

DECLARATION OF DR. DAVID BEGAY Regarding the Roca Honda Project

I, Dr. David Begay, make this declaration based upon my personal knowledge and belief and state:

I am a traditional Navajo indigenous person residing in Ganado, Arizona. I am considered an authoritative representative of the religious and cultural beliefs and traditions of the Diné (Navajo people). I am a Diné Medicine Man and a member in good standing of the Hataalii Association. The Hataalii Association is an association of traditional Diné medicine practitioners, who require their members to be proficient in the cultural and religious ways of the Diné. I regularly conduct traditional Diné ceremonies and travel throughout the Navajo Nation to do so. I also hold a B.A. and M.A. from the University of Arizona, Tucson, in Political Science with a concentration in Policy Analysis and Indian Policy and Law Studies. I received a Ph.D. from the California Institute of Integral Studies, San Francisco, California, with a concentration in Indigenous Education and Application of Traditional Knowledge. I am also adjunct faculty at Northern Arizona University, Flagstaff, in the Department of Physics and Astronomy. I am Vice President for the Indigenous Education Institute, Santa Fe, New Mexico and work with the University of California, Berkeley, Space Sciences Laboratory through a grant from the National Science Foundation (NSF). I also work with the University of Notre Dame, through a grant from the National Aeronautics and Space Administration (NASA).

The lands on Mt. Taylor that will be directly and indirectly affected by the Roca Honda Project are considered a Sacred Site by myself and other members of the Navajo Nation. It is also a recognized Traditional Cultural Property (TCP). Myself and other members of the Navajo Nation have traditionally used and continue to use the Roca Honda Project site and adjacent

Exhibit 1

lands on Mt. Taylor for gathering, religious, cultural, and other traditional uses. These uses will be negatively affected and eliminated by any further mining activities.

Mt. Taylor (Tsoodzil) is culturally significant for the Diné. To understand Mt. Taylor from the Diné perspective, you have to look at it with a very holistic perspective. Indians think holistically – different from Cartesian Western thought. Natives talk about a lifelong experience that is expressed through language, culture and interaction with environment, including Mt. Taylor.

Each tribe has developed unique connection to environment and place. The Navajo talk about East Mountain (Mt. Blanco), West Mountain (San Francisco Peak), South Mountain (Mt. Taylor), and North Mountain (Hesperus). Those are the original boundaries of the Navajo Nation and the traditional Diné homeland. During the 1868 treaty negotiations, Navajo Nation representatives, including Barboncito, talked about these natural features where the Navajo have their place.

Thus, the indigenous relationship to the Earth is special. In Navajo we say *shi ke'ya*. *Shi ke'* means moccasins or shoes, underneath the sole of that shoe. The soles are the shoe's connection to the land. In the Navajo mind, it's a mother and infant relationship, it is natural, it is a bond. It is nothing like the English term "land". It is a mother and infant relationship. It is a biological connection, as well as a mental connection.

From this foundation, Navajo people developed norms, and standards, a medicinal and spiritual system that is intertwined with healing practices that have been going on for many years. All of these things were in place long before the United States government was established. Before Europeans came, Navajos were able to move freely to and on Mt. Taylor. Navajo people could go up to Mt Taylor, make that pilgrimage, without any interference from

the government or mining companies. It was total religious freedom. People had access to Mt. Taylor. It was religious freedom in the purest sense of the word. Most of the laws now restrict religious freedom, instead of giving religious freedom like the Constitution requires. The Forest Service is now taking away that religious freedom, they want to allow mining activities to go on without equally taking into account the religious significance or cultural preservation significance. All the federal laws have diminished native religious freedom, for example, the religious significance of Mt. Taylor is subordinated to mining interests. This process is very painful to native people. This Sacred Site is being exploited for monetary gain. Something we have been holding in reverence since the beginning of time is now being exploited.

The planned Roca Honda mine also concerns me because of its impact on plants and animals. A lot of plants are going to be impacted. A lot of animals are going to be impacted. From the Native American perspective, especially religious or spiritual people, we have to think about these things- the bear, the squirrels, the owl, the hawks, the eagle, the environment including the trees.

From the Western point of view, nothing but human welfare matters. From a Native point of view, all the living things are important, including the trees. The trees are living entities – they are not “just” trees. Trees are rooted into Mother Earth and drink the water that comes from her. If you take away the tree, you have the water in tree form. On top, beyond and below the tree exists. The tree is connected to the entire water cycle, to the runoff, to the watershed, to underground rivers and flows. The tree does not exist by itself – it is connected to everything else, that is how nature works. Only our words separate things in our minds. Localized cause and effect does not work in the Native point of view. There is a holistic cause and effect cycle, disturb one thing and the whole system is affected.

I think if Navajos were to be asked, a significant number would be opposed to the Roca Honda mine because of the cultural connection, the historic connection to Mt. Taylor. Many Navajo ceremonies, like the Blessing Way ceremony, feature Mt. Taylor because of its restorative power. During this ceremony, on the second night from midnight on, participants will be signing the mountain songs, and Mt. Taylor would be part of it. Several hundred ceremonies like this happen every month. Without even going to Mt. Taylor, people look to it for healing and blessings. Even though it may appear that nothing is going on at Mt. Taylor, there is constant activity. People just don't talk about it. It is part of a living religion; our culture is alive, not just historical. These traditions are still being lived.

I plan on going to Mt. Taylor at least twice this year to conduct ceremonies. I plan on going to Mt. Taylor in September to make offerings with six other medicine men. I also plan on going with my grandson in June or July to make offerings for protection because my grandson will be entering the military. Thus, the mining is an affront to the Navajo, including myself. The damage will be permanent and will affect the people in the community forever.

The proposed mine's plan to mine uranium also represents a violation of Diné cultural norms. I was taught that uranium was a part of Mother Earth; that it should not be separated from other things. And Native people, Navajo people, we acknowledge Mother Earth as a whole. It is naturally part of the Earth. At the same time, however, Navajo people have the understanding that there are certain parts of Mother Earth that are dangerous. Over time people have come to understand that there are places and animals that are dangerous and should not be disturbed. Take, for example, rattlesnakes. If you leave them alone, they will leave you alone. But if you poke a rattlesnake, it will strike back. Bears are the same; you respect its danger and learn to live together. Uranium is also the same – it is to be left alone.

Sometime back, after the Navajo people figured out that uranium is one of those dangerous substances, there was a ceremony to put it way back into the ground, a song was sung, and people were told to leave it alone. The Navajo learned to “sing the uranium back into the ground.” We were told keep our hands off it. We were told there are consequences and it can do harm to you, so do not mess with it.

If the Project is approved and begins, it will substantially burden, indeed, eliminate, the exercise of my above-noted religious beliefs and practices. The Roca Honda Project is entirely and completely antithetical to my religious beliefs and will cause them great damage. I will be unable to practice my religion and conduct my religious practices if the Project begins.

I declare under penalty of perjury of the laws of the United States that the foregoing is true and correct to the best of my knowledge and personal belief.

Dated: June 11, 2013.

/s/ David Begay

Dr. David Begay

MASE Comments on the United States Forest Service
Draft Environmental Impact Statement for Roca Honda Mine

June 11, 2013

DECLARATION of Manuel F. Pino, Acoma Pueblo Tribal Member

I Manuel F. Pino , do hereby submit this declaration based upon my personal knowledge and concerns for the protection of Mount Taylor. The opinions and perspectives presented are based upon research of uranium mining and my personal knowledge of the mountain and its significance to the Pueblo of Acoma.

My name is Manuel F. Pino. I am currently a Professor of American Indian Studies and Sociology at Scottsdale Community College in Scottsdale, Arizona. My work address is: Scottsdale Community College, 9000 East Chaparral Road, Scottsdale, Arizona 85256-2626. I currently serve as President of the Board of Directors of the Indigenous Environmental Network based out of Bemidji, Minnesota and Southwest Research and Information Center, Albuquerque, New Mexico. I am also a board member of the Laguna Acoma Coalition For A Safe Environment, and Red Rock Foundation based out of Carefree, Arizona. I am a member of the Multi-cultural Alliance for a Safe Environment based out of Cibola County New Mexico

As a tribal member of the Pueblo of Acoma I have lived on and off the reservation my entire life. I began employment out of graduate school in 1991 at Arizona State University and later transferred to Scottsdale Community College where I am now employed. My education and work experience as a sociologist has provided me with numerous opportunities in working with Indigenous Peoples throughout the world on environmental issues and specifically mining. Growing up at Acoma Pueblo my life has experienced the boom/ bust cycle of uranium mining in the Grants Mineral Belt now currently referred to as the Grants Mining District. My father, uncles, cousins, nephews and aunts were all employed in the uranium mines and mills in the fifty year period of uranium mining.

Having witnessed firsthand the devastating environmental impacts of uranium mining and milling as an undergraduate student at the University of New Mexico it became a lifelong research interest. I began to realize that in addition to environmental devastation the uranium industry was also impacting the health of both mining and non-mining populations, not only at Acoma but at our sister Pueblo to the east Laguna, which facilitated the largest open pit uranium mine in the world from 1952 to 1982 at the Jackpile Mine, and our neighbors to the west the Diné people of the Navajo Nation. It has now been thirty-five years since I have been working on uranium mining and nuclear fuel chain issues throughout the world. Recently I have worked with former uranium workers in New Mexico, Arizona, South Dakota, and Washington to help them gain compensation through the 1990 Radiation Exposure Compensation Act (RECA) and its amendments in the 2000 Uranium Workers Compensation Act. In assisting former miners I found that in all of these geographical areas, despite the fact that former miners were dying of all forms of cancerous related illnesses from exposure to radioactive contaminants that no comprehensive health studies were being conducted in these contaminated communities. These experiences imply paradigms of environmental racism and injustice.

Having presented testimony before numerous congressional committees and before President Clinton's Advisory Committee on Human Radiation Experiments (created by Executive Order in 1994) evidence was presented on the lack of information uranium workers were given in the early years of mining and milling (1940's, 50's and 60's) to the dangers of radiation exposure. In the early years of mining, workers were not provided with respiratory protection, the mines were not ventilated, and direct exposure to contaminants in working conditions were common. Testimony in these hearings were extremely helpful in amending the 1990 RECA to include all uranium workers under the 2000 amendments, not just underground miners as addressed in the 1990 Act. The current legislation still has many flaws but the federal government has acknowledged that health issues among former workers does justify compensation.

As a sociologist I have also noticed in contaminated communities in the Grants Mining District that non-mining populations have also been impacted by uranium mining and milling as well as other impacts resulting from the nuclear fuel chain. Numerous communities like the village of Paguete which is on the Laguna Pueblo and for 30 years was situated approximately 2,000 feet from the Jackpile Mine, has cancer clusters among its population and yet no comprehensive health studies have been conducted at Paguete or any other community on Laguna Pueblo. The open pit mine at Jackpile operated by Anaconda Mining Company and later Atlantic Richfield Corporation produced 25 million tons of ore with the majority of ore going to the Department of Defense to make weapons of mass destruction. The reclamation of the Jackpile completed in 1995 was initially called successful; however, in 2007, the Laguna Pueblo asked the Environmental Protection Agency (EPA) to place Jackpile on the National Priorities List (NPL) for reclamation. The EPA has concluded that reclamation is currently incomplete and a final decision is pending. Historical impacts like the experience at Jackpile are commonplace throughout the Grants Mining District, causing historical and intergenerational psychological trauma among populations living in the Grants Mining District.

In the village of Milan located west of Grants, New Mexico and situated 5.5 miles from the Homestake Mill one of the largest mills at the height of development all the underground wells are contaminated and unfit for human consumption. The site has also contaminated underground aquifers in the area. The site encompasses approximately 200 acres and contains an estimated 21 million tons of uranium mill tailings. The EPA is currently conducting a Human Health Risk Assessment which is scheduled for completion in spring 2013. Water contamination in the area has impacted agricultural and livestock raising which is the livelihood of numerous local residents and which was extremely evident before the uranium mining boom. Local residents living in the contaminated community much like Paguete village suffer from cancerous related illnesses and are trapped in their community because it is impossible to sell their homes and leave due to the fact no one wants to buy a home in a contaminated community. These adverse impacts have caused pain and suffering among local residents, many who never even worked in a uranium mine but are victims based upon where they live.

On the Navajo Nation there are over 1,000 abandoned uranium mines that have not been reclaimed. Many of these abandoned mines exist in the Grants Mining District where new mining is being proposed in the communities of Churchrock and Crownpoint, New Mexico. On July 16, 1979 a tailings pond at United Nuclear Corporation's uranium mill in Churchrock breached its dam emitting 1,000 tons of radioactive waste and 93 million gallons of liquid waste into the Puerco River impacting downstream

populations as far as Navajo County, Arizona over 100 miles from the mill. The EPA is currently reclaiming soil contamination in the area which began almost 30 years after the spill and is considered the largest radioactive accident in the U.S. exceeding the accident at the Three Mile Island Nuclear Power Plant in Harrisburg, Pennsylvania in April 1979. The allegations of environmental racism were raised due to the fact that Three Mile Island received national attention and an immediate federal governmental response while very little attention was given to the Churchrock spill.

The legacy of uranium development on the Navajo Nation, which is about the size of West Virginia, includes numerous contaminated sites like Churchrock. In the early years of mining on the Navajo Nation, people built their homes with mine waste, drank contaminated water, children played on mine waste which was not monitored, and like other communities, is experiencing cancer related illnesses. Recent health studies being conducted by the University of New Mexico and Southwest Research and Information Center on the Navajo Nation in the Grants Mining District correlate renal disease with uranium mining. Results of the study are still being compiled. All of these human rights violations have resulted in the Navajo Nation Tribal Government in 2005 passing the Diné Natural Resources Protection Act which bans all future uranium mining on the Navajo Nation. Legislation was recently passed that regulates transporting any form of nuclear material on the Navajo Nation.

Another major area of concern for Indigenous Peoples in the Grants Mining District is the impact to the tradition, culture and spirituality of Indian Nations. One of the major impacts addressed by spiritual and tribal governmental leaders from numerous tribes is the destruction of sacred sites. A major concern is the impact of uranium mining and milling on Mount Taylor, an 11,000 foot mountain situated in the heart of the Grants Mining District. Development of uranium on or near the mountain has always been a concern for spiritual leaders and traditionalists since mining began in the 1950's. Opposition pitted traditionalists versus progressives who only saw the economic benefit of uranium and employment. As time progressed more and more indigenous people began to see firsthand the environmental degradation, water contamination, impacts to the food chain as livestock grazed on contaminated land and wild animals such as deer and elk were also grazing on the same contaminated areas and drinking from contaminated water sources.

Today several mines in the Mount Taylor district are in the permitting process with New Mexico state regulating agencies and the federal government. Most of these mines are conventional proposals (underground as compared to the proposed in situ leach mining process in Churchrock and Crownpoint). One of these mines is Roca Honda which is situated on two sections of USFS land and a section on State Trust Land. The mining project is a joint venture of Strathmore Minerals and Sumitomo, a Japanese multinational corporation. Currently the USFS is drafting an environmental impact statement (EIS) for exploratory drilling in the Cibola National Forest in the Mount Taylor Ranger District to whom I am submitting this declaration. Development proposals indicate that the majority of the ore mined at Roca Honda would be exported out of the country at the expense of our land, water and air being contaminated.

In the traditional worldview of the Acoma people, Keweshtima "snow covered mountain" is sacred. It is a living entity and is the main source of water utilized by Acoma people for hundreds of years. It is seen

as the life blood of our existence. The water shed off the mountain feeds the Rio San Jose which flows directly through the Acoma reservation. It also feeds and recharges numerous springs in the area. Water from these sources is used for religious purposes. Any form of water contamination and the depletion of water sources will directly impact future generations of Acoma people. If uranium development is allowed in what has been acknowledged by the federal government as aboriginal Acoma land (the Acoma Province) by the Indian Claims Commission, water pilgrimage trails, delicate archeological sites and sacred sites utilized for ceremonial purposes would all be devastated. Acoma people believe that if Mount Taylor is disturbed in ways that endanger the holistic nature of the mountain the whole world could be impacted if Acomas are unable to fulfill their sacred obligations to the mountain. We are inextricably linked to Kaweshtima and if these disturbances disrupt our ceremonial calendar, we too will pay with dire consequences. As an Acoma tribal member, I have participated and continue to participate in the religious and cultural activities of my Pueblo. Therefore, if the Roca Honda mine is constructed, it will substantially burden and in fact eliminate the exercise of my religious beliefs and practices. The Roca Honda Project is entirely and completely antithetical to my religious beliefs and will cause them great damage. I will be unable to practice my religion and conduct my religious practices if the Project begins.

Four other Indian Nations the Hopi, Laguna, Zuni and Navajo who also consider Mount Taylor sacred filed jointly for Traditional Cultural Property (TCP) designation in 2008 which was initially designated by the State Historic Preservation Office in New Mexico. The mountain was listed as one of the 11 most endangered historic places in the U.S. in 2009 by the National Trust for Historic Preservation. Opposition by non-Indians in Cibola County resulted in racist reaction including the beating of five Navajo men in Grants three days after the designation. The TCP was supported by a resolution passed by all 19 Pueblo tribes in New Mexico. Opposition to the TCP has resulted in litigation in state court and a decision is now pending.

To me personally as an Acoma man, the mining of uranium on or near Mount Taylor represents desecration and the violation of our constitutional and human rights as Acoma people to religious freedom. The impact on our ceremonies and pilgrimages to the mountain will be further desecrated beyond what has already happened in the first wave of uranium development. Laws and policies like the American Indian Religious Freedom Act and the Religious Freedom Restoration Act in recent cases (2008) like Navajo Nation v. United States Forest Service in protecting San Francisco Peaks in Arizona have proved to be inadequate. Economic benefit to non-Indian communities always seems to take precedence over religious protection of Indigenous Peoples. What is our legal recourse if U.S. Supreme Court cases like Lyng v. Northwest Indian Cemetery Association (1988) hold that the first amendment right to religious freedom does not apply to Indian religion and spirituality? The holding in Lyng has impacted virtually every Indian Nation in the United States. How can any religious faith be excluded from the ambit of the first amendment? It seems in reference to Indian religious cases that they are seen only as products of an insensitive court system that experienced inordinate difficulty understanding and protecting a set of religions vastly different from those more familiar to American judges. Ironically many Americans revere holy places in lands far away from the U.S. but they are completely unaware of the ones right under their feet at home. To Acoma people Kaweshtima is just as

significant as Jerusalem, Mecca, the Vatican and the Wailing Wall. Can we not understand that? The Lyng doctrine does just that: agencies can destroy Native American holy places in a land that professes religious liberty.

The Roca Honda Mine will create irreversible damage as we have already experienced in the 50 year legacy of uranium mining in the Grants Mining District. If the state of New Mexico, the federal government and the mining companies see this as creating employment why can't these institutions prioritize reclaiming and cleaning up impacted areas as that initiative will also create employment and clean up the devastation of the first 50 year legacy of uranium mining in western new Mexico. The nuclear industry has yet to find a solution for the permanent disposal of high level nuclear waste and the contamination that has resulted from nuclear disasters at Fukushima, Chernobyl, Three Mile Island, and Churchrock should be evidence enough for the USFS and the State of New Mexico to decide that nuclear power is not a safe solution to addressing the current energy crisis in the U.S. and throughout the world. The Roca Honda Mine if permitted will create a substantial burden to all living entities in the area it will impact the future of our traditional homelands as well as the future generations of all people not only in New Mexico but throughout the world.

I hereby declare under penalty of perjury under the laws of the United States that the foregoing is true and correct to the best of my knowledge.

Dated: June 11, 2013

/s/ Manuel F. Pino

Manuel F. Pino

DECLARATION OF BUCKY PRESTON Regarding the Roca Honda Project

I, Bucky Preston, make this declaration based upon my personal knowledge and belief and state:

I am a traditional Hopi man that strives to live a good, safe life in a peaceful and loving way. I am a traditional leader and have run thousands of miles for the protection of water and sacred sites. I am very concerned with the proposed Roca Honda uranium mine on Mt. Taylor.

Mt. Taylor has been here long before any human being, we know this as Hopi people. We have many shrines all the way from here at Hopi to the top of Mt. Taylor. With the arrival of outsiders, we've been cut off from doing our pilgrimages. Wherever we go, they say this is someone else's land, its federal land, its state land, its private land. They put up fences, signs, and say trespassers will be prosecuted. The government made these laws recently, before these laws there was nothing to stop us from making our journeys. All the ceremonies that we have depend on these shrines and places of sacred importance. The government is trying to take this away from us.

People from other countries will never understand because they don't have a history of caring about their environment and their homes. The way my people have survived is with prayer and connection to place, to our sacred places like Mt. Taylor. Tribes throughout Turtle Island and Indigenous peoples throughout the world rely on our culture and prayer as the answer to problems and to lead us through life in a kind and loving way. Outsiders, people foreign to this land, are about brutal punishment and jails. Our people have picked this up and now we have our own jails and systems of punishment. We are no longer living a better, more prayerful way of life. Because of

this transition, our people have picked up these ways and picked up drug and alcohol abuse and unhealthy lifestyles. For them its just about money, everything amounts to money, its not about giving and sharing like we were traditionally taught.

Everything that the Creator blessed us with has been taken away by force from outsiders. Our laws are not man-made. We've made a covenant with the one that put us here. Hopis don't punish by jailing. We look at things and learn from them in ways that can't be understood by the white man. It is always our goal to live together in peace and harmony. Everything is included in this, the trees, the rocks, the dirt, the soil, the animals; they give us what we need to survive. We are ruining these things and ourselves. Like the ozone layer. We are depleting the ozone layer because of how we've chosen to live as human beings. I can feel the difference, the heat on my skin, the air I breathe in, and what I see. You will notice these differences if you live with the environment and appreciate the environment. We are dry farmers in the southwest; we rely on and need the rain. Projects like Roca Honda will waste this precious water.

The gifts from Creator that we were blessed with, like the rocks and trees, they don't change. They have no policies, no rules, they are free to just be. It is because they don't change that we have survived. We've been able to count on them. When we as human beings start changing things and taking things out of the land, like uranium, bad things happen. Creator put those things in the ground and we as human beings shouldn't move things around. Everything is in its place for a reason.

In our Hopi prophecies, it says that the white man will bring disease through technology. They say uranium mining will be done with the newest technology, that they've invented new things, but we are ruining ourselves. This technology is ruining us.

Our people are dying because of uranium mining. We have cancer and diabetes now. Nobody can tell me this isn't from uranium mining, because I know it is. The government doesn't see us as human beings, it doesn't see us as being worthy of life. I don't see the government ever listening to Indigenous peoples because we are always in the way of their development, in the way of making money. All we can do is pray and speak up to protect sacred places, to protect our way of life.

We have to remember everything is where it is for a reason. Everything has a purpose, but we can't go around moving things wherever we want. That's where the sickness comes from. I know as a Hopi person why the Creator put me here. I know why the Hopi people are here. Everything has a purpose, a place, and a reason.

If the project is approved and begins, it will substantially burden, indeed, eliminate, the exercise of my above-noted religious beliefs and practices. The Roca Honda Project is entirely and completely antithetical to my religious beliefs and will cause them great damage. I will be unable to practice my religion and conduct my religious practices if the Project begins.

I declare under penalty of perjury of the laws of the United States that the foregoing is true and correct to the best of my knowledge and personal belief.

Dated: June 7, 2013.

/s/ Bucky Preston

Bucky Preston

DECLARATION OF Malcolm Bowekaty Regarding the Roca Honda Project

I, Malcolm Bowekaty, make this declaration based upon my personal knowledge and belief and state:

I am a traditional man from Zuni Pueblo in New Mexico. I am a practitioner of Zuni religion and very involved in our traditional ceremonies and culture. Mt. Taylor is one of our sacred mountains where we have shrines and places where we harvest plants, minerals, and botanicals. Its Zuni name is translated to the northern mountain where the water dammed, meaning it is where the watershed starts. We harvest the plants that are medicinal, as well as for paints. We harvest the aspen trees for religious purposes. We use the aspens for only certain Kachinas. We harvest obsidian, azurite, red paint, and whitewash in the various sections on and around Mt. Taylor. We harvest native tobacco in the area.

There are several specific places where we make offerings as individual practitioners and there are certain sections around Mt. Taylor that have certain shrines for the different medicine societies. We place offerings near the springs and at other locations. It is also a place of sanctuary when individuals need to meditate. Mt. Taylor is mentioned in our origin stories and many traditional stories reference it. In the old days, we went there to harvest deer, mountain lions, bobcats, and turkeys. It is a place for harvesting animals, but it's gotten a lot harder now for us to do that. Most importantly, Zuni, along with Acoma, Hopi, Laguna, and Navajo have repatriated and reburied human remains on Mt. Taylor. Mt. Taylor has been deemed a burial repatriation area for instances in which human remains are repatriated from museums and such and are not

Exhibit 4

identified to a specific tribe. In those cases, people are identified to take and reburial those remains on Mt. Taylor, since it is a shared sacred place among the tribes.

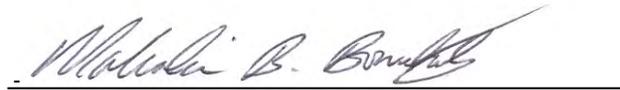
Our oral stories reference Mt. Taylor as a place where people can go to ask for strength and courage, because of the forces that created the mountain. In certain places we actually know about the garnets that are embedded deep in the mountain. It is those substances that are used and guided by the spirits to cure illnesses. Obsidian is still used to make arrowheads by certain medicine societies for certain cultural practices. For the more blessed individuals or practitioners, they may come across quartz crystals.

The roots, shrubs, and berries are harvested. The plants are used to make the prayer sticks used in ceremonies by our medicine societies. We use the spruce when we have feasts or large ceremonies. Mt. Taylor has a series of springs that are sacred; it is where we make our offerings. The items we harvest are used in rituals, ceremonies, and religious practices. We get red clay for our Kachinas and it is our traditional warpaint. We continue to visit all these places today. I visit those places. I know exactly where I need to go to harvest these items. I know the trails. We know where to find what we need for our ceremonies.

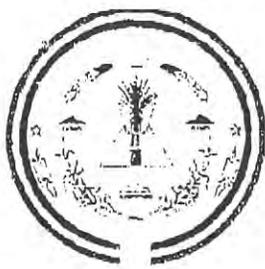
If the Roca Honda mine goes forward, it will dry up the springs and the portals to the spirit world will be shut down. This not only impacts our religion, but the entire region. Drying up of the springs is unacceptable. The depletion of the headwaters and drying of the aquifers will endanger the native tobacco plants and other botanicals that we use. The disturbances will impact the growth of the aspen trees that are significant to us. Mt. Taylor is the only place where we can harvest aspen trees. Losing them would be irreplaceable. The roads that would be established would open the sacred areas for

unsuspecting individuals to desecrate the harvesting areas. The current tourist traffic and hunting traffic on Mt. Taylor drives away the game animals and the birds that we use. The new activity will further disrupt their patterns. Mining trucks will invade their area and their patterns. Some areas will be fenced off, blocking practitioners from accessing areas for harvest. This is unacceptable. If the Roca Honda mine is constructed, it will substantially burden and in fact eliminate my ability to exercise my religious beliefs and practices. The Roca Honda Project is entirely and completely antithetical to my religious beliefs and will cause them great damage.

Dated: June 12, 2013

A handwritten signature in cursive script, reading "Malcolm B. Bowekaty", is written above a solid horizontal line.

Malcolm Bowekaty



Azee' Bee Nahaghá of the Diné Nation

P.O. Box 1570 Chinle, Arizona 86503

David Clark, President
Herman Johnson, V-President
Nathan Begay, Treasurer
Maggie B. James, Secretary

RESOLUTION OF AZEE' BEE NAHAGHÁ OF DINÉ NATION

**STRONGLY OPPOSING URANIUM EXPLORATION, MINING, AND
PROCESSING IN AND AROUND TSOODZIL (MT. TAYLOR) AREA, AND
REQUESTING CONSULTATION OF AFFECTED NATIVE AMERICAN
TRIBES AND COMMUNITIES IN THE ISSUANCE OF ANY PERMITS,
LEASES, OR LICENSES OF ANY MINING ACTIVITY.**

WHEREAS:

1. The Azee' Bee Nahaghá of Diné Nation (ABNDN), formerly known as The Native American Church of Navajoland, was established in 1966 as a nonprofit organization and incorporated within the Navajo Nation and the States of Arizona, New Mexico, Utah and Texas; and
2. The Board of Directors is the governing body of ABNDN, with full authority and responsibility to advise, recommend, and to make necessary decisions to approve policies appropriate in the promotion of and upholding the vital interests of the church; and
3. The general membership is encouraged to assume participation and responsibilities in planning, setting goals and priorities, and making decisions to strengthen overall church goals and objectives; and
4. The Azee' Bee Nahaghá of Diné Nation supports the Fundamental Law of the Dine, as codified in Title I of the Navajo Nation Code, which supports the importance of the preservation and protection of Navajo Nation natural resources, especially the four sacred elements of life -- air, light/fire, water, and earth/pollen -- as these resources are the foundation of the peoples' spiritual ceremonies and Dine lifeway; and
5. Tsoodzil (Mt. Taylor) is the Navajo Holy Mountain of the South and is deeply embedded and rooted in religious practices and beliefs of the Diné and other indigenous people of the area as it contains:
 - i. homes of the holy people;
 - ii. places that are of historical, religious, and cultural significance;
 - iii. places for conducting sacred ceremonies, prayers and offerings;
 - iv. places for gathering medicines, herbs, minerals or other materials for ceremonial and cultural uses;
 - v. locations with traditional and religious stories tied to the land; and

Exhibit 5

- 6. At least a dozen companies have applied for or obtained state and federal permits to explore for and mine uranium on locations on or near Tsoodzil from the New Mexico Mining Minerals Division, New Mexico Environment Department, and State Land Office, in addition to the U.S. Forest Service, U.S. Bureau of Land Management, and the U.S. Nuclear Regulatory Commission; and
- 7. The proposed uranium development will adversely impact Tsoodzil by alteration, disturbance, degradation, and desecration of sacred sites and infringing upon Diné spiritual and cultural practices and beliefs; and
- 8. In addition, the permitting, licensure, and approval of uranium exploration, mining and processing is in violation of the Religious Freedom Restoration Act (RFRA) of 1993, 42 U.S.C. by the recent reversal of decision by the U.S. Ninth Circuit Court of Appeals re: Navajo Nation vs. U.S. Forest Service, 408 F. Supp. 2d 866 (D. Ariz. 2006) regarding another sacred mountain, Dook'oo'sliid (San Francisco Peaks); and
- 9. The Azee' Bee Nahaghá of Diné seeks protection and relief under RFRA emphasizing that any mining activity in and around Tsoodzil would impose a substantial burden as to the free exercise of religious practices by land-use regulations of permits leases, and licenses of such mining activity.

NOW, THEREFORE, BE IT RESOLVED THAT:

The Azee' Bec Nahaghá of Diné Nation hereby strongly opposes uranium exploration, mining, and processing in and around Tsoodzil (Mt. Taylor) area and requesting consultation of affected Native American tribes and local communities in the issuance of any permits, leases, or licenses of any mining activity.

CERTIFICATION

We, hereby, certify that the foregoing resolution was duly considered by the general membership of ABNDN at a duly called meeting at Chichiltah, (Navajo Nation), New Mexico, at which a quorum was present and the same was passed by a vote of 51 in favor, 0 opposed, and 0 abstained, this 9th day of June 2007.

