COMMENTERS EXHIBIT C

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URANIUM EXPOSURE AND PUBLIC HEALTH IN NEW MEXICO AND THE NAVAJO NATION: A LITERATURE SUMMARY

Compiled by Chris Shuey, MPH
Southwest Research and Information Center
P.O. Box 4524, Albuquerque, NM 87196
505-262-1862 • 505-262-1864 (fax) • sric.chris@earthlink.net

I. Occupational Exposures and Health Effects

- **Navajo Uranium Miners.** Risk of lung cancer among male Navajo uranium miners was 28 times higher than in Navajo men who never mined, and two-thirds of all new lung cancer cases in Navajo men between 1969 and 1993 was attributable to a single exposure — underground uranium mining.[1] Through 1990, death rates among Navajo uranium miners were 3.3 times greater than the U.S. average for lung cancer and 2.5 times greater for pneumoconioses and silicosis.[2] Smoking does NOT account for the large increased risk of lung cancer in Navajo men who were uranium miners.[3] The root cause was the miners' exposure to in-mine radon and radon progeny: "The causal association between exposure to radon progeny and lung cancer has been firmly established".[4] Of an estimated 5,000 Navajo uranium workers, 500-600 had died by 1990 and another 500-600 were expected to have died by 2000.[5] Vital status for these workers has not been updated since the early 1990s.

- **All Uranium Miners.** That underground miners of uranium and uranium-containing ores suffer mortality from lung diseases, including lung cancer, at rates significantly greater than the general population was first documented in studies of European miners from the late 16th Century through the first half of the 20th Century.[6] The U.S. Public Health Service first documented high levels of radon and radon progeny in underground uranium mines on the Colorado Plateau in the early-1950s.[7] A decade later, a series of studies confirmed an excess of radiation-induced lung cancers among white Colorado Plateau underground miners.[8] In 1968, the federal government adopted the first in-mine radon exposure standard (4 Working Level Months [WLM] per year), requiring companies to install ventilation systems and provide workers with respiratory protection starting in 1971.[9] Compliance and record-keeping were not uniform or complete, and in 1980, a federal agency tracking uranium miners concluded that the 4 WLM/yr standard "does not provide an adequate degree of protection for underground miners."[10] No changes in the standard have been made since then, and no formal follow up of the health of post-1971 uranium workers has ever been conducted. A workers advocacy group is conducting an informal survey of Post-1971 uranium workers, and through May 2008, had collected more than 1,550 surveys.[11]

- **Uranium Millworkers.** A series of federal studies of mortality among uranium millworkers beginning in 1973 and continuing through 2004[12] has shown progressively increased mortality risks as the millers population has aged. The health of more than 2,000 millers who worked between 1940 and 1972 has been followed since 1952. The most recent evaluation, published in 2004, examined mortality among nearly 1,500 men who worked at seven different uranium mills and who *never* were miners, and confirmed previous findings of an excess mortality risk from non-malignant lung diseases,[13] lung cancer, blood cancers,[14] and chronic kidney disease. However, the risk of death from these diseases was not higher among workers who were employed for the greatest number of years. As a result, while the study found an increased risk for various causes of death among millers, it was unable to show conclusively that these deaths resulted from working in the mills. No studies have included millworkers after 1972.

II. Population Health Studies

- **Uranium Toxicity.** Six population-based studies conducted between 1980 and 1998 consistently found that chronic ingestion of uranium is associated with adverse changes in kidney function.[15] The lowest level of adverse chemical toxicity to the kidney observed in these studies was 14 micrograms per liter (ug/l) in water. Collectively, these studies served as the basis for USEPA's adoption of the national drinking water standard for uranium of 30 ug/l in 2000. Recognition of uranium's nephrotoxicity also

Attachment E

led to a three-fold *decrease* in the state's groundwater protection standard for uranium in 2003[16].

