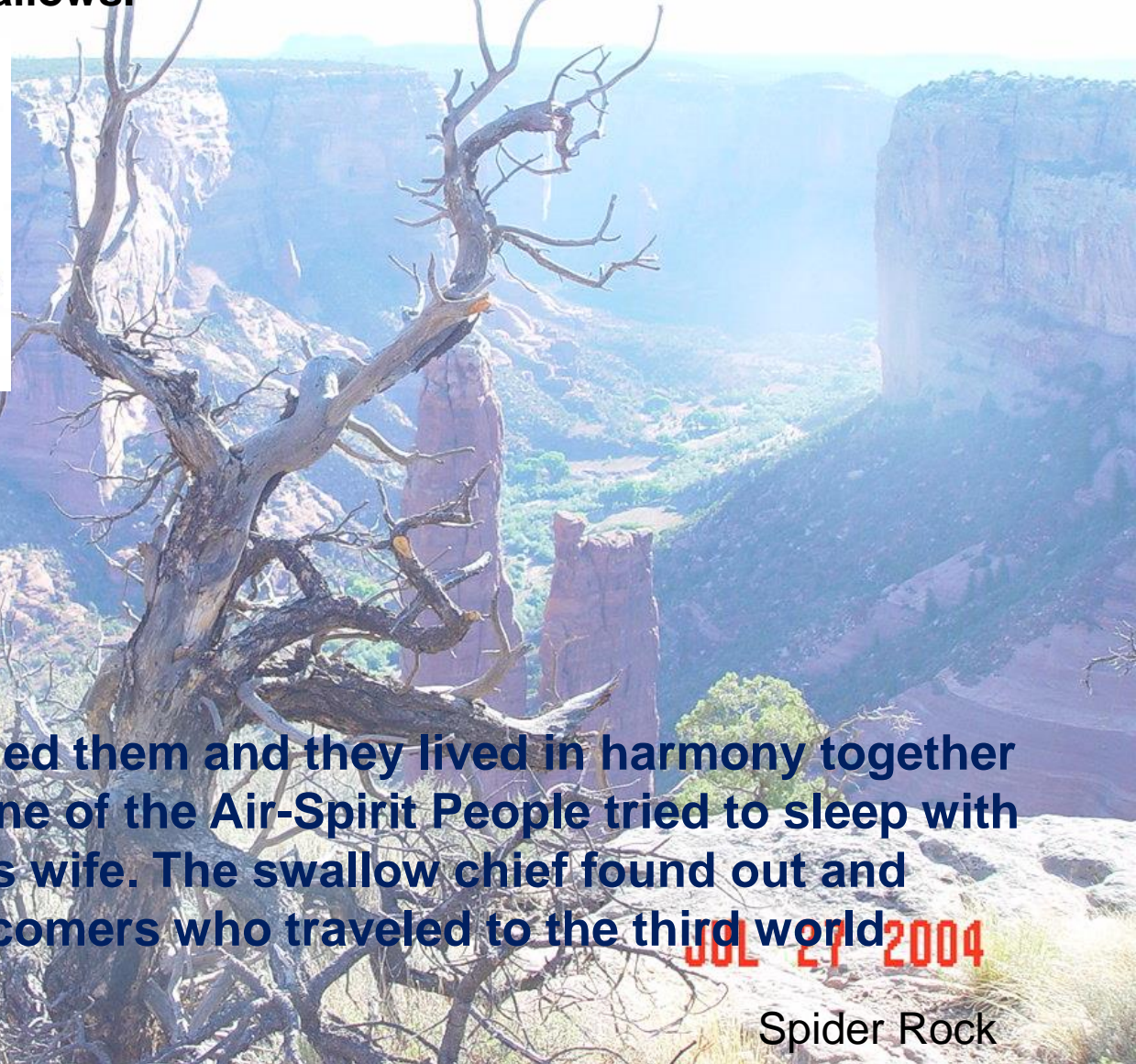
Earth, fire, wind, and water





The first world was small and got crowded, the people quarreled, and made living very unhappy. Some say the first world was destroyed by FIRE


They journeyed to the Second World, Ni' Hodootł izh (Blue World), which was inhabited by various mammals and various birds, including blue swallows.



A swallow welcomed them and they lived in harmony together for 23 days until one of the Air-Spirit People tried to sleep with the swallow chief's wife. The swallow chief found out and banished the newcomers who traveled to the third world.

JUL 27 2004

Spider Rock



**Some say the air
spirited people
destroyed the second
world by ICE.**

In the **Third World**, Ni Haktsooí, “yellow world,” there were two rivers that formed a cross and the six Sacred Mountains, but there was still no sun. More animal spirit beings lived here too.





The **third world** was destroyed by a flood. This time a great flood was caused by the **Big Water Creature (Tééhoołtsódii)** when **Coyote** stole her two babies. It rain and rain and flooded the third world.

It is said that coyote gave the male baby back and kept the female baby. She became the female rain.

At this time, they had seen the water slowly going away in the distance. Gradually the earth rose, the water ran away, and they saw it no more.

Science: Isostatic Rebound. As water moves away land rises.

“Diyin Dine’e”
Holy earth
people.



Dine’ emerged from three previous underworlds into the **fourth world** called the **“Glittering World or the white world.”** Ni’hodisos in Navajo.

The locust was the first to arrive. He was the first to explore the land in the first world. He went into the ground to explore and never came back until the fourth world. He is the defender of all lands.

SCIENCE

Pictures from space of the earth and a view from Saturn showing the moon and the earth.