Motion: Tom Lapaha

Second: Melvin Bedonie

151
David S. Clark, President

151
Herman Johnson, Vice-President

RAMAH NAVAJO CHAPTER

Harry Yazzie Sr.
President

Cecil F. Eriacho
Vice-President

Nancy Martine-Alonzo
Secretary/Treasurer

HCR 61 Box 13
Ramah, New Mexico 87321-9601
(505) 775-7130/7100
FAX (505) 775-7137/7103
Tribal Office



George Apachito
Council Delegate
Navajo Nation Council

Leo L. Pino
Member
Eastern Navajo Land

June 4, 2013

Forest Supervisor
U.S. Forest Service
Cibola National Forest & Grasslands
2113 Osuna Rd., NE
Albuquerque, NM 87113

AND

Honorable Senator Martin Heinrich
702 Hart Senate Office Building
Washington, DC 20510

Honorable Senator Tom Udall
110 Hart Senate Office Building
Washington, DC 20510

Honorable Representative Steve Pearce
2432 Rayburn House Office Building
Washington, DC 20515

RE: ROCA HONDA URANIUM MINE DEIS

TO: Forest Supervisor, U.S. Forest Service and New Mexico Congressional Delegation

I am sending you, attached, the comments and concerns of the Ramah Navajo Community on the proposed Roca Honda Uranium Mine Project and Roca Honda Draft Environmental Impact Statement, as expressed in Ramah Navajo Chapter Resolution No. 051306, dated May 15, 2013. Also attached are the following supporting documents which are referred to in the Resolution: a statement submitted by the Ramah Navajo Community on June 14, 2008, regarding the designation of Mt. Taylor, known to our Diné people as Tsoodzil, as a Traditional Cultural Property; and a letter sent to Nancy Rose, of the U.S. Forest Service/Cibola National Forest, on July 17, 2012, from concerned community elders who opposed the permitting and start-up of the La Jara Mesa uranium mine on Mt. Taylor/Tsoodzil.

As you will see, our community unconditionally opposes the resumption or initiation of any uranium mining on our ancestral lands, which includes Mt. Taylor/Tsoodzil, our most sacred mountain to the south, and strongly urges the U.S. Forest Service to choose the NO ACTION alternative for the Roca Honda Draft Environmental Impact Statement.

Respectfully yours,

Handwritten signature of Harry B. Yazzie Sr.

Harry B. Yazzie, Sr.
President, Ramah Navajo Chapter

Exhibit 6

Cc: Sen. Tom Udall, Albuquerque Office; Sen. Martin Heinrich, Albuquerque/Farmington Offices; Rep. Steve Pearce, Socorro Office; Multicultural Alliance for a Safe Environment (MASE@sric.org)

Harry B. Yazzie, Sr.
President

Cecil F. Eriacho
Vice-President

Nancy R. Martine-Alonzo
Secretary/Treasurer

RAMAH NAVAJO CHAPTER
HCR 61, Box 13 Ramah, New Mexico 87321-9601
(505) 775-7130/7132
FAX (505) 775-7137
Tribal Office



George Apachito
Council Delegate
Navajo Nation Council

Leo L. Pino
Member
Eastern Navajo Land Board

RESOLUTION OF THE RAMAH NAVAJO CHAPTER
NO. 051306

Unconditionally opposing the development or resumption of uranium mining and processing on Ramah Navajo ancestral lands, including the proposed Roca Honda Uranium Mine located on Mt. Taylor/Tsoodzil, one of our most sacred mountains; reaffirming Mt. Taylor's designation as a Traditional Cultural Property with protection as an indigenous historic/cultural/spiritual landmark and the *Diné Natural Resources Protection Act of 2005* which prohibits uranium mining within Navajo Indian Country; and urging the U.S Forest Service to deny the Roca Honda Mine project by choosing the NO ACTION alternative for the Roca Honda Draft Environmental Impact Statement

WHEREAS:

1. Pursuant to Navajo Tribal Council Resolution CJ-20-55, the Ramah Navajo Chapter is a certified Chapter of the Navajo Nation and the Chapter is uniquely situated as a satellite community of the Navajo Nation;
2. By Resolution CAP-34-98, the Navajo Nation Council enacted the Navajo Nation Local Governance Act codified as 26 NNC establishing a new title exclusively for political subdivisions of the Navajo Nation to address the governmental function of chapters that improves the governmental structure and provides the opportunity for local chapters to make decisions over local matters; and allowing communities to excel and flourish, enable Navajo leaders to lead toward a prosperous future and improve the strength and sovereignty of the Navajo Nation, including custom and tradition; and
3. Mt. Taylor, known to our Diné people as Tsoodzil, is very sacred and precious to us as one of the four Diné sacred mountains that define and protect our ancestral homeland; and
4. As one of our holiest places, Mt. Taylor/Tsoodzil is where significant events occurred as our holy deities created the universe and our present-day world--events that brought into existence the fundamental laws, teachings and values that govern our lives and relationships as Diné people and that continue to be recounted from generation to generation as an essential part of our oral history; and
5. As the sacred mountain closest to the Ramah Navajo Community, Mt. Taylor/Tsoodzil is our home, part of our indigenous land base that provides us, from its base to its summit, physical, mental, emotional and spiritual sustenance and well-being into the future with native foods, medicines, tools and special places for giving our prayers, songs and offerings and for conducting our healing ceremonies; and
6. In order to protect the integrity of Mt. Taylor/Tsoodzil and its unique and irreplaceable cultural, ecological and spiritual landscape and life-giving waters for generations to come, the Ramah Navajo Community fully supported the designation of all of Mt. Taylor/Tsoodzil in 2008 as a Traditional Cultural Property (TCP) by the New Mexico Cultural Properties Review Committee, its subsequent listing as one of eleven most endangered historic sites by the National Historic Trust, and its eligibility for inclusion on the National Register of Historic Places; and
7. Our elders voiced their unequivocal opposition to any start-up of uranium mining on Mt. Taylor/Tsoodzil to the U.S. Forest Service in 2012 as a grassroots response to a permit request for the La Jara Mesa Uranium Mine on Mt. Taylor and expressed deep concerns on how the resumption of mining would desecrate one of our most sacred places and threaten the very foundation of our distinctive identity, our indigenous natural/cultural/spiritual resources and traditions and our sovereignty as Ramah Navajo people; and
8. The proposed Roca Honda Uranium Mine, located on Mt. Taylor near San Mateo, NM, and situated partly on the Mt. Taylor TCP in the Cibola National Forest, would, according to the U.S. Forest Service's summary of the project's Draft Environmental Impact Statement (DEIS), cause significant "adverse impacts to tribal resources and practices related to the sacred character of Mt. Taylor for the Acoma, Laguna, Zuni, Hopi and Navajo in particular, causing irreparable harm to the tribes and their traditional cultural practices"(from U.S. Forest Service's "*Roca Honda Mine DEIS ~ Cultural Resources*" summary sheet, 2013); and

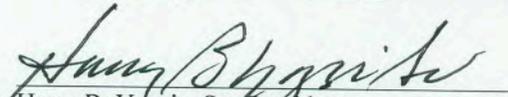
9. Mt. Taylor/Tsoodzil provides precious water, one of the four sacred elements of Diné life, to our region of west-central New Mexico, and the proposed Roca Honda uranium mine, as well as any other existing or proposed mines on our sacred mountain, would threaten the life-giving qualities and the quantity of this water for generations to come through the dewatering process and the irreversible contamination of groundwater, springs, aquifers, surface waters, soils/land with uranium, toxic heavy metals, and radioactive substances and wastes from mining operations; and
10. Uranium mining that occurred on Mt. Taylor/Tsoodzil and in western New Mexico over three decades ago has left an unconscionable legacy of hundreds of abandoned mines and radioactive wastes that the mining companies still have not remediated and that continue to contaminate and degrade our sacred ancestral lands, while compromising the health and well-being of all peoples in our area with debilitating illnesses and cancers that have resulted in premature deaths and whose full impacts on future generations are still not known; and
11. Our Diné fundamental laws, which teach us to value and respect life and "all the natural resources within the four sacred mountains...especially the four sacred elements of life--air, light/fire, water and earth/pollen--for these resources are the foundation of the peoples' spiritual ceremonies and the Diné way of life..." and "to maintain harmony and balance in life and a healthy environment" (*Diné Natural Resources Protection Act of 2005*), admonish us not to disturb uranium, a substance known to be of great harm to the people, but to leave it in the ground untouched as its ultimate use is to power the weapons of war which will bring untold destruction and sorrow to all life on Mother Earth; and
12. Despite the far-reaching concerns that the development of the Roca Honda Uranium Mine raises, the Ramah Navajo Community has not yet received formal notification of this proposed project from the U.S. Forest Service nor been fully informed of its potential impacts on the Ramah Navajo people by the agency, in line with current state, federal and international protocols for tribal consultation.

NOW, THEREFORE, BE IT RESOLVED THAT:

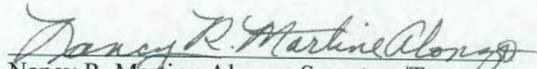
1. The Ramah Navajo Community reaffirms the Diné fundamental laws that impart teachings of valuing life above any monetary gain, as well as the provisions of the *Diné Natural Resources Protection Act of 2005* that prohibits uranium mining and processing within Navajo Indian Country, and unconditionally opposes the initiation or resumption of any uranium mining on Mt. Taylor/Tsoodzil, our sacred mountain of the South, and on any other lands that are part of our indigenous ancestral homeland, considering the deleterious legacy of past uranium mining in western New Mexico and the potential irreparable harm that the proposed Roca Honda Uranium Mine and all other uranium mines will bring to our ancestral homeland and especially to the unique natural, cultural and spiritual landscape and life-giving waters of Tsoodzil.
2. The Ramah Navajo Community urges the U.S. Forest Service to respect the designation and protection of Mt. Taylor/Tsoodzil as a very special and irreplaceable Traditional Cultural Property; to choose the NO ACTION alternative for the Roca Honda Draft Environmental Impact Statement; and to institute a process of dialogue/consultation with the Ramah Navajo Chapter on any proposed developments that may potentially impact the integrity of our sacred homeland and lifeways.

CERTIFICATION

We hereby certify that the foregoing resolution was duly considered by the Ramah Navajo Chapter at a duly called meeting in Mt. View, (Navajo Nation) New Mexico at which a quorum was present and that the same was passed by a vote of 16, in favor 0, opposed, and 12, abstained on this 15th day of May 2013.


 Harry B. Yazzie, Sr., President

 Cecil F. Eriacho, Vice-President


 Nancy R. Martine-Alonzo, Secretary/Treasurer

 George Apachito, Council Delegate

Motioned by: Sarah Adeky

Seconded by: Nixon Martinez

RAMAH NAVAJO COMMUNITY POSITION STATEMENT ON TSOODZIŁ TO BE DESIGNATED AS A TRADITIONAL CULTURAL PROPERTY

JUNE 14, 2008

The Ramah Navajo Community is in support of emergency, and ultimately permanent, designation of Mt. Taylor, which our people call Tsoodził, as a Traditional Cultural Property by the New Mexico Historic Preservation's Cultural Properties Review Committee. We want to thank the Review Committee for reopening the public comment process and for giving us the opportunity today to contribute our thoughts on this critically important issue.

For us, the term, "traditional cultural property," is inadequate in describing our historic and deep relationship with Mother Earth and especially with special places like Tsoodził, one of our most sacred mountains. Our elders talk about Mother Earth as indigenous land--land that no one really has claim to or owns, but for which all peoples have a responsibility to honor, respect and protect throughout their lifetime.

We live with Mother Earth in our hearts each and every day. We hold Tsoodził and other places of special significance to us close to our hearts. Tsoodził is one of the Diné four sacred mountains and is associated with the south direction. It is a very holy place for us--an essential part of our homeland, our existence and distinctive identity as Diné and Ramah Navajo people, and our well-being, and that of all peoples, into the future.

Our elders and medicine people tell us that, according to Diné traditional oral history, our ties to Tsoodził go back to the time of creation when the Fundamental Laws of the Diné people were formed to establish the foundation for our relationships with Mother Earth and for maintaining balance and harmony in our lives. At that time, the four sacred mountains, including Tsoodził, the holy mountain of the South, were created, along with over twelve other mountains, peaks and natural features, to define the boundaries of our sacred Diné cultural homeland. These sacred mountains were placed for the Diné to use as guides for survival and for bringing us our wisdom, strength and well-being. This relationship with Tsoodził and the other sacred mountains, passed down from generation to generation in our families, remains a strong bond to this day.

Our traditional oral history also recounts significant historical events which occurred at Tsoodził and relate to our origins, our cultural traditions, our teachings, and our values. Our stories of emergence, for example, tell of how the Holy People made their home at Tsoodził and named the sacred mountains; how the Hero Twins struggled, endured and overcame the many hardships and challenges put before them; and how they battled with the monsters who were intent on destroying the world. And from these and many other stories have come our most precious teachings that connect us to the unique traditional historical relationships that mark how we came into being, as well as the prayers and songs that form the basis of our healing ceremonies and rituals.

In our world view, everything in life is interrelated. Our traditional lifeways, resources and practices were all put in place from the beginning of our history as an integral whole. Thus, originating from Tsoodził come

---->

- ❖ the very elements of life that make up our natural world;
- ❖ our stories, songs and prayers that guide our survival;
- ❖ our teachings that relate to each generation how to live life in a good way;
- ❖ our traditional medicines, wild foods, herbal plants and minerals that we use in our daily lives;
- ❖ our forests where trees that are culturally significant to us and important wild animals live;
- ❖ our sacred water and the life-giving sources for moisture--the rain and the snow--that replenish Mother Earth; and
- ❖ the special places for prayers, offerings, ceremonies, and healing that maintain and restore balance and harmony in life.

When used with respect in accordance with the Fundamental Laws of the Diné people, the special cultural landscape of Tsoodzil, linked to all the other mountains sacred to us, teaches us our history and how to effectively provide for ourselves. Tsoodzil gives us the foundation for our values, our actions, and our existence as Diné and Ramah Navajo people for generations to come. Its sacredness is like that of a church and our country's flag. And because Tsoodzil holds within it our unique stories and history, it can teach and nurture a broader understanding among all peoples of the indigenous world view, and of respect and reverence for the natural world.

Our medicine people tell us that destruction is not part of our Fundamental Laws and our teachings. They have seen some of our sacred places disturbed or destroyed and how the spirit of these lands is now no longer there. They caution that such disrespect and destruction will lead to imbalances and disharmony, with negative consequences that affect all who inhabit the Earth.

Our history, our traditions and our lifeways are all spiritually tied to Tsoodzil and all the other places we hold sacred. Unimpeded development can do harm to our sacred lands and threaten their integrity, undermining the spiritual foundation of our lives. For this reason, we ask that Tsoodzil be kept in its natural state. We also ask that a proper consultation process be put in place to consider the appropriateness of proposed developments--one that is respectful of and honors the government-to-government relationships that are established with tribes and tribal communities, like ours, as sovereign entities.

Our elders and medicine people have reiterated many, many times that continued infringement on lands sacred and irreplaceable to us and other Native peoples constitutes cultural genocide and cannot be condoned. That is why we are here today to present our views and to ask that they be respectfully considered in the decision on the emergency nomination of Tsoodzil/Mt. Taylor as a Traditional Cultural Property.

Ahéheé/thank you.

July 17, 2012

Nancy Rose, Forest Supervisor
USDA Forest Service
Cibola National Forest
2113 Osuna Rd.
Albuquerque, NM 87113-1001

Dear Ms. Rose:

We send you this letter as concerned citizens and elders of the Ramah Navajo Community to unequivocally oppose Laramide Resources USA's request for approval of a permit which will allow start-up of the La Jara Mesa uranium mine on Mt. Taylor. After extensive discussions about the project, we feel that such a development will desecrate one of our most sacred lands and threaten the foundation of our heritage, our culture, and our spirituality—in essence, our identity and sovereignty as Diné and Ramah Navajo people. Briefly, our opposition is based on the following.

- Mt. Taylor is known to us as Tsoodzil, our sacred mountain to the south. Tsoodzil is one of the four Navajo sacred mountains which the Holy People put in place with sacred songs and prayers and define the homeland for the Diné people. As such, Tsoodzil is very precious to us. It gives us our life, our livelihood, our wealth, and our future. It was at Tsoodzil that sacred animals, which constitute our wealth and the cornerstone for our social, economic and spiritual well-being, were given to us. To this day, we continue to gather our most sacred plants—our native foods, medicines, healing herbs, and mountain tobacco—minerals and ceremonial water there.

Tsoodzil is our home. From the base of the mountain to the top, Tsoodzil carries all of our songs and prayers for the Hozhonji/Beautyway ceremonies. To us, Tsoodzil is a very sacred and unique ecological, cultural and spiritual landscape. It enables us to plan for the future through songs and prayers and provides us protection into the future, thus affording us longevity and well-being as a people for many generations to come. Our medicine people have and continue to go to Tsoodzil to share stories, to give offerings, and conduct healing ceremonies and prayers there, in accordance with the most essential of our Fundamental Laws (Diné Bi Beehaz'áanii Bi Tsésiléli): Sa'ah Naagháai Bikee Hozhóón ~ roughly translated as "to live a long life with contentment and in harmony and beauty."

It is for these reasons that the Ramah Navajo Community supported the designation of Tsoodzil as a Traditional Cultural Property (TCP) and that we now oppose any disturbance or development that will alter and/or damage this very sacred mountain in ways that harm its life-giving properties. As Diné people, we have a responsibility to protect all life on Tsoodzil for the well-being of all peoples into the future. The processes used in uranium mining will disturb and destroy the peaceful environment of our sacred mountain and the privacy that is required for us to carry out essential traditional practices, adding to the loss of our sacred ancestral land base, our homeland, and our rights to freely practice our long-standing spiritual beliefs.

- Water is one of the most sacred Diné elements of life. To us, water is life. On Tsoodzil, natural springs give us our sacred water, including water for our ceremonies, and replenish the aquifers and all sources of surface and ground water. We are concerned that new uranium mining will affect both the quantity and quality of water in our region. Already, two proposed mines, the Roca Honda mine and the Rio Grande Resources mine, will require the respective withdrawal and discharge of 6,000,000 gallons and

10,000,000 gallons of water each day. How much more water will be needed for the proposed La Jara Mesa mine and others that will be proposed in the future? What will the true impacts of water usage for mining and milling be on the water table for the region, especially in this time of extreme drought? And what assurances are there to guarantee that the quality of water will meet the standards for good, safe drinking water, that there will be no contamination once the mines begin and end their operations?

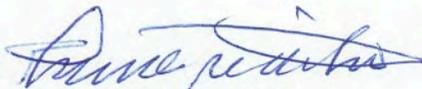
- Mining companies have left a legacy of negative impacts from uranium mining in the Grants-Milan area since the 1940s and 1950s. People have gotten ill and have died from debilitating and life-threatening diseases. The land has been contaminated with radioactive wastes and the water is unsafe to drink. Because the mining companies have not brought the land and water back to good health and restored them to desired pre-mining conditions after over a half-century since the mines began, these precious resources continue to pose great threats and endanger the well-being of all life. No new mining should proceed before the harmful impacts left by uranium mining are effectively addressed and remediated. Additionally, given this unfortunate history and legacy of irresponsibility, we question how the mining industry will keep potential contamination from the proposed mine from harming the sacredness of Tsoodzil and the surrounding area (e.g., will tarps covering the uranium ore being transported through New Mexico to Utah provide adequate containment?), as well as how accidents and associated liabilities will be handled.

In closing, we look forward to continued consultation on the proposed La Jara Mesa mine and other similar developments, as stipulated by federal-tribal consultation policies and our inherent rights as Diné people of free, prior and informed consent on matters pertaining to our sacred ancestral lands, as outlined by the United Nations Declaration on the Rights of Indigenous Peoples.

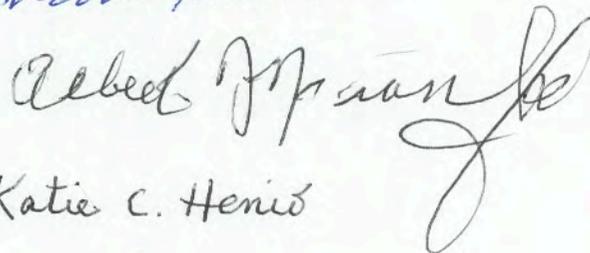
Ahéhee' ~ thank you.

Sincerely,

Chimeco Eriacho



Albert J. Frank



Katie C. Henio

Katie C. Henio

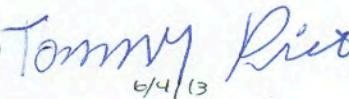
Lee Pino



Tom Skeet



Additional concurrence: Tommy Pino



6/4/13

Cc: Files/

**Declaration of George Rice Evaluating the United States Forest
Service's
Draft Environmental Impact Statement
for the Proposed Roca Honda Mine**

George Rice
June 10, 2013

Introduction

This evaluation was performed on behalf the Multicultural Alliance for a Safe Environment. It is based on a review of the *Draft Environmental Impact Statement for Roca Honda Mine, Sections 9, 10 and 16, Township 13 North, Range 8 West, New Mexico Principal Meridian, Cibola National Forest, McKinley and Cibola Counties, New Mexico* (DEIS) and related documents (see references).

I am a professional hydrologist with more than 30 years experience. This experience includes working with uranium mines and uranium mining wastes. I have a Masters of Science degree in Hydrology from the University of Arizona and I am a licensed professional geoscientist in the State of Texas (license number 6144). A copy of my curriculum vitae, outlining my education and professional experience, is attached.

In my professional opinion, the U.S. Forest Service's evaluation of the hydrological impacts of the proposed Roca Honda mine is deficient in several respects. I describe these deficiencies in the accompanying comments.

Roca Honda Resources (RHR) has submitted a plan to develop an underground uranium mine approximately 3 miles northwest of San Mateo and 22 miles northeast of Grants, New Mexico (figure 1).¹ The mine would occupy 1968 acres in Sections 9, 10, and 16, Township 13 North, Range 8 West, New Mexico Principle Meridian.²

The mine would extract uranium ore from the Westwater Canyon Member (Westwater) of the Morrison Formation (figure 2). The depth would range from 2,100 and 2,800 feet below ground surface.³ RHR plans to operate the mine for 18 to 19 years. This period includes development, mining, and reclamation.⁴ However, the life of the mine could be extended beyond 19 years if market conditions warrant, or if additional ore is discovered.⁵

The Westwater is saturated with groundwater. Therefore, the mine will have to be dewatered.⁶ RHR hired INTERA Inc. (INTERA) to estimate the effects of dewatering on

¹ USFS, 2013, pages i and v.

² USFS, 2013, page v.

³ USFS, 2013, page i.

⁴ USFS, 2013, page 3.

⁵ USFS, 2013, page 34.

⁶ INTERA, 2012, table 1.1.

Exhibit 19

groundwater levels, springflows, and stream flows in the vicinity of the mine.⁷ INTERA used a computerized groundwater flow model (MODFLOW-SURFACT) to estimate these effects.⁸ The pumping rate required to dewater the mine was estimated to be between 4000 and 8000 gallons per minute (gpm).

Water pumped from the mine would be discharged via a pipeline to the watershed of San Lucas Arroyo⁹, approximately 8 miles northeast of proposed mine (figure 1).¹⁰

⁷ INTERA, 2012.

⁸ INTERA, 2012, page 38.

⁹ Aka San Lucas Canyon (USFS, 2013, page 112).

¹⁰ RHR, 2012a, page 47 and figure 1-3. This differs from the DEIS, which states that the pipeline will be 5.5 miles long (USFS, 2013, page 41).

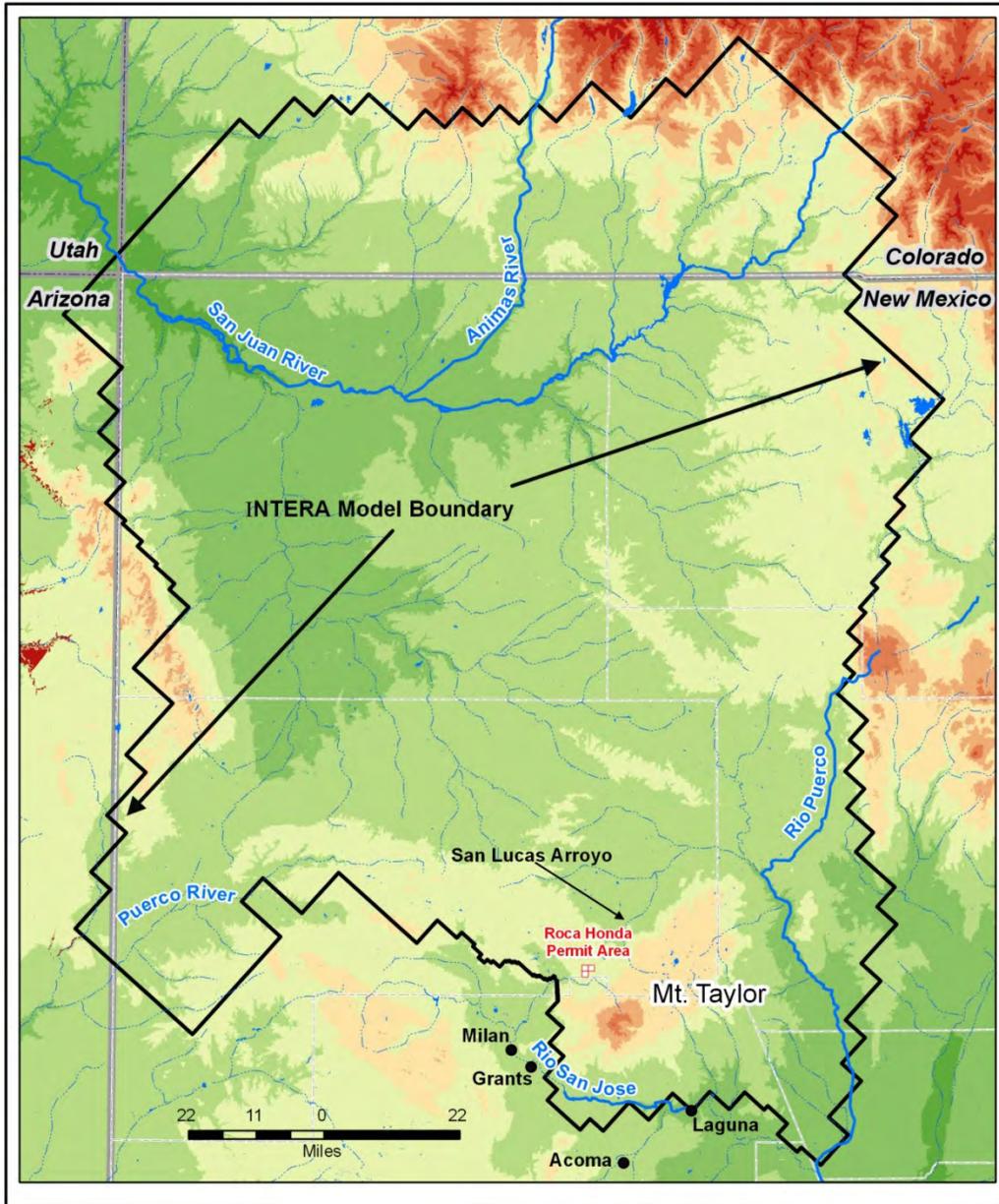


Figure 1
Location and Model Area Map
(adapted from INTERA, 2012, figures 1.3, 2.6, and 2.10)

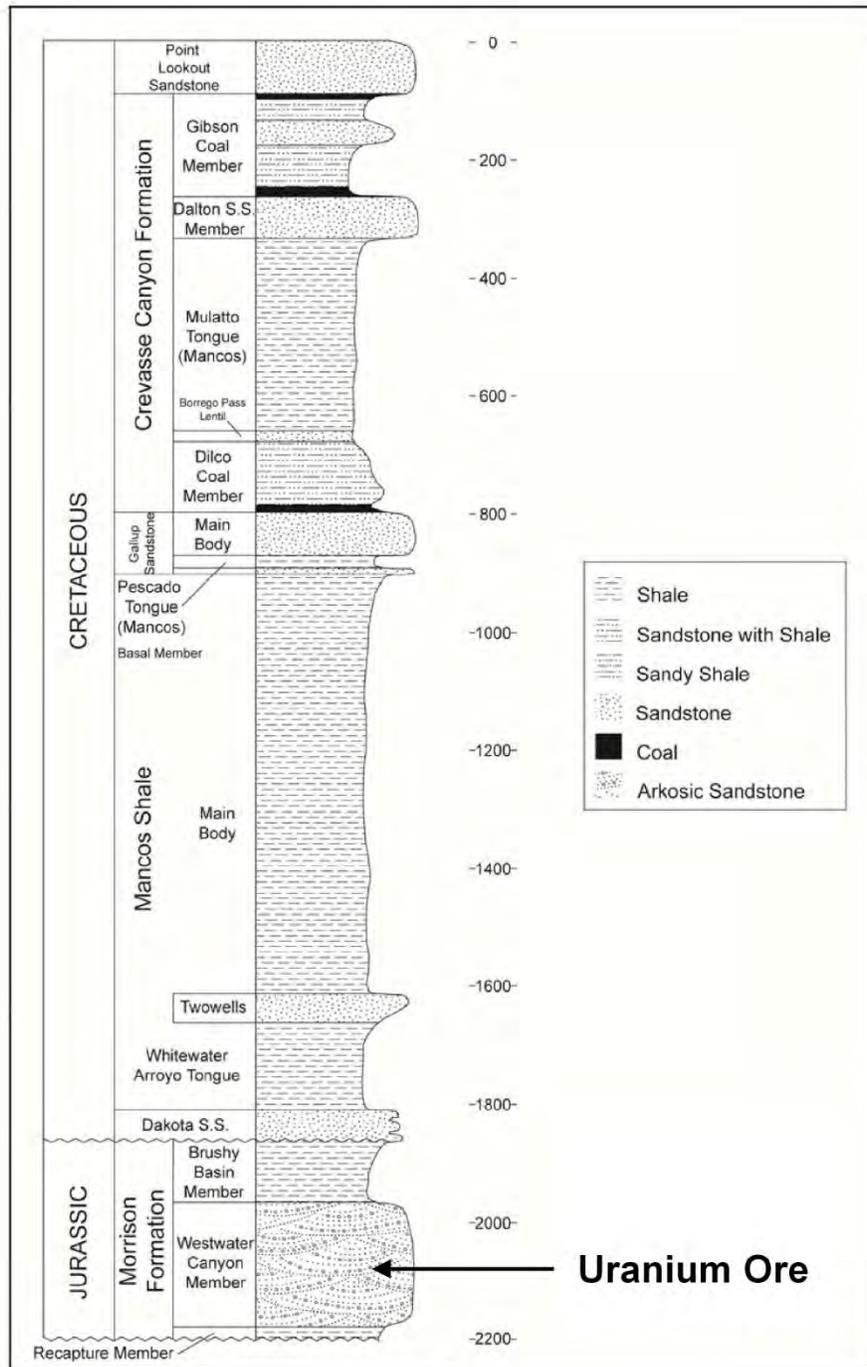


Figure 2
Geologic Cross Section at Proposed Roca Honda Mine
 (adapted from USFS, 2013, figure 39)

The model covers most of the San Juan Basin. The basin is about 140 miles wide and 200 miles long. It extends from the area around Mount Taylor in the southeast, to just beyond the Arizona border on the west, and into Colorado on the north (figure 1).¹¹ The model has ten layers representing different hydrogeologic units (figure 3). The bottom layer represents the Westwater. In the area of the proposed Roca Honda Mine, the total thickness of these layers is about 2200 feet (figure 2).¹²

Model Layer	Hydrostratigraphic Unit
1	San Jose Formation
2	Animas and Nacimiento Fms
3	Ojo Alamo Sandstone
	Kirtland and Fruitland Fms
	Pictured Cliffs Sandstone
4	Lewis Shale
5	Cliff House Sandstone
	Menefee Formation
	Point Lookout Sandstone
6	Mancos Shale (NW only)
	Gallup Sandstone (SW only)
7	Mancos Shale
8	Dakota Sandstone
9	Brushy Basin Member of Morrison Formation
10	Westwater Canyon Member of Morrison Formation

Figure 3
INTERA Model Layers
(adapted from INTERA, 2012, figure 3.2)

¹¹ INTERA, 2012, page 9 and figures 2.6 and 3.1.

