2004

Research on Health

Diné Citizens Against Ruining Our Environment

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Introduction

Put aside the man made dangers of unstable support beams, dynamite blasts pre-exploding and even exploding •on-time•, fires in the mines, all the problems produced by falling and flying debris, gas, fumes from trucks hauling ore from underground, and dust from mining of heavy metals. Put all that aside and assess whether the manifest consequences may be •enough?•

Any kind of mining, whether it is for gold, silver, diamonds, coal, lead, zinc, iron, copper, asbestos uranium - whatever, it is has serious life destroying consequences. Many dimensions of environmental destruction ensue. Earth, water, air, plant and animal life, including humans are impacted.

The mining of uranium has special resonance because of its association with radiation. Radiation brings back the horrors of Hiroshima and Nagasaki, the ensuing •Cold War Effort• of the late 1940s through at least the 1980s, with the consequent tragic morbidity and mortality associated with uranium mining activities. The full consequences of these activities remain to be seen as does that of the contamination of air, soil and water and the contaminating effects on citizens living near or downwind from uranium mines.

Report on First Year of Activities

The report presented here is a description of activities for the first year of an investigation of the health and environmental effects of radioactive contamination caused by working in and/or living near the now abandoned uranium mining and milling operations. Its focus is on McKinley County, New Mexico and its surrounding area, the location of the Eastern Navajo Agency (ENA). Whether environmental and health problems experienced by people living in the ENA are the result of their having worked in uranium mills, lived near and still living close to sources of radiation contamination is the question. Uranium mines in the ENA have been inoperative for decades, however, many abandoned and un-reclaimed open pit and underground mines, mill tailings piles remain. Hundreds of uranium drillings remain uncapped as well, and continue to pose threats to the health and the environment of people living in the area.

The McKinley County area is near Grants, New Mexico, once known as •the uranium capital of the world• because it sits on a uranium belt approximately 30 miles wide and 75 miles long. More than one hundred-fifty uranium mines and 5 mills were located in McKinley County during the •uranium boom• of the decades of the 1940s through the 1970s. By the early 1980s most of the mines were closed because of lack of demand for uranium in the marketplace. In McKinley County a great deal of clean-up of tailing pile wastes, resolution of continuing contamination of water supplies, continuing contamination of air from the waste products, and reclamation of contaminated land remains to be done.

This investigation includes community outreach, education and community involvement in the research process. Understanding the different dimensions and the pervasiveness of the contamination will help to provide more accurate information for the communities concerning

the causes, treatment and prevention of environmental and health problems related to uranium mining and milling. Taking advantage of existing traditional as well as western oriented community and local health organizations with a community centered approach will foster links for later education and feedback to the organization on progress and problems with environmental contamination and the health and health care of people living in this area.

Five Navajo communities are involved in the project. Two important tools have been developed for this investigation. People from the communities involved have developed questions which will be used to interview residents in the five communities located near the old mines and mills. All interviewers speak both the Navajo and English languages and were trained in the methods of interviewing. There are no words in the English language for some Navajo words and no Navajo translation of some words and/or phrases in the English language. Also, some interviewees do not speak English, therefore questions were developed to be culturally sensitive and, at the same time to obtain the most accurate and useful information for the purposes of the survey. Questions were developed, discussed, modified, some questions were added and some were deleted. The purpose of the questions is to serve as the basis for •focused dialogues• with interviewees. The questions have been pre-tested and are organized to be administered. GIS mapping was used to create a second tool, an extensive database mapping the study region. A great deal of relevant informative data is available now on the map and once the health survey is completed and analyzed, that data also will be layered on the GIS map. This will allow for examination of the patterns of health problems and environmental impact from radioactive contamination in relationship to location of mines, mills and tailings. Evidence of consequences emanating from the long history of not just uranium mining and milling but the lack of care in disposing of contaminated waste and continued use of contaminated products in this area will be discernible.

Project Modification

Changes in the project goals and adjustments have been made for two reasons. Delays in obtaining approval for the research from one Indian Health Service facility has forced and adjustment to plans to allow for an additional year for the process of obtaining that last Indian Health Service approval, writing a proposal and submitting it before the Navajo Health Review Board. Reevaluation of where Dine Care can have the most impact is the second reason for new plans or directions to the project goals. For further discussion of this issue, see Appendix A.

Literature Review

A summary of the very small amount of information available concerning the illnesses and deaths of Navajo people who had worked as millers and lived near the uranium mines, mills and/or tailing piles and dams. The concern is with health issues of former mill workers; however, it has been reported that some people worked as both mill workers and miners at different times depending on what work was available. Their families living with them at or near the mining sites also breathed the air, drank the water, ate the foods (animals and plants) and used the plants in the area for medicine . Many former employees and their families remain in the same area and in some of those areas mines remain open and tailing piles remain un-reclaimed. People who now live near, have lived near and/or did work in the uranium industry

faced and continue to face the tragic consequences of contamination from uranium and its by-products. •The Navajo tribe•s office of the Navajo Abandoned Mine Lands Reclamation Program in 2000 •identified 1,300 abandoned uranium mines. Since 1989, about half the mines have been sealed with concrete and other materials. But piles of exposed uranium ore waste rock remain. The rock can contain •hot spots• of uranium ore.• (1)

•Even where mine reclamation has occurred, there are waste rock houses left standing or only partially dismantled. And because traditional Navajo families are sheep herders who live spread out from one another •their high desert homeland covers parts of Arizona, Utah and New Mexico • the EPA does not know how many uranium homes exist on the reservation.• (1)

Eichstaedt (1994) adds that •Undetermined tons of exposed radioactive mine waste remains on native lands. Rainwater has leached [and continues to leach] uranium by-products and toxic metals into underground water, with potentially long-lasting consequences... uranium pit mines remain open, filled with water, inviting children to swim and animals to drink.• (2) (p.xvi).