Pictures from NASA’s Cassini spacecraft





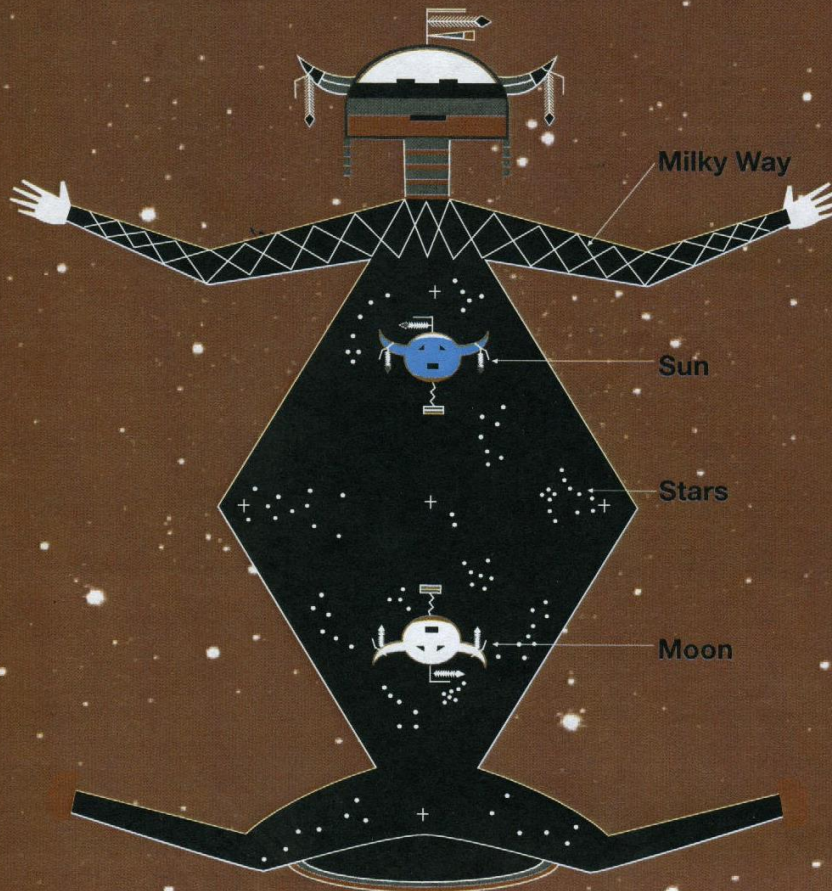
""The fifth world,"" as an old Navajo said, "would not come for thousands of years. Man does not know of its coming. As long as the plants and animals continue to live and grow, we are in the 'fourth world.' When they are gone, we will be somewhere else."

All life and geological formations are animated and connected by means of life giving holy winds, sacred water, and fire....Roman Bitsuie.

Science: The Milky Way is the galaxy that contains our Solar System. The Milky Way is home to us humans. It contains our solar system. The Milky Way does not sit still, but is constantly rotating. As such, the arms are moving through space



Father Sky The Living Universe



Chinle Curriculum Center

First Man and First Women first offered prayers by sprinkling cornmeal above the early dawn turning into milky way. The stars stretched and whirled around Mother earth becoming a protective shield.

Today Navajo people sprinkle corn pollen toward the early dawn. In Navajo Sand paintings, the Milky way stretches across Father Sky's body to help, heal and restore harmony and balance in people's lives.

Father sky is the home to all the stars, moons, and planets.

To the Diné, Yikaisdahi, the Milky Way, is our home.

SCIENCE EMERGENCE

Geologic Time Scale Four Time Periods

Cenozoic Era

65 mya to present

Mesozoic Era

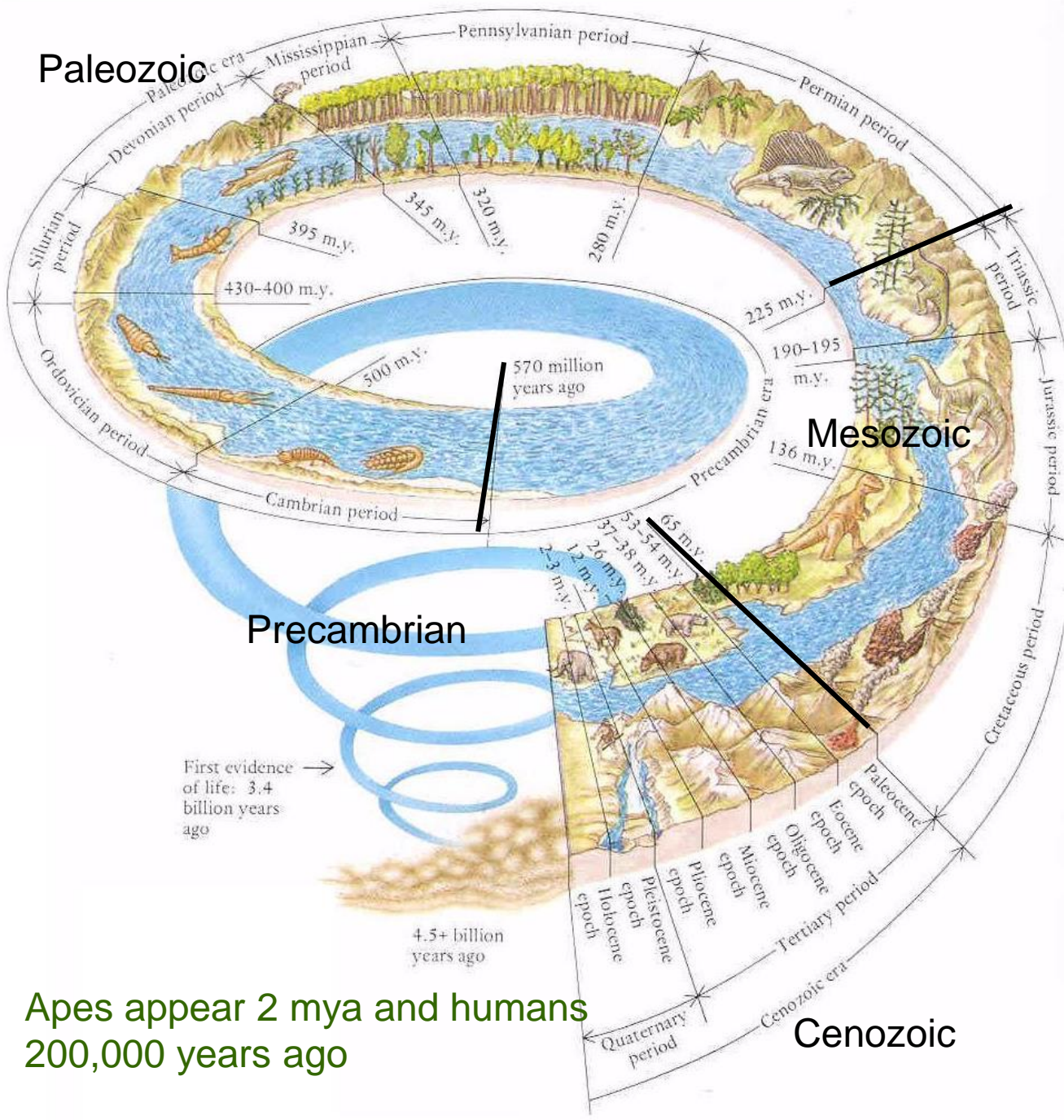
225 to 65 mya

Paleozoic Era

570 to 225 mya

Precambrian

Era 4.5 billion to
570 million years
ago



Paleozoic

Mesozoic

Precambrian

Cenozoic

Apes appear 2 mya and humans
200,000 years ago

First evidence
of life: 3.4
billion years
ago

4.5+ billion
years ago

570 million
years ago

Navajo Traditions & Culture

Navajo Fundamental laws declares that all humans and other life forms need clean air and clean water and that human care and protection of the land is consistent with K'e or a duty of maintaining respect and reverence for fire, water, air, and mother earth.