¹² USFS, 2013, figure 39. The hydrogeologic units represented by layers 1 through 4 are not present at the mine.

INTERA modeled four scenarios. All of the scenarios simulated existing pumping, i.e., water supply pumping for Gallup and Crownpoint, and dewatering for the Lee Ranch coal mine. Scenarios three and four added potential future pumping, including water rights filed with the New Mexico Office of the State Engineer, and dewatering at the Mount Taylor Mine. Scenarios two and four added pumping for dewatering the Roca Honda Mine.¹³ The scenarios are summarized in table 1.

Table 1
Pumping Simulated in Model Scenarios

	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Existing pumping	Yes	Yes	Yes	Yes
Potential future pumping (not Roca Honda)	No	No	Yes	Yes
Roca Honda dewatering	No	Yes	No	Yes

This evaluation focuses on the modeling performed by INTERA.

General Comment on the INTERA Model

The estimates produced by the INTERA model appear to be optimistic rather than conservative. That is, the model probably underestimates the effects of dewatering. It does not account for all the factors that could act to decrease water levels, springflows, and stream flows. Some of the assumptions incorporated into the model appear to be unrealistic, and some conditions and reasonably foreseeable events have been ignored.

Conclusions concerning the effects of dewatering on water supplies (e.g., pueblos of Acoma and Laguna)¹⁴, springflows (e.g., Horace Spring)¹⁵, and stream flows (e.g. Rio San Jose)¹⁶ are not reliable.

The model should be revised to incorporate the recommendations given below. Conclusions concerning the effects of dewatering, and decisions regarding the proposed mine, should be based on the results of the revised model.¹⁷

¹³ USFS, 2013, page 165; and INTERA, 2012, table 3.5.

¹⁴ INTERA, 2012, page 85.

¹⁵ INTERA, 2012, page ii.

¹⁶ INTERA, 2012, page ii.

¹⁷ Most of the recommended revisions are independent of each other and should be incorporated simultaneously.

Specific Comments

Comment 1: Assumed recharge along San Mateo Creek

The INTERA model assumes that recharge into the Westwater occurs along San Mateo Creek; 4 to 6 miles west of the RHR mine permit area.¹⁸ This recharge is simulated by a series of injection wells along the creek.¹⁹ The applied recharge rate varies from 367 to 824 gpm (figure 4).²⁰ This recharge probably decreases the predicted effects of dewatering on groundwater levels, springflows, and stream flows.

There are a number of problems with this assumed recharge.

1) Although recharge may occur along San Mateo Creek,²¹ INTERA has not presented any data or analysis²² to show that recharge does occur.

2) INTERA has not presented any data or analysis to support the amount of recharge it assumes will occur.

3) INTERA has not presented any data or analysis to support the variations in recharge it assumes will occur.

4) INTERA has not presented any data to show that San Mateo Creek will flow at a rate that could sustain the amount of recharge it assumes to occur. Data presented in the DEIS indicate that the average flow rate is about one half cubic foot per second (cfs), or less.²³ One half cfs equals 224 gpm. This is much less than the recharge rates assumed by INTERA.²⁴ It should be noted that only a portion of the flow would recharge the Westwater. Some of the water would flow beyond the recharge area, and some would be evapotranspired²⁵.

¹⁸ INTERA, 2012, figure 3.7.

¹⁹ INTERA model input file for scenario 2 (Scenario2.wel).

²⁰ INTERA model input file for scenario 2 (Scenario2.wel). 367 gpm is the same as 0.82 cfs, or 592 ac-ft/yr. 824 gpm is the same as 1.84 cfs, or 1329 ac-ft/yr. The assumed recharge rates were different in the calibration runs (see comment 6 below). A recharge rate of 113 gpm was assumed for the steady-state, predevelopment calibration (prior to 1930, see model input file SS_cal.wel). Recharge rates varying from 113 to 1073 gpm were assumed for the transient calibration (1930 – 2012, see model input file Transient.wel).

²¹ Brod and Stone state that San Mateo Creek is a source of recharge where it flows across bedrock outcrops (Brod and Stone, paragraphs 53 and 67).

²² Analysis, i.e., a technical demonstration.

²³ USFS, 2013, figures 33, 35, and 37. Flows measured at stations 08342600 (San Mateo Creek) and 08342700 (Arroyo del Puerto just above confluence with San Mateo Creek).

²⁴ The model may have been developed under the assumption that RHR would discharge water from dewatering into San Mateo Creek. This was the original plan (RHR, 2011, page 8-18). The discharge would have been approximately 10 cfs (INTERA 2012, table 1-1). However, RHR now plans to discharge water from dewatering to the watershed of the San Lucas Arroyo, approximately 8 miles northeast of proposed mine (RHR, 2012a, page 47 and figure 1-3).

²⁵ Evapotranspiration: The combination of evaporation and transpiration by plants. Evapotranspiration transfers water from the surface or soil, to the atmosphere.

Recommendation

RHR/INTERA should gather the data necessary to realistically estimate the amount of recharge occurring along San Mateo Creek. Given the length of the period simulated (113 years), the effects of climate change should be incorporated into the estimate. If the resulting estimate differs from the assumptions in the model, the model should be revised to accord with the estimate. If such an analysis is not performed, the model should be revised to exclude the assumed recharge.

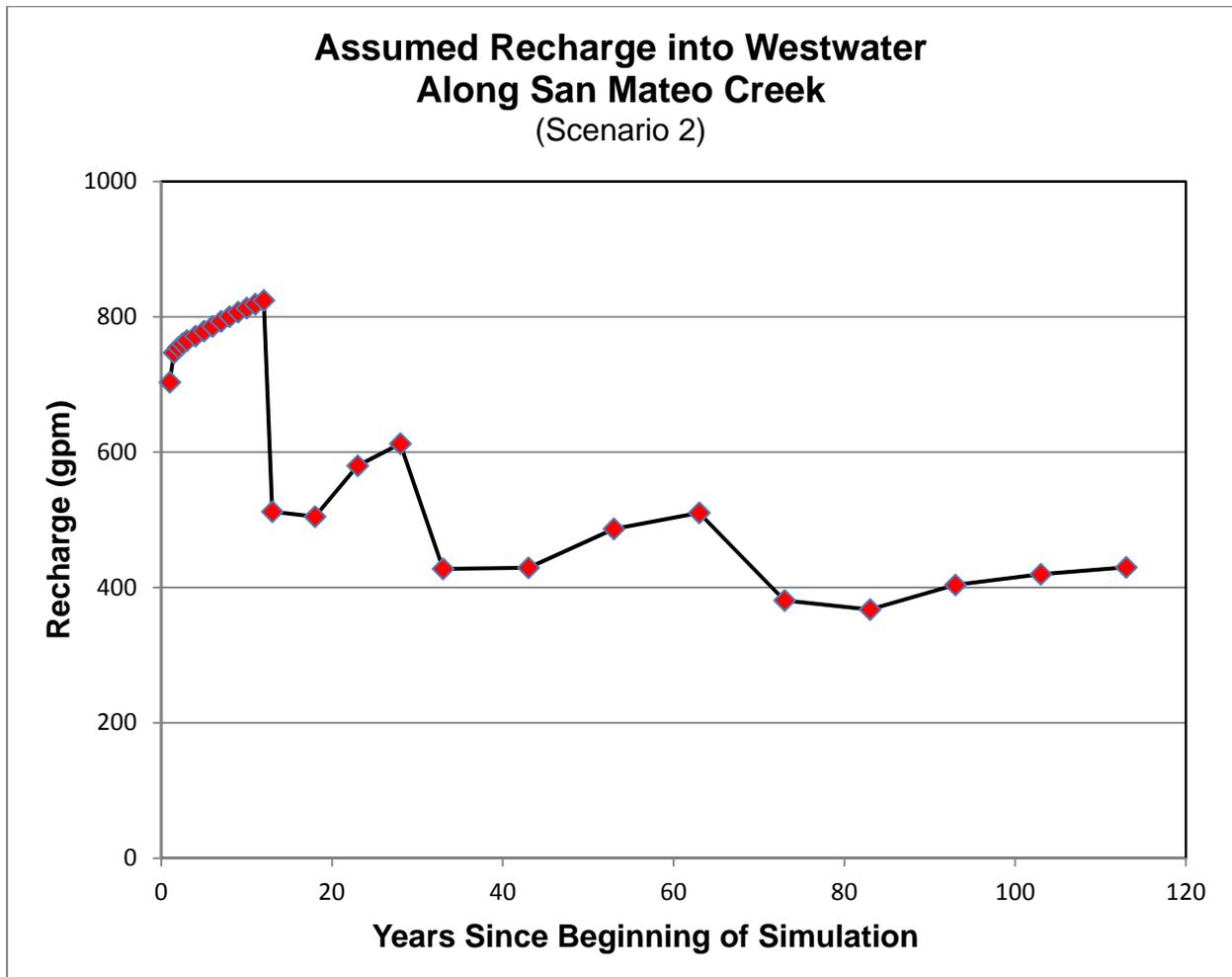


Figure 4
Assumed Recharge into Westwater Along San Mateo Creek
(source: INTERA model input file for scenario 2 (Scenario2.wel))

Comment 2: Dewatering Rates

The rate of pumping that will be required to dewater the Westwater is not yet known. Several estimates of the maximum rate have been given:

- 4000 gpm²⁶
- 4500 gpm²⁷
- 8000 gpm²⁸

Regarding dewatering rates, RHR has stated:²⁹

The true amount cannot be accurately assessed until such time as there is sufficient draw-down data available from the depressurizing activity described above.

The lower estimate is based on RHR's knowledge of dewatering rates at other mines in the area.³⁰ Higher rates may be required due to the presence of zones of high hydraulic conductivity (e.g., paleochannels)³¹, leakage from underlying or overlying units, or the expansion of the mine in response to the discovery of additional ore. The following statement is from Lyntek, the company that designed the mine water treatment plant (WTP):³²

The WTP has been designed to accept 8,000 gpm. This allows for unanticipated increases in water production from the mine, contingency capacity to accommodate upset conditions, and possible expansion of the mine (which could require additional dewatering during the life of the mine).

Clearly, the rate at which RHR will dewater the Westwater is not yet known. Nonetheless, the INTERA model simulated only one dewatering rate: 4500 gpm.³³

Recommendation

The possibility that dewatering rates will be substantially higher than 4500 gpm should not be ignored. The model should be revised to estimate the effects of higher dewatering rates.

²⁶ USFS, 2013, page 4.

²⁷ USFS, 2013, page 160; and INTERA, 2012, table 1.1.

²⁸ USFS, 2013, page 155; RHR, 2012a, page 22; and Lyntek, 2011, page 7.

²⁹ RHR, 2012a, page 22. A similar statement is also made in RHR, 2012b, response to item # 6.

³⁰ USFS, 2013, page 155.

³¹ A paleochannel is an ancient, buried stream channel. The Westwater is a fluvial (stream-deposited) sandstone unit (Fitch, 2006, page 5). Thus, it probably contains paleochannels.

³² Lyntek, 2011, page 7.

³³ INTERA, 2012, table 1.1, and; INTERA model input file for scenario 2 (scenario2.wel).

Comment 3: Duration of Dewatering

RHR estimates that the life of the mine will be 18 to 19 years.³⁴ This includes three to four years of development³⁵, 13 years of production³⁶, and about two years of post-production reclamation.³⁷ However, the life span of the mine, particularly the duration of the production period, is not well known at this time. The following statement is from the DEIS:³⁸

However, the ultimate mine life of the Roca Honda Mine would depend on uranium market conditions and potential identification of additional uranium ore. Therefore, the ultimate mine life could well exceed 18–19 years.

The modeling performed by INTERA is not consistent with the information given above. There are two problems.

First, the model simulates only 12 years of dewatering from the Westwater.³⁹ This includes two years of shaft construction (2000 gpm), and ten years of mine production (4500 gpm) (figure 5). Thus, the model simulates a production period that is three years less than the estimated production period.

Second, it is clear that mine production may exceed the 13-year estimate. The INTERA model does not account for this possibility.

Recommendation

The INTERA model should be revised to simulate more than 13 years of dewatering. The simulated dewatering should account for the possibilities that mining may be suspended for a period⁴⁰, and that additional ore may be discovered and mined.

³⁴ USFS, 2013, page 34.

³⁵ Mine development includes construction of dewatering wells, a water treatment plant, production shafts, ventilation shafts, and surface facilities (USFS, 2013, page 39).

³⁶ USFS, 2013, page 45. This differs from the *Mine Operations Plan*, which states that the mine will produce ore for eleven and one half years (RHR, 2012a, page 17).

³⁷ RHR, 2012a, page 17.

³⁸ USFS, 2013, page 34.

³⁹ INTERA, 2012, table 1.1, and: INTERA model input file for scenario 2 (Scenario2.wel).

⁴⁰ Dewatering continued at the Mt. Taylor Mine when production was suspended due to a drop in uranium prices (RGR, 2012, page 3).

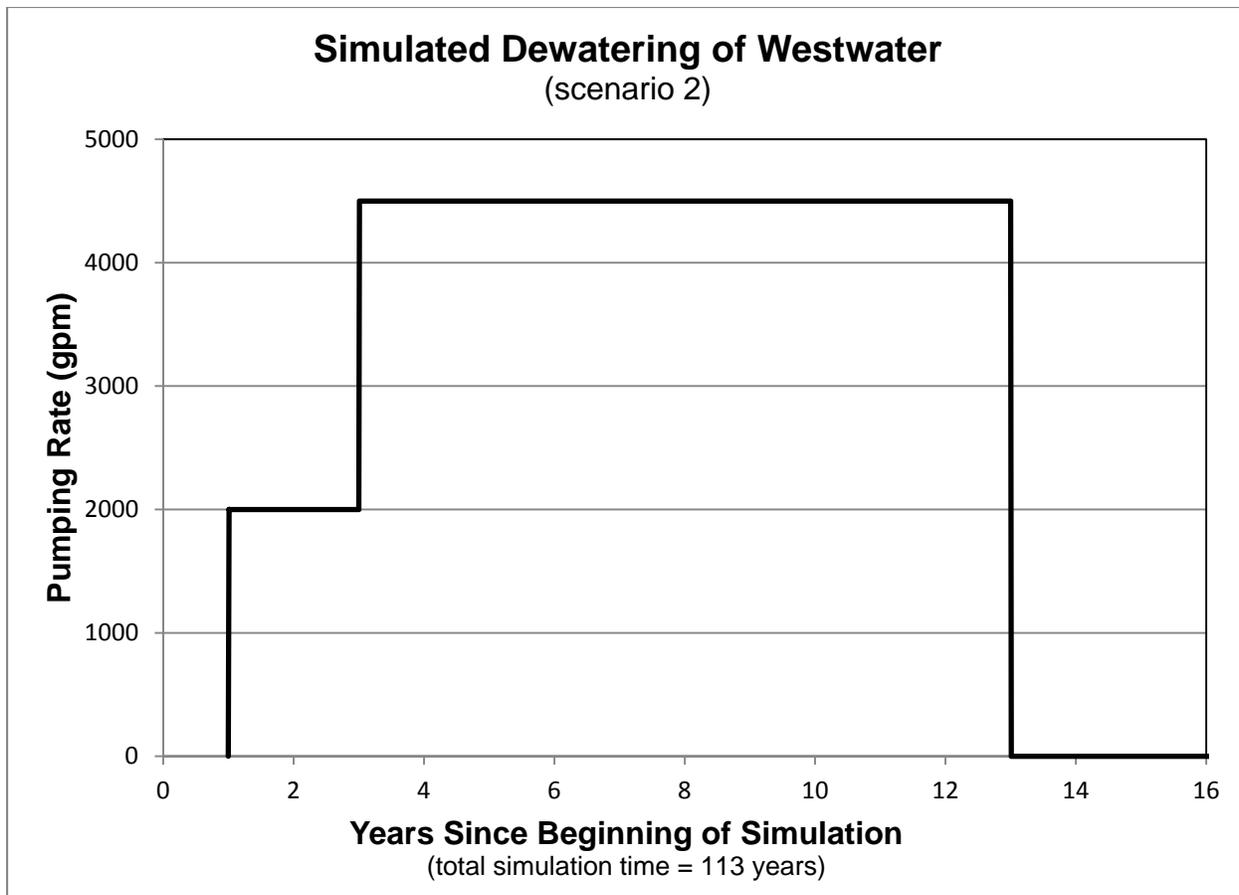


Figure 5
INTERA Model Simulated Dewatering of Westwater at Roca Honda Mine
(source: INTERA model input file for scenario 2 (Scenario2.wel))

Comment 4: Cumulative Effects, Dewatering at Other Uranium Mines

The DEIS considers the cumulative effects of pumping from other mines in the area.⁴¹ The spatial boundary for the cumulative effects analysis is the San Juan Basin, and the temporal boundary is 100 years after mining at Roca Honda ends.⁴² However, the INTERA model does not accurately simulate pumping that is likely to occur at two other uranium mines.⁴³ These are the Mount Taylor Mine, and the Cebolleta Mine.

The Mount Taylor mine is about two miles southeast of the Roca Honda Mine.⁴⁴ It is owned by Rio Grande Resources (RGR).⁴⁵ It is now on standby status but RGR plans to return the mine to operating status by October 2014.⁴⁶ When dewatering resumes,

⁴¹ USFS, 2013, pages v, 83 – 86, 131, and 164.

⁴² USFS, 2013, page 179.

⁴³ Model scenarios 3 and 4, see table 1 above.

⁴⁴ INTERA, 2012, figure 1.3.

⁴⁵ RGR, 2013, page 2.

⁴⁶ RGR, 2013, pages 1 and 2.

RGR estimates they will pump groundwater at a rate of 4000 to 5000 gpm (6450 to 8065 acre feet per year).

The INTERA model simulated dewatering at the Mount Taylor Mine. However, the simulated rate was 640 acre feet per year (397 gpm).⁴⁷ This is less than one-tenth the rate that RGR estimates will be required to dewater the mine.

The proposed Cebolleta Mine⁴⁸ is about 22 miles southeast of the Roca Honda Mine.⁴⁹ The mine would have to be dewatered, but the dewatering rate has not yet been determined.⁵⁰ The INTERA model did not simulate dewatering at the Cebolleta Mine.⁵¹

In addition, RHR has stated that they expect mining to occur on neighboring properties. The following is from the Albuquerque Journal:⁵²

“Although our plan only entails nine years of actual mining, once you get in there, our neighbors will want access to their ore also so we fully anticipate another nine years with the other properties added in,” he said.

He explained, “What you’re doing here is you’re permitting the surface disturbance Once we have all the underground development done, I would fully expect our neighbors to say, ‘can you mine our ore?’ ”

One of its neighbors is uranium mining company URI.

Mining on neighboring properties would require additional dewatering. The INTERA model did not simulate the dewatering required to mine neighboring properties.

Recommendation

The model should be revised to 1) accurately simulate the pumping expected to occur at the Mt. Taylor mine, 2) incorporate reasonable estimates of pumping at the Cebolleta Mine, and 3) incorporate reasonable estimates of the pumping required to mine neighboring properties.

⁴⁷ INTERA, 2012, table 3.5 and; INTERA model input file for scenario 3 (Scenario3.fwl).

⁴⁸ NEI, 2012, attachment B.

⁴⁹ Broad Oak Associates, 2007, figure 2.

⁵⁰ SWCA Environmental Consultants, 2012, page 10-8.

⁵¹ INTERA, 2012, table 3.5 and; INTERA model input file for scenario 3 (Scenario3.fwl). The proposed Cebolleta Mine would be in Townships 10 and 11 North, and Ranges 4 and 5 West (Broad Oak Associates, 2007, figure 2.).

⁵² *Nation’s largest uranium mine planned for N.M.*, by Michael Hartranft, Journal staff writer, Sunday, May 19, 2013. The statements are attributed John DeJoia, senior vice president of Strathmore’s New Mexico operations and manager of Roca Honda Resources. It should be noted that the DEIS states that the mine will produce ore for 13 years (USFS, 2013, page 45), and the RHR Mine Operations Plan states that the mine will produce ore for eleven and one half years (RHR, 2012a, page 17).

Comment 5: Effects of Dewatering on Water Supplies of Milan and Grants

The towns of Milan and Grants pump their water from the San Andres Aquifer.⁵³ The San Andres Aquifer is below the Westwater and is present at the Roca Honda Mine site.⁵⁴ The San Andres Aquifer is also a major source of water for Horace Springs.⁵⁵

INTERA claims:

*The public water supplies for the Village of Milan and the City of Grants will not be affected by Roca Honda mine dewatering because they pump groundwater from aquifers that are stratigraphically lower than the Westwater and separated from it by thick shale intervals with low hydraulic conductivity.*⁵⁶

INTERA does not provide any analysis to support this claim. The INTERA model simulates groundwater flow only in the Westwater and the geologic units above the Westwater.⁵⁷ Thus, it cannot be used to estimate the effects of dewatering on aquifers below the Westwater.

There is no technical reason for not including aquifers below the Westwater. Other models of the area, including those developed by Frenzel and Lyford⁵⁸, Kernodal⁵⁹, and Carpenter and Shomaker⁶⁰, included aquifers below the Westwater.

Aquifers below the Westwater could be affected as the result of faulting or fractures. The area around the mine contains many faults that extend from land surface to below the San Andres Aquifer.⁶¹ Ten faults have been mapped in the RHR permit area.⁶² These faults may act as groundwater flow paths between the Westwater and the underlying aquifers.⁶³

Recommendation

RHR/INTERA should perform an analysis to support the claim that dewatering at the Roca Honda Mine will not affect the water supplies of Milan or Grants. The most realistic analysis would be based on an aquifer test that is designed to determine the

⁵³ USFS, 2013, page 165.

⁵⁴ INTERA, 2012, figure 2.2.

⁵⁵ USFS, 2013, pages 143 - 145.

⁵⁶ INTERA, 2012, page ii.

⁵⁷ INTERA, 2012, figure 2.4; and USFS, 2013, page 161.

⁵⁸ Frenzel and Lyford, 1982, figure 3.

⁵⁹ Kernodle, 1996, figure 36.

⁶⁰ Carpenter and Shomaker, 1998, table 1.

⁶¹ Brod and Stone, 1981, figure 1.

⁶² USFS, 2013, figures 26 and 27; and Brod and Stone, 1981, figure 1.

⁶³ Flow along faults is discussed by Brod and Stone. They discuss the effects of dewatering only on flow between the Westwater and overlying units (Brod and Stone, 1981, paragraph 70). However, dewatering may also affect flow between the Westwater and underlying units. In the vicinity of the proposed mine, the hydraulic heads in the Westwater and the San Andres Aquifer are about the same (INTERA 2012, figure 4.12; and Frenzel, 1992, figures 9 and 36).

effects of dewatering on aquifers below the Westwater.⁶⁴ If RHR/INTERA cannot provide a realistic analysis to support their claim, they should 1) not make the claim, and 2) revise the model to include aquifers below the Westwater.

Comment 6: 605 Spring

The springs closest to the RHR permit area are Bridge Spring and 605 Spring. Bridge Spring discharges along San Mateo Creek, about 4000 feet south of the permit area.⁶⁵ 605 Spring also discharges along San Mateo Creek, about a quarter mile downstream of Bridge Spring.⁶⁶ RHR states that 605 Spring is probably perennial.⁶⁷ Bridge Spring is not perennial.⁶⁸

The INTERA model report discusses the effects of dewatering on Bridge Spring, but 605 Spring is not mentioned.⁶⁹ The report gives no reason for this omission.

Recommendation

RHR/INTERA should explain why 605 Spring is not mentioned in the INTERA report.

Comment 7: Exploration Boreholes

Exploration boreholes were first drilled in the mine permit area in the 1950s.⁷⁰ The area now contains over 400 boreholes.⁷¹ If left unsealed, these boreholes will act groundwater flow paths between the Westwater and overlying units. Available documents do not indicate whether the boreholes were completely sealed, i.e., from top to bottom.⁷² These boreholes were not addressed in the INTERA model.

Recommendation

RHR/INTERA should explain why it is not necessary to address the boreholes. Otherwise, the model should be modified to account for the presence of boreholes.

⁶⁴ Such a test would require the installation of monitor wells in the aquifers below the Westwater.

⁶⁵ RHR, 2011, appendix 8-B, figure 8-B-1.

⁶⁶ RHR, 2011, appendix 8-B, figure 8-B-1.

⁶⁷ RHR, 2011, appendix 8, page 7.

⁶⁸ USFS, 2013, page 140; and RHR, 2011, appendix 8-B, table B-1.

⁶⁹ INTERA, 2012, page 96 and table 5.1.

⁷⁰ Fitch, 2006, page 20.

⁷¹ RHR, 2011, page 10-1.

⁷² At least some of the boreholes were plugged at the surface with cement (Fitch, 2006, page 15).

Comment 8: Model Verification

INTERA calibrated its model in two steps.⁷³ First, for the period prior to significant groundwater pumping.⁷⁴ Second, for the period from 1930 to 2012.⁷⁵ INTERA states:⁷⁶

The very good calibrations to two independent data sets demonstrate that the historical groundwater flow models can reproduce observed groundwater flow behavior. The predictive model is therefore a valid tool for estimating the effect of projected RHR mine dewatering on the groundwater system.

This is incorrect. In order to have confidence in model results, calibration is a necessary, but not a sufficient, step. The model must also be verified.⁷⁷ To verify a model, the calibrated model is used to simulate a period (verification period) that was not used to calibrate the model. Then the model results are compared to the conditions that were known to exist during the verification period. For example, INTERA could have calibrated its model for the period from 1930 to 2000, and then attempted to verify it for the period 2001 to 2012. However, INTERA did not attempt to verify its model.

Recommendation

Because the calibrated model was not verified, we do not know how well it can 1) reproduce conditions that were known to exist in the past, or 2) estimate conditions that will exist in the future. We must have less confidence in estimates produced by unverified model than we would have in estimates produced by a verified model.

Comment 9: Mine Backfill

After all the ore in a portion of the mine (room) has been extracted, that portion will be backfilled with either non-ore rock excavated from the mine, or with aggregate imported from local quarries.⁷⁸ The purpose of the backfill is to prevent the collapse of the rooms.⁷⁹

Initially, the excavated non-ore rock will be hoisted to the surface and stockpiled. But as mining proceeds and more space is created underground, the non-ore rock will be stockpiled underground and used as backfill without first being hoisted to the surface.⁸⁰

Non-ore rock may contain contaminants such as uranium, radium, arsenic, molybdenum, and selenium.⁸¹ When exposed to oxygen as a result of mining, these

⁷³ Calibration is the process of adjusting model parameters so that model results will match the conditions that were known to exist in the past.

⁷⁴ INTERA, 2012, page 56. This was a steady-state calibration, i.e., constant water levels.

⁷⁵ INTERA, 2012, page 56. This was a transient calibration, i.e., changing water levels.

⁷⁶ INTERA, 2012, page 56.

⁷⁷ Aka, history matching (Mandle, R.J., 2002, pages 18 and 19).

⁷⁸ RHR, 2012, page 37.

⁷⁹ RHR, 2012, page 37.

⁸⁰ RHR, 2012, page 53.

contaminants can be mobilized.⁸² They may then contaminate groundwater after mining ceases and groundwater moves back into the mine. RHR recognizes this possibility and plans to test the non-ore rock that is brought to the surface. If testing indicates that contaminants may be mobilized, the rock will not be used as backfill. Instead, it will be hauled off-site for disposal.⁸³ However, there is no indication that RHR plans to test the non-ore rock that is not hoisted to the surface.

Recommendation

RHR should test the non-ore rock that is not hoisted to the surface in the same way it tests the non-ore rock that is hoisted to the surface. If testing indicates that it contains contaminants that may adversely affect groundwater quality, it should not be used as backfill. Instead, it should be brought to the surface and hauled off-site for disposal.

Comment 10: Cumulative Effects, Discharge to San Lucas Arroyo

RHR plans to discharge water pumped from the Roca Honda Mine to the watershed of San Lucas Arroyo.⁸⁴ The discharge rate will range from 4000 to 8000 gpm.⁸⁵

The operators of the Mount Taylor Mine also plan to discharge water to the watershed of San Lucas Arroyo.⁸⁶ The discharge rate from the Mount Taylor Mine is estimated to be 4000 gpm to 5000 gpm.⁸⁷

The DEIS does not address the effects of the combined discharges from the Roca Honda and Mount Taylor mines.

Recommendation

The DEIS should address the effects of the combined discharges on the San Lucas Arroyo watershed.

⁸¹ USFS, 2013, pages 148 and 150.

⁸² USFS, 2013, pages 148 and 177.

⁸³ USFS, 2013, pages 48 and 49.

⁸⁴ RHR, 2012a, page 47 and figure 1-3.

⁸⁵ See comment 2, above.

⁸⁶ RGR, 2013, page 6 and figure 2-2.

⁸⁷ RGR, 2013, page 6.

Comment 11: Treatment of Arsenic and Radium

A water treatment plant would be built to treat water pumped from the mine,⁸⁸ and runoff from ore and non-ore stockpiles.⁸⁹ This water is expected to contain high concentrations of uranium, radium, arsenic, and selenium.⁹⁰ It appears that RHR plans to reduce the concentrations of these contaminants to standards required by the New Mexico Water Quality Control Commission (NMWQCC).⁹¹ For uranium and selenium, the NMWQCC standards are the same as the US EPA drinking water standards (MCLs).⁹² However, the NMWQCC standards for arsenic and radium are higher than the EPA MCLs (table 2). The DEIS does not explain why RHR is not required to reduce arsenic and radium concentrations to EPA MCLs.

Table 2
NMWQCC Standards⁹³ VS EPA MCLs⁹⁴

Contaminant	NMWQCC Standard	EPA MCL
Arsenic	100 µg/L	10 µg/L
Radium	30 pCi/L	5 pCi/L
Selenium	50 µg/L	50 µg/L
Uranium	30 µg/L	30 µg/L

Recommendation

The DEIS should explain why concentrations of arsenic and radium do not have to be reduced to EPA MCLs. Otherwise, RHR should be required to reduce arsenic and radium concentrations to EPA MCLs.

⁸⁸ USFS, 2013, page 4.