Over the past three decades evidence concerning the health and environmental risks involved with working in or living near uranium mines and mills of the Southwest has increased. Currently the National Institute for Occupational Safety and Health (NIOSH) is collaborating with the US Army Environmental Hygiene Agency in a study of uranium millers in the Four Corners area. This is a cross-sectional medical survey. A mobile van was sent out to communities in the area to carry out the medical component of the study. Specifically, the study is investigating •the health effects of uranium milling including the effects of exposure to radon chemicals and uranium on the health of those individuals employed in uranium mills ... during the period beginning on January 1, 1947 and ending on December 31, 1971."(3) It responds to Public Law 103-139 in which Congress appropriated $500,000 to DOD for this purpose. The study is in its final stages of analysis. It is expected that the findings will be published by the end of 2003 or early 2004. Only about sixty (60) Navajo people are included in that study.(4)

Perhaps one reason for the lack of participation in the NIOSH study is the experience of Navajo workers who took part in an earlier effort to obtain compensation. Eichstaedt (1994) described a meeting held in Shiprock in February 1993 at the Office of Navajo Uranium Workers (ONUW).(2) Five hundred forty-nine Navajo uranium workers were brought to the ONUW Office for medical examinations and tests. They were given breathing tests to determine damage to their lung capacity and chest x-rays were done. The resulting statistics were confusing and alarming. After the screening began10 people died of unknown causes and 4 miners died of lung cancer. However, under Department of Justice guidelines **only 5 of 549** workers were eligible for compensation for respiratory disease.

One of the consequences of uranium mining activity for people living in the ENA area is contamination of the water supply. It was only after an Environmental Protection Agency (EPA) lawsuit charging mining companies with negligence that those companies agreed to provide safe drinking water to the ENA communities. Unfortunately for the communities involved the lawsuit provided for safe drinking water only for 10 years! The •good water• stopped flowing

in the late 1990s. Many people did not even know that at that 10 year deadline they began once again to drink contaminated water. For those who knew or became aware there was a hard choice to be made - either drink contaminated water or pay for and haul in •good water.• For many it wasn•t (and isn•t) a choice. Ludescher**,** on July 18, 2000**,** wrote that according to the Navajo Nation Department of Water Resources, •Navajos who haul water for household use spend nearly 37 times as much per acre-foot as typical suburban water users in this region. It makes •this water among the most expensive in the United States for a sector of the population that is among the poorest.• Some people do not have access to transportation because there is no public transportation, they lack vehicles or because of the lack of roads and many cannot afford the cost of the •good water•**.** (5)

•The lack of water infra-structure and economic development and poverty on the Navajo Nation are connected, according to the report....The lack of a reliable and affordable drinking water supply also contributes to a high incidence of illness, disease and infection due to waterborne contaminants, the Navajo Nation report stated..•

•IHS plans for future water needs are designed for a demand of only 100 gallons per day. This rate is approximately half of the non-Indian per person use in Arizona and does not address commercial or industrial water users.•

While groundwater contamination remains a critical issue in this area •Groundwater is the most heavily utilized and dependable municipal water source for the Navajo Nation.... In 1998 there were 237 public water supply systems. The majority of these systems relied on groundwater.• (5)

Water is not the only issue. Elders live in this area and families raised in the area still live here. People are concerned about why sheep herders are dying from cancer much like the men who worked in the mines years earlier. There are issues of contamination of food supplies such as the corn from their cornfields, the sheep and rabbits, the wild berries and roots they eat; the plants they use for medicine. Even the sand used for sand paintings in the traditional healing ceremonies can be contaminated. Families are concerned because they know that people have swam in and still swim in the ponds created by dams for the containment of mill tailings. This contamination began with the opening of the uranium mines and it will continue, elders and residents argue, until the mines are sealed, the tailing piles removed. When the local water is once again safe for drinking, the food and plants used for medicine safe to consume and the air is safe to breathe then, they will be satisfied.

Certainly not enough systematic research has been done concerning the consequences of mining for the Navajo people of the ENA; however, there is some evidence gathered locally and much more evidence concerning the illness and death concerning the impact of uranium mining and milling in other parts of the nation and the world.

Local Evidence

Almost 75% of the population of McKinley county is American Indian and most of that 75% is made up of Navajo people.(6) Access to health care is a major issue for residents of McKinley county. Access to hospitals and health care facilities is one indicator of access. Information is presented in Table 1 below concerning the number of hospitals serving the people of McKinley County and the surrounding area. McKinley County has one community hospital with 113 beds and Cibola County which is adjacent to McKinley County has one community hospital with 22 beds. Health care also is obtained at the Indian Health Services facility in Crownpoint and in Gallup at the Indian Medical Center.

Table 1

Number of Hospitals by County -1998*

County	Number	Number of Beds
McKinley County	1 Community	113
Cibola County	1 Community	22

***Information taken from Table B-4. Counties - Vital Statistics and Health, US Census Bureau, County and City Data Book: 2000

Differences in causes of death and deformity associated with uranium mining activities is presented in the tables below. Some evidence is presented for Navajo tribal people only; other data are presented for McKinley County and the County data is shown with that for the state of New Mexico. Following the presentation of tables is a review of issues and evidence in the literature concerning the impact of uranium milling activities including the serious issues involved in disposal of mill tailings. Finally an abbreviated review of the more general context of those milling activities is given.

Death rates for 1990-1999, by age group, from all causes for Navajo, the Total New Mexico

American Indian and Total New Mexico population are given in Table 2. For Navajo people more than twenty percent (20.7 %) of deaths occurred for those in the age group of 25-44 years and twenty-two percent (21.9 %) occurred in the age group of 45-64. For the total American Indian people, about twenty percent (19.7%) of deaths occurred in the age group 25-44 while about twenty-three percent (23.2%) of the deaths occurred in the age group 45-64. The total New Mexico population had rates that were much lower for both the 25-44 age group (8.6%) and for the 45-64 year age group(17.5%). Also there is a striking difference in proportion of deaths in the 1-24 year age group for the total population of New Mexico (3.5%) and for the other two groups (about 11% for both the total New Mexico American Indian and the Navajo population.