Protect our environment and care for Mother Earth for our children's grandchildren so they enjoy a place on this earth.

We appreciate all living things (life) and the following sacred elements land, air, water, and light.

K'e is how to live in balance with nature and all of Mother Earth's inhabitants and surroundings. All life forms, including humans, are connected to each other.

Attain balance between hozho (condition of a perfect state) and nayee or ate'el'inigii (one that kills).

OCT 20 2004

Natural Pond in Tuba City, AZ

It is imperative that contaminated groundwater be restored to pristine conditions because of the importance of the environment to religious ceremonies and the essential life giving precious water to all land, plants, animals, and people.



A Navajo medicine man cannot store the materials needed for ceremonies and thus must have access to uncontaminated soil, plants, and water when a ceremony is to take place.

Navajo Nation Council Resolution

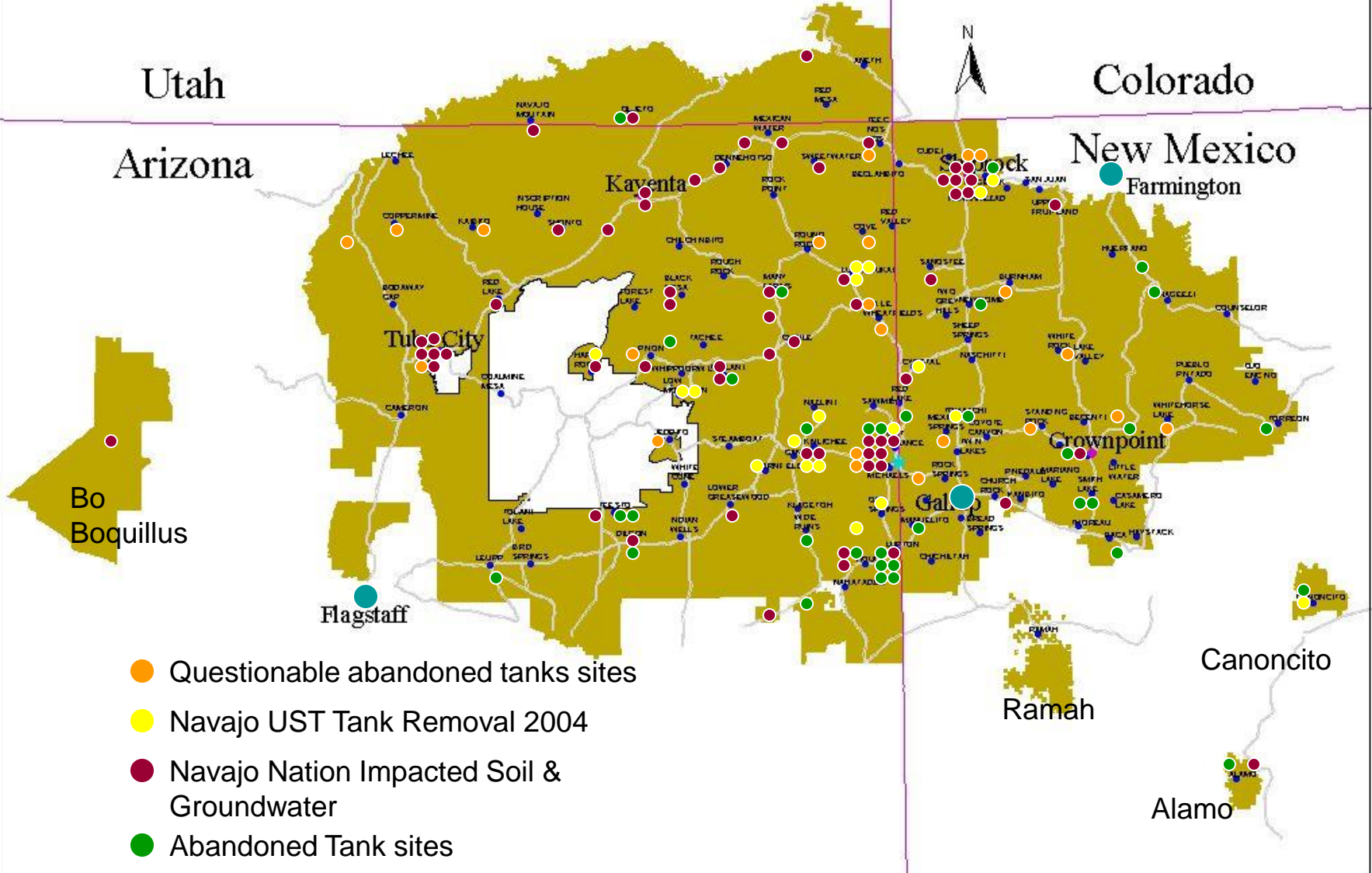
CAP-47-95

In the Navajo Way, the Earth is our Mother, the mountains part of her sacred body, the water courses her veins and arteries. When the Earth is injured, the resultant instability, imbalance and disharmony bring illness to life on Earth including human kind.”



Navajo Nation Impacted Soil and Groundwater

hhaven Leaking UST Program 1/30/13






“So people (*Navajo*) haul water, as many as 80 percent of people in some communities.” Shaun McKinnon -The Arizona Republic
Aug. 26, 2007



Pump and Treat



The image shows an oil pumpjack in a desolate, arid landscape. The ground is cracked and dry, with a large, shallow, muddy pool of water in the foreground. The sky is overcast and grey. In the background, there are more pumpjacks and utility poles on a hillside.

Cleanup Standards should incorporate the value of 'sacredness' for land, water and air to protect Groundwater. We believe it's appropriate to set the point of compliance at leaking sites at the source area and/or the point of highest Contaminant of concern (COC) concentrations as determined during site assessment activities.