⁸⁹ USFS, 2013, pages 49 and 150.

⁹⁰ USFS, 2013, table 15.

⁹¹ USFS, 2013, table 15.

⁹² MCL: maximum contaminant level. The highest concentration allowed in drinking water (EPA, 2009, page iii).

⁹³ USFS, 2013, table 157.

⁹⁴ EPA, 2009.

Comment 12: Contingency Plans

The DEIS does not contain contingency plans that describe the corrective actions that would be taken if mining causes unanticipated adverse effects on water quality, water supplies, springflows, or stream flows.

Recommendation

The DEIS should contain contingency plans to be invoked if mining causes unanticipated adverse effects. At a minimum, the plans should:

- Include descriptions of the circumstances that will trigger corrective actions.
- Include descriptions of the corrective actions.
- Identify monitoring periods.
- Identify the entity responsible for determining that corrective actions are necessary.
- Identify the entity responsible for performing the corrective actions.
- Present the criteria that will be used to judge the effectiveness of corrective actions.

Comment 13: Bridge Spring Drawdown

INTERA states that the maximum simulated drawdown at Bridge Spring under scenario 2 was 0.73 feet.⁹⁵ This is incorrect. The maximum simulated drawdown at Bridge Spring was 1.19 feet.⁹⁶

Recommendation

RHR/INTERA should correct the reported drawdown for Bridge Spring.

I hereby declare under penalty of perjury under the laws of the United States that the foregoing is true and correct to the best of my knowledge.



George Rice

⁹⁵ INTERA, 2012, table 5.1.

⁹⁶ See output files for scenario 2 simulation.

June 10, 2013

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General

More than 20 years experience in groundwater contamination investigations.

Education

M.S. Hydrology, University of Arizona, 1991
B.S. Hydrology, University of Arizona, 1979

Employment History

1993: Consultant
1988 - 1993: The MITRE Corporation, Brooks Air Force Base, Texas
1983 - 1988: SHB Geotechnical Engineers, Inc., Albuquerque, New Mexico
1980 - 1983: University of Arizona, Tucson, Arizona
1979 - 1980: U.S. Forest Service, Gifford Pinchot National Forest, Vancouver,
Washington

Experience

- Design and install monitor well networks.
- Design, perform, and analyze aquifer tests.
- Design and install vadose zone monitor networks.
- Design and conduct groundwater sampling programs.
- Apply groundwater flow and contaminant transport models to predict the fate of groundwater contaminants.
- Participate in multidisciplinary teams to select and design hazardous waste disposal sites.
- Conduct third party reviews of environmental documents and field programs.
- Expert Witness.

Attachment A

Representative Projects

UMTRA Project, Arizona, Colorado, New Mexico, Utah, Wyoming. Groundwater contamination caused by uranium mill tailings. Typical contaminants: metals (arsenic, uranium). Worked for SHB Geotechnical Engineers, Inc. Determined extent and character of contamination, developed plans to cleanup tailings and groundwater.

Yucca Mountain Nuclear Waste Repository, Yucca Mountain, Nevada. Worked for Southwest Research Institute and HOME (Healing Ourselves and Mother Earth). Evaluated the potential for groundwater to contact waste canisters, and established background concentrations for radionuclides in aquifer down gradient of the proposed waste repository.

Kelly Air Force Base, San Antonio, Texas. Groundwater contamination caused by discharge of contaminated water, leakage from tanks and lines, and disposal of wastes. Typical contaminants: solvents (TCE, PCE), fuel components (benzene), metals (chromium, thallium). Member of Kelly Air Force Base RAB. Commented on Air Force's plans to cleanup contaminated soils and groundwater.

Pantex Plant, Amarillo, Texas. Groundwater contamination caused by discharge of manufacturing process water and disposal of wastes. Typical contaminants: (TCE, PCE), explosives (RDX), metals (chromium), radionuclides (tritium). Worked for STAND (Serious Texans Against Nuclear Dumping). Evaluated DOE's plans to delineate, cleanup, and monitor contaminated groundwater.

Los Alamos National Laboratory, Los Alamos, New Mexico. Groundwater contamination caused by discharges and disposal of industrial wastes. Typical contaminants: explosives (RDX, perchlorate), metals (chromium), radionuclides (plutonium, tritium). Worked for CCNS (Concerned Citizens for Nuclear Safety) and Los Alamos National Laboratory. Evaluated the potential for laboratory contaminants to reach the Rio Grande, and evaluated disposal options for radioactive wastes.

Kingsville Dome Mine, Kleberg County, Texas. Groundwater contamination caused by in-situ uranium mining. Typical contaminants: metals (molybdenum, uranium). Worked for the Kleberg County URI Citizen Review Board. Evaluated URI's progress in cleaning up contaminated groundwater, and plans for post-cleanup monitoring.

Flint Hills Refinery, Corpus Christi, Texas. Groundwater contamination caused by leakage from refinery. Typical contaminants: fuel components (benzene). Worked with concerned citizens to evaluate the Texas Commission on Environmental Quality's plans to determine the extent of contamination.

Longhorn Army Ammunition Plant, Karnack, Texas. Groundwater contamination caused by discharge of contaminated water, leakage from tanks, and disposal of wastes. Typical contaminants: solvents (TCE, DCE), explosives (RDX, perchlorate), metals (antimony, thallium). Worked for Caddo Lake Institute. Evaluated Army's plans to clean-up contaminated groundwater.

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Rice, G., Green, R., Pohle, J., 1993, *Reduction in Uncertainty in the Geologic Setting Performance Measure, 10 CFR 60.113(a)(2): Computer Code Selections, Conceptual Models, and Databases*, Prepared for Nuclear Regulatory Commission Contract NRC-02-88-005, Center for Nuclear Waste Regulatory Analyses, San Antonio, Texas.

Rice, G. 1994, *AGUA Report, Contamination of the Edwards Aquifer in Bexar County*.

Green, R., Meyer, K., Rice, G., 1994, *Hydraulic Characterization of Hydrothermally-Altered Nopal Tuff*, Prepared for Nuclear Regulatory Commission Contract NRC-02-93-005, Center for Nuclear Waste Regulatory Analyses, San Antonio, Texas.

Green, R.T., Dodge, F.T., Svedeman, S.J., Manteufel, R.D., Rice, G., Meyer, K.A., Baca, R.G., 1995, *Thermally Driven Moisture Redistribution in Partially Saturated Porous Media*, Prepared for Nuclear Regulatory Commission Contract NRC-02-93-005, Center for Nuclear Waste Regulatory Analyses, San Antonio, Texas.

Rice, G., 1996, *The BFI Tessman Road Landfill: Hydrologic Issues*, Prepared for Larry R. Daves and Associates, San Antonio, Texas.

Rice, G., 1997, *Groundwater and Groundwater Contamination in the Vicinity of Mr. Quintanilla's House, 710 Price Avenue, San Antonio, Texas*, Prepared for Tinsman & Houser, San Antonio, Texas.

Rice, G., 2001, *Evaluation of Groundwater Characterization and Modeling at the Pantex Plant*, June 2001. Prepared for Serious Texans Against Nuclear Dumping (STAND).

Rice, G., 2001, *Evaluation of HDR/SAWS Modeling of the Carrizo-Wilcox Aquifer in Lee, Bastrop, and Milam Counties, Texas*.

Rice, G., 2002, *Groundwater Modeling at Pantex, and Recommendations of the Technical Advisory Group*, Prepared for Serious Texans Against Nuclear Dumping (STAND), September 2002.

Rice, G., 2003, *Background Concentrations of Contaminants in the Ogallala Aquifer at Pantex, an Evaluation*, Prepared for Serious Texans Against Nuclear Dumping (STAND), May 2003.

Rice G., and P. Allison, 2004, *Contaminants in The Ogallala Aquifer at the Pantex Plant*, STAND Technical Report 2004-1, May 2004.

Rice, G., 2004, *The Potential for Groundwater Contaminants from Los Alamos National Laboratory to Reach the Rio Grande*, July 2004.

Rice, G., 2006, *Effects of URI's Kingsville Dome Mine on Groundwater Quality*, Prepared for the Kleberg County URI Citizen Review Board, July 2007.

Rice, G., 2012, *Occurrence of Groundwater at the Compact Waste Facility, Waste Control Specialists Facility, Andrews County, Texas*, May 3, 2012.

Comments on the Environmental Impact Statement for the Roca Honda Mine

By Doug Brugge, PhD, MS

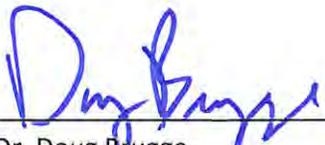
June 9, 2013

I am a professor of public health and have extensive knowledge from years of study of the hazards associated with uranium mining. My Curriculum Vitae, demonstrating my expertise, is attached as Attachment A. After reviewing the relevant portions of the United States Forest Service's Draft Environmental Impact Statement (DEIS) on the proposed Roca Honda uranium mine, I hereby submit the following comments on the DEIS:

- 1) While there are numerous health hazards associated with uranium mining, radon is both the best documented and the most exquisitely toxic, capable of causing cancer in tiny concentrations. The EIS documents distance to nearest receptors and calculates dose rates for these receptors. While the highest dose rates are below the EPA standard of 10 mrem/y. However the upper rates calculated are close to the standard (>8 mrem/y) and there is certainly error inherent in such estimates. Accordingly, I would suggest that some additional examination of exposure is warranted.
- 2) Also related to radon exposure, I would point out that the current exposure standard for radon in mines, 4 WLM, was determined to be inadequate for health protection by the National Institute of Occupational Safety and Health in 1987 when they proposed lowering the standard to 1 WLM. While the proposed standard is not required, a reasonable accommodation that would provide more protection would be to reach an agreement with this mine to adhere to the more protective recommended level.
- 3) It is also worth noting that a purely health based standard for uranium in drinking water would be substantially lower than the level set by EPA based in part on economic considerations. The WHO proposes 2 ug/L uranium be the standard for drinking water.
- 4) The reports of county wide health statistics I found to be not that helpful. Only a fraction of the people in each county is affected by historical uranium mining exposure. If these statistics are meant to suggest that there has or has not been health impacts from past uranium mining, they are far to general measures to tease out such effects.
- 5) I would disagree with the interpretation of the literature found on p. 384 of the DEIS that states that Navajo people are particularly susceptible to the effects of radon exposure. My interpretation of the literature is that the studies on Navajo people show that radon causes lung cancer even in the absence of smoking and that the studies say little about one ethnic or racial group's susceptibility.
- 6) It is curious that the section on injuries, starting on p. 394, does not mention occupational injuries.

- 7) The EIS largely misses the most recent findings on uranium health effects that are just emerging in the literature. I would suggest reading my 2011 review, attached as Attachment B.
- 8) Note, on p. 409, that radon gas does not attach to particles, but rather radon daughter products attach to particles. Also, on that same page, note that radium is mentioned, but thorium is not.
- 9) Note that the Boice studies cited on p. 428 are ecological studies, are studies conducted in a way that is sort of like comparing the county level data earlier in the EIS. That this approach is weak in terms of establishing health associations because of no individual level exposure assessment or individual level control of potential confounding factors. Thus, such studies cannot be used as more than preliminary evidence (hypothesis generating) with regard to drawing conclusions about causal associations.
- 10) Finally the EIS strikes me as being overly optimistic about the potential for this new mine to avoid the myriad problems that were experienced in this same part of the country over a 50 year span of mining in the latter half of the last century. It is true that there are better regulations in place, but some of the same economic disincentives, to maximize profit and reduce costs, persist and regulations are only as good as their enforcement. Further, we live in a time when there is not robust support for regulation and enforcement of regulations against private companies.

I hereby declare under penalty of perjury under the laws of the United States that the foregoing comments are true and correct to the best of my knowledge.



Dr. Doug Brugge

Date: 06-10-13

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Department of Public Health and Community Medicine
Tufts University School of Medicine
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Boston, MA 02111
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EDUCATION

Undergraduate

1982 BA (cum laude), Biology, and Chemistry, Washington University (St. Louis)

Graduate School

1987 PhD, Cellular and Developmental Biology, Harvard University

1988 MS, Industrial Hygiene, Harvard School of Public Health

ACADEMIC APPOINTMENTS

1983 and 1985, Teaching fellow, Department of Cellular and Developmental Biology,
Harvard University
1987, Lecturer, Biology Department, Roxbury Community College
1988 to 1994, Labor educator/industrial hygienist, Massachusetts Coalition for Occupational
Safety and Health and The New England Consortium, University of Massachusetts at
Lowell
1994 to 1996, Project coordinator/ research associate, Department of Family Medicine and
Community Health, Tufts University School of Medicine
1996 to 1998, Instructor, Department of Family Medicine and Community Health, Tufts
University School of Medicine
1998 to 2004, Assistant professor, Department of Family Medicine and Community Health, Tufts
University of Medicine
2004 to 2009, Associate professor, Department of Public Health and Family Medicine, Tufts
University School of Medicine
2012 to present, Secondary appointment, Jonathan M. Tisch College of Citizenship and Public
Service, Tufts University
2009 to present, Professor, Department of Family Medicine and Community Health, Tufts
University of Medicine

OTHER PROFESSIONAL ACTIVITIES

1993 to 1994, Technical counsel for parents of the Agassiz School in Jamaica Plain, Boston. Pro
bono assignment through the Massachusetts Environmental Justice Network
1993 to 1994, Advisor to the producer of the PBS film, *The Return of the Navajo Boy*
1994 to present, Director, Navajo Uranium Miner Oral History and Photography Project, Tufts
University School of Medicine
1997 to 1999, Developed and implemented an initiative to expand the diversity of teaching and

- research faculty for the Department of Family Medicine and Community Health, Tufts University School of Medicine
- 1998, Co-developed a policy on community collaborations for the Department of Family Medicine and Community Health, Tufts University School of Medicine
- 1998 to 2007, Director, Health Careers Opportunities Program, Department of Public Health and Family Medicine
- 2001 to 2005, Co-director, Healthy Public Housing Initiative, Tufts, Boston and Harvard Universities
- 2005 to present, Director, Tufts Community Research Center, Jonathan M. Tisch College of Citizenship and Public Service, Tufts University
- 2008 to present, Associate Director for Community-Academic Collaborative Research, Tufts Clinical and Translational Science Institute

AWARDS AND HONORS

- 1996, Certificate of appreciation, Boston Hispanic Sub-Parent Advisory Council
- 1997, Certificate of merit, Alternatives for Community and Environment
- 1999, Recognition, US Congressional Record
- 1999, Certificate of appreciation, Eastern Navajo Dine against Uranium Mining & Southwest Research and Information Center
- 2000, Certificate of recognition, Committee for Boston Public Housing
- 2002, Recognition, 25th anniversary banquet, Chinese Progressive Association
- 2004, Environmental merit award, US Environmental Protection Agency, New England
- 2008, Certificate of appreciation, Massachusetts Institute for Community Health Leadership
- 2008, Honorable mention, Community-Campus Partnerships for Health annual award, for the Navajo Uranium Miner Oral History and Photography Project
- 2009, Finalist, Thomas Ehrlich Civically Engaged Faculty Award, Campus Compact
- 2010, Tufts Community Research Center Annual Award, for the Community Assessment of Freeway Exposure and Health study.

HOSPITAL, MEDICAL SCHOOL, OR UNIVERSITY COMMITTEE ASSIGNMENTS:

- 1997, Grievance Committee, Graduate Programs in Public Health, Tufts University School of Medicine
- 2003, Epidemiology position search committee, Graduate Programs in Public Health, Tufts University School of Medicine
- 2000 to 2006, Admissions Committee, Tufts University School of Medicine
- 2000 to present, Scholarship Committee, Graduate Programs in Public Health, Tufts University School of Medicine
- 2006 to present, Research Committee, Jonathan M. Tisch College of Citizenship and Public Service, Tufts University
- 2007 to 2009, Steering Committee, Community Partnerships and the Elimination of Health Disparities, Cancer Center, Tufts Medical Center
- 2008 to present, Aligning Researchers and Communities for Health Leadership Committee, Clinical and Translational Science Institute, Tufts University School of Medicine/Tufts Medical Center

OTHER MAJOR COMMITTEE ASSIGNMENTS:

1993 to present, Steering Committee, Campaign to Protect Chinatown, Chinese Progressive Association
1993 to 1994, Member, Massachusetts Attorney General's Committee on Residential Lead Paint Removal
1993 to 1994, Community representative, Institutional Bio-safety Committee, Millennium Pharmaceuticals, Incorporated
1993 to 1994 Member, Health and Research Subcommittee of the National Environmental Justice Advisory Council, a federal advisory committee to the US Environmental Protection Agency
2003 to 2004, Member, Concord-Alewife Planning Study Committee, Community Development Department, City of Cambridge
1999 to 2011, Advisory board, The New England Consortium, University of Massachusetts Lowell
2000 to 2011, Board of directors, Committee for Boston Public Housing

TRAINING OF GRADUATE STUDENTS/POST DOCTORAL

PhD Theses (committee member)

Kristen Welker-Hood, PhD, 2005 Validity and Reliability of the Health Public Housing Initiative Environmental Assessment Survey. Doctoral dissertation, Boston University.
Department of Environmental Health, Boston University School of Public Health
Jamie DeLemos, PhD, 2008, Integrating uranium geochemistry, geographic information systems, risk modeling: An interdisciplinary & participatory approach to assess the environmental and human health impacts of uranium mining on the Navajo Nation, Department of Civil and Environmental Engineering, Tufts University
Christine Rioux, Roadway traffic exposure and CRP levels, Interdisciplinary Program, Tufts University (2009)
Christina Hemphill, Acute association of traffic-related air pollution and cardiovascular markers, Harvard School of Public Health (2011).
Bindu Panikkar, Occupational health of immigrants in Somerville, Department of Civil and Environmental Engineering, Tufts University (2011)
Allison St. Vincent, Modeling UFP geographically and temporally, Department of Civil and Environmental Engineering, Tufts University (in progress).
Kevin Lane, exposure assessment, Department of Environmental Health, Boston University School of Medicine (in progress).
Nira Hadar, Non-traditional risk factors for venous thromboembolism (VTE), Tufts University Sackler School (in progress).
Matt Simon, modeling UFP for the Puerto Rican Health Study, Department of Civil and Environmental Engineering, Tufts University (in progress).

Masters Theses (committee member)

Christine Ash (MS), 2008, Exposure assessment next to I-93 in Somerville, Department of Civil and Environmental Engineering, Tufts University.
Jeff Trull (MS), 2010, UFP levels and atmospheric inversions, Department of Civil and Environmental Engineering, Tufts University.
Elizabeth Baker (MA), 2012, SES, PAHs and cardiovascular health, Harvard Extension School.

Undergraduate Honors Theses (committee member)

Linh Phan, 2007, Study of crime in Boston Chinatown, American Studies, Tufts University.
Stanislav Henkin, 2008, Respiratory disease in adult Puerto Ricans in the Boston area, Community Health, Tufts University.

Laura Corlin, 2013, Respiratory Factors Associated with Asthma among Adult Chinese Immigrants in Boston, Community Health, Tufts University.

TEACHING RESPONSIBILITY

Course director

2007 Applied learning experience for MPH students, Tufts University School of Medicine
1997 to 2008, rotations for 3rd and 4th year medical students with the Indian Health Service, Tufts University School of Medicine
2001 to present, Occupational and environmental health, for MPH students, Tufts University School of Medicine
2002 to present, Community-based research: methods and ethics, for MD/MPH students, Tufts University School of Medicine

Other teaching

1994 and 1996, Facilitator for the problem based learning seminars for MD students, Tufts University School of Medicine
1995, Occupational and environmental health: Issues in preventive medicine, for MD/MPH students, Tufts University School of Medicine
1996, Socio-political forces in occupational health and safety, for MD/MPH students, Tufts University School of Medicine
1997, Occupational and environmental health: Issues in preventive medicine, for MD/MPH students, Tufts University School of Medicine
1997 to 2000, Assistant Course Director and section leader, Patient, doctor, society for medical students, Tufts University School of Medicine
2007 Small group instructor, Epidemiology and biostatistics, for medical students, Tufts University School of Medicine
2005 to present, Guest lecture annually for the Introduction to Community Health Class, Tufts University, Medford, MA.

PROFESSIONAL SOCIETIES

1995 to 2011, American Public Health Association
2005 to present, Community-Campus Partnerships for Health
2008 to present, International Society of Environmental Epidemiology

MAJOR RESEARCH INTERESTS

Highway pollution and health: Direct the Community Assessment of Freeway Exposure and Health study, a set of community-based participatory research studies that includes an observational study of ultrafine particles and blood markers of cardiovascular disease risk, two randomized crossover interventions of in-home HEPA filtration to reduce particulate pollution and longitudinal observation of the Puerto Rican Health Study cohort.

Native Americans and uranium: Direct the Navajo Uranium Miner Oral History and Photography Project that produced a book, numerous journal articles, widespread media coverage, an exhibit and a video.

Boston Chinatown: Led studies of traffic injuries, crime and environmental health in Boston Chinatown. Collaborators included the Chinese Progressive Association, South Cove Community Health Center, the Josiah Quincy Elementary School and others.

Housing conditions and health: Co-directed (with Spengler, HSPH and Hynes, BUSPH) a citywide, multi-year initiative to evaluate and intervene with respect to housing conditions and asthma in public housing. Partners included two city agencies, four community organizations, two consultant groups and the three universities. Resulted in the Boston Housing Authority changing its pest management practice.

Asthma: Led studies on Chinese and Black immigrants and asthma. Published first prevalence study and only studies of nativity and asthma in Chinese immigrant children. Contributed to a bilingual, Chinese-English asthma education program. Also did studies on how managed care plans conduct asthma management which led to an EPA national award program for MCOs.

Research ethics: Led several small studies of research ethics in Chinese, Navajo and public housing populations.

Health communication: Led a study of the role of language in patient-health care provider communication.

Environmental tobacco smoke: Directed a study of recent Asian immigrants and ETS and was a co-investigator (Hyde, PI) on three studies of ETS and restaurant workers

RESEARCH SUPPORT

ACTIVE

1 D18HP13622-01-00 (Brugge) 09/01/09 – 06/30/13 3.00 calendar months
HRSA \$563,617

Health Careers Opportunity Program

Our program will increase the number of disadvantaged students graduating from: 1) medical school in primary care and/or 2) public health graduate programs. The partnership includes students, teachers, professors, professionals, administrators, and parents.

1 R01 ES015462-02 (Brugge) 06/13/08 - 03/31/13 4.80 calendar months
NIH/NIEHS \$355,624

Community Assessment of Freeway Pollution and Health (CAFEH)

To study the relationship between air pollutants emitted from motor vehicles on major highways and chronic health effects in individuals living in nearby communities.

No number (Brugge) 07/01/05 - 06/30/13 1.2 calendar months
Tufts University \$30,000

Community Research Center, University College of Citizenship and Public Service

One year of support to develop the Tufts Community Research Center.

UL1 RR025752 (Selker) 05/19/08 - 04/13/13 1.20 calendar months
NIH \$3,711,779

Clinical and Translational Science Initiative

Role: Co-Investigator

The community engagement component of the CTSI will work with local community organizations to improve their understanding of and involvement in research.

1P50CA148612-01 (Tucker) 04/01/10 - 03/31/15 1.20 calendar months
NIH/NHLBI \$1,488,735

Boston Puerto Rican Health Study

Role: PI of Project 4: A CBPR investigation of traffic pollution and CVD in Puerto Rican adults

Our overall aim for this renewal is to extend follow-up and to measure and analyze relevant characteristics and CVD risk factors, and to add additional contextual and outcome measures for CVD risk in this established cohort of Puerto Rican adults, so that we may better understand the dynamics of these disparities.

HUD (CFDA Number: 14.906) 05/01/09-05/30/13 1.20 calendar months
Subcontract City of Somerville Housing Division \$205,549

Evaluation of Cardiovascular Health Benefits of In-home Air Filtration

Role: Co-Investigator

We propose to measure the health benefits of air cleaning technology in homes adjacent to a highway in Somerville, Massachusetts, just north of Boston. This study builds on an on-going, NIEHS-funded, investigation of health effects in people exposed to near-highway air pollution.

Healthy Housing Solutions, Inc. (Brugge) 06/14/11 – 6/13/13
CDC \$17,399

Healthy Housing Solutions

This study will examine the connections between housing, the indoor environment and health, particularly within low-income housing and in relation to asthma.

Past (dollars to Tufts)

1982 to 1987, National Science Foundation Graduate Fellowship, Harvard University

1987 to 1988, Graduate fellowship, Harvard School of Public Health

1995 to 1996 US Environmental Protection Agency, \$15,000, Indoor air quality, co-investigator

1995 to 1996: US Environmental Protection Agency, \$20,000, Navajo uranium miner oral history and photography project, principle investigator

1995 to 1997: Ruth Mott Fund, \$22,000, Navajo uranium miner oral history and photography project, principle investigator

1996 to 1997: US Environmental Protection Agency, Indoor air quality, \$14,000, co-investigator

1996 to 1997: Ford Foundation, \$15,000, Navajo uranium miner oral history and photography project, principle investigator

1996 to 1997: US Environmental Protection Agency, Indoor air quality, \$20,000, co-investigator.

1997 to 1998: US Environmental Protection Agency, Indoor air quality, \$15,000, co-investigator.

1997 to 1998: US Environmental Protection Agency, Indoor air quality, \$10,000, co-investigator

1998 Tufts Institute of the Environment, Navajo uranium miner oral history and photography project, \$5,000, principal investigator

1998: Ruth Mott Fund, \$10,000, Navajo uranium miner oral history and photography project, principal investigator

1998: Education Foundation of America, \$25,000, Navajo uranium miner oral history and photography project, principle investigator

1997 to 1999: Mass. Department of Public Health, Environmental tobacco smoke in Chinese and Vietnamese immigrants, \$35,000, principal investigator

1998 to 1999: US Environmental Protection Agency, Healthy public housing pilot study, \$30,000, co-investigator

1999 to 2000: US Environmental Protection Agency, A Pilot Home Asthma Intervention Study in Boston Public Housing, \$10,000, co-investigator

1999 to 2000: US Environmental Protection Agency, Healthy public housing pilot study, \$100,000, principle investigator

1999 to 2003: US Health Resource Services Administration, Health careers opportunities program, \$850,000, principle investigator

1999 to 2004: US National Institute of Environmental Health Sciences, Nuclear risk management for native communities, \$50,000, consultant

2000 to 2001: US Environmental Protection Agency Best Practices at Managed Care Organizations, \$40,000, co-investigator

2000 to 2001: Massachusetts Department of Public Health, Environmental tobacco smoke exposure in bar workers, \$69,000, co-investigator

2001 to 2002: National Institutes of Health, Short courses for environmental health research ethics, \$30,000, consultant

2001 to 20002: Massachusetts Department of Public Health, Environmental tobacco smoke exposure in bar workers, \$75,000, co-investigator

2002 to 2003: Josiah Macy Foundation, Health careers opportunities program, \$19,500, principle investigator

2001 to 2004: US Housing and Urban Development, Healthy public housing initiative, \$152,000, co-principal investigator

2002 to 2005: Kellogg Foundation, Healthy public housing initiative, \$86,000, co-principal investigator

2003 to 2005: Tufts University College of Citizenship and Public Service, Faculty fellowship for citizenship and public service, \$30,000, principle investigator

2003 to 2007: US Health Resources and Services Administration, Health careers opportunities program, \$1.3 million, principle investigator

2005 to 2008: National Cancer Institute, Language, literacy, culture: Communication of health concepts, \$100,000, principal investigator

2005-2009 Blue Cross/Blue Shield Foundation of Massachusetts, \$300,000, co-investigator

2008 to 2010 NICHD (subcontract with UMASS), Using CBPR to design and pilot a physical activity program for youth with ASD, consultant

2010 to 2011 Tufts Clinical and Translational Science Initiative, \$10,000, An Investigation of Multiple In-Home Health Hazards in Boston-based Family Childcare Providers' Facilities, Co-PI.

2011-2012 University-Municipal Partnerships for Children's School Success, \$50,000, Co-PI.

2009-2012 Nuestro Futuro Saludable: The JP Partnership for Healthy Caribbean Latino Youth, approx. \$1,000,000, Co-PI.

EDITORIAL BOARDS AND ACTIVITY

2005 – present, Board member, Reviews on Environmental Health

2006 – present, Associate Editor for Environmental and Occupational Health, Journal of Immigrant and Minority Health

2011 – present, Board member, Akademii meditsinskikh nauk Tajikistana” (Herald of Tajikistan Academy of Medicine)

Peer review for

Allergologia et Immunopathologia
 Allergy
 American Indian Quarterly

American Journal of Public Health
Annals of Allergy, Asthma & Immunology
Archives of Environmental and Occupational Health
Canadian Medical Association Journal
Cell Biology and Toxicology
Environment International
Environmental Health
Environmental Health Perspectives
Environmental Research
Environmental Science and Technology
Health Education and Behavior
Health Promotion Practice
Indoor Air
International Journal of Physical Sciences
Journal of Comparative Effectiveness Research
Journal of Epidemiology and Community Health
Journal of Exposure Science and Environmental Epidemiology
Journal of Health Communication
Journal of Public Health Management and Practice
Journal of Public Health Policy
Journal of the American Medical Association
Journal of Urban Affairs
Local Environment
National Academies Press
New Solutions
Nicotine & Tobacco Research
Noise and Health
Pediatrics
Pharmacogenetics
Progress in Community Health Partnerships
Public Health Reports
Rural Sociology
Science and Engineering Ethics
Science of the Total Environment
Toxicology
Transportation Research Part A: Policy and Practice
Women & Health

NATIONAL AND INTERNATIONAL GRANT REVIEW PANELS

Networks of Centres of Excellence, Toronto, Canada, May 2004.
Special Interest Projects, Prevention Research Centers, US Centers for Disease Control and Prevention, Atlanta, GA, June 2004.
Community Level Health Promotion Study Section, US National Institutes of Health, Washington, DC, February 2005.
Health Careers Opportunities Program Review, US Health Resources and Services Administration, Washington, DC, May 2005.
Community Level Health Promotion Study Section, US National Institutes of Health, Washington, DC, September 2005.

Community Level Health Promotion Study Section, US National Institutes of Health, Washington, DC, June 2006.

Health Literacy study section, ZRG1 RPHB-B (50), US National Institutes of Health, Washington, DC, March 2007.

Health Literacy study section, ZRG1 RPHB-B (50), US National Institutes of Health, Washington, DC, November, 2007.

Epidemiology of Bacterial Infection and Asthma, 2008/01 ZRG1 HOP-W (02) M, US National Institutes of Health, by phone, November, 2007.

Health Literacy study section, ZRG1 RPHB-B (50), US National Institutes of Health, Washington, DC, June, 2008 (deputy chair).

US Civilian Research & Development Foundation, Central Asia Research Travel (CART) competition. Review of proposal to address uranium in the Kyrgyz Republic, September, 2008.

CBPR Special Review Panel, ZRG1 HOP-M 50 R, US National Institutes of Health, Washington, DC, October, 2008.

Health Literacy study section, ZRG1 RPHB-B (50), US National Institutes of Health, Los Angeles, CA, March, 2009 (deputy chair).

Challenge grant reviews, US National Institutes of Health, by mail, June 2009.

P20 pilot center application for NIEHS, ZES1 LKB-G (P2) 1, by phone, July, 2009.