Table 2

1990-1999 New Mexico Resident Deaths by Navajo, Total New Mexico American Indian and Total New Mexico Population*

	1-65+	1-24		25-44		45-64		65+	
		N	%	N	%	N	%	N	%
Navajo	4,718	532	11.3	977	20.7	1,035	21.9	2174	46.1
NM Indian	7,687	787	10.2	1,514	19.7	1,785	23.2	3,601	46.8
New Mexico	118,455	4,184	3.5	10,235	8.6	20,749	17.5	83,287	70.3

*selected ages do not include deaths under one year or unknown ages. Refer to Infant Mortality section for deaths under one year of age. Due to rounding percents may not add to 100.
Source: Office of New Mexico Vital Records and Health Statistics, Public Health Division Department of Health, New Mexico Tribal Report 2002.

Table 3 presents deaths for selected age groups for three time periods. It appears that while there was a decrease in total deaths for the youngest age group in the 1991-1993 aggregated time period and in the 1997-1999 aggregate for those 1-24 years old.

However, there was actually an increase in the percentage of deaths that occurred in the 45-64 year old category from the 1991-1993 aggregrate to the 1997-1999 aggregate.

Table 3

New Mexico Resident Deaths Navajo Affiliation* Reported By Selected Age Groups, Aggregate Years 1991-1993, 1994-1996,1997-1999

	1991-1993	1994-1996	1997-1999
1-24	12.7	11.6	9.1
25-44	22.4	21.0	19.1
45-64	20.8	21.6	24.0
65+	44.2	45.9	47.7

*****Information taken from Figure 8; Selected ages do not include less that one year of age. Due to rounding percents may not add to 100

Source: Office of New Mexico Vital Records and Health Statistics Public Health Division, Department of Health, New Mexico Tribal Report 2002

The next table, Table 4, presents the leading causes of death for Navajo people in aggregated years. Among this group, malignant neoplasms was consistently ranked the third leading cause of death for the 9 year aggregate (1991-1999) and for the 3 year aggregates. Accidents are the number one cause of death and do not significantly fluctuate in these aggregated years. Diseases of the heart ranked second and was slightly more (1.6%) in the 1997-1999 aggregated years than in the 1994-1996 period. There is evidence in the literature, discussed later, that raises concern also for the differences in heart disease among workers in the uranium industry and other groups.

Table 4

New Mexico Residents - Leading Causes of Death*
Navajo Affiliation Reported - Aggregated Years
1991-1999, 1991-1993, 1994-1996, 1997-1999

9 Year Aggregate - 1991-1999				3 Year Aggregate - 1991-1993			
Rank	Cause	N	%	Rank	Cause	N	%
1	Accident	927	20.6	1	Accident	316	21.7
2	Disease of Heart	694	15.4	2	Disease of Heart	223	15.3
3	Malignt Neoplsm	553	12.3	3	Malignt Neoplsm	166	11.4
4	Diabetes	286	6.3	4	Diabetes	86	5.9
5	Cerebro vasc.Dis.	159	3.5	5	Cerebro vasc. Dis.	47	3.2
3 Year Aggregate - 1994-1996				3 Year Aggregate - 1997-1999			
Rank	Cause	N	%	Rank	Cause	N	%
1	Accident	292	20.0	1	Accident	319	20.0
2	Disease of Heart	213	14.6	2	Disease of Heart	259	16.2

3	Malignt Neoplsm	197	13.5	3	Malignt Neoplsm	190	11.9
4	Diabetes	95	6.5	4	Diabetes	106	6.6
5	Cerebro vasc. Dis.	51	3.5	5	Chronic Liver Dis & Cirrhos	69	

*Due to the implementation of ICD-10 in 1999, comparability ratios have been applied to statistics for the years prior to 1999. Numbers will not equal those previously reported due to the application of comparability ratios.
Source: Office of New Mexico Vital Records and Health Statistics, Public Health Division, Department of Health, New Mexico Tribal Report 2002

Table 5

New Mexico Residents Leading Cause of Death*
Navajo Affiliation Reported for Tribe of Child
Aggregate Years - 1991-1993, 1994-1996, 1997-1999

	Congenital Anomalies		SIDS		Disorders Related to Short Gestation	
	Number	Rate	Number	Rate	Number	Rate
1991-1993	33	4.0	17	2.0	3	0.4
1994-1996	21	2.9	5	0.7	6	0.8
1997-1999	18	2.5	5	0.7	10	1.4

*****Due to the implementation of ICD-10 in 1999, comparability rations have been applied to statistics for the years prior to 1999. Numbers will now equal those previously reported due to the application of comparability ratios
SOURCE: The State Center for Health Statistics at the Office of New Mexico Vital Records and Health Statistics

Congenital anomalies is ranked first in causes of death for children in all three aggregate years Information in Table 5 presents the leading causes of death for children whose tribal affiliation was reported as Navajo in the state of New Mexico. While the death rate for the category, congenital anomalies, is lower for the 1997-1999 aggregate (4.0) than for 1991-1993 aggregate

years (2.5) it remains the leading cause of death for Navajo children. Supporting evidence for this finding is in the literature and is discussed later in this report. Ranked second, SIDS also is lower in the most recent 1997-1999 aggregate years that in the prior aggregated years while for the third ranked leading cause of death, disorders related to short for gestation, the rate actually is higher (1.4) in the 1997-1999 group than it is in the 1991-1993 year aggregate (0.4).

Data for McKinley County and the State of New Mexico

The next series of tables presents data for residents of McKinley County and for the state of New Mexico. Table 6, below, presents death rates by year between 1990 and 2000 for McKinley County and the state of New Mexico. Death rates are lower for residents of McKinley County than for the state of New Mexico in every year of the decade.