DEC 13 2002

NAPI Farmington, NM

Navajo Nation Petroleum Cleanup Standards Development

Henry Haven Jr., Navajo
Nation EPA

Matt Small, U.S. EPA

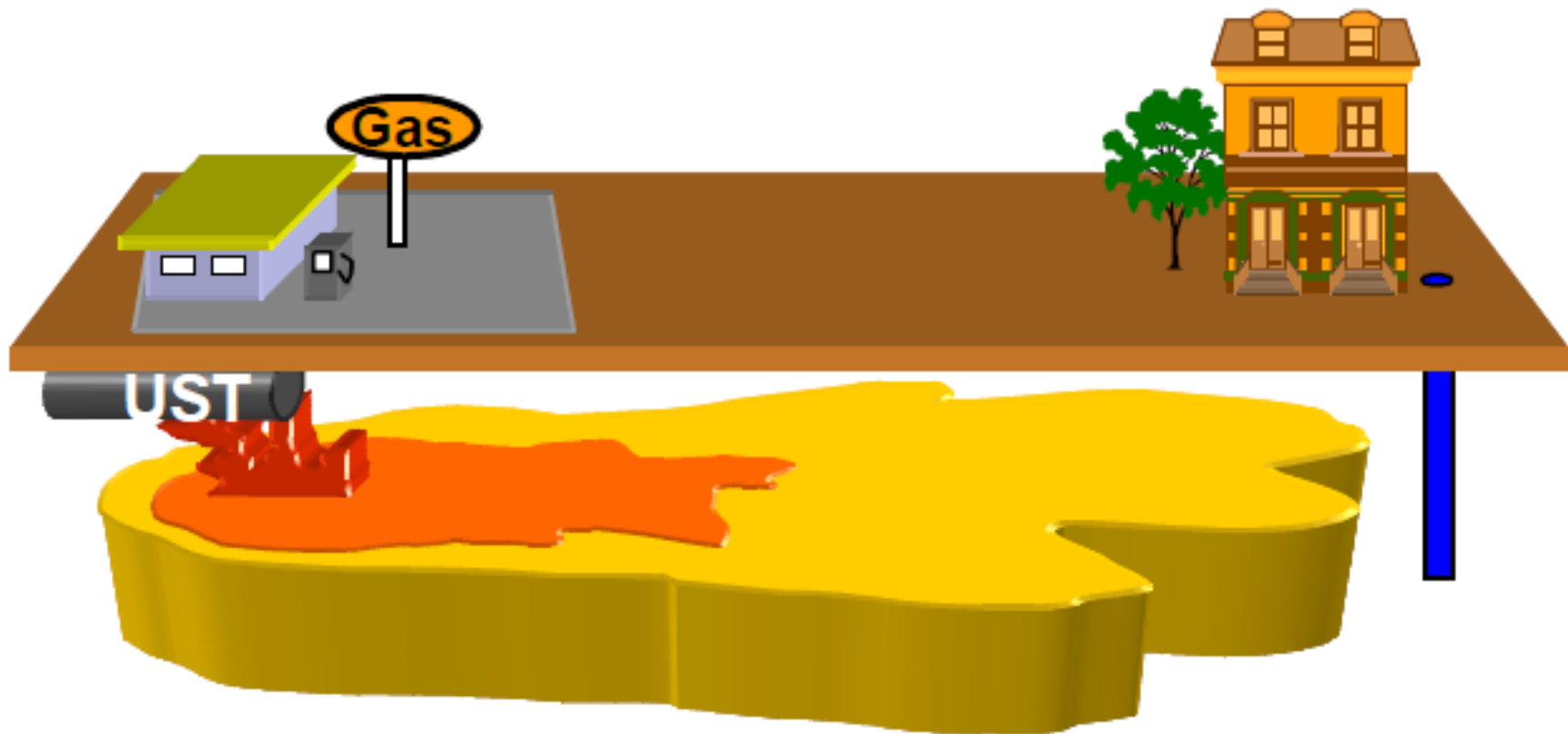
Draft

**THE NAVAJO NATION
EPA UST/LEAKING UST SOIL AND WATER
CLEAN UP STANDARDS
2004**



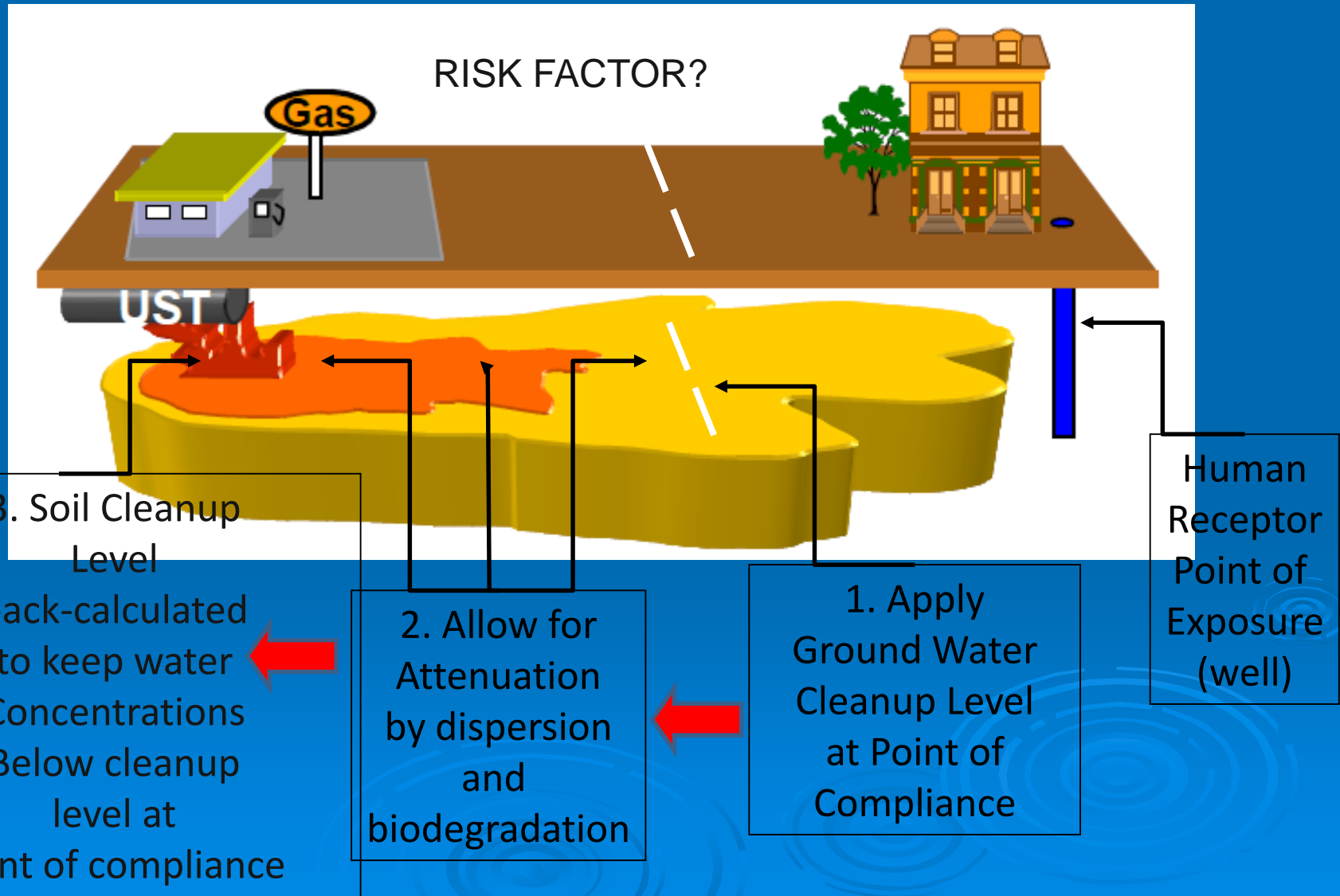
“In the Navajo Way, the Earth is our Mother, the mountains part of her sacred body, the water courses her veins and arteries. When the earth is injured, the resultant instability, imbalance and disharmony bring illness to life on Earth including mankind.”