Pilot grant reviews for the Tufts Clinical and Translational Research Initiative, July, 2009.

CBPR Special Review Panel, ZRG1 HOP-M 50 R, US National Institutes of Health, Washington, DC, October, 2009.

NHLBI Clinical Trials Review Committee, US National Institutes of Health, by phone, June 2010.

Faith Based R21, ZMD1 PA 07 1, US National Institutes of Health, by phone, June 2010.

Pilot grant reviews for the Tufts Clinical and Translational Research Initiative, July, 2010.

Special Emphasis Panel, PCORI 6, US National Institutes of Health, Washington, DC, February 21, 2012.

National Geographic, March, 2013.

Community Level Health Promotion Study Section, US National Institutes of Health, Washington, DC, Member July 1, 2010 – present.

Chair, Community Level Health Promotion Study Section, US National Institutes of Health, Washington, DC, Member July 1, 2010 – present.

BIBLIOGRAPHY

Original Research (peer reviewed)

1. Broda H, Brugge D, Homma K, Hastings JW. Circadian communication between unicells? Effects on period by cell-conditioning of medium. *Cell Biophysics*, 8:47-67, 1986.
2. Barbeau E, DeJong W, Brugge D, Rand W. Does cigarette advertising adhere to the tobacco industry's voluntary advertising and promotion code? An Assessment. *Journal of Public Health Policy*, 19(4):473-488, 1998.
3. Brugge D, Leong A, Averbach A, Cheung FM. An environmental health survey of residents of Boston Chinatown. *Journal of Immigrant Health*, 2:97-111, 2000.
4. Hynes P, Brugge D, Watts J, Lally J. Public health and physical environment in Boston public housing. *Planning, Practice, and Research*, 15:31-49, 2000.

5. Brugge D, Carranza L, Stienbach S, Wendell A, Hyde J. Environmental management of asthma at Massachusetts MCOs. *Journal of Public Health Management and Practice*, 7(5):36-45, 2001.
6. Brugge D, Rice P, Terry P, Howard L, Best J. Housing conditions and respiratory health in a Boston public housing community. *New Solutions: A Journal of Environmental and Occupational Health Policy*, 11(2): 149-164, 2001.
7. Brugge D and Goble R. The history of uranium mining and the Navajo People. *American Journal of Public Health*, 92:1410-1419, 2002.
8. Brugge D and Tai M. Use of small area data to support a community agenda in Boston Chinatown. *Local Environment.*, 7:203-219, 2002.
9. Brugge D, Lai Z, Hill C, Rand W. Traffic injury data, policy, and public health: Lessons from Boston Chinatown. *Journal of Urban Health: Bulletin of the New York Academy of Medicine*, 79:87-103, 2002.
10. Brugge D, DeJong W, Hyde J, Le Q, Shih C-S, Wong A, Tran A. Development of targeted message concepts for recent Asian immigrants about second hand smoke. *Journal of Health Communication*, 7:25-37, 2002.
11. Brugge D, Melly S, Finkelman A, Russell M, Bradeen L, Perez R, Henson L, Heeren T, Snell J, Helms D, Hynes, HP. A community-based participatory survey of public housing conditions and associations between renovations and possible building-related symptoms. *Applied Environmental Science & Public Health*, 1:89-101, 2003.
12. Hynes HP, Brugge D Osgood N, Snell J, Vallarino J, Spengler J. "Where does the damp come from?" Investigations into the indoor environment and respiratory health in Boston public housing. *Journal of Public Health Policy*, 24:401-426, 2003.
13. Brugge D, Goble R. The Radiation Exposure Compensation Act: What is fair? *New Solutions: A Journal of Environmental and Occupational Health Policy*. 13:385-397, 2003.
14. Brugge D, Kole, A. A case study of community-based participatory research ethics: The Healthy Public Housing Initiative. *Science and Engineering Ethics*, 9:485-501, 2003.
15. Brugge D, Bagley J, Hyde J. Environmental management of asthma at top-ranked U.S. managed care organizations. *Journal of Asthma*, 40:605-614, 2003.
16. Lee T, Brugge D, Francis C, Fisher O. Asthma prevalence among inner-city Asian American school children. *Public Health Reports*, 118:215-220, 2003.
17. Brugge D, Vallarino J, Ascolillo L, Osgood N, Steinbach S, Spengler J. Comparison of multiple environmental factors for asthmatic children in public housing. *Indoor Air*, 13:18-27, 2003.
18. Hyde JN, Brugge D, Repace J, Rand W. Assessment of sources of second hand smoke exposure in a putatively non-exposed population. *Archives of Environmental Health*, 59:553-557, 2004.
19. Greenfield RO, Lee AC, Tang R, Brugge D. Screening for asthma in Cantonese-speaking immigrant children. *BMC Public Health*, 5:48, 2005.
20. Brugge D, Kole A, Lu W, Must, A. Susceptibility of elderly Asian immigrants to persuasion with respect to participation in research. *Journal of Immigrant Health*, 7:93-101, 2005.
21. Brugge D, Welker-Hood K, Kosheleva A, Saddler S. Association and correlation of self-reported home environmental factors and health symptoms. *Archives of Environmental and Occupational Health*. 61:33-41, 2006. PMID: 17503619
22. Freeman ER, Brugge D, Bennett-Bradley WM, Levy JI, Rivera Carrasco E. Challenges of conducting community-based participatory research in Boston's

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10. Laws MB, Davila M, Manis M, Stone K, Perez C, Around D, Reisner E, Zamore W, Brugge D. Sociodemographic Characteristics and perception of risk from near highway pollution. International Society for Exposure Science - International Society for Environmental Epidemiology & Exposure. Seoul, Korea, August-September 2010.

11. Brugge D, Woodin M, Tin AH, Moy S, Palella M. Place of birth interacts with SES, pest exposure and allergy on asthma diagnosis. International Society for Exposure Science - International Society for Environmental Epidemiology & Exposure. Seoul, Korea, August-September 2010.
12. Brugge D. Nuclear power's dirty secrets. Doshisha University, Kyoto, Japan, September 4, 2010.
13. Brugge D, Fuller CH, St. Vincent A, Lane K, Martinez LP, Woodin M, Zamore W, Durant J. Ultrafine particulate pollution gradients near highways and cardiovascular health in older adults: Study design and early findings. International Conference on Global Health and Public Health Education. Hong Kong, China, October 2011.
14. Brugge D. Uranium and its decay products – radon, radium and thorium – heavy metal toxicity. Uranium, health and environment, Bamako, Mali, March, 2012.
15. Brugge D. Keynote: Uranium as resource and socio-economic consequences. Experience with uranium mining in the Dine territory of the Dine (Navajo), USA. Uranium, health and environment, Bamako, Mali, March, 2012.

Invited Domestic Lectures

1998

Talk on Navajo uranium miners at Utah State University in conjunction with a show of the exhibit, *Memories Come to Us in the Rain and the Wind*, Logan, UT, April 16.

1999

Talk on Navajo uranium miners at University of New Mexico in conjunction with a show of the exhibit, *Memories Come to Us in the Rain and the Wind*, Albuquerque, NM, January 23.

Talk on housing and asthma to US EPA asthma conference, Johns Hopkins School of Public Health, Baltimore, MD, November 18.

2000

Presentation on health risk from the Sequoyah Fuels Corporation nuclear waste site to the staff of the Hastings Health Clinic, Tahlequah, OK, March 24.

Two talks on Navajo uranium miners at Misericordia College in conjunction with a show of the exhibit, *Memories Come to Us in the Rain and the Wind*, Dallas, PA, October 23.

2001

Lecture on the Navajo experience with uranium mining at Syracuse University, Syracuse, NY, April 16.

Workshop on decommissioning the Sequoyah Fuels Corporation nuclear waste site to the Community Council, Gore, OK, June 15.

Workshop on the Radiation Exposure Compensation Act at Laguna Pueblo, NM, August 10.

Lecture on the environmental prevention of asthma at managed care organizations, The Pediatric Asthma Coalition of New Jersey, East Brunswick, NJ, November 30.

2002

Featured speaker on asthma prevention and managed care, The 7th Annual Disease Management Congress, Chicago, IL, September 19.

Presentation on the Radiation Exposure Compensation Act to the Laguna-Acoma Coalition for a Safe Environment, Laguna, NM, November 9.

2003

Workshop on the reclamation plan for the Sequoyah Fuels Corporation nuclear waste site to the Community Council, Gore, OK, May 15.

Talk on heating systems and health in housing developments. Multifamily Buildings 2003, New York, NY, June 10.

2004

Guest lecture on the Radiation Exposure Compensation Act in the Department of Chemistry at the University of Wisconsin, Madison WI, March 4.

Presentation, Committee To Assess the Scientific Information for the Radiation Exposure Screening and Education Program, National Research Council, The National Academies, Washington, DC, March 24.

2005

Environmental Justice Panel. Quality in Education for Minorities conference. New York City, February 25.

2006

Language, Education Level, Culture and Communication with Health Care Providers. Understanding and promoting health literacy: Meeting of the principal investigators and federal staff, Bethesda, MD, October 31.

Book release party, Navajo Studies Conference: In the sacred manner we walk as Dine. Albuquerque, NM, November 3.

2007

Presentation of a study comparing community and student survey teams at the Healthy Public Housing Initiative (HPHI) Summit. New York Academy of Medicine, New York, NY, February 15.

Talk on the Navajo people and uranium mining, Navajo Nation Department of Health and Human Services, Window Rock, AZ, June 7.

Interview on the Navajo people and uranium mining, In Focus, KNME television, Albuquerque, NM, aired June 22.

Testimony on Navajo uranium issues before the Committee on Oversight and Government Reform, House of Representatives, Congress of the United States, Washington, DC, October 23.

Talk on immigration, infection and asthma, Institute for Community Research, Hartford, CT, November 2.

2008

Lecture on nuclear power, global warming and uranium mining, Gaylord Nelson Lecture Series, Nelson Institute for Environmental Studies, University of Wisconsin-Madison, Madison, WI, February 27.

Interview on nuclear power, global warming and uranium mining, The Progressive Radio Show by Matthew Rothschild, aired March 17.

Live telephone interview, Canadian purchase of Iraqi uranium, Canadian TV, July 6.

Lecture on health effects of uranium mining to the Dan River Basin Association (closed session), Danville, VA, November 8.

Lecture on health effects of uranium mining to the Dan River Basin Association (public session), Chatham, VA, November 8.

2009

Lecture on community-based participatory research, Ohio State University, Columbus, OH, May 28.

Talk, 360° of Human Subjects Protections in Collaborative Engagement Research. University of Chicago Medical Center, Chicago, IL, June 24, 2009.

2010

Talk on student participation in community-based research, American Association of Colleges & Universities, Washington, DC, January 22.

Lecture on health effects of uranium mining, Symposium on uranium mining in Virginia, Richmond, VA, March 11.

Lecture, Bilagáana: The Career of a White Boy from the Rez, middle and high school students, Telluride, CO, December 6.

Lecture, Health Effects of Uranium Mining: New Research Findings, Telluride, CO, December 6.

2011

Talk on “Building university commitment for community engaged research,” Tripp Center, the Institute for Community Research, Center for Public Health and Health Policy, and Center for Health Intervention and Prevention, Hartford, CT, February 11.

Talk on “Use of cross-over design,” Centers for Population Health and Health Disparities Meeting, Chicago, IL, June 30.

Lecture, “Nuclear Power’s Dirty Secrets,” In the “Nothing can go wrong: Rethinking nuclear energy in the 21st century” lecture series, Science and Technology Studies Program, Brown University, Providence, RI, October 13.

Keynote, Bilagáana: The Career of a White Boy from the Rez, Red Valley High School, Red Valley, AZ, November 10.

2012

Remarks, Reception and dinner, Developing an environment to support community-engaged research, Case Western Reserve University, Cleveland, OH, May 23.

Panelist, Building your community engagement capacity, Case Western Reserve University, Cleveland, OH, May 24.

Participant, VDH small group discussion meeting on uranium mining and water, Warrington, VA, August 16.

Lecture, The Navajo experience with uranium mining, environmental policy class, Colby College, Waterville, ME, October 24.

Lecture, The tainted dessert, lunchtime series, Colby College, Waterville, ME, October 24.

Webinar, The Tufts Community Research Center: Expanding community engaged research, Ohio University, via teleconference, November 9.

2013

Lecture, Considering the health effects of the full range of exposures from uranium mining, Northern Arizona University, April 5.

Invited Local Lectures

1999

Talk on managed care and asthma, Pediatric Asthma Conference, Brandies University, Waltham, MA, September 17.

Talk on housing and environment to Boston Society of Architects, Boston, MA, October 18.

2000

Presentation to, "Focus on new HUD regulations & healthy homes" a conference put on by the New England Lead Coordinating Committee, Boston, MA, March 6.

Testimony, Boston City Council on health and development, Boston, MA, April 11.

Talk on "Housing conditions and respiratory health in Boston public housing" at a conference titled, "Researching social inequities in health", Harvard School of Public Health, Boston, MA, June 12.

Interview on environmental health in Boston Chinatown, BNN TV evening news, Boston, MA, June 29.

Departmental seminar about Navajo uranium miners and federal compensation to the Work Environment Department, University of Massachusetts at Lowell, Lowell, MA, September 18.

Presentation on use of data for community organizing in Boston Chinatown at the Community Action Information Network conference on Race, Space and Policy Issues, Roxbury, MA, December 14.

2001

Presentation on health and housing conditions, Boston Housing Authority, Boston, MA, January 24.

Presentation on an asthma pilot study in public housing to the Boston Urban Asthma Coalition, Boston, MA, February 8.

Lecture on Health and housing conditions to the Health Policy Summer Program, Harvard School of Public Health, Boston, MA, July 19.

2002

Presentation on healthy public housing study progress, Policy Advisory Board of the Healthy Public Housing Initiative, Boston, MA, May 10.

Talk on asthma and managed care, Asthma and Allergy Month event, US EPA Region One, Boston, MA, May 15.

Presentation on research findings about environmental health and safety in Boston Chinatown, Boston Redevelopment Authority, Boston, MA, June 12.

2003

Expert testimony, Joint Committee on Health, Massachusetts State legislature, in favor of a bill that would establish an asthma registry and require MCO reimbursement for certain durable goods and educational interventions, Boston, MA, July 16.

Presentation on environmental interventions for asthma to the Asthma Regional Council, Cambridge, MA, September 25.

Expert testimony, Massachusetts State Board of Building Regulations and Standards, in favor of amendments to the state building code designed to reduce moisture damage and mold, Boston, MA, November 25.

2004

Lecture on healthy public housing, Building a Healthy Community: Bridging the Health Disparities Gap, Tufts University School of Medicine, Boston, MA, April 3.
Talk on the Healthy Public Housing Initiative, Forging Creative Alliances: Collaborative Problem-solving for Environmental and Public Health Issues in Massachusetts, New England School of Law, Boston, MA, April 8.
Expert testimony on Asian American health disparities before the Joint Committee on Health Care, Massachusetts Oversight Hearing, Harvard University School of Public Health, Boston, MA, April 12.

2005

Guest lecture about research in Boston Chinatown for the class "Active Citizenship in an Urban Community: Race, Class, Culture and Politics." Tufts University, Medford, MA, March 28.
Lecture on asthma in Boston Chinatown as part of the Tufts Institute of the Environment Sustainability Week, Boston, MA, March 29.
Presentation on asthma and pedestrian injuries in Boston Chinatown at a community meeting on the Silver Line, Phase III, Boston, MA, June 23.

2006

Workshop on environmental justice for the Chinatown Resident Association, Boston, MA, February 8.
Talk on the Healthy Public Housing Initiative to the Eastern Sociological Society, Boston, MA, February 24.
Talk on community collaborative research to the undergraduate scholars of the College of Citizenship and Public Service, Medford, MA, March 1.
Talk on the Healthy Public Housing Initiative to the first annual Tufts Community Research Symposium, Medford, MA, March 31.
Testimony on traffic-related air pollution and public health, joint session, Somerville Alderman and Planning Board, Somerville, MA, June 15.
Talk on Chinatown research to the Chinatown Youth Initiative, Boston, MA, July 19.
Talk on Chinatown research to The Medical Foundation, Boston, MA, November 9.

2007

Legislative Briefing on near-highway pollution and health, Massachusetts House of Representatives, Boston, MA, April 5.
Talk on immigrants and asthma, World Asthma Day, Massachusetts State House, Boston, MA, May 1.
Talk on asthma to the Health Careers Opportunities Program high school class at the University of Massachusetts Boston, Boston, MA, July 16.
Lunchtime seminar on asthma and immigration, Environmental Health Program, Harvard School of Public Health, Boston, MA, August 1.
Presentation of obesity and acculturation survey findings to the Malden Public Schools, Malden, MA, October 12.
Talk on community-based participatory research for the Institute for Community Health, Cambridge Health Alliance, Cambridge, MA, November 26.
Talk on environmental tobacco smoke in homes to "Translational research: Applying discovery," Jean Mayer USDA Human Nutrition Research Center on Aging, Boston, MA, November, 29.
Seminar, Immigration, infection and asthma, Department of Public Health and Family Medicine, Tufts University School of Medicine, Boston, MA, November 13.

2008

- Panelist, LEED-ND: Integrating best practices in design, planning, and public health? Massachusetts Institute of Technology, Cambridge, MA, February 21.
- Guest lecture, on nuclear power, global warming and uranium mining, Community Health 99: Introduction to Global Health, Tufts University, Medford, MA, March 25.
- Guest lecture on community-based participatory research, Introduction to Environmental Justice, Harvard Extension School, Cambridge, MA, April 3.
- Guest lecture, on nuclear power, global warming and uranium mining, environmental science class, Suffolk University, Boston, MA, April 7.
- Panel on community-based participatory research, Leadership and Faculty Development Conference, Harvard Medical School, Boston, MA, April 30.
- Lecture, asthma, immigration and infection. Tufts Schweitzer Fellows, Tufts University School of Medicine, Boston, MA, September 13.
- Panelist, The environmental burden in Boston's disadvantaged communities, Environmental Action Committee of Phillips Brooks House and Kirkland House, Harvard University, Cambridge, MA, October 23.
- Talk on Chinatown research, Urban Environmental Policy and Planning, Tufts University, Medford, MA, November 3.
- Talk on Community Assessment of Freeway Exposure and Health, MOVE Massachusetts membership meeting, Boston, MA, November 21.
- Talk on Community Assessment of Freeway Exposure and Health, US Environmental Protection Agency, Boston, MA, December 10.

2009

- Talk on asthma, immigration and infection. "High Table" Tufts University, Medford, MA February 12.
- Guest lecture, asthma, immigration and infection, Environmental Justice and Health of Urban Populations, Northeastern University, Boston, MA, March 10.
- Guest lecture on Chinatown research, environmental justice class, University of Massachusetts Dartmouth, Dartmouth, MA, April 2.
- Guest lecture on community-based participatory research, Introduction to Environmental Justice, Harvard Extension School, Cambridge, MA, April 2.
- Guest lecture, on nuclear power, global warming and uranium mining, environmental science class, Suffolk University, Boston, MA, April 6.
- Panelist, Toxic traffic: Reducing the risk. Museum of Science, Boston, MA, May 3.
- Talk on asthma and media. Kaiser Media Fellows, Tufts University School of Medicine, Boston, MA, August 17.
- Guest lecture on community-based participatory research, Environmental Health Policy class, Brown University, Providence, RI, November 5.
- Talk, Community Assessment of Freeway Exposure and Health Study: Rationale, Methods, and Approach, Society for Risk Analysis, New England Chapter, Boston, MA, November 19.
- Testimony, Joint Committee on the Environment, Natural Resources & Agriculture, Massachusetts State House, in favor of H.808, *An Act reducing human exposure to particulate matter pollution.*

2010

- Facilitated discussion of community-collaborative research with Building Your Capacity: Advancing Research Through Community Engagement, Boston, MA, February 5.

Lecture on Chinatown environmental justice research, Introduction to Environmental Justice, Harvard Extension School, Cambridge, MA, March 30.

Talk on Asthma, Immigration and the Immune System, T32 brown bag lunch series, Tufts Medical Center, Boston, MA, April 15.

Lecture on particulate pollution for Scientific Foundations of Social and Behavioral Medicine class, Tufts University School of Medicine, May 19.

Talks on CBPR and asthma for Community Engagement Seminar, T32 program, July 14.

Panelist, Distrust, Race and Research, Center for Community Health Education Research and Service, Northeastern University, July 14.

Presentation of the Community Assessment of Freeway Exposure and Health study to legislative aides of the Boston delegation, Massachusetts State House, July 19.

Presentation of the Community Assessment of Freeway Exposure and Health study to the Northeast States for Consolidated Air Use Management (NESCAUM), Northampton, MA, October 14.

Guest lecture on the Community Assessment of Freeway Exposure and Health study to Environmental Health Policy class, Brown University, Providence, RI, November 2.

Seminar, Place of birth and asthma, Boston University School of Public Health, Boston, MA December 3.

2011

Facilitated discussion of community-collaborative research with Building Your Capacity: Advancing Research Through Community Engagement, Boston, MA, January 7.

Lecture on Community Assessment of Freeway Exposure and Health, Introduction to Environmental Justice, Harvard Extension School, Cambridge, MA, April 12.

Facilitated discussion of grant writing with Building Your Capacity: Advancing Research Through Community Engagement, Boston, MA, April 15.

Host and facilitator, Evaluation: Your new BFF: An introduction to evaluation for community-based organizations, Medford, MA, April 28.

Talk on Cardiovascular health and near highway pollution: The CAFEH study. A research day on sustainability, Medford, MA, May 3.

Talk on Asthma and Chinese immigrants to the United States to visiting students from Beijing, China, Tufts Medical School, Boston, MA July 26.

Lecture, Bilagáana: The Career of a White Boy from the Rez, middle and high school students, HCOP Program, Boston, MA, August 3.

Clinical research seminar, Can migration studies help us understand what causes asthma in children?, Clinical Research Resources Office, Boston University School of Medicine, September 21.

Lecture, Bilagáana: The Career of a White Boy from the Rez, middle school students, Curley School after school program, Boston, MA, December 12.

Testimony, Hearing on “clean construction” bill, Boston City Council, Boston, MA, December 20.

2012

Lecture on Community Assessment of Freeway Exposure and Health, Introduction to Environmental Justice, Harvard Extension School, Cambridge, MA, March 27.

Talk on Community Assessment of Freeway Exposure and Health, Graduate Seminar, Tufts Clinical and Translational Science Institute, Boston, MA, March 29.

Facilitated discussion of community-collaborative research with Chinatown Building Your Capacity: Advancing Research Through Community Engagement, Boston, MA, March 30.

Greeting, about Community Assessment of Freeway Exposure and Health, Chinatown Resident Association banquet, Boston, MA, March 30.

Panelist, Hazardous Waste, Communicating Science Symposium, Wellesley College, Wellesley, MA, April 14.

Talk on Project 4: A CBPR investigation of traffic pollution and CVD in Puerto Rican adults, Boston-based Centers for Population Health and Health Disparities Joint Meeting, Harvard School of Public Health, Boston, MA, April 17.

Talk on Community Assessment of Freeway Exposure and Health, Community Forum: The Health of Chinatown, Tufts Clinical and Translational Science Institute, Asian Community Development Corporation, Boston, MA, April 27.

Lecture on “The Scientist and the Community,” Responsible Conduct of Research course, Office of the Vice Provost, Medford, MA, May 8.

Webinar presenter, ALA of MA discussion on upcoming healthy air attacks, Boston, MA, June 14.

Talk on Community Assessment of Freeway Exposure and Health to visiting students from Nanjing, China, Tufts Medical School, Boston, MA July 11.

Introduction of Community Assessment of Freeway Exposure and Health to children in the Chinatown Adventure summer camp, Tufts Medical School, Boston, MA August 1.

Panelist, Case examples of community-based participatory research (CBPR), Chinatown Leader’s Brunch, Tufts Clinical and Translational Science institute, Boston, MA, September 20.

Talk on community-based participatory research, Jonathan M. Tisch College of Citizenship and Public Service, Medford, MA, October 17.

2013

Lecture on Community Assessment of Freeway Exposure and Health, Introduction to Environmental Justice, Harvard Extension School, Cambridge, MA, March 26.

Lecture on “The Scientist and the Community,” Responsible Conduct of Research course, Office of the Vice Provost, Boston, MA, April 16.

Talk, “Asthma, Immigration and Infection” Primary Prevention of Asthma: A Symposium on Current Evidence, Research Needs and Opportunities for Action, Waltham, MA, April 23-24.

Talk, Path to professorship, Harvard School of Public Health, April 30.

Published Abstracts

1. Brugge D and Hyde J. Lessons in exploring approaches to partnerships between communities and environmental health researchers. American Public Health Association Conference, Indianapolis, IN. November 1997.
2. Brugge D, T Benally, P Harrison, M Austin-Garrison, L Fasthorse-Begay. Oral histories provide insights into historical and contemporary exposures of Navajo Indians to byproducts of uranium mining. American Public Health Association Conference, Indianapolis, IN. November 1997
3. Brugge D, Benally T, Harrison P, Yazzie E, Austin-Garrison M, Fasthorse-Begay L. Use of oral histories to examine historical and contemporary exposures of Navajos to byproducts of uranium mining. International Society of Environmental Epidemiology/International Society of Exposure Assessment Joint Conference, Boston, MA. August 1998.

4. Brugge D, Leong A, Cheung FM. Traffic and development in Boston Chinatown: An analysis of police accident report data and a cross-sectional survey of residents. International Society of Environmental Epidemiology/ International Society of Exposure Assessment Joint Conference, Boston, MA. August 1998.
5. Brugge D, Leong A, Cheung FM. A community-based study of the impact of traffic and development on health and safety in Boston Chinatown. American Public Health Association Conference. Washington, DC, November 1998.
6. Hynes P, Brugge D, Mahoney D, Watts J, Lolly J, Lopez R. Public health in public housing: An evaluation and analysis of the indoor environment with community participation. American Public Health Association Conference. Washington, DC, November 1998.
7. Hynes P, Brugge D, Mahoney D, Watts J, Lolly J, Lopez R. Public health in public housing: An evaluation and analysis of the indoor environment with community participation. International Society of Environmental Epidemiology/ International Society of Exposure Assessment Joint Conference, Boston, MA. November 1998.
8. Brugge D, Vallarino J, George D, Spengler J. A pilot home asthma intervention for residents of public housing. American Public Health Association Conference. Chicago, IL, November 1999.
9. Brugge D, Leong A, Averbach A, Cheung FM. A cross-sectional survey of Boston Chinatown residents for environmental factors. American Public Health Association Conference. Chicago, IL, November 1999.
10. Brugge D, Benally T, Yazzie E. Navajo oral histories help set the basis for research agenda on uranium. American Public Health Association Conference. Chicago, IL, November 1999.
11. Brugge, D., Panel chair. Is there a trade off between access to housing and public health? American Public Health Association Conference. Boston, MA, November 2000.
12. Brugge D, Vallarino J, Ascolillo L, Osgood N, Stienbach S, Spengler J. Comparison of multiple environmental factors in one public housing development. American Public Health Association Conference. Atlanta, GA, October 2001.
13. Brugge D, Bagley J, Hyde J. Environmental management of asthma at top-ranked U.S. managed care organizations. American Public Health Association Conference. Philadelphia, PA, November 2002.
14. Hyde J, Brugge D, Repace J, Rand W, Bagley J, Tanaka T. Biological markers of exposure in Boston restaurant and bar workers prior to the May 5, 2003 smoking ban. 2003 National Conference on Tobacco or Health. Boston, MA, November 2003.
15. Brugge D, Lee T, Francis C, Fisher O. Asthma prevalence among inner-city Asian American schoolchildren. American Public Health Association Conference. San Francisco, CA November 2003.
16. Brugge D, Melly S, Finkelman A, Russell M, Bradeen L, Perez R, Henson L, Heeren T, Snell J, Helms D, Hynes, HP. A community-based participatory survey of public housing conditions and associations between renovations and possible building-related symptoms. 16th Conference of the International Society for Environmental Epidemiology, August 2004.
17. Brugge, panel chair. A community-city-university collaboration for healthy public housing. American Public Health Association Conference. Washington, DC, November 2004.

18. Brugge D, Panikkar B, Snell J, Melly SVinas B. Possible health benefits to energy savings in public housing. American Public Health Association Conference. Washington, DC, November 2004.
19. Brugge D, Becker J, Balbach, E. A project to increase participation of disadvantaged students in medicine and public health. Bureau of Health Professions First All-Grantee Conference. Washington, DC, June 2005.
20. Brugge D. Navajo Nation Human Research Review Board. Navajo Studies Conference: In the sacred manner we walk as Dine. Albuquerque, NM, November 2006.
21. Lee AC, Brugge D, Phan L, Woodin M. A comparison of knowledge about asthma between Asians and Non-Asians at two pediatric clinics in Boston Chinatown. American Public Health Association Conference. Boston, MA, November 2006.
22. Greenfield R, Brugge D, Lee AC, Tang R. Obesity epidemic in Chinese American youth? A literature review and cross-sectional study. American Public Health Association Conference. Boston, MA, November 2006.
23. Phan L, Brugge D, Fefferman N. Built environment and health-related crimes: A retrospective study in Boston Chinatown. American Public Health Association Conference. Boston, MA, November 2006.
24. Repace J, Hyde J, Brugge D. Secondhand tobacco smoke exposure and dose in Boston bars and bartenders. International Society for Environmental Epidemiology & Exposure. Paris, France, September 2006.
25. Brugge D, Rivera-Carrasco E, Zotter J. Community-based participatory research in Boston's neighborhoods: Asthma case examples. Society for Epidemiologic Research. Boston, MA, June, 2007.
26. Brugge D, Phan L, Fefferman N. The built environment and health-related street crime: A pilot study in Boston Chinatown. Leading the way, partners for change: 4th annual Asian American health conference, New York, NY, September, 2007.
27. Dhar A, Brugge, D. Feasibility of studying the effect of major construction on the health of residents in Boston Chinatown. Leading the way, partners for change: 4th annual Asian American health conference, New York, NY, September, 2007.
28. Brugge D, Henkin S, Bermudez O, Gao X. A case-control study of BMI and asthma in Asian immigrant children. American Public Health Association Conference. Washington, DC, November 2007.
29. deLemos JL, Menache M, Brugge D, Durant JL, Bostick B, Landis JD, George C, Rock T, Lewis JL. Geochemical controls on uranium mobility to inform human health exposure assessment in the Church Rock mining district: Navajo Nation, NM. American Public Health Association Conference. Washington, DC, November 2007.
30. deLemos, JL, Bostick, BC, Quicksall, AN, Landis, JD, George, CC, Slagowski, NL, Rock, T, Brugge, D, Lewis, JL, Durant, JL. The DiNEH Project: Geochemical controls on uranium transport in a waste-burdened mining district, Navajo Nation, NM. 234th National Meeting of the American Chemical Society, Boston, MA, 2007.
31. Ash C, Durant J, Brugge D, Zamore W, Wood E, Herndon S, Jayne J, Kolb C, Knighton WB. Spatial and Temporal Variation of Near-Highway Air Pollution Gradients. World Environmental and Water Resources Conference 2008, Honolulu, HI, May 2008.
32. Brugge D, Lane K, Chin M, Palella M. Development of an asthma education program for Chinese immigrant children. International Society for Environmental Epidemiology & Exposure. Pasadena, California, October 13, 2008.