Death rates fluctuated in McKinley County but were slightly lower in the year 2000 (558.8) than in 1990 (592.6) while for the state as a whole death rates fluctuated as well but the death rate in 2000 (722.9) was slightly higher than in 1990 (694.0)**.**

TABLE 6

New Mexico Residents Death Rates
1990-2000

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
McKenley Co.	592.6	684..6	624.3	624.9	587.9	634..2	600.6	580.2	631.2	673.9	558.8
New Mexico	694.0	752.5	704.1	723.8	732.2	743.0	730.1	732.1	741.7	772.1	722.9

Source**:** New Mexico Department of Health, Office of New Mexico Vital Records and Health Statistics

When examining the leading causes of death separately for the residents of New Mexico and for McKinley County it appears, from Table 7 below, that there are some differences in leading cause of death. For example, diabetes mellitus is the fourth leading cause of death for residents of McKinley County while for residents of New Mexico cerebrovascular diseases is the fourth leading cause of death.

For McKinley County residents, the fifth leading cause of disease is chronic liver diseases and cirrhosis while for residents of New Mexico, chronic lower respiratory diseases rank fifth**.** Interestingly, the rate of death from malignant neoplasms is higher for all residents of New Mexico that for residents of McKinley County.

TABLE 7

New Mexico Resident Deaths **Leading Causes of Death - 1996-2000* Average**					
McKinley County			**New Mexico**		
All Races/All Ages	Number	Rate	**All Races/All Ages**	Number	Rate
All Causes	2,088	620.2	All Causes	64,510	744.3
Diseases of the Heart	386	114.5	Diseases of the Heart	15,997	186.6
Malignant Neoplasms	351	104.4	Malignant Neoplasms	13,993	161.4
Accidents (Unintentional Injury**)**	384	84.3	Accidents (Unintentional Injury)	4,528	52.2
•(Motor Vehicle Accidents)	(155)	(46.1)	•Motor Vehicle Accidents)	(1,824)	(21.0)
Diabetes Mellitus	134	39.7	Cerebrovascular Diseases	4,019	46.4

Chronic Liver Diseases and Cirrhosis	111	33.0	Chronic Lower Respiratory Diseases	3,937	45.4

*2000 data are provisional
Rate per 100,000 population. Rate numerators were deaths for years 1996-2000, divided by 5; denominator was the 1998 population.
Due to implementation of ICD-10 in 1999, comparability ratios have been applied to statistics for years prior to 1999. Rates and numbers may not equal those previously reported due to the application of comparability ratios.
SOURCE: New Mexico Department of Health, Office of New Mexico Vital Records and Health Sttatistics.

TABLE 8

Cancer Incidence Among Males, Incidence Rate and Number 1994-1998 Aggregate

	McKinley County		**New Mexico**	
SITE	**Rate**	**Number**	**Rate**	**Number**
All Cancers	303.8	313	392.7	16,199
Stomach	12.5	12	8.9	366
Colon and Rectum	30.0	30	41.2	1,697
Liver and Intrahepatic Bile Duct	16.8	18	6.9	287
Gallbladder	3.2	3	0.9	37
Pancreas	8.5	8	9.1	373
Lung and Bronchus	28.1	27	52.8	2,165
Melanomas of the Skin	7.6	8	14.9	641
Prostate	82.3	78	124.1	5,029
Urinary Bladder	11.9	11	21.7	895
Kidney and Renal Pelvis	19.5	21	15.0	516

Non-Hodgkins Lymphomas	9.3	12	15.0	634
Leukemias	10.0	16	11.7	488
All Other Cancers	64.0	69	72.2	3035
SOURCE: New Mexico Tumor Registry, University of New Mexico				

Table 8 above provides evidence concerning cancer incidence among Males in McKinley County and in New Mexico for the 1994-1998 aggregated years. This table suggests that for all cancers among males, the rate for McKinley County males is lower than that for New Mexico. Cancer of the stomach is notably more for McKinley County males (rate = 12.5) than that for New Mexico (rate = 9.9). For liver and intrahepatic bile duct cancer the difference in rates is greater; 16.9 vs 6.9 respectively. Gallbladder and kidney and renal pelvic cancer rates are also higher for McKinley County males than for New Mexico males as a whole. The incidence of colon and rectal cancer, lung and bronchus cancer, melanomas of the skin, prostate cancer, non-hodgkins lymphomas and all other cancers appear to be lower for males of McKinley County than for those of the state of New Mexico.

TABLE 9

Cancer Incidence Among Females, Incidence Rate and Number 1994-1998 Aggregate				
	McKinley County		**New Mexico**	
SITE	**Rate**	**Number**	**Rate**	**Number**
All Cancers	262.0	365	310.4	14,890
Stomach	10.8	15	4.5	233
Colon and Rectum	29.2	40	29.7	1,543
Liver and Intrahepatic Bile Duct	8.2	12	3.0	157
Gallbladder	6.7	8	1.5	74
Pancreas	10.8	14	31.4	1,535
Lung and Bronchus	12.0	14	31.4	1,535
Melanomas of the Skin	4.5	7	10.2	502
Breast	74.1	103	99.7	4,839
Cervix	11.6	17	8.5	419

Corpus and Uterus, NOS	13.7	21	16.4	780
Ovary	15.1	20	11.9	578
Urinary Bladder	2.8	4	6.4	335
Kidney and Renal Pelvis	10.0	13	6.6	320
Non-Hodgkins Lymphomas	8.2	11	10.2	510
Leukemia	1.0	2	7.8	383
All Other Cancers	43.2	64	46.4	2,298

Rates are per 100,000 and age-adjusted to the 1970 standard
SOURCE: New Mexico Tumor Registry, Universiyt of New Mexico

Rates for incidence of cancer among female residents of McKinley County and for the state of New Mexico are shown in Table 9. Cancer rates for stomach cancer, liver and intrahepatic bile duct cancer, cancer of the gallbladder, pancreas, cervix, ovary, and kidney and renal pelvic cancer are all notably higher for women of McKinley County than for women of New Mexico as a whole. Some of the categories of cancer which we might expect to be related to uranium activities are the same for the men and women of McKinley County. For example liver and intrahepatic bile duct cancer and kidney and pelvic cancer have been suggested to be caused by contamination from the mining activities as has stomach cancer.