Nihima’ Dini’sin Baa’aho’Iya’
“Keep Mother Earth sacred and take care of her”

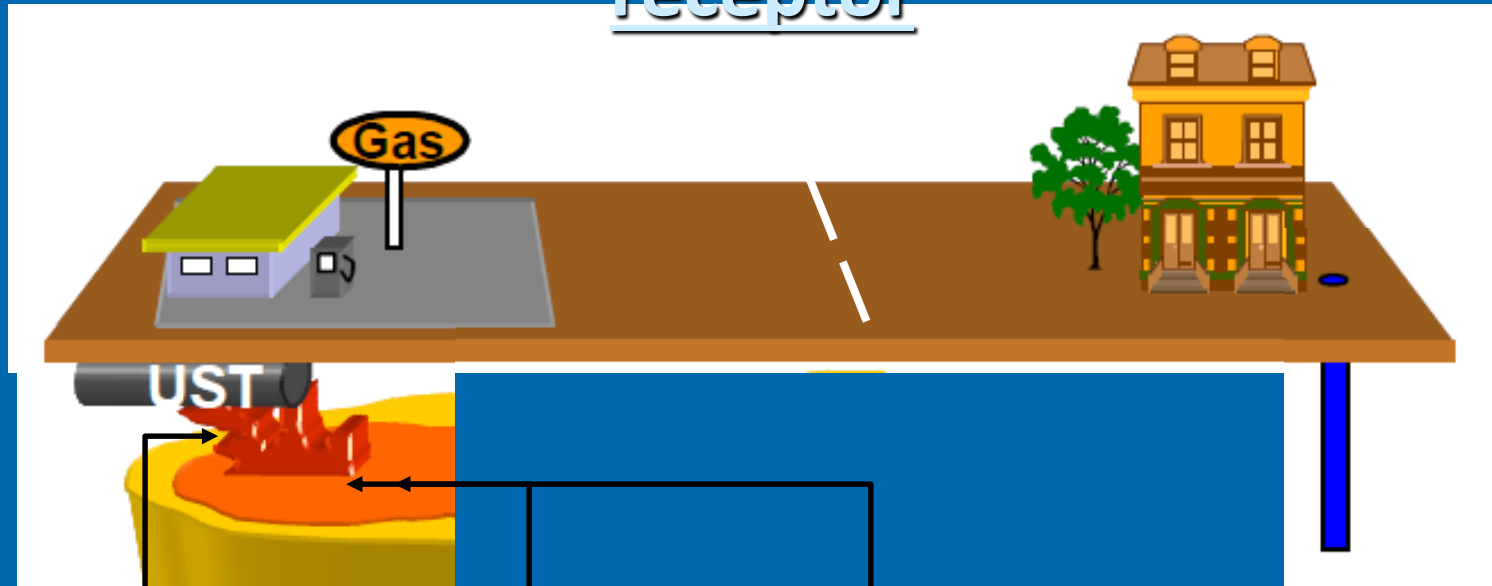


Sources → Pathways → Receptors

Soil Cleanup levels “back calculated” from the point of compliance, to protect the receptor



Navajo Soil Cleanup levels “back calculated” from the first water contacted, to protect water as the receptor