33. Rioux CL, Kurian J, Parmenter B, Gute DM, Brugge D. Comparison of four methods for characterizing traffic-related air pollution (TRAP) exposures in Boston's inner core. International Society for Environmental Epidemiology & Exposure. Pasadena, California, October 14, 2008.
34. Ash C, Durant J, Brugge D, Zamore W, Wood E, Herndon S, Jayne J, Kolb C, Knighton W. Spatial and temporal distribution of vehicle exhaust emission gradients near highways in Somerville, Massachusetts. International Society for Environmental Epidemiology & Exposure. Pasadena, California, October 13, 2008.
35. Brugge D, Henkin S, Tucker K, Gao N, Gao X. Risk factors for respiratory disease in Puerto Rican adults. International Society for Environmental Epidemiology & Exposure. Pasadena, California, October 14, 2008.
36. Yee BE, Ahmed, IM, Idupuganti, R, Brugge D, Schumann, R. Second-Hand Smoking in Children: How Extensive Is It? American Society of Anesthesiologists, Orlando, FL, October 20, 2008.
37. Brugge D, Woodin M, Tin A, Moy S, Palella M. Effect modification of asthma by SES in US and foreign born children. International Society for Environmental Epidemiology & Exposure. Dublin, Ireland, August 27, 2009.
38. Brugge D, Reisner E, Carrasco E, Hemphill C, Arond D, Lowe L, Kuang B, Mwamburi M, Laws B, Zamore W, Durant J. Community assessment of freeway exposure and health: Approach and methods. International Society for Environmental Epidemiology & Exposure. Dublin, Ireland, August 27, 2009.
39. Brugge D, Siu J, Woodin M, Hui C, Moy S, Schiff D, Nui D, Palella M. An assessment of the effect of highway proximity to homes and schools on pediatric asthma and lung function. International Society for Environmental Epidemiology & Exposure. Dublin, Ireland, August 27, 2009.
40. Martinez LS, Russell B, Brugge D. Tufts Community Research Center (TCRC): Facilitating the development of partnerships that transform research. Community Campus Partnerships for Health, Portland Oregon, May, 2010.
41. Fuller CH, Mwamburi M, Zamore W, Durant J, Spengler J, Brugge D. Exposure to highway-related ultrafine particles and cardiovascular markers. Urban Environmental Pollution, Boston, MA, June 21, 2010.
42. St. Vincent, A.P., Trull, J., Zamore, W., Brugge, D., and J.L. Durant. Modeling spatial and temporal variation in the distribution of highway-generated air pollution in a residential urban neighborhood. Urban Environmental Pollution, Boston, MA, June 22, 2010.
43. Rioux, CL, Gute DM, Brugge D, Peterson S, Parmenter B. *Transportation Planning Tools for Public Health Scientists*. Oral presentation at Urban Environmental Pollution Conference. Boston, MA. June 2010.
44. Fuller CH, Zamore W, Durant J, Spengler J, Brugge D. Exposure to highway-related ultrafine particles and cardiovascular markers: The CAFEH Project. International Society for Exposure Science - International Society for Environmental Epidemiology & Exposure. Seoul, Korea, August-September 2010.
45. St. Vincent A, Trull J, Zamore W, Brugge D, Durant JL. Modeling the Distribution of Highway-Generated Air Pollution in a Residential Urban Neighborhood. International Society for Exposure Science - International Society for Environmental Epidemiology & Exposure. Seoul, Korea, August-September 2010.
46. Zamore W, Nesson B, Nicklas J, Provost D, Lipson S, Sittenfeld D, Rioux C, Brugge

- D, Reisner E. Bringing the science of near source mobile pollution and the risk of neighborhood health impacts to the attention of citizens and policy leaders. International Society for Exposure Science - International Society for Environmental Epidemiology & Exposure. Seoul, Korea, August-September 2010.
47. St. Vincent A, Milando C, Zhu S, Zamore W, Brugge D, Durant J. Evaluation of the Quick Urban and Industrial Complex (QUIC) Modeling System to Predict Ultrafine Particle Levels in an Urban Neighborhood near a Highway. American Geophysical Union Fall Meeting, San Francisco, CA, December 15, 2010.
 48. Fuller CH, Zamore W, Manis M, Durant J, Brugge D, Spengler J. Indoor-outdoor differences in ultrafine particles in homes near a highway. Indoor Air 2011, June 5-10, 2011, Austin, TX.
 49. Padró-Martínez, L. T., Owusu, E., Reisner, E., Zamore, W., Brugge, D. and Durant, J. L.: A Study of the Cardiovascular Health Benefits of Reducing Ultrafine Particle Exposures in Homes Near Highways by Indoor Air Filtration: Study Design and Methods. International Society of Exposure Science, Baltimore, MD, October 2011.
 50. Lane KJ, Scammell MK, Levy JI, Marden A, Parambi RJ, Fuller CH, Brugge D. Micro-Environment Time-Activity Ascertainment for Near Highway Air Pollution Study: Evaluation and Validation Using GPS. International Society of Exposure Science, Baltimore, MD, October 2011.
 51. Fuller C.H., Durant J.L., Williams P., Brugge D., Spengler J.D. Indoor-Outdoor Differences in Ultrafine Particles in Homes Near a Highway, International Society of Exposure Science, Baltimore, MD, October 2011.
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Health effects of uranium: new research findings

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Abstract

Recent plans for a nuclear renaissance in both established and emerging economies have prompted increased interest in uranium mining. With the potential for more uranium mining worldwide and a growth in the literature on the toxicology and epidemiology of uranium and uranium mining, we found it timely to review the current state of knowledge. Here, we present a review of the health effects of uranium mining, with an emphasis on newer findings (2005–2011). Uranium mining can contaminate air, water, and soil. The chemical toxicity of the metal constitutes the primary environmental health hazard, with the radioactivity of uranium a secondary concern. The update of the toxicologic evidence on uranium adds to the established findings regarding nephrotoxicity, genotoxicity, and developmental defects. Additional novel toxicologic findings, including some at the molecular level, are now emerging that raise the biological plausibility of adverse effects on the brain, on reproduction, including estrogenic effects, on gene expression, and on uranium metabolism. Historically, most epidemiology on uranium mining has focused on mine workers and radon exposure. Although that situation is still overwhelmingly true, a smaller emerging literature has begun to form around environmental exposure in residential areas near uranium mining and processing facilities. We present and critique such studies. Clearly, more epidemiologic research is needed to contribute to causal inference. As much damage is irreversible, and possibly cumulative, present efforts must be vigorous to limit environmental uranium contamination and exposure.

Keywords: environment; epidemiology; exposure; human health; toxicity; uranium.

Uranium mining

The mining of uranium has long been controversial, and a renewed debate has emerged as the demand for mining has

increased. Nuclear power companies in the USA are pushing to expand nuclear capacity for the first time in the more than 30 years since the Three Mile Island nuclear reactor disaster in 1979. As of early 2011, the US Nuclear Regulatory Commission had received active applications for 28 new reactors (1) and were expecting applications for new uranium mining projects at 25 sites by 2013 (2). Kazakhstan, Canada, and Australia account for about two thirds of the world's production of uranium from mines. After a decade of falling mine production, since 1993, the output of uranium has generally risen and now meets about three quarters of the demand for nuclear power generation (3). Additionally, highly enriched uranium obtained from the decommissioning of nuclear weapons can also be recycled as nuclear fuel. After the recovery of uranium prices since about 2003, much activity has been reported in preparing to open new mines in many countries, including Canada, USA, Russia, France, UK, Argentina, Kazakhstan, Mongolia, and Namibia. China and India, two possible major actors in the future of nuclear power (4), may be importing uranium from these countries. The World Nuclear Association reference scenario projects world uranium demand as about 77,000 tons of uranium in 2015, most of which will come directly from mines (5). However, the recent crisis in Japan at the Fukushima Nuclear Power Plant may be dampening enthusiasm for a large expansion of nuclear power.

Uranium is a radioactive metal element that occurs naturally in low concentrations (a few parts per million) in soil, rock, surface water, and groundwater. Uranium is the heaviest naturally occurring element, with an atomic number of 92. Uranium in its pure form is a silver-colored heavy metal that is nearly twice as dense as lead. In nature, uranium exists as several isotopes, primarily U-238 (99.274%), U-235 (0.72%), and a very small amount of U-234 (0.0057%) by weight. U-234 represents a very small fraction of the total weight but is responsible for up to half of the radioactivity in refined natural uranium. U-235 is the isotope that is required for the production of nuclear power and weapons because it can sustain a fission chain reaction, which the others cannot. Enriched uranium (EU) is obtained from natural uranium by removing some of the U-238 to increase the percentage of U-235. Depleted uranium (DU), predominantly U-238, remains as a by-product of the enrichment process. The radioactively mediated health effects between natural and depleted uranium are expected to be different, but the chemically mediated effects would depend not on the isotope ratio, but rather on the chemical form of the uranium.

Uranium itself has a very low level of radioactivity. The three types of atomic radiation of concern to human health and safety in regard to uranium mining and nuclear power generation are α , β , and γ radiation. All are capable of displacing

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electrons from atoms and molecules and are referred to as ionizing radiation. Uranium decays very slowly by emitting an α particle, along with some γ radiation. α Particles, composed of two protons and two neutrons, are the most biologically destructive of the three, up to 20 times more damaging to intracellular structures than γ -rays. α Particles do not normally penetrate skin, but when ingested or inhaled, and positioned within living tissue, they discharge their α particles directly into the structures of the cell, damaging the cell's contents, including mitochondria, enzymes, and DNA. The second leading cause of lung cancer, after smoking, is radon, an α emitter. The Biological Effects of Ionizing Radiation (BEIR) VII report (6) reflects the scientific consensus that there is no safe level of exposure to radiation, namely, that the risk of cancer decreases with decreasing dose with no known threshold.

The half-life of U-238 is 4.5 billion years, meaning that each atom of uranium decays very infrequently, resulting in a low specific activity. Uranium minerals, however, are always associated with other radioactive elements like radium and thorium in the ore that arises from the radioactive decay of uranium (7) (see Figure 1, decay products). Uranium is also toxic chemically, similar to nickel and chromium. Therefore, uranium's radioactivity is a secondary concern, and its chemical toxicity constitutes the primary environmental health hazard.

Uranium mining and processing

Historically, most of the uranium mines and mills in the USA were located in the Colorado Plateau region of the southwestern USA (9). Many of these mines were operated on Native American land. Most US mills have been remediated under the Uranium Mill Tailings Radiation Control Act of 1978 (Pub. L. 95-604, Nov. 8, 1978, 92 Stat. 3021, Title 42, Sec. 7901 et seq.). Nevertheless, mines in the USA have just begun to be addressed. Active mining and processing of uranium continues outside of the USA, with many uranium mines active or in development in all corners of the globe (10).

Uranium has been extracted from underground, open-pit, and in situ leach mining. In the course of mining, the ore is hauled away from mine sites and the waste rock and soil, called tailings, are left behind, often in large piles. The tailings have too little uranium to be processed but are still radioactive and may contain non-radioactive toxic heavy metals. The ore is transported to mills for processing into a more concentrated form of uranium known as yellowcake, which is mostly triuranium octaoxide. The next step in the nuclear fuel process is to produce "enriched" uranium, which has a U-235 concentration >20%. Enrichment requires the conversion of yellowcake to uranium hexafluoride (UF_6), which is a gas that can be processed into EU and DU.

	Uranium-238 series, includes ^{234}U series						Uranium-235 series				
Np											
U	^{238}U 4.5E9		^{234}U 2.5E5 y				^{235}U 7.1E8 y				
Pa		^{234}Pa 1.2 m						^{231}Pa 3.3E4 y			
Th	^{234}Th 24 d		^{230}Th 8E4 y				^{231}Th 25.5 h		^{227}Th 18.7 d		
Ac								^{227}Ac 21.8 y			
Ra			^{226}Ra 1600 y						^{223}Ra 11.4 d		
Fr								^{223}Fr 21.8 m			
Rn			^{222}Rn 3.82 d						^{219}Rn 4.0 s		
At				^{218}At 2 s						^{215}At 1E-4 s	
Po			^{218}Po 3.05 m		^{214}Po 1.6E-4 s		^{210}Po 138 d		^{215}Po 1.8E-5		^{211}Po 0.5 s
Bi				^{214}Bi 19.7 m						^{211}Bi 2.15 m	
Pb			^{214}Pb 26.8 m		^{210}Pb 22.3 y		^{206}Pb stable		^{211}Pb 36.1 m		^{207}Pb stable
Tl				^{210}Tl 1.3 m		^{206}Tl 4.2 m				^{207}Tl 4.79 m	

• α decay; • β decay; half-life (d=days; m=minutes; s=seconds; y=years)

Figure 1 Uranium decay series. Reprinted from Agency for Toxic Substances and Disease Registry, 2011 (8).

A by-product of the conversion to UF_6 is an acidic waste referred to as raffinate. The raffinate stream contains trace amounts of toxic heavy metals as well as uranium, radium, and thorium and their decay products. When not disposed of properly, this waste can leach into the groundwater from settling ponds or runoff to contaminate soils and surface water. The environmental health hazards and impacts to workers and the general public must be considered at all stages of the nuclear cycle as contaminants may include uranium, radon gas, radium, thorium, other radionuclides, and non-radioactive contamination from dust and heavy metals like arsenic, lead, and nickel. This review will focus on uranium and only briefly touch on the other contaminants in uranium ore, although uranium mining and processing workers and nearby residents are exposed to a mixture of contaminants.

The regulation of exposure to uranium remains a source of contention. For example, the US Environmental Protection Agency (EPA) has set the level of uranium allowed in drinking water at 30 $\mu\text{g/L}$ based in part on economic feasibility. In contrast, the World Health Organization has set a limit in water of 2 $\mu\text{g/L}$ based on the lowest observed adverse effect level (LOAEL) without regard to economic consequences. Another regulation of concern is the US Department of Energy level for uranium in urine of 1.5 $\mu\text{g/L}$. Given that the main health concerns of uranium derive from its chemical properties, this limit may not be adequate because it is based only on radiation effects. Other uranium regulations are listed in our earlier article (9).

Contamination of areas around uranium mines

The effects of uranium extraction and processing do not stop with the consequences for miners and mill workers. Uranium can be transferred in the food chain from soil to plants and animals, including humans. The concentration of uranium is still high, compared with the natural background, in the farmed land of the floodplains of the Rivers Zwickauer Mulde and Vereinigte Mulde in Germany, which drain former uranium mining and milling areas in Saxony (11, 12). A study in Germany in 2009 compared control plants with wild and cultivated plants from the immediate vicinity of uranium waste dumps and found that they stored up to 8-fold higher uranium concentrations (13).

Uranium releases, like the massive spill of uranium tailings at Church Rock, NM, USA, in 1979 and the deadly release of uranium hexafluoride from the Sequoyah Fuels plant in Gore, OK, USA, are not widely known but are comparable in impact with the widely recognized release at Three Mile Island (14). In the USA, dozens of uranium mill sites had to be "decommissioned" at considerable cost to the taxpayers. The US EPA has said that removing the contamination stemming from hard-rock mining could be among the greatest costs to the Superfund Program for cleaning up toxic sites. Groundwater and surface water in the vicinity of uranium-mining operations frequently become contaminated. Naturally occurring toxic chemicals that have been documented in groundwater include arsenic, manganese, radon, and uranium (8, 15). These materials are present in especially high concentrations

in mining districts and occur widely in certain geologic formations (15, 16). Nevertheless, uranium is not among the chemicals commonly tested in private wells.

The Navajo Nation is the largest Native American reservation in the USA, covering 27,000 square miles in Arizona, Utah, and New Mexico, and abandoned uranium mines remain a significant problem there. Hundreds of miners in the Navajo Nation died and experienced illness and other as yet undetermined harm from these abandoned mines, which expose residents to uranium and other ore contaminants through airborne dust and contaminated drinking water. Many homes were built with mine wastes, which are radioactive (17). Families living in homes built with uranium tailings were exposed to high levels of radon. Today, the Navajo Nation has banned uranium mining on lands that it controls. Some lands, however, are in dispute as to Navajo Nation control, and activists are concerned that proposed in situ leach mining on these lands could contaminate the source of drinking water for Navajo community members (18).

In 2010, testing of the mine dumps around Krugersdorp, a mining town in the West Rand of the Gauteng province of South Africa, revealed that radiation levels were 15 times higher than background levels. Uranium was extracted there in 1952 as a by-product of the gold-refining process. Radiation levels at the Tudor Shaft Informal Settlement in Krugersdorp reached such levels that, in February 2011, the community members were urgently relocated. The high radiation levels did not include exposure to radon, to inhalation, or to ingestion but rather represent only external dose (19).

Uranium mining companies in Australia are continuing to deplete and pollute water resources according to Green (20). In situ leach uranium mining is used at the Beverley uranium mine and is also the mining method proposed for use at other South Australian mines, including Oban, Beverley Four Mile, and Honeymoon.

A study in Portugal measured ambient radiation doses and determined radionuclide concentrations in mining waste and soils in 60 areas of former radium and uranium mining. In several places, mining waste and low-grade uranium ore left on the surface contain radioactivity above regional background. Nevertheless, most of the former mining sites present only low radionuclide concentrations. In the mining facilities where radioactive ore was chemically extracted, however, mill tailings contained elevated levels of radioactivity, up to 200 times the levels in unaffected soils of the region. Mud from neutralization ponds used to treat acid mine waters also contains elevated radionuclide concentrations (21).

Past uranium mining in the area of Cunha Baixa village, near Mangualde (Portugal), led to the contamination of sub-surface waters used for irrigation in the agricultural area of this village. One parcel of land was irrigated with water containing a high uranium concentration (13.7 Bq/L) and another was irrigated with water containing a low uranium concentration (0.3 Bq/L). Agricultural procedures were controlled, and radionuclide concentrations in soil and irrigation water were measured. The results show a significant uptake of radium, reaching 12.9 ± 1.2 Bq/kg dry weight, and a minor uptake of other radionuclides by potatoes. Radium transfer to potatoes was enhanced in the parcel of land irrigated with

water containing high radium concentrations, but radionuclide concentrations in irrigation water had a minor effect on the transfer of uranium, thorium, and polonium to potatoes. Radionuclides were largely accumulated in tubers' peel and, in general, peeling removed most of the radioactivity. As radium in irrigation water was found to be accumulated in potatoes, the radionuclide could be transferred to humans through the food chain (22).

Mihalík et al. (23) studied the impact of an abandoned uranium mining area on the contamination of agricultural land in its immediate surroundings, focusing on the influence of uranium tailing piles. The monitoring was carried out on arable land near Příbram in Central Bohemia, Czech Republic, which is located 600 m northeast of the bottom of the piles. The high uranium content in the topsoil ranged from 40 to 220 ppm. A former portion of it was found in an exchangeable fraction (49%). Both findings made this land unsuitable for agricultural use. The sequential extraction revealed a shift in the uranium content among sample spots situated in and outside the path of the predominant wind direction. In the first group, uranium bound mainly to iron/manganese oxides, whereas in the other samples, uranium accumulated in the more mobilizable fractions.

In the USA, deLemos et al. (24, 25) studied environmental uranium contamination in a former mining and milling area in the Eastern Agency of the Navajo Nation in New Mexico. Despite decades of inactivity in the mines and mills, environmental contamination was widespread, often in proximity to homes, areas grazed by livestock, and locations frequented by children and families. The uranium contamination in this area was predominantly in the highly soluble chemical forms that could be spread when disturbed or by the bursts of precipitation that occur in this semiarid region at certain times of the year.

Mathews et al. (26) conducted a probabilistic assessment of the chemical and radiologic risks of chronic exposure to uranium in freshwater ecosystems. The results indicate that the percentage of species radiologically protected by the chemical benchmark decreases with increasing degrees of uranium enrichment and with increasing periods of radioactive decay. In contrast, the freshwater ecosystem is almost never chemically protected by the radiologic benchmark, regardless of the source term or decay period considered, consistent with the risks to the environment from the chemical toxicity of uranium generally outweighing its radiologic toxicity.

Radium

As part of the uranium decay series, radium is present in uranium mine tailings. During the milling of uranium ore into yellowcake, much, but not all, of the radium is left behind. Most radium exposures today are from wastes left over from mining and processing uranium ore or from naturally occurring radium in groundwater or soil. Radium has a much higher specific activity than uranium, releasing more radiation per atom.

Radon

Radon gas, one of the decay products of uranium, has been extremely well studied in uranium miners and determined to be an exquisitely toxic carcinogen. An increased risk of lung cancer at high concentration of residential radon has been found for both smokers and non-smokers (27). Here, we briefly relate some of the findings for radon in the context of uranium mining. Radon gas is continuously produced by the decay of thorium 230, a radioactive decay product of U-238, through radium. Thorium 230 has a half-life of 76,000 years and will produce radon gas unabated for millennia. In undisturbed uranium deposits, most of the radon gas is trapped within rock formations until it decays into other radioactive by-products, but crushed tailings on or near the earth's surface allow considerable amounts of radon to escape. Radon can enter homes in a number of ways and accumulate to high concentrations (27–29). Homes built with uranium tailings, a surprisingly common problem in mining areas, will have high levels of radon because the tailings release much larger amounts of radon gas than the undisturbed ore.

Radon and radon progeny present in underground mines, in houses, and in other enclosed areas represent the most important contribution to doses from natural sources of radiation. A study by Sainz et al. (30) revealed that residential radon concentrations are higher in homes that are close to uranium mines. A comparative analysis was conducted of residential radon exposure data in two radon-prone areas, Ștei, Transylvania, Romania, which is near old Romanian uranium mines, and in the granitic area of Torrelodones town, Sierra de Guadarrama, Spain. Measurements of indoor radon were performed in 280 dwellings in Romania and 91 dwellings in Spain using Columbia Resin 39 (CR 39), a thermoset plastic that is an excellent recorder of nuclear α particle tracks. The highest value measured was 2650 Bq/m³ in Ștei area and 366 Bq/m³ in the Spanish region. The high value in Ștei had been previously shown to be related to houses built using uranium waste as a construction material (31). In another study, lung cancer cases in Ștei were compared with other communities in the Transylvania area. Measurements were performed using CR-39 track detectors exposed for a minimum of 3 months. The linear risk model of Darby was used to simulate the dose-effect relationship and relative lung cancer risk at low doses of α particles specific to residential radon exposures. The predicted relative risks at the measured exposure levels, together with information on the total number of reported lung cancer deaths and the number of people living in these regions, was used to estimate the fraction of lung cancer cases in each area that was attributable to radon. The percentages (16.67% for Ștei area, 9.09% for Cluj, 5.66% for Bistrita-Nasaud, 4.76% for Sibiu, and 12.28% for Alba county) among lifetime non-smokers, mirrored the variations in average annual radon concentrations in these areas (232, 114, 71, 62, and 161 Bq/m for Ștei area, Cluj, Bistrita-Nasaud, Sibiu, and Alba, respectively) (32).

Digging uranium-bearing ore inevitably releases large quantities of radioactive radon gas into the mine atmosphere. Radon has a relatively short half-life (3.8 days), long enough

to seep out of ore and into the air. Because of dilution, the distance from radon sources that gives an appreciable health risk remains unclear. When it reaches the surface of the soil, radon disperses and is diluted to low levels in the outdoor environment, but when moving upward through the soil beneath a home, the gas can enter through cracks or other openings in the foundation and accumulate to high levels. Because radon travels through ground faults, cracks in the earth, and in underground rivers and streams, one house could have dangerously high radon levels and neighboring houses less. Moreover, levels can change from one month to the next.

Established health concerns

Serious concerns surrounding the proposal for new uranium mining include the health impacts on local communities, radioactive waste management, and transport of uranium ore through communities. Uranium mine workers are exposed to radiation and chemical toxicity from the ore itself, as well as from the inhalation of radon gas. In the USA, eight illnesses are federally recognized among miners, mill workers, and uranium transport workers and qualify for compensation (33). Congress passed the Radiation Exposure Compensation Act, 42 USC, § 2210 note (2006), on October 5, 1990, which covers all states where uranium was mined and processed. The act offers an apology and monetary compensation to individuals who contracted certain cancers and other serious diseases following their occupational exposure to radiation while employed in the uranium industry during the buildup to the Cold War.

As of May 5, 2011, 7150 uranium miners, millers, and ore transporters had been compensated a total of over \$713 million from the US government for health problems, including lung cancer and silicosis (34). Of claims filed, 62%–77% have been approved. Although this assessment of harm to uranium workers is not entirely scientific, the screening is partially based on scientific evidence. Thus, the successful claims provide an estimate, probably an underestimate, of the toll that has been taken by uranium mining in the USA. Widespread health impacts from the last uranium boom still plague communities around the western USA, and those who were injured are still fighting for recognition (35). Although some claim that under new regulations and approaches, uranium can be mined and milled without hurting residents and the environment, the historical record is not encouraging.

An increasing proportion of uranium is produced by in situ leach mining, which solubilizes uranium in the process of extracting it from aquifers. In northern Colorado, the Canadian Powertech Uranium Corporation is proposing an in situ leach uranium mine in the plains northeast of Fort Collins. Landowners around the mine site between the towns of Wellington and Nunn worry that the leaching process will contaminate groundwater that feeds domestic water wells. The Colorado Mined Land Reclamation Board approved new rules intended to protect Colorado's groundwater during in situ uranium mining, which extracts the mineral by injecting a solution underground (36). The new rules require establishing

the level of groundwater purity before prospecting for uranium begins and then establishing a similar baseline for water quality before mining begins. Powertech said the new regulations are arbitrary and capricious and will be a "fatal" blow to uranium mining in northern Colorado and sued to stop the state from implementing water quality regulations for in situ uranium mines (37). The Colorado Mining Association issued a statement that they "share the concern" of their member Powertech over some provisions of the new regulations. Previously, Cotter Corporation, a subsidiary of San Diego-based General Atomics, had sued the Colorado Mined Lands Reclamation Board over cleanup orders at Cotter's Schwartzwald Mine, which drains into Ralston Creek near Golden upstream from a water reservoir that supplies drinking water to 1.3 million metro Denver-area residents. Cotter accused the board of abusing its discretion when it ordered them to pump out and treat uranium-tainted water from a mine shaft that inspections had shown to be rising toward the rim of the defunct mine (38). In contrast, in response to pressure from Powertech, South Dakota recently suspended state regulation of an operation near the Black Hills that will conduct in situ leach uranium mining. Opponents of the easing contended that the in situ technique could result in groundwater contamination and wanted the extra oversight that state regulation would provide (39).

Uranium distribution in the body

After ingestion, most uranium is excreted within a few days and never enters the bloodstream. The small fraction (0.2%–5%) that is absorbed into the bloodstream is deposited preferentially in bone (about 22%) and kidneys (about 12%), with the rest being distributed throughout the body (12%) and excreted. Most of the uranium entering the kidneys leaves within a few days (in urine), whereas that deposited in bone can remain for many years. After inhalation, generally, only a small fraction penetrates to the lung's alveolar region, where it can remain for years and has the ability to, depending on solubility, enter the bloodstream (40).

For an urban Indian (Bombay) population living in a normal background environment, the total organ burdens were reported as follows: skeleton>muscle>soft tissue >lungs>kidney>liver>heart (41). Sections of lymphatic and lung tissues taken from deceased former nuclear workers with a known history of occupational exposure to specific actinide elements (uranium, plutonium, or americium) were analyzed by laser ablation inductively coupled plasma mass spectrometry. Images were made of thorium (^{232}Th), uranium (^{235}U and ^{238}U), and plutonium (^{239}Pu and ^{240}Pu) mass distributions in sections of tissue. In lung samples of workers not exposed to uranium, ^{238}U concentrations ranged up to 170 ng/g. Localized mass concentrations of ^{238}U in lymph node tissue from a person not occupationally exposed to this element (chronic natural background inhalation exposure) ranged up to 375 ng/g. In a person occupationally exposed to air-oxidized uranium metal, the maximum ^{238}U isotopic mass concentration in a lymph node, measured at higher resolu-

tion (with a 30- μ m laser spot diameter), was 8500 ng/g. The isotope ratio signifies natural uranium (42).

Established uranium toxicity

The established health effects associated with chemical and radiologic toxicity of natural uranium have been extensively reviewed by Brugge et al. (9). Briefly, the primary reported health outcomes documented up to 2004 with respect to uranium were renal, developmental, reproductive, diminished bone growth, and DNA damage, as derived from experimental animal studies and human epidemiology. Uranium is known to be hazardous to humans in at least two ways. As with other heavy metals like chromium and nickel, uranium is chemically toxic to kidneys and other organs. Also, because all uranium isotopes are radioactive, they emit radiation – a known carcinogenic agent. Uranium's chemical toxic effects generally occur at lower uranium concentrations than its radiation effects because of uranium's low specific activity (43). Uranium was first observed to be a nephrotoxin, and its toxicity to kidneys has long been recognized. Other aspects of uranium's toxicity have emerged more recently, including genotoxic and reproductive effects. A list of reported conditions associated with uranium exposure can be found in the works of Abu-Qare and Abou-Donia (44) and Craft et al. (45).

Nephrotoxic effects

In animal studies, uranium is well proven to be toxic to the kidneys, mainly causing damage to the proximal tubular epithelium (45), presumably due to heavy metal toxicity. Kidney damage in animals has been extensively reviewed by the Agency for Toxic Substances and Disease Registry (8). We will review more recent studies in detail below.

Bone

Uranium is incorporated into the bone matrix by displacing calcium to form complexes with phosphate groups (46). Uranium accumulates in bone, affects bone metabolism in laboratory animals, and, when ingested in drinking water, increases the urinary excretion of calcium and phosphate, important components in the bone structure (47). Radium released from uranium tailings, which also deposits in bone and has a much higher specific activity than uranium, is an established bone carcinogen.

Genotoxic effects (in vitro)

The source of the genotoxicity of uranium may be both its chemical and its radiologic properties. Both depleted and natural uranium are expected to have similar chemical toxicity, which is expected to depend on the chemical form of the uranium compound. The DNA damage is repairable by cells, but α particles are more likely than other forms of radiation to cause double-stranded DNA breaks that are not readily repaired. Attempts at repair can lead to deletions, inversions, acentric fragments, and cross-linking, as repair enzymes try to work

with missing and scrambled pieces. Damaged DNA is associated with many diseases in humans, like cancer and inheritable disease (6-BEIR VII), as well as teratogenic effects, including mental retardation and birth defects (48, 49).

Lin et al. (50) investigated the effects of uranyl nitrate on micronuclei formation, chromosome aberrations, and sister chromatid exchanges in Chinese hamster ovary (CHO) cells. Uranyl nitrate at concentrations ranging from 0.01 to 0.3 mM increased the frequencies of micronuclei, sister chromatid exchanges, and chromosome aberrations. The authors concluded that uranyl nitrate can cause genotoxicity and cytotoxicity in CHO cells. Hao et al. (51) evaluated the potential genotoxicity of DU in rats induced by chronic oral exposure (in food at doses of 0, 4, or 40 mg/kg/day for 4 months) and evaluated by sperm abnormality assessment, the bone marrow micronucleus test, and the comet assay. The animals were subsequently mated, resulting in the birth of F1 rats. The uranium content in F1 rats was significantly higher than that in F0 rats in both the kidney and ovary ($p < 0.05$). The authors concluded that the results provide evidence that DU can accumulate from generation to generation. The sperm abnormality rate, marrow cell micronuclei rate, comet tail length, and tailed cell percentage increased in each treatment group in each generation compared with the control group ($p < 0.05$). In India, Prabhavathi et al. (52) demonstrated chromosomal aberrations in the leukocytes of men occupationally exposed to uranyl compounds. Workers were occupationally exposed to such uranyl compounds as uranium dioxide, uranium trioxide, uranyl fluoride, and uranyl nitrate. The results indicated a significant increase in the incidence of chromosomal aberrations, attributed to a cumulative effect of the chemical toxicity and radiotoxicity of uranyl compounds.