Finally, two relevant tables concerning infant and childhood deaths are presented.. Table 10, below, presents infant mortality rates for selected causes by county of residence for two aggregates of years. For McKinley County residents the infant mortality rates due to birth defects, while it was less for the 1996-2000 aggregate than for the 1991-1995 group, it was twice that for New Mexico as a whole in boththe 1996-2000 and the 1991-1995 aggregate (4.2 vs 2.0 for the 1991-1995 group and 2.3 vs 1.6 for the 1996-2000 aggregate). The rate for SIDS and for all others causes was similar for McKinley County and for New Mexico. While rates of all infant deaths were less for the 1996-2000 aggregate than for the 1991-1995 aggregrate for both McKinley County and New Mexico the rate remains higher for McKinley County.

TABLE 10

Infant Mortality Rates By County of Residence for Selected Causes*
1991-1995 and 1996-2000 Aggregates

	All Infant Deaths		**Birth Defects**		**SIDS**		**All Others**	
	1991-1995	**1996-2000**	**1991-1995**	**1996-2000**	**1991-1995**	**1996-2000**	**1991-1995**	**1996-2000**

McKinley County	11.0	7.5	**4.1**	**2.3**	**1.5**	0.6	5.0	4.6
New Mexico	7.6	6.5	2.0	1.6	1.4	0.7	4.1	4.2

*2000 data are provisional.
Rates per 100,000 population
Due to implementation of ICD-10 in 1999, comparability ratios have been applied to statistics for years prior to 1999. Rates and numbers may not equal those previously reported due to the application of comparability ratios.
SOURCE: NM Department of Health, Office of NM Vital Records and Health Statistics.

TABLE 11

New Mexico Residents Ages 20 and Younger Selected Diagnosis Reported To Children•s Chronic Conditions Registry -2000*

	McKinley County		**New Mexico**	
	Number	**Rate**	**Number**	**Rate**
Children in Registry	4,320	1358.2	90,763	1534.5
Congenital Anomalies - All	1,243	390.8	22,241	376.0
•Neural Tube Defects	46	14.5	870	14.7
---Cleft Lip/Cleft Palate	237	74.5	2,946	49.8
•Down Syndrome		13.5	997	16.9
---All Other Anomalies	917	288.3	17,428	294.6
Asthma	657	206.6	20,904	353.4

* = <3
Rates per 10,000 population ages 20 years and younger**.**

NOTE: Children in registry totals include all other conditions not listed above.
SOURCE: NM Department of Health, Children•s Medical Services.

The rate for all congenital anomalies is somewhat higher for residents of McKinley County than for New Mexico (390.8 vs 376.0 respectively) and the cleft lip/cleft palate rate is remarkably higher in McKinley County (74.5) than for New Mexico (49.8). The rate for neural tube defects is the same; the rate for down syndrome is the same and the rate for asthma is higher for New Mexico residents as a whole (353.4) than for McKinley County residents (206.6).

The data presented in the tables above are supported by research reported in the literature and provide evidence to support arguments concerning further investigation into the consequences for mill workers and their families of living close to and/or working in the uranium industry.

The discussion below links the hazards faced by people working in/living near uranium mines and mills. It is followed by a description of some of the difficulties found in attempting to store uranium mill tailings. Research compiled by a National Institute of Occupational Safety and Health (NIOSH) Task Force in 1980 presented evidence of linkages between underground miners, open pit miners and uranium mill workers in terms of health risks faced by these workers. (7) The complex of hazards in the uranium mine and mill environment goes beyond radon and radon decay products commonly associated with health effects of uranium mining. The three types of hazardous materials resulting from radioactive materials associated with uranium ore and occurring at each mine site include

- X •uranium and uranium decay products, such as thorium and radon and emissions gamma and alpha radiation from uranium decay products other than radon
- X heavy metals occurring in varying concentrations in uranium ores including vanadium, lead, arsenic, selenium and chromium and
- X workplace hazards associated with mines and mills in varying concentrations including diesel and gasoline exhaust and blasting residue in mines and sulfuric acid, kerosene and other reagents in mills.• (7)

While the original RECA legislation •was far too narrow• (7) and was amended in 2000, Navajo mill workers and their families in the ENA who worked in the mills make up one group not included in any of the legislation and now face/have recently faced or will face the illnesses and the deaths of family members which they believe are the results of those members having worked in the uranium mills and industry.

Uranium Mill Tailings Disposal

In a discussion of the dilemmas facing many national governments and some private naational and international corporations, Diehl describes some of the problems involved in storing or disposing of mill tailings.(8) Usually uranium mill tailings are dumped as sludge in special ponds or piles where they are abandoned. Thirty million tons of solid material existed as tailing piles [at the time of this writing in the largest piles of mill tailing in the US and Canada alone. A

great deal more of this waste exists in the former Soviet Union and other countries of the world.

The sludge produced is has almost the same amount of uranium ore that is milled, Diehl states, and long lived •decay products such as thorium-230 and radium-226 are not removed [thus] the sludge contains **85% of the initial radioactivity** of the ore. (8; p.5 of 10) Because of technical limitations of extraction of uranium from the ore, the sludge also contains 5% to 10% of the uranium initially present. •In addition, the sludge contains heavy metals and other contaminants such as arsenic, as well as chemical reagents used during the milling process.• (8 p. 5 of 10)

When uranium containing ore is removed from its relatively safe underground location through the processes of mining and milling some of its hazardous constituents are converted to fine sand , then to sludge where the components become more hazardous because of susceptibility to dispersion in the environment. Geochemical disequilibrium of constituents of tailings piles create various reactions which cause additional hazards to the environment. Diehl gives the example of dry areas where salts containing contaminants can migrate to the surface of the tailing pile where they are subject to erosion and he states later •Tailings piles are subject to many kinds of erosion.... (8 p.6 of 10) Gullies can form after heavy rainfall, floods can destroy the whole deposit, plants and burrowing animals can penetrate deep into the deposit and disperse materials, enhance radon emanation and make the deposit more susceptible to climatic erosion.• (8 p.7 of 10)

Radon 222 gas emanates from the tailings piles because of the decay of radium-226 which has a half-life of 1600 years, therefore presenting a longterm hazard. Because the parent product of radium 226, **thorium 230** (with a half-life of 80,000 years) is also present there is continuous production or radium 226. •Radon-222, a radioactive gas can cause lung cancer. Some of this radon escapes from the interior of the pile. Radon releases are a major hazard that continues after uranium mines are shut down.• (8; p.7) Radon spreads quickly with the wind, according to Diehl, and the wind blows mightily over the McKinley County and northern Mew Mexico area generally. While the excess risk is small for the individual, because of the large numbers of people involved, the risk must be addressed.