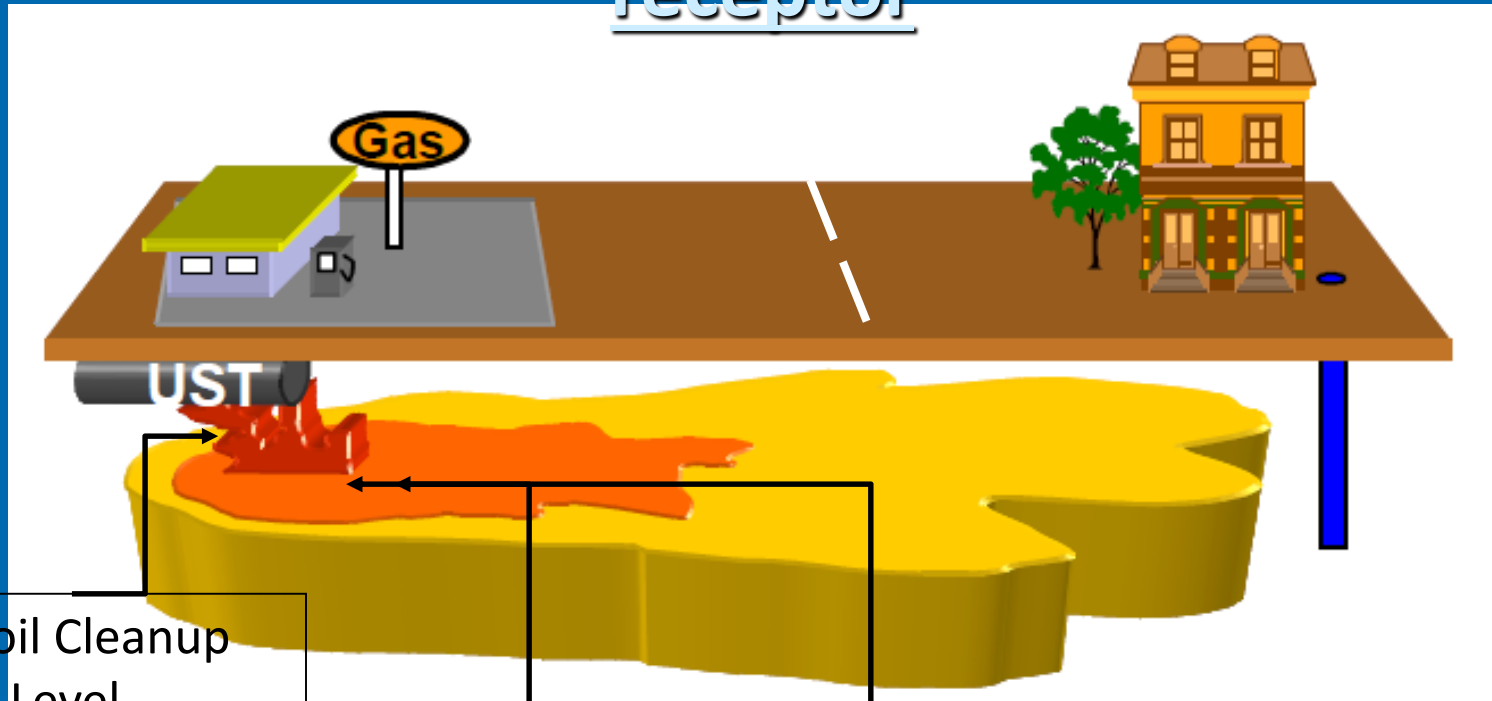
2. Soil Cleanup Level

back-calculated to keep water Concentrations Below cleanup level at point of compliance

1. Apply Ground Water Cleanup Level at first water contacted at the site

first water contacted at the site is both the Point of Compliance And the Receptor

Navajo Soil Cleanup levels “back calculated” from the first water contacted, to protect water as the receptor



2. Soil Cleanup Level back-calculated to keep water Concentrations Below cleanup level at point of compliance

1. Apply Ground Water Cleanup Level at first water contacted at the site

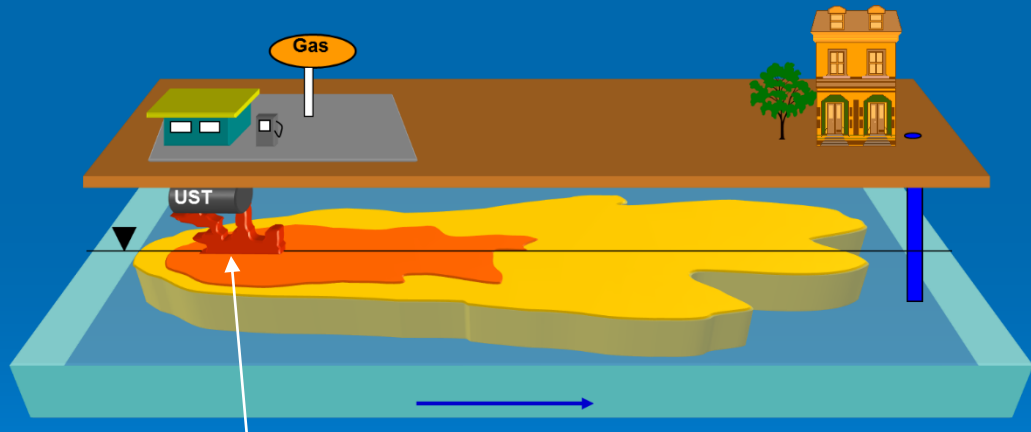
first water contacted at the site is both the Point of Compliance And the Receptor



$$C_w \left[K_d + \frac{(\theta_w + \theta_a H')}{\rho_b} \right] = \text{Screening Level for Soil}$$

Where:

- C_w is the target water cleanup goal from Table 4.(mg/L). Chemical-dependent.
- K_d is the soil-water partition coefficient (L/kg). calculated by multiplying K_{oc} by f_{oc}.
- K_{oc} is the soil organic carbon/water partition coefficient (L/kg). Chemical-dependent.
- 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}). equal to n - θ_w. default value is 0.13
- n is the soil porosity (L_{pore}/L_{soil}). equal to 1 – (p_b/p_s). 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.



Key Point, DAF=1

Screening levels for soil are calculated without dilution or attenuation. This means that the point of compliance for groundwater contamination is at the water table at the first point of contact between contaminated soil and the groundwater. The point of compliance is not downgradient and it is not at the property boundary.