The exposure of human cells in vitro to DU results in the following genotoxic effects [reviewed by Fairlie (53)]: genomic instability (54), transformation to a tumorigenic state (55), mutations (56), DNA oxidative damage (57), activation of gene expression pathways (58), DNA-U adducts (59), induction of dicentric chromosomes, a radiation-specific change in human cells (50), and chromosomal damage (60).

Using an in vitro cellular model to study DU exposure, Miller et al. (55) reported the ability of DU-uranyl chloride to transform immortalized human osteoblast cells to the tumorigenic phenotype. DU exposure in vitro to immortalized human osteoblast cells was neoplastically transforming, mutagenic, genotoxic, and induced genomic instability, with instability manifested as delayed reproductive death and micronuclei formation. The implication from these in vitro results is that the risk of cancer induction from internalized DU exposure may be comparable with other biologically reactive and carcinogenic heavy-metal compounds like nickel.

Developmental defects

When given orally or subcutaneously to mice, uranium is a developmental toxicant. Decreased fertility, embryo/fetal toxicity, including teratogenicity, and reduced growth of the

offspring have been observed following uranium exposure at different gestation periods (61).

Paternain et al. (62) observed embryo lethality in mice receiving uranyl acetate dihydrate (25 mg/kg/day). Significant increases in the number of dead young per litter were seen at birth and at day 4 of lactation in the 25-mg/kg/day group. The growth of the offspring was significantly lower for the uranium-treated animals. No adverse effects on fertility were evident at the doses used in this study. Llobet et al. (63) evaluated the reproductive and developmental toxicity of uranium in male Swiss mice treated with doses of uranyl acetate dihydrate ranging from 0 to 80 mg/kg/day for 64 days. Mating male mice with untreated females to assess male fertility demonstrated a decreased pregnancy rate that was not dose-dependent. No adverse effect on spermatogenesis or testicular function was noted in male mice.

Established human health effects

Besides uranium, the associated radioactive decay products and heavy metals found in uranium ore are also of substantial human health concern:

- radon, a cause of lung cancer;
- radium, a cause of bone cancer, cancer of the nasal sinuses and mastoid air cells, and leukemia;
- arsenic, a cause of lung and skin cancer, as well as neurotoxicity, hyperpigmentation, and hyperkeratosis of the skin.

In addition, thorium is a radioactive decay product that is present in uranium ore and has a relatively high specific activity. However, the direct evidence for thorium's toxicity rests heavily on its use as a colloidal suspension administered to human patients, which is unlikely to mirror the entry into and transport through the body or any resulting health effects.

Uranium in drinking water

A study in Germany investigated the association between the internal exposure of children and young adults to uranium and epidemiologically relevant external determinants of exposure (64). Data were obtained from the German Environmental Survey for Children (GerES IV) conducted by the Federal Environment Agency (Umweltbundesamt), with data on 1780 children 3–14 years old and their home environment, and the German Environmental Specimen Bank (ESB, section: human specimens), with data on 2253 students 20–29 years old. Bivariate correlation analysis and two decision tree models showed moderate but significant associations between uranium in human urine and uranium levels in drinking water, in stream sediments, and in upper and lower soils.

Mao et al. (65) investigated the association between drinking water concentration levels of uranium and silicon in humans and microalbuminuria, a sensitive biologic indicator of renal dysfunction. Linear regression analysis revealed a statistically significant association between the uranium cumulative exposure index and albumin per millimole of creatinine ($p=0.03$). No significant relationship appeared

for silicon, although a positive trend was seen. Increasing levels of microalbuminuria were observed at uranium concentration levels below the Canadian Maximum Allowable Concentration.

Zamora et al. (66) conducted a study of the chemical effects on the human kidney induced by the chronic ingestion of uranium in drinking water. Urinary glucose was significantly different and positively correlated with uranium intake for males, females, and pooled data. Increases in alkaline phosphatase, a marker for cell toxicity, and β_2 -microglobulin, an indicator of kidney function, were also correlated with uranium intake for pooled data. In contrast, the indicators for glomerular injury, creatinine and protein, were not significantly different between the two groups nor was their urinary excretion correlated to uranium intake. The results suggest that at the intakes observed in this study (0.004–9 $\mu\text{g}/\text{kg}$ body weight), the chronic ingestion of uranium in drinking water affects kidney function and that the proximal tubule, rather than the glomerulus, is the site for this interference.

Ingestion of water from drilled wells is a source of high uranium exposure in some populations. Seldén et al. (67) found that, in a population in Sweden, urine uranium levels were strongly correlated to levels in drinking water from drilled wells in uranium-rich bedrock. Using uranium in urine from the entire study group as a marker of exposure and controlling for age, sex, and smoking, the researchers found statistically significant increases in β_2 -microglobulin, protein HC, and immunoglobulin kappa light chains. Such associations were not apparent in dichotomized analysis or for association with uranium in water, but continuous measures of uranium in urine should be the best metric of exposure of those available. Increased urine excretion of protein HC portends poor renal outcome, and light-chain proteinuria has been described in renal tubular dysfunction (68), as well as β_2 -microglobulin as a marker for renal tubular toxicity (69).

Kurttio et al. (70) measured uranium concentrations in drinking water and urine in 325 persons who had used drilled wells for drinking water. The median daily uranium intake was 39 μg (range 7–224 μg). The uranium concentration in urine was statistically significantly associated with increased fractional excretion of calcium and phosphate. The uranium concentrations in drinking water and daily intake of uranium were statistically significantly associated with calcium fractional excretion but not with phosphate or glucose excretion. Uranium exposure was not associated with creatinine clearance or urinary albumin, both of which reflect glomerular function. Thus, uranium exposure was weakly associated with altered proximal tubule function without a clear threshold, suggesting that even low uranium concentrations in drinking water can cause nephrotoxic effects. The same group (71) found that uranium exposure was associated with greater diastolic and systolic blood pressures and cumulative uranium intake was associated with increased glucose excretion in urine. Indicators of cytotoxicity and kidney function did not show evidence of renal damage. The authors (72) also reported that a marker for bone resorption, serum type I collagen carboxy-terminal telopeptide (CTX), and serum osteocalcin were elevated in 146 men 26–83 years old, who, for an average of 13 years, had

used drinking water originating from wells drilled in bedrock in areas with naturally high uranium content.

Overall, the epidemiologic studies are consistent with the animal studies. Taken together, the evidence is convincing of nephrotoxicity in humans at environmental exposure concentrations.

Cancer

Uranium miners have a substantially increased risk of death from lung cancer that has been attributed to cumulative exposure to radon decay products (73–76). Excess mortality from non-malignant respiratory diseases that is likely due to exposure to fresh silica dust has also been reported (77). To assess the consequences of uranium mining in a non-smoking population, Gilliland et al. (78) examined lung cancer incidence among Navajo men residing in New Mexico and Arizona from 1969 to 1993. The researchers conducted a population-based case-control study and found that uranium mining contributed substantially to lung cancer among Navajo men over the 25-year period following the end of mining for the Navajo Nation. Of the 94 incident lung cancers among Navajo men, 63 (67%) occurred in former uranium miners. The relative risk for a history of mining was 28.6 [95% confidence interval (CI) 13.2–61.7]. Thus, lung cancer has a strong relationship with uranium mining, even in the absence of smoking. The Navajo experience with uranium mining is a unique example of exposure in a single occupation accounting for the majority of lung cancers.

In 1997, Roscoe (77) reported an updated retrospective cohort mortality study conducted on 3238 White males from the US Public Health Service cohort of Colorado Plateau uranium miners. Significantly elevated standardized mortality ratios (SMRs, or ratio of observed deaths to expected deaths) were found for pneumoconiosis (SMR=24.1, 95% CI 16.0–33.7), lung cancer (SMR=5.8, 95% CI 5.2–6.4), tuberculosis (SMR=3.7, 95% CI 1.9–6.2), chronic obstructive respiratory diseases (SMR=2.8, 95% CI 2.2–3.5), emphysema (SMR=2.5, 95% CI 1.9–3.2), benign and unspecified tumors (SMR=2.4, 95% CI 1.0–4.6), and diseases of the blood and blood-forming organs (SMR=2.4, 95% CI 1.0–5.0), although some of the rare cancers were based on small numbers of cases. No significantly lowered SMRs were found for any disease. For lung cancer and pneumoconiosis, the SMRs increased with increasing exposure to radon progeny or with duration of employment. From the standpoint of possible effects of uranium ore contaminants other than radon, the findings for benign and unspecified tumors and for disease of the blood and blood-forming organs are of most interest.

Genetic effects

Zaire et al. (79, 80) reported a much higher prevalence of cancer among male workers in the open-pit uranium mine in Namibia than in the general population. The later study (80) that excluded smokers was an improvement on the original study (79). The investigators measured uranium excretion in urine, neutrophil counts, and the serum level of follicle-

stimulating hormone, luteinizing hormone, and testosterone and analyzed chromosome aberrations in whole blood cells using fluorescence in situ hybridization. A 3-fold increase in chromosome aberrations was found in miners when compared with non-exposed control subjects ($p < 0.0001$). Cells with multiple aberrations like “rogue” cells observed for the first time in miners had previously been found only after short-term high-dose radiation exposure, for example, from the Hiroshima atomic bomb or the Chernobyl accident. The authors concluded that the miners exposed to uranium were at an increased risk of acquiring various degrees of genetic damage and that the damage might be associated with an increased risk for malignant transformation.

Au et al. (81) investigated whether residents residing near uranium-mining operations in Karnes County, TX, USA (target population), who are potentially exposed to toxicants from mining waste, had increased genotoxic effects compared with those residing elsewhere (the reference population). The authors found that individuals who resided near uranium-mining operations had a higher mean frequency of cells with chromosome aberrations and higher deletion frequency but lower dicentric frequency than the reference group, although the difference was not statistically significant. After the cells were challenged by exposure to γ -rays, the target population had a significantly higher frequency of cells with chromosome aberrations and deletion frequency than the reference group. The latter observation suggests an abnormal DNA repair response in the target population.

Birth defects

Shields et al. (82) investigated birth defects in Navajo uranium-mining communities, comparing their results with fathers who were miners and with proximity of the home to mines and waste. The authors found weak associations between mothers and fathers living near uranium tailing or mine dumps and birth defects in their children. Proximity to mine waste, however, likely introduces substantial exposure misclassification, which would bias findings toward the null. Also worth noting is that the large number of types of birth defects complicates the test for associations. This study divided birth defects into three categories and tested for associations with each group as well as all outcomes.

New research findings (2005–2011)

Epidemiologic studies of environmental exposures to uranium

Worker mortality study updates Canu et al. (83) reviewed 18 cohort and five nested case-control studies published since 1980. Workers occupationally exposed to uranium appear to be at increased risk of mortality from neoplasms of the lung, larynx, and lymphatic and hematopoietic tissue. Currently, available evidence for a positive association between internal exposure to uranium and the risk of cancer is limited. The common weaknesses in those studies reviewed

include low statistical power for rare cancers and the inability to assess internal exposure to uranium.

A French cohort study presented the risk of death from lung cancer and from other causes of death for uranium miners through 1999 and estimated associations with radon exposure (84). The miners did not differ significantly in overall mortality from the general male population. The analysis confirmed an excess risk of lung cancer death ($n=159$, $SMR=1.43$, 95% CI 1.22–1.68), which increased significantly with cumulative radon exposure – excess relative risk (ERR) per 100 working level months (WLM)=0.71, 95% CI 0.29–1.35. The ERR per unit exposure was much higher after 1955, when the accuracy of exposure measurement improved substantially (ERR per 100 WLM=2.00, 95% CI 0.91–3.65). A significant excess of kidney cancer deaths ($n=20$, $SMR=2.0$, 95% CI 1.22–3.09) was not associated with cumulative radon exposure. Kidney cancer is of note given the known nephrotoxicity of uranium. No excess was observed for other causes of death, except silicosis ($n=23$, $SMR=7.12$, 95% CI 4.51–10.69).

Tomasek et al. (85) studied lung cancer in two cohorts of French and Czech uranium miners. Miners from these two cohorts were characterized by low levels of exposure (average cumulated exposure of <60 WLM) protracted over a long period (mean duration of exposure of 10 years) and by a good quality of individual exposure estimates (95% of annual exposures based on radon measurements). The 574 lung cancer deaths observed were 187% higher than expected from national statistics. This significantly elevated risk was strongly associated with cumulative radon exposure.

Mortality studies of uranium miners on USA's Colorado Plateau have identified associations between exposure to radon progeny and risk of lung cancer. A 2009 update by Schubauer-Berigan et al. (86) added 15 years of mortality follow-up for the 4137 miners (primarily White or Native American) in the Colorado Plateau cohort. For White miners, the SMR for lung cancer compared with the regional population was 3.99 (95% CI 3.43–4.62) for the period 1991–2005. For Native American miners, the lung cancer SMR was 3.27 (95% CI 2.19–4.73). These SMRs have not declined substantially since the 1980s. The apparent interaction between radon and smoking in causing lung cancer remains submultiplicative but greater than additive. Mortality rates from silicosis remain highly elevated in the cohort. Elevated mortality rates were observed from interstitial pulmonary fibrosis, multiple myeloma, and non-Hodgkin lymphoma. Significant trends were observed with increased radon exposure and silicosis and pulmonary fibrosis mortality and in the incidence of diabetes-related end-stage renal disease among White miners.

Thus, some suggestive evidence has emerged from the occupational studies for cancers and diseases other than lung cancer, which is caused by radon, and silicosis, which is caused by blasted sand, suggesting the possibility of a role for uranium, radium, thorium, external ionizing radiation, or other contaminants in the ore.

Ecologic mortality studies Few non-occupational epidemiologic studies have been conducted of uranium exposure from mining and processing (as opposed to natural uranium

in drinking water). Most studies have not found strong, population-level connections between uranium and health problems. Such study designs, however, are often ecologic. Here, we discuss in some depth four of these studies, with the goal of contrasting our interpretation of the significance and limitations of the findings with the conclusions of the authors.

Karnes County, TX, USA: A study conducted of residents near a former uranium milling and mining site in Karnes County found no increase in cancer deaths (87). The study was a modified ecologic design, which calculated SMRs for counties, including Karnes, relative to the state of Texas, and to the total US population. The SMRs for Karnes were divided by SMRs for five counties nearby in Texas to generate “relative risks.” These relative risks could have been called “risk ratios” rather than “relative risks” to avoid potential confusion with relative risks from cohort studies that have individual-level exposure and confounder information. A problem with this sort of analysis is that substantial unmeasured differences in the demographic profiles were likely for the counties, the state, and the USA. A study like this one would be expected to identify only particularly robust elevations or depressions in causes of death and should not be taken as proof that an association does or does not exist. Together with other stronger evidence, the study might be part of establishing a coherent picture of such associations, but by itself, it is limited in terms of the conclusions that can be drawn.

Ecologic studies are limited primarily by the lack of data on individual persons, depending rather on composite values within a geographic area – counties in the case of this study. Thus, everyone within the county is assigned the same exposure. In addition, because little individual or county-wide data are available on most individual risk factors (diet, smoking, physical activity, and so forth), such confounders cannot be controlled for, even on a population level. Because of these limitations, ecologic designs are considered hypothesis-generating, rather than providing convincing evidence for or against an association.

Because it focused solely on mortality, this Texas study has additional limitations. By definition, mortality is not the only health outcome about which we might be concerned. Birth defects, lifelong debilitating illnesses that are not the cause of death, and even less debilitating, non-fatal health effects might be of concern but are not measured in a mortality study. Mortality studies also depend on the accuracy of records of cause of death, but we know that recording cause of death is sometimes erroneous or misleading and that this was more so in the past. In the case of a county dominated by a single employer, we might also be concerned with hesitancy to report certain causes of death in earlier periods.

Montrose County, CO, USA: Cancer and non-cancer mortality was studied in populations living near uranium and vanadium mining and milling operations in Montrose County, CO, USA, from 1950 to 2000 (88). This study is also a modified ecologic design that calculates SMRs for counties, including Montrose, relative to the state of Colorado and to the US population. The SMRs for Montrose are divided

by SMRs for five counties elsewhere in Colorado, again to generate relative risk. An association was found for lung cancer mortality but not for other deaths. The limitations of the study are essentially the same as those for Karnes County, TX. In addition, one of the comparison counties to Montrose, Mesa County, should have been removed from the analysis because this county had 55 uranium mines. The presence of other mine types (coal, gold) and other mineral extraction and industrial activities in the comparison counties were not reported. The paper did not note that the SMR for lung cancer using the state as the comparison group was significantly high, whereas the SMR for lung cancer using the USA as the comparison group was significantly low. These findings are not consistent with the conclusion stated by the authors that lung cancer was elevated in Montrose County. This problem likely reflects a poor demographic fit of statewide and US populations to the county-level population.

Although the analysis appears sound for this study, the interpretation by the authors is problematic in several ways. The authors claimed that “[e]nvironmental exposures to uranium, however, have not been linked to any detrimental effects” (88, p. 719). In other studies, however, environmental exposures to uranium have been linked to genetic effects and to changes in kidney function, and toxicologic studies add additional concerns. Further, and also contrary to the claims of the authors, miner studies have provided some evidence for cancers and diseases besides those associated with radon and silica exposure, as discussed above. The authors also claimed that the study findings “suggest” that the exposures to the Montrose population “were likely too low to result in toxic effects” (88, p. 719). Most of the citations supporting this claim were for studies of DU, which is not a fair comparison with the mining and milling context. In any case, this Montrose study by itself is not sufficient to conclude that environmental exposures to uranium mining contaminants have no health consequences.

Uruvan, CO, USA: A mortality study was conducted of all adult residents who ever lived in Uruvan, CO, USA, a company town built around a uranium mill. Boice et al. (89) found an association for lung cancer mortality, but not for other cancer deaths. Increased lung cancer mortality was seen among males but not among females. This study is reported as a cohort mortality study of all adult residents who ever lived in Uruvan, CO, USA. Unlike most cohort studies, this study did not analyze outcomes at the individual level, but rather pooled residents into broad categories, like mill workers, men and women, and others. Thus, the analysis is essentially an ecologic design. The study had access to substantial data on individuals, so why a more conventional longitudinal analysis, like Cox proportional hazards models, was not attempted is unclear. Such an analysis might have had greater power to see associations and would have controlled for multiple variables in the same statistical model(s). Another important limitation of the analysis is that deaths occurring before 1979 were excluded. Therefore, there may be a diminished ability to see associations with types of mortality having short latency periods that are potentially related to uranium ore exposure. The reason for this deficit is that the mill began operating in 1936 and thrived during the

uranium boom of the 1950s. A large majority of residents lived in Uruvan from 1936 to 1964, most for <10 years, whereas mining and milling had ceased by 1984. Thus, for example, deaths from diseases requiring 10–20 years to manifest clinically might be concentrated in the earlier period that was not studied. Leukemia would be an example of a cancer that has a brief latency, whereas lung cancer would be expected to arise over longer periods. The lack of follow-up during the earlier period, combined with pooling subpopulations into broad categories, lack of individual exposure data, and lack of information on important potential confounding risk factors (smoking, obesity), results in a study design that has significant limitations. Further, the company that ran the town also paid for the analysis, apparently, as part of legal proceedings, which appears to be a conflict of interest.

The authors also selectively cited a 1997 paper (90) stating that uranium has not been linked to detrimental health effects while ignoring more recent opinions providing evidence to the contrary (8, 9).

Grants, NM, USA: Uranium mining took place from early in the 1950s to 1990 in the US, and a uranium mill operated from 1958 to 1990 in Grants, NM, USA (91). This study evaluated cancer mortality during 1950–2004 and cancer incidence during 1982–2004 among county residents. The total numbers of cancer deaths and incident cancers were close to that expected (SMR 1.04, 95% CI 1.01–1.07; SIR 0.97, 95% CI 0.92–1.02). Lung cancer mortality and incidence were significantly increased among men (SMR 1.11, 95% CI 1.02–1.21; SIR 1.40, 95% CI 1.18–1.64) but not women (SMR 0.97, 95% CI 0.85–1.10; SIR 1.01, 95% CI 0.78–1.29). Similarly, among the population of the three census tracts near the Grants Uranium Mill, lung cancer mortality was significantly elevated among men (SMR 1.57, 95% CI 1.21–1.99) but not women (SMR 1.12, 95% CI 0.75–1.61). Except for an elevation in mortality for stomach cancer among women (SMR 1.30, 95% CI 1.03–1.63), which declined over the 55-year observation period, no significant increases in SMRs or SIRs for 22 other cancers were found. Although they could not draw etiologic inferences from the data, the authors suggest, reasonably, that excesses of lung cancer among men were likely due to previously reported risks among underground miners due to exposure to radon gas and its decay products.

The study succeeded in obtaining a worker population of 5640 from a single company but excluded about half of those due to having worked for <6 months or lack of demographic data. Again, unlike most cohort studies, this one does not analyze outcomes at the individual level, but rather pools residents into broad categories – mill vs. mine workers, men vs. women. Hence, as with the Montrose study, this study had access to substantial data on individuals and it appears that it could have been conducted as a longitudinal analysis.

Proximity to uranium contamination and health risk

Preliminary results from an on-going cross-sectional study of non-occupational uranium exposures based at the University

of New Mexico suggest that residents who live near mines and uranium tailings are at increased risk of kidney disease, hypertension, diabetes, and autoimmune disease (92, 93). The results to date indicate that the best predictor of disease is the proximity to mine waste features, weighted by the surface area of the feature. In other words, for two mines of equal size, the value is greater for the closer mine, but a big waste pile 10 miles away may be less important than several smaller mine features within 1 mile of a home. The researchers reported that those living in areas with the greatest number of mine features were twice as likely to report hypertension after controlling for other significant risk factors. Proximity to abandoned uranium mines was also a significant risk factor for autoimmune disease. The study used logistic regression and Bayesian model development for analysis.

The Fernald Feed Materials Production Center in the USA functioned as a uranium processing facility from 1951 to 1989. The potential health effects among residents living near this plant were investigated. The results showed that residents in the vicinity of the Fernald plant with elevated exposure to uranium, primarily via inhalation, exhibited decreases in white blood cell counts and small, although statistically significant, sex-specific alterations in systolic blood pressure, a measure that is less stable than many biologic markers (94).

Recent findings on cancer

Canu et al. (95) investigated the risk of lung cancer with regard to protracted occupational exposure to reprocessed uranium compounds. Male workers (n=2709) employed at the AREVA NC uranium processing plant between 1960 and 2005 in France were included in the cohort. Historic exposure to reprocessed uranium compounds classified by their solubility type was assessed on the basis of the plant's specific job-exposure matrix. Cox proportional hazard models adjusted for attained age, calendar period, and socioeconomic status were used to estimate relative risks with regard to each type of uranium compound. The relative risk of lung cancer tended to increase with the decreasing solubility of reprocessed uranium compounds. The highest, although not statistically significant relative risk, was observed among workers exposed to slowly soluble reprocessed uranium dioxide. This study, despite the small number of incident cases, is the first suggesting an increasing risk of lung cancer associated with exposure to reprocessed uranium. The authors also found increased SMRs for lymphatic (n=9) and pleural cancer (n=5).

Uranium has been mined and milled in a Northern Territory Aboriginal domain of Australia, the Kakadu Region, for the past three decades. Since 1981, at least 120 leakages, spillages of contaminated water, and breaches of regulations have occurred. Exploratory research undertaken in 2005 and 2006 found a significant overall increase in the incidence of cancer among Aboriginal people in the Kakadu region – some 90% greater than would be expected (96).

In South Carolina, USA, concentrations of natural uranium are elevated in groundwater at amounts that, in many instances, exceed safe drinking water standards. Wagner et al. (97) performed an ecologic study to evaluate 134,685 cancer

cases in census tracts with elevated groundwater uranium and more frequent groundwater use. Data sources included incident total, leukemia, prostate, breast, colorectal, lung, kidney, and bladder cancers (1996–2005, SC Central Cancer Registry); demographic and groundwater use (1990 US Census); and groundwater uranium concentrations (n=4600, from existing federal and state databases). Kriging, a method with some important limitations, especially when applied to groundwater systems that are often not connected to each other, was used to predict the average uranium concentrations within tracts. The relationship between uranium and standardized cancer incidence ratios was modeled among tracts with substantial groundwater use via linear or semiparametric regression, with and without stratification by the proportion of African Americans in each area. Tracts with $\geq 50\%$ groundwater use and uranium concentrations in the upper quartile had increased risks for colorectal, breast, kidney, prostate, and total cancer compared with referent tracts. Noteworthy is that significant potential for confounding and exposure misclassification exists for this study.

Recent findings for kidneys

Some recent findings build on classic research in animals and humans regarding effects on the kidneys. Prat et al. (98) examined the association between a possible new biomarker, osteopontin (OSTP), and uranium exposure both in vitro using a human kidney cell model and in the urine of exposed individuals. The study of HK2 cells indicated that OSTP secretion decreased after uranium exposure in a concentration- and time-dependent manner, but its suppression did not affect cell sensitivity to uranium. Despite wide inter-individual variability, this parameter also decreased in human urine when urinary uranium exceeds 30 $\mu\text{g/L}$ after an acute exposure, a value considered critical for kidney damage. The decrease of urinary OSTP could be a useful additional biomarker for monitoring possible kidney damage after uranium exposure.

In Connecticut, a child who was exposed to naturally occurring uranium in groundwater from a private well showed evidence of nephrotoxicity (99). The family discovered elevated concentrations of uranium in their drinking water, with levels measured at 866 and 1160 $\mu\text{g/L}$, values well above the US EPA maximum contaminant level for uranium in public water supplies of 30 $\mu\text{g/L}$ (see earlier). The source of exposure was found to be a 500-ft well that tapped groundwater from the Brookfield Gneiss, a geologic formation known to contain uranium. The child was reported to derive a major portion of her nutritional intake from infant formula that was mixed with contaminated well water. After correction for creatinine excretion, the β_2 -microglobulin excretion rate remained elevated ($>40 \mu\text{g/mmol creatinine}$) in the child, a 3-year-old, with a corrected level of 90 $\mu\text{g/mmol creatinine}$. Three months after cessation of well-water consumption, this child's corrected β_2 -microglobulin level had fallen to 52 $\mu\text{g/mmol creatinine}$. This study highlights the inherent biologic vulnerability of young children to residential environmental exposures, which is a reflection of the large amount

of time that children spend in their homes, the developmental immaturity of their kidneys and other organ systems, and the large volume of water they consume relative to body mass (100). Moreover, the toxicodynamic processes that determine exposure, absorption, metabolism, excretion, and tissue vulnerability are all age-related. For example, an adult is estimated to absorb 10% of ingested lead, whereas a 1- to 2-year-old child will absorb 50% of ingested lead (101). Because the biotransformation of xenobiotics is developmentally regulated, children have a relative inability to detoxify and excrete many exogenous chemicals. The tissue distribution of xenobiotic chemicals varies with the developmental stage of the child, which, in turn, determines the activity of the metabolic pathways that result in their activation or deactivation (102). The developmental stage also determines the genetic polymorphisms of each locus that determine the activity of each component enzyme – for example, human chromosome 16 contains the functional genes for the synthesis of metallothioneins (MTs), small, cysteine-rich inducible proteins that regulate the intracellular concentration of metal ions and protect against heavy metal toxicity. The basal tissue level of MT is age-related, with liver MT levels decreasing during infancy and increasing thereafter until middle age (102, 103).

Malard et al. (104) used innovative proteomic techniques to analyze urinary protein modulation associated with acute uranium exposure in rats. The analysis revealed 14 modulated proteins (seven with increased levels and seven with decreased levels) in urine after intravenous exposure to uranyl nitrate, confirmed by Western blot. Some of the modulated proteins corresponded to proteins already described for nephrotoxicity (albumin, α 1-antiproteinase, serotransferrin) and indicated a loss of glomerular permeability. Others revealed tubular damage, like epidermal growth factor and vitamin D-binding protein. A third category included proteins that had not yet been described in urine as being associated with metal stress.

Zimmerman et al. (105) assessed the nephrotoxicity of a single exposure to DU in adult male Sprague-Dawley rats. Dose-related increases in serum and kidney uranium were noted. The DU concentration peaked on day 1 in the kidney and on days 3–7 in serum. Dose-related elevations of creatinine and blood urea nitrogen concentrations were seen on days 3 and 7. A decline in serum albumin coinciding with creatinine and blood urea nitrogen suggested protein-losing nephropathy. Dose-related acute tubular necrosis and proliferative glomerulonephritis were observed.

Zamora et al. (106) conducted a study of an aboriginal community to determine whether kidney function had been affected by the chronic ingestion of uranium in drinking water from the drilled wells in the community. Uranium concentrations in drinking water varied from <1 to 845 ppb. A correlation of uranium excreted in urine with bioindicators at $p \leq 0.05$ indicated interference with the reabsorptive function of the kidney.

Recent findings for reproductive effects

Angenard et al. (107) provided the first evidence that uranium can impair the development of human gonads. Using an in

vitro organ culture system, the authors investigated the effects of uranyl acetate on human gonads during the first trimester of gestation (7–12 weeks), which is a critical step in the development of a functional reproductive system. In human fetal ovaries, 0.05 mM uranium significantly decreased germ cell density by increasing the apoptosis rate. In human fetal testes, 0.1 mM uranium similarly reduced the number of germ cells. Human fetal germ cells were more sensitive than mouse germ cells to uranium in the same experimental conditions.

An experimental animal study found that drinking water with uranium concentrations below the US EPA water standard acts like estrogen, causing estrogen receptor-dependent responses in female mice (108). The authors exposed intact, ovariectomized, or pregnant mice to DU in drinking water, ranging from 0.5 to 28 mg/L (0.001–120 μ M). Mice that drank uranium-containing water exhibited estrogenic responses, including the selective reduction of primary follicles, increased uterine weight, greater uterine luminal epithelial cell height, accelerated vaginal opening, and persistent presence of cornified vaginal cells. Coincident treatment with the antiestrogen, ICI 182,780, blocked the responses to uranium or to the synthetic estrogen diethylstilbestrol. In addition, mouse dams that drank uranium-containing water delivered grossly normal pups but had significantly fewer primordial follicles than pups whose dams had drunk control tap water. The uranium concentration and the route of exposure used in these studies were environmentally relevant for uranium mining/milling in the Colorado plateau in the Four Corners region of the American Southwest. The data suggest that uranium is an endocrine-disrupting chemical and that populations exposed to environmental uranium (including indigenous populations in the USA living near uranium mine tailings) should be followed for increased risk of fertility problems and reproductive cancers.