Another issue addressed by Diehl is the danger of tailings dam failures. •Tailings dams are often not of stable construction. Being made from sediment of the coarse fraction of the tailings sludge, strong rain or snow storms can cause dam failure. In 1977, there was a spill of 50,000 tons of sludge and several million liters of contaminated water near Grants, New Mexico; in 1979, in Church Rock, New Mexico another spill of more than 1000 tons of sludge and about four million liters of contaminated water.• (8; p.9)

The Ambrosia Lake storage site is a site for storage of mill tailings. It is located in McKinley County and continues to be of concern to local residents.

Ambrosia Lake

The original uranium mill at the Ambrosia Lake site was built by the Phillips Petroleum

Company in 1957 to process ore from nearby mines. Uranium ore was processed there between 1958 and 1963. For a brief time in 1963, United Nuclear Corporation(UNC) purchased and operated the mill. From the late 1970's to the early 1980's UNC operated an ion exchange system, extracting uranium from mine water. Mill tailings covered 111 acres when mill operations were abandoned in 1982 (9)

The site is within the Ambrosia Lake Mining District, near the center of the Grants Mineral Belt. It is •located on a 290-acre tract of land in McKinley County, approximately twenty five miles north of Grants, New Mexico.... Milling operations at the site created process-related wastes and tailings, a sandlike waste, containing radioactive materials and other contaminants....Decommissioned uranium mills, abandoned underground mines, mine shafts and vents, ore piles, tailing piles, and heap leach piles are close to the site.• (9)

According to a U. S. Department of Energy (DOE) fact sheet, (5) between 1987 and 1995 the site was remediated. •Contaminated materials were consolidated and encapsulated on site in an engineered disposal cell.... This cell contains 6,931,000 dry tons of contaminated material, with a total activity of 1,850 curies of radium-226. It measures about 2,500 feet by 1,600 feet and rises about 50 feet above the surrounding terrain. It occupies approximately 91 acres and •The cell design promotes rapid runoff of precipitation to minimize runoff.•(9) It does not say to **prevent runoff; it says to minimize it.** [my emphasis] In addition there is no monitoring of groundwater at the Ambrosia Lake site because •the uppermost aquifer is considered a •limited use• aquifer.•(9)

In 1998 the U.S. Nuclear Regulatory Commission included the Ambrosia Lake Disposal Cell under general licence with the (DOE) as the responsible agency for long-term monitoring and maintenance of the Cell and site. The integrity and long-term safety of the site are the responsibility of DOE•s Long-Term Surveillance and Maintenance (LTSM) Program in Grand Junction, Colorado. •These materials will remain potentially hazardous for thousands of years.• (10)

Importation of uranium from other countries and the lack of demand for uranium for new nuclear power plants in the U.S. resulted in a drop in the profitability of uranium mining and milling. Mills had their operations scaled back or they were shut down. The NRC agrees with Diehl (above) that •The waste from these mills - mill tailings - pose a potential hazard to public health and safety. Uranium mill tailings contain the radioactive element radium, which decays to produce radon, a radioactive gas. The radium in these tailings will not decay entirely for thousands of years.• (10)

Two programs were established by Congress through the Uranium Mill Tailings Radiation Control Act (UMTRCA) in 1978. UMTRCA mandated •remedial action at abandoned mill tailing sites which were a consequence largely of the production of uranium for the weapons program• was one program established as a joint Federal/State-funded program (Title I -- Reclamation Work at Inactive Tailings Sites).(10) Under this program cleanup and remediation of the mill tailings was and remains the responsibility of the DOE with evaluation of DOE•s

design and implementation being done by the NRC. After remediation is completed, the NRC must concur with the EPA that the site meets standards set by EPA. Reclamation at 19 inactive uranium tailing piles involved piles ranging in size from •approximately 60,000 to 4.6 million cubic yards of material. Except for two sites in Pennsylvania, all inactive sites are located in western states. By August of 1999, the NRC and EPA concurred that completion of construction and surface cleanup had been accomplished at 18 sites, including the site at Ambrosia Lake, New Mexico. The only remaining site, according to the fact sheet is at Grand Junction, CO where a portion of the site will remain open until 2030 to accept additional waste from tailings contaminated properties. (10)

DOE initiated ground water cleanup in 1991. In 1995 final Title I ground water standards had been issued by the EPA. In the February 2000 NRC stated that ground water cleanup compliance had been demonstrated at eight sites.

Concern for water safety comes from examining the milling process used for uranium. Ore is extracted by deep mining or through an open pit. •The rock is crushed and sent through a mill where the extraction process concentrates the uranium into •yellowcake•, a uranium oxide compound. The remainder of the crushed rock, in a processing fluid slurry, is placed in a tailings pile/cell. This •pile• is actually a constructed impoundment or a former uranium mine pit .... •(10) Residents who live near the old mine pits and tailing piles worry that seepage of contaminants into the water supply as a consequence of this process is another factor contributing to the fact that they must still buy their water in order to have safe water for drinking, cooking, etc.

When one reads of the in-situ leaching (ISL) uranium extraction process where wells are drilled into rock formations containing uranium ore and water, with added oxygen and sodium bicarbonate is injected down the wells to mobilize the uranium in the rock so that it dissolves in the ground water the consequences appear to be even more ominous. The water is pumped to the surface, where a processing plant separates the uranium from the water. Waste from this process also is disposed of in tailings piles at the mill sites.