- **Community Health Studies.** Despite more than 50 years of uranium development on the Navajo Nation, no *comprehensive* public health study has ever been conducted in uranium-mining communities.[17] The federally funded **DiNEH Project** is an ongoing cross-sectional study examining the relationship of high rates of kidney disease in the Eastern Navajo Agency to exposure to uranium and other heavy metals in the environment. Preliminary results of the study indicate that the percentages of self-reported chronic kidney disease, diabetes, high blood pressure and autoimmune diseases are higher in Navajo communities with higher numbers of uranium mines.[18] Initial exposure modeling indicates that environmental exposures, including living within 0.8 kilometer of a uranium mine site and coming in contact with uranium wastes, are significant predictors of kidney disease/diabetes.[19]

- **Navajo Neuropathy.** Progressive neurological deterioration of the hands and arms of two Navajo sisters (two of 37 cases) was attributed to their exposures as fetuses and newborns to uranium mine wastes and consumption of mine water; genetic predisposition or causes were ruled out in these cases.[20] Most people with Navajo neuropathy died of liver failure and other complications in their late teens or early 20s, and the number of cases declined to zero after closure of abandoned open pit uranium mines by the early 1990s.[21]

- **Birth Defects.** Rates of birth defects in babies born to Navajo women living in uranium mining areas in New Mexico and Arizona between 1964 and 1981 were 2 to 8 times the national averages, depending on the type of defect.[22] An association between uranium exposure and birth defects may be significant when the mothers' and fathers' exposures are combined.[23]

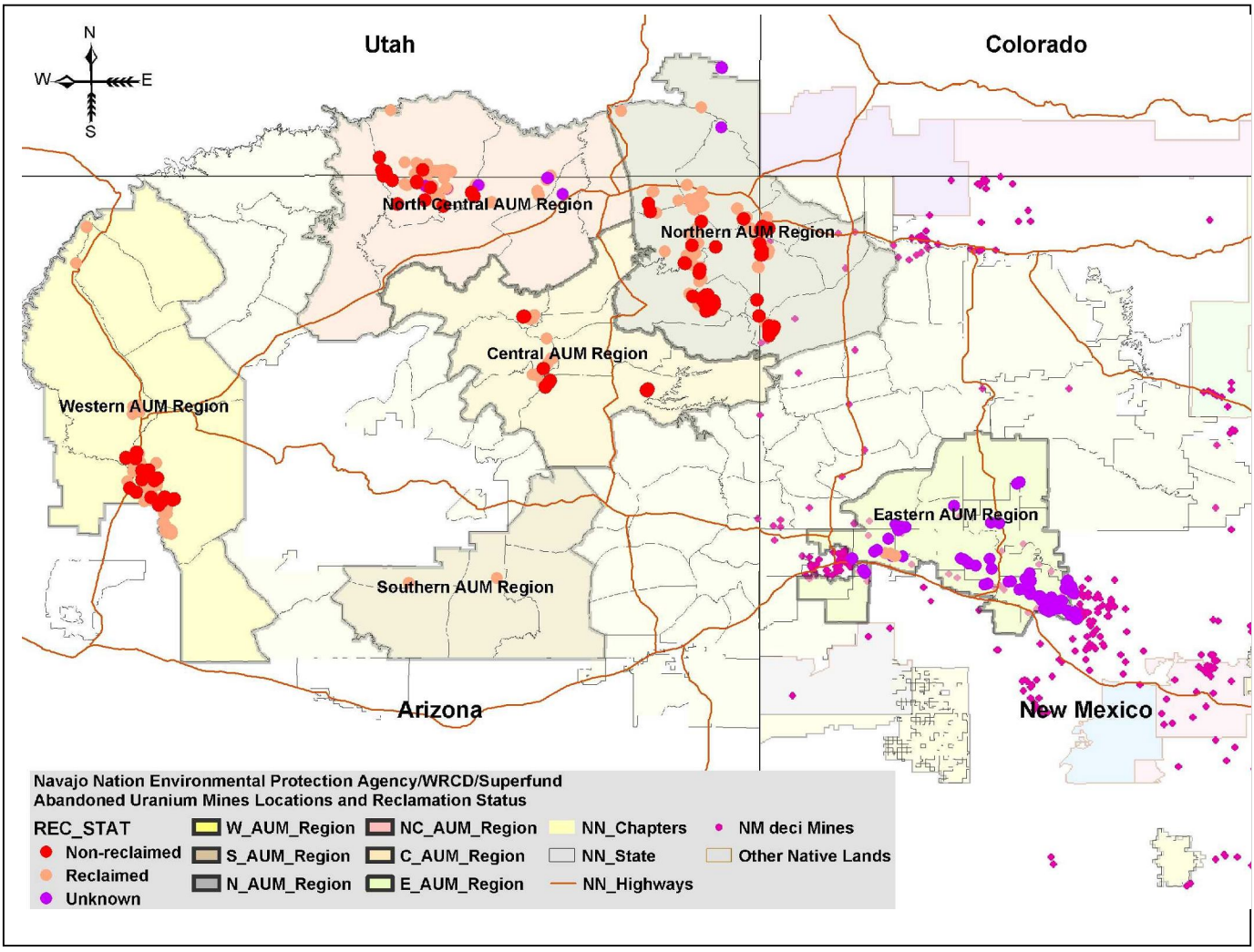
III. Ecological and Environmental Studies in New Mexico and the Navajo Nation