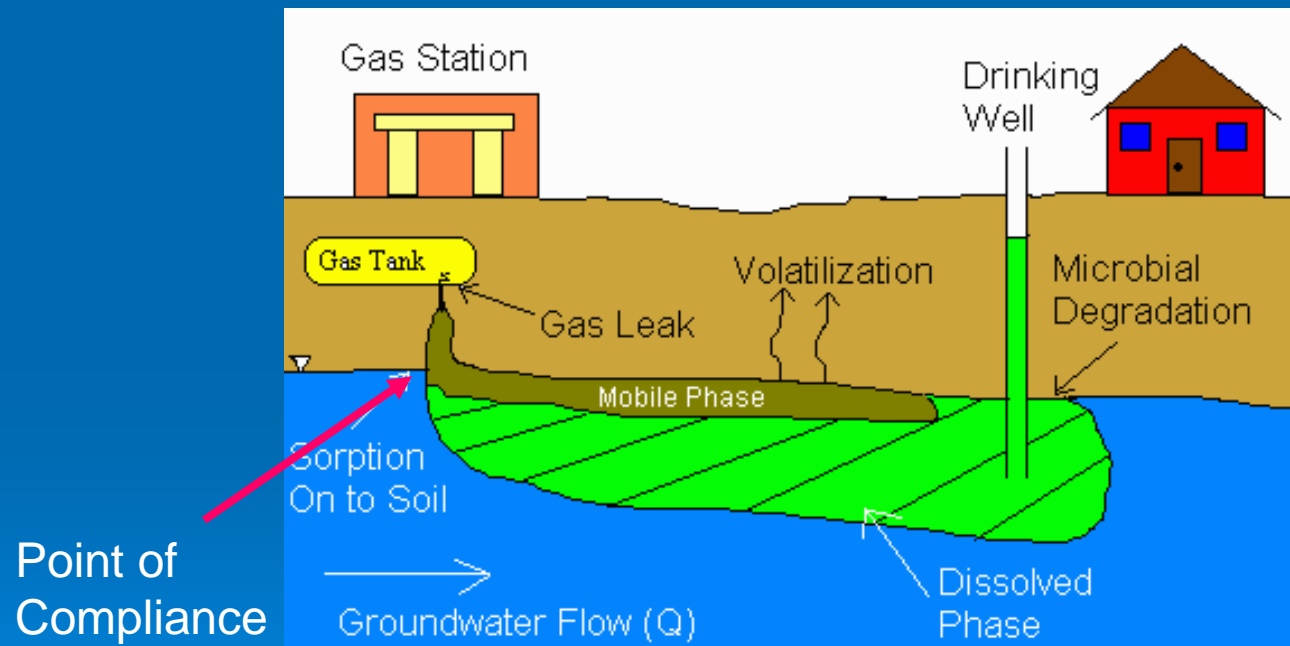
Table 4. Water Clean Up Standards

	Water Clean Up Standard ** (ug/l)	Source, MCL = Maximum Contaminant Levels	EPA Method
BTEX			
Benzene	5	Federal Drinking water MCL	
Toluene	1000	Federal Drinking water MCL	
Ethylbenzene	700	Federal Drinking water MCL	
Xylenes (total)	10,000	Federal Drinking water MCL	
PAH			
Acenaphthene	670	National Recommended Water Quality Criteria	
Anthracene	8300	National Recommended Water Quality Criteria	
Benz(a)anthracene	0.0028	National Recommended Water Quality Criteria	
Benzo(a)pyrene	0.2	Federal Drinking water MCL	
Benzo(b)fluoranthene	0.0028	National Recommended Water Quality Criteria	
Benzo(k)fluoranthene	0.0028	National Recommended Water Quality Criteria	
Chrysene	0.0028	National Recommended Water Quality Criteria	
Dibenzo(a,h)anthracene	0.0028 (0.03)	National Recommended Water Quality Criteria	
Fluoranthene	300	National Recommended Water Quality Criteria	
Fluorine	1300	National Recommended Water Quality Criteria	
Indeno(1,2,3,-c,d)pyrene	0.0028	National Recommended Water Quality Criteria	8270C
Naphthalene	6.2	EPA Region 9 Tap Water PRGs "Cal Modified"	8310
Phenanthrene	6.2	State of New Mexico	
Pyrene	960	National Recommended Water Quality Criteria	
Lead	15	Federal Drinking water MCL	6010B, 6020
Additives			
MTBE	2.6 (5)	EPA Region 3 Tap Water RBCs	
TBA	12	State of California	
EDB	0.05	Federal Drinking water MCL	8260B
EDC OR 1, 2 DCA	5	Federal Drinking water MCL	

	Table 5. Soil Clean Up Standards		
	Soil Clean Up Standard+** (mg/kg)	Source	EPA Method
BTEX			
Benzene	0.002 (0.5)	Calculated (see text)	
Toluene	0.6	Calculated (see text)	
Ethylbenzene	0.7	Calculated (see text)	
Xylenes	7	Calculated (see text)	
PAH			
Acenaphthene	10	Calculated (see text)	
Anthracene	490	Calculated (see text)	
Benz(a)anthracene	0.002	Calculated (see text)	
Benzo(a)pyrene	0.4	Calculated (see text)	
Benzo(b)fluoranthene	0.007	Calculated (see text)	
Benzo(k)fluoranthene	0.007	Calculated (see text)	
Chrysene	0.002	Calculated (see text)	
Dibenzo(a,h)anthracene	0.02	Calculated (see text)	
Fluoranthene	64	Calculated (see text)	
Fluorine	36	Calculated (see text)	
Indeno(1,2,3-c,d)pyrene	0.02	Calculated (see text)	
Naphthalene	0.02	Calculated (see text)	
Phenanthrene	0.3	Calculated (see text)	8270C
Pyrene	200	Calculated (see text)	
TPH			
Gasoline	500		
Diesel	500		
Waste Oil	500		
Lead	54	State of New Mexico	6010B, 6020
Additives			
MTBE	0.0006	Calculated (see text)	
TBA	0.003	Calculated (see text)	
EDB	0	Calculated (see text)	8260B
EDC OR 1, 2 DCA	0.001	Calculated (see text)	

Why is Point of Compliance Important?

We must address contamination at the source and address impacted groundwater resources at the point where contamination meets the groundwater -- not downgradient. Its too late when contamination reaches the drinking water well.



In view of cultural and traditional values - Navajo EPA cleanup standards:

does not endorse a tiered approach to remediation.

believes that promulgating a single value for each contaminant for each medium best serves the Navajo cultural and traditional values.

recognizes the nature of the relationship between the Navajo people and the natural resources they live on, it is appropriate to set a point of compliance at leaking source area and/or the point of highest contaminant of concern concentrations.

will not consider Monitored Natural Attenuation as an acceptable cleanup method unless contamination levels are within 10% of the values of the relevant cleanup standards.