The second program of UMTRCA (Title II -Licensed Uranium Recovery Facilities and Mill Tailings Sites) gave authority to the NRC to control radiological and non-radiological hazards. Authority for generally applicable standards for both radiological and non-radiological hazards was allocated to the EPA. Under this legislation disposal sites eventually will be owned by the State or Federal government. (10) These sites consist of 24 uranium recovery facilities licensed by NRC. There •are sixteen conventional uranium mills, 6 in-situ leach (ISL) facilities, one mine water ion-exchange facility, and one mill tailings waste disposal facility•(10)

Thus, the communities around the Ambrosia Lake site and the McKinley County area find themselves linked to many other communities in this country and in many other countries. The unlikely and unwanted link for each of these communities is the common factor of uranium mill tailings waste and the issues and problems concerning the consequent contamination of the water, soil and air from that waste.

Epidemiologic Evidence Concerning Health Effects of Uranium on Mill Workers

Relatively little epidemiologic evidence exists in the literature concerning the impact of chronic exposure to uranium on the health of mill workers and their families and even less information is found on the subject for Navajo workers. The few studies that do exist are reviewed below.

Renal Disease:

- A discussion of the impact of exposure to depleted uranium during the Gulf War stated that •Once uranium enters the body, a portion will be soluble as determined by its chemical and physical characteristics. The more soluble a compound, the quicker it will be absorbed from the lung into the blood and the more completely it will be absorbed from the lung and gastrointestinal tract....The most soluble compounds will be absorbed from the lungs within hours or days. Occupationally, workers processing uranium are usually exposed to its more soluble forms.• (11)

The authors report that •In general, the soluble compounds, such as the halides and uranites, are far more toxic to the kidney because they promote a greater blood concentration, while insoluble compounds, such as oxides are more toxic to the lung because their longer residence in the lung produces a larger radiation dose.• The kidney is considered the target organ for uranium for chemical toxicity. •The primary renal site of action of uranium is the proximal tubule where proton secretion degrades the bicarbonate complex of the uranyl ion permitting the uranium to react with apical cell membranes of the tubular epithelium. This view is supported by the observation that alkalinization of urine increases urinary uranium excretion.• (11)

An excess of deaths from renal disease was found among a cohort of white male US uranium millers by Waxweiler, et al. (1983) While the authors found an excess of chronic renal disease (6 where 3.6 were expected) they did not see the excess mortality as clearly occupationally linked because of other factors in the work histories of members of the cohort. However they did find significant non-malignant respiratory disease which is reported below.(12)

In a study to evaluate health effects among a group of white Colorado uranium mill workers occupationally exposed to elevated levels of •yellow cake• Thun, et al. (1985:83-90) reported findings that indicated reduced proximal renal tubular reabsorption of amino acids and low molecular weight protein.(13) The authors found that •The uranium mill workers showed a significantly higher excretion of beta-2 microglobulin and five amino acids than the reference group• (concrete workers nearby) and that •the length of time worked full-time in the yellowcake area of the old mill was the variable that best predicted the beta-2 clearance relative to creatinine.•(13) They concluded that the study is more likely to have under - rather than over-estimated the severity of uranium induced nephropathy. The authors state that the study•s occupational significance is two-fold. •First, it provides supplemental evidence that the renal effects of chronic occupational exposure to soluble uranium should not be ignored....• •... this

and other investigations describing transient albuminuria in workers acutely overexposed to soluble uranium suggest that occupational exposures can and do exceed the •no-effect• level.(13) Also of concern is the epidemiologic finding of a 2.6 -fold excess in deaths from chronic and unspecified nephritis and renal sclerosis in a retrospective study of mortality among a cohort of US white male uranium miners....• The second implication of the study •is that the assumptions underlying the current occupational standard for soluble uranium in air and for uranium in urine should be carefully scrutinized.... to our knowledge, no epidemologic studies have systematically evaluated renal tubular function in uranium workers, nor has routine medical monitoring been conducted using sensitive measures of tubular function....The dipstick measurement of urine albumin is...an insensitive test for renal tubular injury.•(13) Pinkerton and Bloom (3) point out that Thun•s findings are •consistent with the known toxic effect of soluble uranium on the kidney tubules.

Non-malignant respiratory disease:

In the 1983 study by Waxweiler et al.(12) an excess in deaths was found from •other non-malignant respiratory disease• in their mortality study of 2002 uranium mill workers. Mill workers were about 2.5 times more likely to die of these causes than expected by US death rates.

The US Public Health Service in 1950 reported that •26.5 percent of the white millers ... and 20 % of Native American millers ... showed more than usual pulmonary fibrosis.• (2) Whether it may be that •uranium ore dust and radon daughter exposures contribute to the excess mortality from non-malignant respiratory disease among uranium miners and millers is a question raised by Pinkerton and Bloom. Wilson•s study reported in Pinkerton and Bloom of morbidity among workers •in a uranium processing plant, in which silica exposure was minimal or absent, found increased non-malignant respiratory disease among workers with higher cumulative uranium exposure compared to lower.• (2)

Cancer:

Epidemiologic studies show an excess of lung cancer in uranium workers occurs among underground miners because occurrence of lung cancer among miners is closely related to levels of exposure to radon daughters, however, there are continuing questions regarding the mill workers and the occurrence of lung cancer. Mill workers, it is said, do not face the same experience because mills have not been found to trap high concentrations of radon and radon-daughters. At the same time, former mill workers state that sometimes people worked in the mills and other times in the mines, depending on what jobs were available. There is, however, clear evidence of other forms of cancers among mill workers found in the literature

Among white uranium mill workers, lymphatic malignancies were linked to uranium exposure, (Waxweiler, et al., 1983 (12), Archer, 1973) (13) The authors of those studies suggest that 230^{TH} (230 Thorium), rather than uranium, was the causative agent. Robinson (7) pointed out that thorium-230 is the parent product of radium-226 and is one of the decay products in the

sludge of uranium mill tailings.