- **Churchrock Spill.** The July 16, 1979, uranium mill tailings spill at the United Nuclear Corporation Church Rock, N.M., tailings disposal facility was the largest release of radioactive wastes, by volume, in U.S. history, and ranked second only to the Chernobyl reactor accident in 1986 in total curies of radiation released to the environment. Yet this event received significantly less national media coverage than the March 1979 Three Mile Island nuclear reactor accident, which released less than a third of the radiation released in the Church Rock accident.[24]

- **Animal Studies.** Livestock that grazed in uranium mining areas of the Grants Mineral Belt were found to have significantly higher levels of uranium and radium in their muscles and organs than livestock not raised in uranium mining areas, according to a series of studies done in the 1980s to assess the effects of the July 1979 Church Rock uranium mill tailings spill and nearly 20 years of chronic mine-water discharges to the Puerco River system.[25]

- **Navajo Abandoned Mines.** More than 1,200 abandoned uranium mines have been documented on the Navajo Nation,[26] and of those, as many as 500 may need environmental restoration costing hundreds of millions of dollars.[27] (***See map below***.) More than 100 abandoned uranium mines have been documented in 17 chapters of the Eastern Agency of the Navajo Nation in New Mexico.[28] Two of those mines sandwich a Navajo community where nearly 6,000 cubic yards of radium- and uranium-contaminated soils were removed from around six homes by USEPA in Spring 2007.[29] USEPA and other federal agencies have developed a 5-year plan to investigate and clean up of high-risk uranium mine and waste sites, contaminated structures and polluted water wells as a result of Congressional inquiries.[30]

- **Waste Volumes.** The New Mexico Bureau of Geology documented 123 abandoned uranium mines in Cibola County, 358 in McKinley County and 109 in Sandoval County.[31] About half of those mines were developed and operated in the Grants Mineral Belt between 1950 and the early-1990s, generating 38 million tons of ore by 1970, and roughly an equivalent volume thereafter.[32] About a third of that total was taken from the Jackpile Mine on Laguna Pueblo, once the largest open-pit mine in the world.[33] Seven uranium mills were operated in the state between 1947 and 1995, generating more than 90 million tons of radioactive tailings, all of which have been subject to reclamation pursuant to federal regulations.[34] Each of these mills and tailings disposal sites caused extensive groundwater contamination by radium, uranium, various trace metals and dissolved solids. One estimate is that 1.2 million acre-feet of groundwater (or enough to fill Elephant Butte Reservoir *more than twice*) have been contaminated in the Ambrosia Lake-Milan area from historic mine and mill discharges, and less than two-tenths of 1 percent has been treated to reduce contaminant levels.[35]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Navajo Nation Environmental Protection Agency/WRCD/Superfund
Abandoned Uranium Mines Locations and Reclamation Status
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N_AUM_Region
NC_AUM_Region
C_AUM_Region
E_AUM_Region
NN_Chapters
NN_State
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Other Native Lands

CITATIONS

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