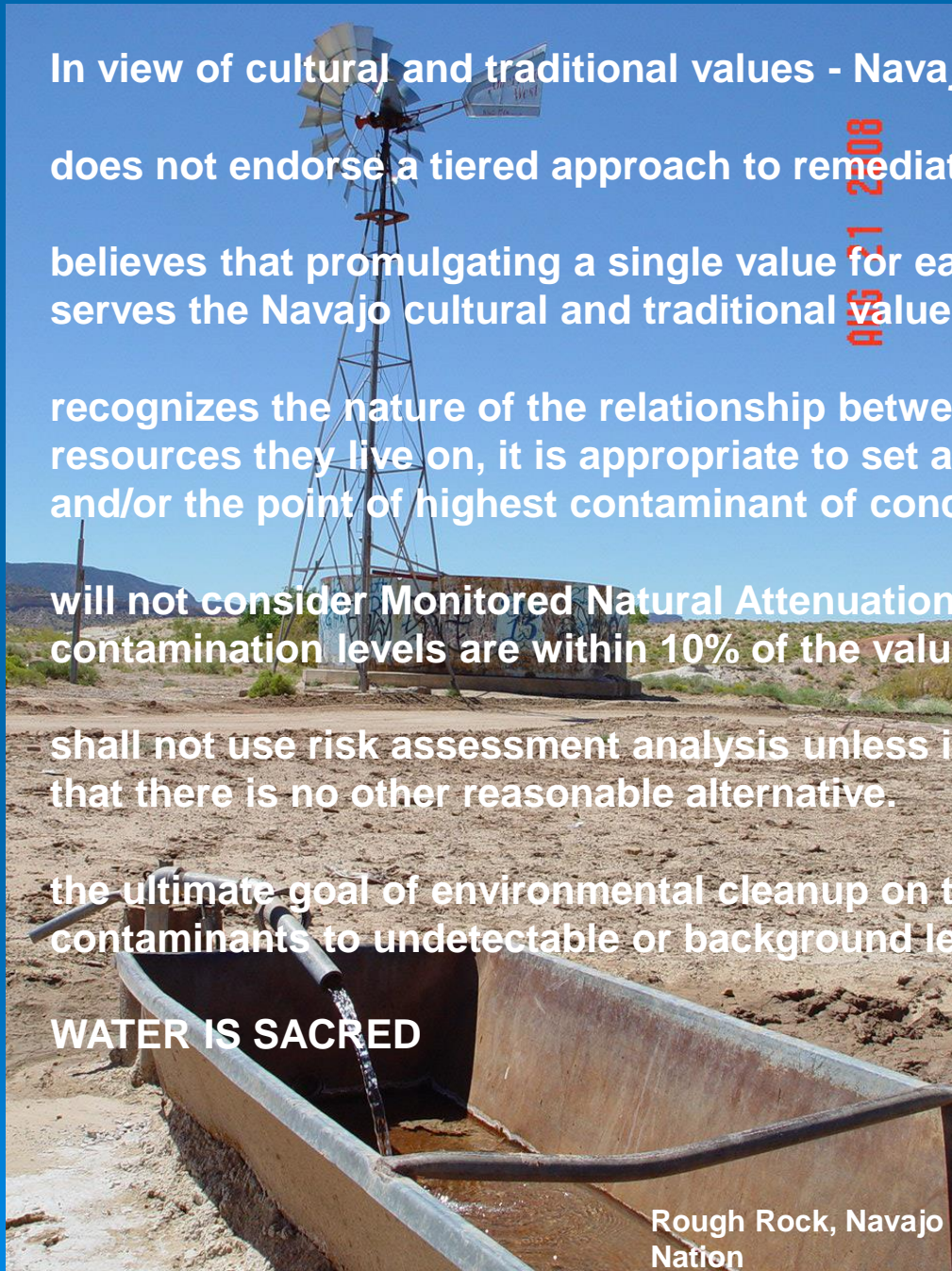
shall not use risk assessment analysis unless it is convincingly proven and agreed upon that there is no other reasonable alternative.

the ultimate goal of environmental cleanup on the Navajo Nation is to reduce contaminants to undetectable or background levels.

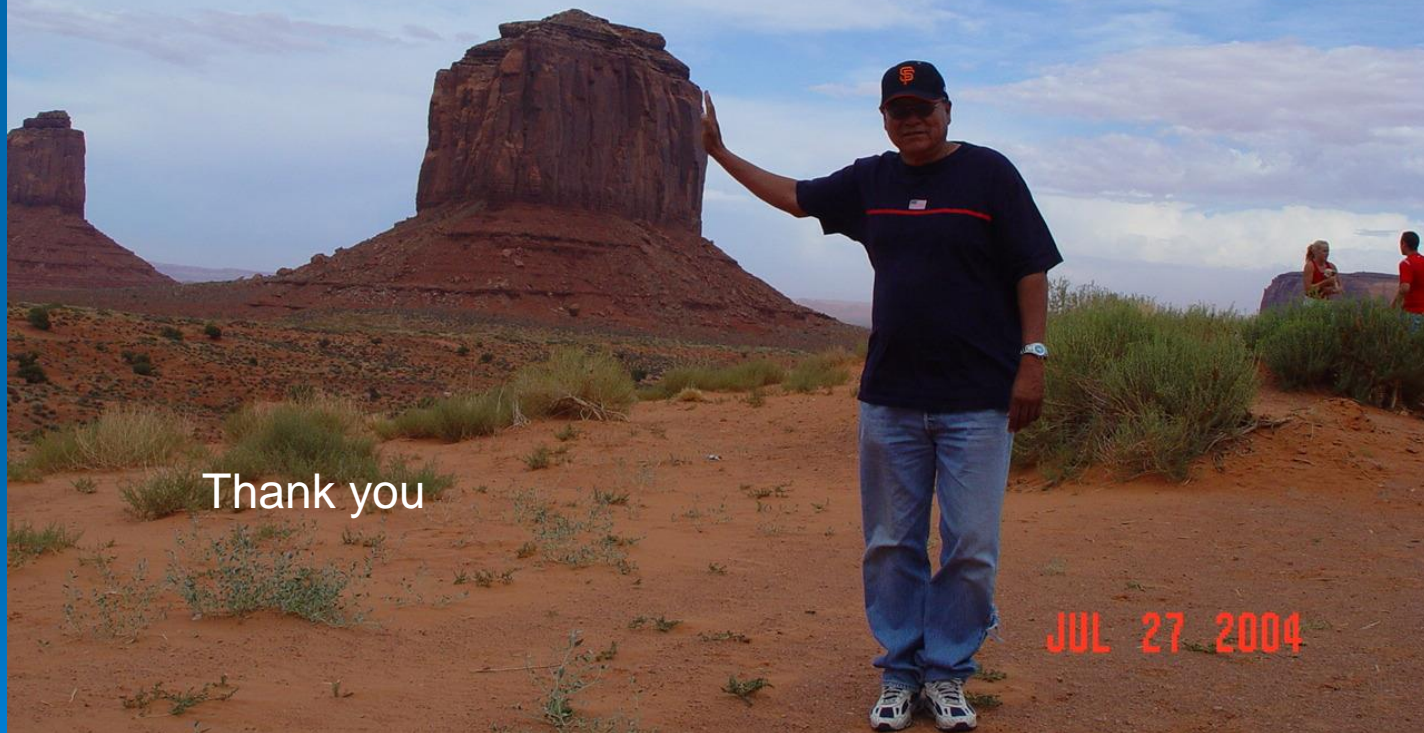
WATER IS SACRED

Rough Rock, Navajo
Nation

August 2009



“My intent is to plant seeds of ideas and raise doubts about what we believe...many of our beliefs are inherited, not opinions that we have thought through.” Vine Deloria, Jr.



Thank you

JUL 27 2004