An excess risk of leukemia mortality was observed in the vicinity of uranium mills in Spain. •A statistically significant 30% increase for the Andújar mill and, on the borderline of statistical significance, a 68% increase for the Ciudad Rodrigo mill....The influence of natural radiation on mortality could not be incorporated into the analysis. However the Andújar and Ciudad Rodrigo facilities are located in parts of the country with high levels of natural radiation.• (14) The same authors, in another paper report •excess lung [relative risk (RR) 1.12, 95% confidence interval(CI), 1.02-1.25] and renal cancer mortality (RR1.37, 95%CI, 1.07-1.76) around the uranium mills. (15) At Andujar (Jaen), a uranium mill operated from 1959 to 1981 and left behind around 1 million m3 of mill tailings. At Saelices el Chico near Ciudad Rodrigo (Salamanca), the Elefante uranium Mill was operational between 1973 and 1993. This plant was rep laced by the new Quercus plant...scheduled to operate until 2001. During its lifetime, the Elefante plant produced a total of 3430 tonnes of U3O8 (2909tU), leaving behind 7.15 million tones of heap leaching wastes and 372 m3 of mill tailings.•(15)

The Agency for Toxic Substances and Disease Registry (ATSDR)pointed to the problems at the Monticello Mill Tailings Site, an abandoned uranium processing mill, as the source of contamination in soils and building throughout the city of Monticello, Utah. •The mill produced vanadium (1942-1943), and uranium (1949-1960).• (16 p.1 of 19) •Contaminated soils were taken from the mill site and used as fill for open lands; backfill around water, sewer, and electrical lines; and sand mix in concrete, plaster, and mortar. As a result, residents have been exposed to low levels of uranium, radium-226, radon-222, and associated radiation.• Yellow cake (uranium oxides, black cake (vanadium oxides), and uranium remain on the mill site, however, the authors argue that access to the mill is strictly controlled and the mill site •currently does not pose a direct threat to area residents.• (16)

ATSDR, in reviewing available health outcome data, identified increased risk in the county in which Monticello is located. The agency found that when compared to other Utah counties there was increased risk for 1) renal failure in women, 2) breast cancer in women, and 3) cancer associated with the respiratory tract. •In occupational cohort studies of the uranium mill workers, mortality due to lung cancer, lymphoma, and nonmalignant respiratory disease has been reported.• (16)

Perceived Effects of Occupational Exposure:

Dawson and Madsen (1995) in a case study of 81 American Indian uranium mill workers who worked during the 1950s and 1960s found that the workers had vivid recollections of the dust and fume hazards associated with the work environment even though more than 20 years had passed since their mill employment.(17) The respondents spoke of many health problems. •Respiratory problems were among the most often reported types of health problems.• Rashes also were frequently identified as health issues. **(** At a recent meeting in Albuquerque, of community residents and interviewers for the community health survey, one member brought photos she had taken of the rash on hands of a woman who lives near one of the McKinley County mill site. She reported that the rash has spread to other parts of the woman•s body and

they are concerned about whether it is related to her living near the site.)
Dawson and Madsen also report that •many respondents said they were experiencing emotional problems related to their physical illnesses. Anxiety and depression concerning their health and the health other miller friends were the most identified forms of stress. The people most likely to report emotional problems... felt that their illnesses were the result of their millwork.• The authors call for the inclusion of American Indian mill workers in a retrospective epidemiologic study as a basis for policy making decisions regarding their current physical and emotional health. (17)

Eichstaedt (2) also discusses the devastating psychological and cultural impact as well as the physical impact that uranium mining has had on the Navajo people and on their lands.

Evidence of other consequences of uranium mining
Shields, et al. (18) evaluated the role of environmental radiation in the etiology of birth defects, stillbirths, and other adverse outcomes of pregnancy for 13,329 Navajos born at the PHS/IHS hospital in Shiprock, NM, mining areas from 1964-1981. One of four large mill tailing piles on the Navajo Reservation was located at the outskirts of Shiprock. (Chenoweth in Shields, et al.) The results •showed increased odds ratios for adverse birth outcomes in children of fathers who had worked in the mine and for mothers or fathers who had lived within 0.805 km (0.5 mi.) of a mine, mine dump or mill tailings pile. The odds ratios by exposure to various uranium operations for all outcomes was statistically significant for children of mothers living near a mine dump or tailings. (18;p.545) •Correlation coefficients among exposure variables showed expected associations reflecting that fathers and mothers shared exposures and that a person who was working or living near a mine was also likely to live near a mine dump or mill tailings. (18; p. 545)

What are the gaps in our knowledge and what important issues remain to be addressed?
The answers to these questions will vary depending on who one asks. ATSDR (16) suggests the following for their group:

- There is a need to determine whether the current occupational radiation exposure limits are adequate for radiation workers.
- Internal dosimetry of radiation workers is not well characterized or understood, and the relationship between internal radiation dose and health effects needs to be evaluated.
- Results from ongoing mortality studies need to be evaluated to improve understanding of causes of cancer and chronic disease. Additional studies can be proposed to focus on a single disease in worker groups.
- There is a need to ensure that complete records, including industrial hygiene and work history data for the various levels of subcontractors at each site are available.

The Navajo people living in communities affected by uranium mining and milling and the aftermath have other questions that are more basic. How do we find safe food to eat? How can we get safe fresh water to drink? Where do we find fresh uncontaminated air to breathe?

With the addition of the information gathered in this study from the use of GIS mapping technology and the community health survey which is created by and administered by Navajo people from the communities who speak the Navajo language evidence will be added to that which already exists. Hopefully, this added evidence and the increasing information concerning exposure to uranium related exposure to radiation in the Gulf War and other military activities will ensure that action is taken to provide expert treatment and compensation to everyone affected by exposure to uranium products and its by-products and clean-up of the contamination of water, air, food supply and soil as well as reclamation of the land will be accomplished so that this tragedy finally ends.