Recent findings on genotoxicity

Darolles et al. (109) evaluated the genotoxic profile of uranium with the cytokinesis-block micronucleus centromere assay, a metaphase analysis that overcomes the kinetic problems inherent in the use of human lymphocytes. The results showed that the genotoxic profile of uranium depends on its isotopic composition. DU and EU are low and high clastogens, respectively, yet the DU aneugenic effects remain high (resulting in an abnormal number of chromosomes in any given homologous pair of chromosomes), indicating a need to study the potential role of the aneugenic effects of DU in carcinogenic risk assessment linked to uranium internal exposure.

Knöbel et al. (110) investigated the genotoxic effects of uranyl nitratetriacetate in human adenoma cells (LT97). The compound (0.5–2 mM) increased chromosomal aberrations in chromosomes 5, 12, and 17, which harbor the tumor-related genes *APC* (adenomatous polyposis coli), *KRAS* (Kirsten ras oncogene), and *TP53* (tumor suppressor p53). The authors concluded that if they reach the food chain in sufficient amounts, uranium compounds could increase alimentary genotoxic exposure in humans. Data from Stearns

et al. (59) suggest that uranium could be chemically genotoxic and mutagenic through the formation of strand breaks and covalent U-DNA adducts. Thus, the genotoxic risks for uranium exposure could go far beyond those for radiation exposure.

Miller et al. (111) investigated the involvement of DNA methylation in DU-induced leukemia. Methylation was measured by the direct analysis of the 5-methylcytosine content of spleen DNA in DU leukemic mice. Spleen hypomethylation occurred during DU-induced leukemogenesis (chronic internal DU exposure), and aberrant gene transcription was also detected. The authors concluded that epigenetic mechanisms are implicated in DU-induced leukemia. The data are evidence of aberrant DNA hypomethylation being associated with DU leukemogenesis.

An early childhood disease labeled "Navajo neurohepatopathy," a rare hepatocerebral mitochondrial DNA depletion syndrome prevalent in areas of the Navajo Nation contaminated with uranium, was reported to be caused by a genetic mutation (112). Several scientists interviewed for a book written by a newspaper reporter about uranium mining (113) suspected that uranium ore exposure could be contributing to the disease. Although a slight chance remains that contaminants from uranium ore might trigger such an underlying genetic condition, this view seems highly unlikely because the genetic study showed that every child tested who had the disease was homozygous for the mutation, but every child tested who did not have the disease was not homozygous.

Recent mouse oocyte studies

Arnault et al. (114) showed that natural uranium intoxication (5, 50, or 400 mg/L of uranyl nitrate in drinking water) affects female fertility by disturbing mouse folliculogenesis *in vivo* and oocyte meiosis *in vitro*. Kundt et al. (115) tested Swiss female control mice and mice chronically contaminated with uranyl nitrate in drinking water at 2.5, 5, or 10 mg U/kg/day for 40 days. The number and quality of ovulated oocytes, chromatin organization, and nuclear integrity showed high sensitivity to uranium contamination. The LOAEL for this system was estimated at a level below 2.5 mg U/kg/day for female mice. Feugier et al. (116) evaluated the effect of DU on mouse oocyte quality after 49 days of subchronic contamination in drinking water [0 (control), 10, 20, and 40 mg/L]. The proportion of healthy oocytes was reduced by half ($p < 0.001$) at 20 mg/L compared with the control group. The no observed adverse effect level for oocyte quality was determined at 10 mg/L in drinking water.

Recent experimental animal findings for effects on the brain

Uranium can cross the blood-brain barrier (117). Houpert et al. (118) studied the accumulation of uranium in the brain of rats after repeated exposure by inhalation or by injection (chronic exposure or acute exposure). For each route of administration, the amount of uranium entering the brain was low. The results showed different accumulation in the brain

areas according to the route of intake. Injection gave a rather homogeneous distribution among the olfactory bulbs, cortex, striata, hippocampus, cerebellum, whereas both inhalation and ingestion yielded a heterogeneous but specific accumulation, with the highest concentrations targeting the olfactory bulbs (inhalation) and striata (ingestion). Such differences in distribution suggest the operation of different mechanisms of delivery of uranium to the brain tissues. The same group (119) reported that enriched but not DU affects the central nervous system in the long-term exposed rat, suggesting that the radiologic activity induces the primary events of these effects of uranium.

In a study by Bensoussan et al. (120), rats drank 40 mg/L uranyl nitrate for 1.5 or 9 months. The cortex and hippocampus were removed and gene expression and protein levels were analyzed to determine potential changes in cholinergic receptors and acetylcholine levels. The results indicate that the cholinergic system is a target of uranium exposure in a structure- and time-dependent manner. Bussy et al. (121) reported that cholinergic acetylcholinesterase (AChE) activity was transitionally perturbed in the cerebellum after 6 months ingestion of 40 mg/L uranyl nitrate. After 1.5 months of exposure, the dopamine level increased in the hypothalamus. After 6 months of exposure, a tiny but significant modification of the dopaminergic turnover ratio was detected in the frontal cortex. After 9 months, uranium significantly decreased the 5-hydroxyindoleacetic acid level and the serotonergic turnover ratio in the frontal cortex and the 3,4-dihydroxyphenylacetic acid level and dopaminergic turnover ratio in the striatum. Uranium brain accumulation was statistically significant in the striatum after 1.5 months and in the striatum, hippocampus, and frontal cortex after 9 months of exposure.

Monleau et al. (122) studied the bioaccumulation of uranium in male rats after exposure to repeated depleted uranium dioxide inhalation, together with behavioral effects. The uranium concentrations in the brain 1 day after the end of the exposure period varied as follows: olfactory bulb > hippocampus > frontal cortex > cerebellum, subsequently decreasing rapidly. Compared with control rats, the spontaneous locomotion activity of exposed rats was increased 1 day postexposure and the spatial working memory was less efficient 6 days postexposure.

Barillet et al. (123) studied adult male zebrafish (*Danio rerio*) to assess early changes induced by waterborne exposure to different isotopic compositions of uranium (DU associated with or not associated with U-233). Oxidative stress and neurotoxicity were selected as effect end points to characterize uranium chemotoxicity and radiotoxicity, respectively. Oxidative stress induced by uranium (U-238 and U-233) exposure led to decreases in superoxide dismutase and catalase activity levels, as well as total glutathione content in liver extracts, and was significantly more marked in the U-233-exposed fish. A significant increase in AChE activity was seen in brain extracts at the same level of both isotopes, suggesting combined radiotoxic and chemotoxic effects. Lestaavel et al. (124) reported that chemically induced oxidative stress plays a key role in the mechanism of uranium neurotoxicity but concluded that both chemotoxicity and radiotoxicity are important.

Another study followed the short-term kinetics of uranium in rat brain after the intraperitoneal injection of each rat with 1 mg uranyl acetate/kg (125). The uranium entered the brain rapidly and was initially concentrated in the hippocampus and striatum. The overall clearance was relatively slow, and the uranium content of the hippocampus, cerebellum, and cortex remained elevated for more than 7 days after a single exposure.

Inhaled uranium has been proposed to enter the brain not only by the common route of all modes of exposure, the blood pathway, but also by a specific inhalation exposure route, the olfactory pathway. As mentioned earlier, the results of a study in rats by Tournier et al. (119) showed a specific frontal-brain accumulation of the inhaled uranium that was not observed with injected uranium. The finding that inhaled uranium was higher than injected uranium in the olfactory bulbs and nasal tubercles give prominence to a role of olfactory receptor neurons in the direct transfer of the uranium from the nasal cavity to the brain.

As an experimental simulation to the long-term exposure to uranium pollutants in drinking water, Kelada et al. (126) studied histologic alterations in the cerebral cortex of albino rats ingesting a soluble uranium compound (60 $\mu\text{g}/\text{kg}$ body weight dissolved uranium in 14.21 μL uranyl acetate added to 1 mL tap water administered by orogastric intubation for 90 days). The applied dose and duration of exposure to uranyl acetate in drinking water induced focal degenerative changes in some neurons of the cerebral cortex that were associated with moderate increases in the neuroglial reaction, a consistent feature in almost all forms of brain pathology. The stimulus that evokes the neuroglial reaction seems usually to be purely chemical and arises from the presence of degeneration products of nervous tissue (127).

Experimental animal studies with DU have demonstrated that that uranium is not only present in the brain but also alters behavior, notably locomotor activity, sensorimotor ability, the sleep/wake cycle, and the memory process, as well as the metabolism of neurotransmitters. Lestaeval et al. (128) showed that at levels at which no nephrotoxicity could be detected (144 $\mu\text{g}/\text{kg}$ DU by injection), measurable changes in behavior were seen. Briner and Murray (129) studied the short- and long-term effects of DU exposure on open-field behavior and brain lipid oxidation in rats. Rats exposed to drinking water containing 150 mg/L DU showed behavioral changes in males and lipid oxidation, regardless of sex, in as little as 2 weeks.

Recent molecular studies

Examining changes at the molecular level is important for understanding the chain of events leading to cellular damage. Using a combination of conventional biochemical studies and serial analysis of gene expression, Taulan et al. (130) presented a comprehensive view of renal molecular events in mice after long-term exposure to uranyl nitrate in mineral water (80 or 160 mg uranyl nitrate/L for 4 months). Substantial molecular changes were observed in toxicogenomic profiles. Exposure to uranyl nitrate induced dramatic alterations in the expression

levels of more than 200 genes, mainly up-regulation, including oxidative-response-related genes, genes encoding for cellular metabolism, ribosomal proteins, signal transduction, and solute transporters. Seven differentially expressed transcripts were confirmed by real-time quantitative polymerase chain reaction. In addition, significantly increased peroxide levels support the implication of oxidative stress in the uranyl nitrate toxicant response.

Calcium released from the endoplasmic reticulum through special calcium release channels – inositol 1,4,5-trisphosphate receptors (IP3Rs) and ryanodine receptors (RyRs) – serves as a main source of cytosolic calcium signaling in most cell types. Ondrias et al. (131) found that uranyl acetate modulates gene expression and protein levels of type 2 but not type 1 IP3Rs in mouse kidney cells. Another study (132) reported that uranyl acetate (5 or 50 μM) up-regulates both messenger RNA (mRNA) and protein levels of both type 1 and type 2 IP3Rs in human embryonic kidney cells (HEK293) as an experimental model. This increase was associated with the elevated expression of proapoptotic factors Bax and caspase 3 and also by a higher extent of apoptosis. Conversely, the induction of apoptosis resulted in increased mRNA levels of IP3R2 and also elevated levels of apoptotic markers.

Tissandié et al. (133) investigated the *in vivo* effects of a chronic exposure to EU on vitamin D3 metabolism, a hormone essential in mineral and bone homeostasis. Rats were exposed to EU in drinking water for 9 months at a concentration of 40 mg/L (1 mg/rat day). The contamination did not change the vitamin D plasma level. The vitamin D receptor and retinoid X receptor α , encoding the nuclear receptors involved in the biologic activities of vitamin D, showed a lower expression in kidney, whereas their protein levels were paradoxically increased. Gene expression of vitamin D target genes, epithelial Ca^{2+} channel 1 and calbindin-D28k involved in renal calcium transport were decreased. Among the vitamin D target organs examined, the molecular modifications occurred exclusively in the kidney. This study showed that a chronic exposure to EU affects both mRNA and protein expressions of renal nuclear receptors involved in vitamin D metabolism, with no modification of circulating vitamin D.

Gazin et al. (134) reported that uranium induces significant tumor necrosis factor α (TNF- α) secretion and p38 mitogen-activated protein kinase (MAPK) activation in a rat alveolar macrophage cell line. As both TNF- α and MAPK participate in the inflammatory response, the results could contribute to a better understanding of the pathologic effect of uranium on the lung.

Uranium as an environmental contaminant has been shown to be toxic to both eukaryotes and prokaryotes, but no specific mechanisms of uranium toxicity have been proposed so far. A study by VanEngelen et al. (135) used a combination of *in vivo*, *in vitro*, and *in silico* studies in bacteria to describe the direct inhibition of pyrroloquinoline quinone (PQQ)-dependent growth and metabolism by uranyl cations. PQQ is the third redox cofactor after nicotinamide and flavin in bacteria. In humans, PQQ functions as an essential nutrient and antioxidant. Electrospray ionization mass spectroscopy,

UV-vis optical spectroscopy, competitive Ca^{2+} /uranyl binding studies, relevant crystal structures, and molecular modeling unequivocally indicated the preferred binding of uranyl ion simultaneously to the carboxyl oxygen, pyridine nitrogen, and quinone oxygen of the PQQ molecule. The toxicity patterns were consistent with the biotic ligand model of acute metal toxicity. Lead, for example, has also been shown to interfere with the function of PQQ (136).

Based on DNA microarrays, Prat et al. (137) reported a comparative gene expression analysis following the acute uranium exposure of several human cell lines taken from kidneys or lungs as representative targets. In kidney cells, 70 genes overexpressed and 112 underexpressed were involved in cell signaling, cell defense, and apoptosis. Immunoblotting assays showed that uranyl ions affect the excretion of OSTP (bone sialoprotein 1), a glycoprotein associated with bone resorption and kidney mineral stones, in a time- and dose-dependent manner.

Lerebours et al. (138) examined the effects of waterborne uranium exposure on gene expression in four organs (brain, liver, skeletal muscles, and gills) of the zebrafish (*Danio rerio*). The *abcb311* gene, which is involved in liver detoxification, was induced 4- and 24-fold in organisms previously exposed to 23 ± 6 and 130 ± 34 $\mu\text{g U/L}$, respectively. In gills, at the highest uranium concentration, *gpx1a* (glutathione peroxidase 1a), *cat1* (catalase 1), *sod1* (superoxide dismutase 1), and *sod2* genes were up-regulated at day 21, indicating the onset of oxidative stress. Mitochondrial metabolism and DNA integrity also were affected because *cox1*, *atp5f1* (ATP synthase), and *rad51* (DNA double-strand repair protein) genes were up-regulated at day 21 and during the depuration phase. In skeletal muscles, the induction of *cox1* (cytochrome C oxidase subunit 1), *atp5f1*, and *cat* at day 3 suggested an impact on mitochondrial metabolism and the production of reactive oxygen species. In the brain, *gls1* (glutaminase) was also induced at day 3, suggesting a need for the glutamate synthesis involved with neuron transmission.

Wan et al. (139) studied mouse immune cell lines. Lymphoproliferation analysis indicated that macrophage accessory cell function was altered with 200 μM DU after an exposure time of 2 h. Microarray and real-time reverse transcriptase-polymerase chain reaction analyses revealed that DU alters gene expression patterns in macrophages and CD4+ cells. The most differentially expressed genes were related to signal transduction, neurotrophic factors, chemokine and chemokine receptors, and interleukins like IL-10 and IL-5, indicating a possible involvement of DU in cancer development, autoimmune diseases, and the T-helper 2 polarization of T cells.

The studies at the molecular level described here included in vitro and in vivo experiments and DNA microarrays to examine gene expression and the effect of uranium on various biomolecules. The effects of acute and chronic exposure to uranium were compared in rodents and fish and in mouse and human cell lines, using both eukaryotes and prokaryotes. The results demonstrate that many biologic responses are changed by uranium, even for dosages that are not acutely toxic. Although these molecular changes may not

necessarily lead to pathologies, such studies must be continued to further our understanding of the primary events of uranium toxicity.

Conclusions

Without a doubt, as research looks deeper into the toxicity and epidemiology of uranium, many new effects are being found. The estrogenic and brain effects described above are novel findings. But even within the oldest and most established of toxicities – nephrotoxicity – new findings are deepening our knowledge, including molecular and mechanistic evidence that is quite recent. Today, both the well-established health concerns and other risks associated with uranium exposure clearly require further research but already appear plausible based on the evidence to date. Uranium by itself has both radiologic and chemical properties. Although heavy metal toxicity seems to be implicated in most aspects of uranium toxicity, some evidence has emerged for its radiologic effects. In some cases, the mechanism driving the effects on biologic systems is not clear. On the whole, the evidence base rests more on toxicology than on epidemiology, limiting the ability to extrapolate to humans. Many epidemiologic studies of environmental, as opposed to occupational (where the exposures are higher and radon is the main concern), are ecologic in design. Robust study designs are needed that have individual-level data and control for confounding at a reasonable level. Many of the animal and cell findings reported in this review could be explored in human populations with varying degrees of exposure, although it makes sense to conduct studies preferentially among persons having high contrasts of exposure to increase the possibility of seeing associations. Compared with a decade ago, the need to control and limit exposure to uranium seems more important than ever. If a new “uranium boom” is indeed emerging, then efforts must be vigorous to limit environmental contamination and exposure.

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DECLARATION OF DR. Michael R. Edelstein

June 11, 2013

U.S. Forest Service

Comments on the DEIS for Roca Honda Mine

I, Michael R. Edelstein, do hereby swear that the following is true to the best of my knowledge. I am qualified and competent to give this declaration, and the factual statements herein are true and correct to the best of my knowledge, information and belief. The opinions expressed herein are based on my best professional judgment.

Name and Title

1. My name is Michael R. Edelstein. I am Professor of Environmental Psychology in the Environmental Studies and Sustainability Studies programs at Ramapo College of New Jersey. My work address is c/o School of Social Sciences and Human Services, Ramapo College of NJ, 505 Ramapo Valley Road, Mahwah, New Jersey 07430.

Professional Qualifications

2. My education and experience as a professional Environmental Psychologist are elaborated on my curriculum vita, attached here as Exhibit A. I earned a Ph.D. in Social Psychology from the State University of New York at Buffalo, awarded in 1975. I began work in the brand new emerging field of Environmental Psychology in 1970, serving as a faculty member in the School of Architecture and Environmental Design from 1971-74 and as staff Environmental Psychologist at BOSTI, the Buffalo Organization of Social Technical Innovation, during this period. By Environmental Psychology, I refer to the field of Psychology inspired by the National Environmental Policy Act of 1970 to address the mutual relationship of people and environment.

I was hired as a professor of Environmental Psychology by the School of Environmental Studies at Ramapo College of New Jersey in 1974 and have taught there since.

3. My work on the psycho-social impacts of environmental contamination and degradation began in 1979 with research on community opposition to a hazardous facility and at the Love Canal neighborhood in Niagara Falls, New York. In 1980, I gave expert testimony at hearings on a landfill expansion permit based on field research I conducted. The next year I was invited to serve as an expert witness in what would become a precedential toxic tort case, Ayers v. Jackson Township. In the subsequent interval of thirty -plus years, I have continued my research, consulting and expert testimony in the field of Psycho-Social Impacts, a field I helped to develop in the early-mid 1980s when I worked as part of teams conducting state studies under the Nuclear Waste Policy Act, during the effort to site a high level nuclear waste repository. During that time, I did extensive research around the Hanford Nuclear Reservation. I have worked on assessments of other high profile issues subsequently, most notably, the Exxon Valdez accident, as well as a score of toxic tort and administrative cases where my

expertise was sought. Most of my work has addressed contamination resulting from landfills or siting of hazardous waste facilities or impacts associated with the Superfund process. Some of my work has addressed issues now identified under the term Environmental Justice. In 2010, I conducted research and prepared testimony before Alberta's Energy Resource Conservation Board in cases addressing energy, one involved gas well expansion and the second tar sands upgrading. Recently I prepared testimony and served as expert witness on Environmental Justice before the Atomic Safety and Licensing Board hearings on the re-permitting of the Indian Point Nuclear Complex. I have recently also worked on EJ issues relating to housing in New York City. I was a founding member of the International Association of Impact Assessment and still periodically attend and speak at their yearly events, as I did in May, 2013.

4. My work on Psycho-social Impacts has been reflected in my presentations to peers and my writing journal articles, book chapters and books. My work not only addresses impacts of facilities or events, but also the regulatory process and citizens' participation within it. I am best known for my book, *Contaminated Communities*, now in its second edition from Westview Press (2004). Named by others as a classic of the field, this volume was an effort to show convergence from diverse sources to confirm my own observations and theory about the Psycho-Social Impacts of contaminating events. In the past decade, I have done considerable research in the former Soviet Union, including on the impacts of Chernobyl and the prior 1957 Mayak (or Kushtym 57) disaster in the Ural Mountains. This work culminated in a co-edited Journal edition and book (Edelstein, et al., 2007). Recent work has focused on the Aral Sea disaster in Uzbekistan and has culminated in a co-edited journal edition and book (Edelstein et al, 2012).

5. My work also informs and is reinforced by my teaching at the undergraduate and graduate levels, which regularly includes a capstone undergraduate course on Environmental Impact Assessment, along with various other courses in Environmental Psychology, Sustainability and Environmental Studies. I have taught Environmental Assessment for some thirty years.

6. My expertise has also been informed by pro-bono work at the community scale, where I served for ten years on my community's Environmental Review Board, evaluating Environmental Impact Statements; and founded and led several community organizations. One of these, Orange Environment, Inc, I have been President of for more than thirty years. In my role with OEI, I was integral to Clean Water and RCRA Citizen Suit actions, evaluating and sometimes challenging Environmental Impact Statements and also bringing environmental issues for adjudication in permit hearings before administrative law judges. I have also taught numerous community workshops on Environmental Impact Assessment. One important additional experience I gained in this context is with party of interest processes that provide for operator funded community participant monitoring and oversight, including penalties and enforcement actions that the public monitors can exercise at least partial control in initiating.

7. My work on radioactivity was also informed by a combination of my community and education roles. When the radon gas issue broke in Pennsylvania in the 1980s, I was in the position to compare the responses of New York, which was slow to respond, and New Jersey, which responded quickly. OEI subsequently undertook a program of community radon testing that was eventually taken over by New

York State and served as a model for their early work in the area. Meanwhile, at Ramapo, I co-chaired early conferences on radon and became academically involved with the issue, resulting in co-editing one volume on the topic and, subsequently, co-authoring a book on the topic (Edelstein et al, 1998). I have served as an expert consultant to a radon toxic tort case that addressed alleged misrepresentation of radon remediation systems in new housing.

8. I have on a number of occasions worked with environmental issues for Native Peoples. My first experience was a study of the opposition by Native Hawaiians to geothermal energy development on the Big Island. I subsequently conducted field research on the impact of the historic draw down of the Santa Cruz River, as well as the Asarco mine, on Tohono O'Odham residents of the San Xavier reservation. For a time, I was the research team member focused on native impacts for the Oiled Mayors study of the Exxon Valdez accident. I also did a preliminary assessment on the impact on the Karuk People of the collapse of the salmon population in the Klamath River. A current project being carried out by a Ph.D. candidate I co-supervise is on impacts to the Sami people of northern Sweden of massive wind power development. And I have worked on issues of the Ramapough Indians for many years, currently through my supervision of a Ph.D. candidate working on the impacts of contamination for the tribe. Although I have visited the Navajo Nation, the Hopi Reservation and the Pueblos involved in MASE, I have not previously worked with them.

9. Based upon my extensive research and scholarly work, detailed above, my comments here are informed by a thorough understanding of the fields of Environmental and Social Psychology, Psycho-Social Impact Assessment and Environmental Justice, Environmental Studies and Sustainability and the topics of radon gas exposure, radioactive waste, nuclear impact and environmental siting, risk, hazard and disaster.

Fundamental Theory

10. **The Theory of Environmental Turbulence.** In my past work, I have had the opportunity to observe extensively and to think deeply about how people are affected and victimized when the environments they live in become contaminated or significantly degraded or placed in threat of future contamination or degradation. Based upon these observations, I have developed a core of fundamental theory that I use to assess psycho-social impacts in different situations. This theory is grounded in my empirical work and derives from observations I have made about impacts on the lives of people I have interviewed in contaminated communities. While the body of theory has proven to be continually predictive and has received extensive peer review, it is also flexible and malleable to address emergent learning from a given context and situation as it arises. This work bridges the fields of Psycho-Social impact assessment and Environmental Justice. The following elements are integral to my basic theory of contamination, what I call "the Theory of Environmental Turbulence."

11. **Social Process in Eco-Historical Context.** Individuals are always understood to be part of a family or other intimate groups, a community (neighborhood, locality, coworkers), institutional groups (municipality, state, nation, education, total institution), and broader worlds (national and global society). These nested "levels of social process" can be directly impacted by events and they, in turn, can

affect other levels of process. Moreover, at any and every level, there are influences from historical and environmental trends and milestone events that influence the meaning and implication of impacts.

12. **Lifestyle.** Psychology conventionally deals with behavior as a prior process for investigation. In a parallel vein, I am concerned with "lifestyle," or the normal behaviors that people carry out in the course of their day that become the habits or rituals or structure of their lives. These behaviors may be individual or social, occur in particular places, and have particular meanings. Some of lifestyle is consciously designed (deciding where to live) but much of it is taken up from the dominant culture and replicated, even if it is personalized and seen as a reflection of the person. For this reason, most people's behavior is fundamentally similar (within a common range). Often much of lifestyle is assumed until it is interrupted, at which point people become aware of it.

13. **Lifescape.** Psychologists are also interested in perception and cognition as a fundamental process. In parallel, I am concerned with "lifescape." Lifescape refers to the underlying assumptions behind everyday life or how people understand life. I have been taught by the people I observe that five constants occur in lifescape: 1. How we view our health, 2. How much in control of our lives we believe we are and to what degree that control is shared with others, 3. the security, safety and privacy afforded by our homes and community, 4. the security and safety offered by the environment, 5. The security and comfort offered by others, principally our trust in institutions and others to protect us from harm and to help us should need occur. A sixth element of lifescape that is sometimes useful to consider is livelihood, or the stability of work and the ability to be economically secure. The details of these core lifescape characteristics vary by context.

14. **Stress and Trauma.** Psychologists are also interested in emotion and psychological wellbeing and, also, the physiological functioning of the person. The concept of stress bridges these realms. I am concerned with how much stress is placed on people, individually and collectively, and how they cope and their ability to cope with the overall burden and types of stressors they encounter. Within this I consider aspects of emotional health and stability at the individual and collective sphere. This includes the topics of trauma, social dysfunction, and other components of psychological health.

Environmental Turbulence reflects the condition of lost normalcy, when an event or discovery changes the perception and reality of normal life. In contrast to normal life, in a turbulent environment, people are forced to make adaptations and expend coping capacity that often tests or exceeds their limits. Fundamental understanding of life is inverted. And stress levels are high, at levels found for major life crisis, with consequences for psychological health that involve panic, traumatic reactions, depression, anger, paranoia, concern for health, self-destructive behavior, conflict, violence and other conditions at levels or frequencies beyond that found in normal life situations. Such stress responses also occur for families, communities, institutions, and societies, leading to dysfunctional syndromes appropriate for analysis of different levels of social process.

15. **Stigma and Fear.** Finally, I am concerned by factors that influence how one is perceived by others, particularly what I call "environmental stigma" an emergent class of stigma or prejudice which is accompanied by a parallel process of victimization. It is the case, as I document, that "outsiders don't

understand" what victims of environmental turbulence have experienced. This lack of understanding is a cause of environmental stigma. In the regulatory context, a basic concern is that the decision makers and regulators may not fully appreciate what it is like to be in the victim's shoes. Therefore, insufficient weight is placed on psycho-social impact given its centrality to the affected public. I am also concerned with "anticipatory fears," or future threats that are of concern to people now. One aspect of the victims understanding of the world is that such threats are possible and perhaps likely, even if others see them as unimportant, insignificant or remote.

This is the structure of my conventional psycho-social analysis.

16. **Environmental Justice.** Environmental Justice (EJ) impacts are another frame for assessment for Indigenous Peoples. As defined and practiced under Executive Order 12898, they reflect the identification of disproportionate adverse impacts placed on a particular group, usually defined by minority status, poverty or another indication of either systematic bias or inefficacy. Often these impacts are directed to groups that have been historically subject to such conditions. At its core, E.O. 12898 seeks to avoid situations where an historical pattern of environmental injustice is perpetuated by a government decision. EJ impacts come in many forms of abuse, but at root they are all Psycho-Social in nature.

EJ is understood to be an effect upon historically marginalized and thus disempowered groups (minorities, poor, Native Americans, and more broadly, children and elders) that involves the intersection of the two elements of what I have called "*Environmental Stigma*." On one side of this dual process, a stigmatized or marginalized population is placed in situations of peril that the dominant population would not tolerate. On the other, the environment itself becomes stigmatized, thereby further stigmatizing those who live there, hold it sacred or are otherwise associated with it. Such populations are placed in what I have called *perpetual jeopardy* because of legacy environmental impacts, on one hand, and because the devaluing of the place they are dependent upon becomes more and more attractive for a continuation of or new stigmatizing practices. It is already contaminated and the people are already poisoned, so there appear to be low consequences for doing more of the same. In more common language, the place is rendered a sacrifice zone and those attached to it are approved for sacrifice. Executive Order 12898 was designed to create a decision point for breaking this chain of stigmatization, contamination and degradation.

17. **Indigenous Impact.** What I learned in working with Native peoples is that the conventional structure of lifestyle and lifescape are significantly different than that found in non-native people. These differences can be summarized. For Native (Indigenous, First) Peoples,

A. there are additional layers of meaning behind behavior that reflect different spheres of awareness not in the consciousness of non-natives,

B. the self is always embodied within a larger Self or community, and thus the Western notion of the individual is not appropriate. The individual is never separate from the group and their understanding and impact is unified.

C. there is no perceived boundary between person and environment, and nature and environment are integral to every aspect of lifescape. Thus, the notion of personal control might be reconfigured as personal responsibility to the tribe and nature.

D. history is present in nature, where ancestors' remains exist, and where understandings about origins and relationships involve a presence of historical beings and events.

E. people's lifestyles are resource dependent, they eat local food from plants, fish and animals.

F. impacts to community and environment are personal impacts. Psychology and psychological impact have a much broader and inclusive sphere than for non-natives. What is routinely described as "Religion" or "Culture" is more appropriately understood as the equivalent of the Western "Psychological" and "Psycho-Social." One cannot talk about the psychological wellbeing of native people without considering the religious and cultural aspects of lifestyle and lifescape.

G. historical Environmental Injustice is melded with an overall history of Injustice. The effect of these injustices can be described in Psycho-Social terms.

H. oral tradition requires a functioning community. Local Knowledge and Traditional Knowledge, passed down through oral traditions and rituals in the landscape, provide a detailed understanding, intimacy and basis for communication with the environment. Any break in the chain of stories risks that they will be lost, and with them, the knowledge that they impart.

I. live simultaneously in local Native and dominant worlds. As a result of this "simultaneity," the structure of their lives and their way of thinking is both Western and native, with a wide range of combinations. Therefore the issues of Psycho-Social impact are both the same (or within the same range) as for any other person in the larger culture and, at the same time, fundamentally different and distinct according to their traditional background (again within a range). To a varying degree, as these two cultural worlds diverge, the individual and community are placed in a conflicting and complex set of relationships that add yet a third dimension to any possible impact.

In sum, when Native Peoples are involved, the task of the impact assessor is to focus on how the proposed project may cause significant adverse Psycho-Social impact using three different lenses, appreciating that each has its own strengths and vulnerabilities. They must assess Native Americans as modern people, as Native Americans, and as people straddling two different worlds that may complicate impact. Furthermore, it is not enough to classify impacts as religious or cultural, as if these realms are not part of the Psycho-Social life of people. Rather, such impacts can be discussed under cultural impacts but they must also be understood as Psycho-Social and impacts.

Purpose of My Comments

18. I was retained by MASE to review the Draft Environmental Impact Statement (DEIS)¹ on the proposed Roca Honda Uranium Mine. In particular, my focus has been to evaluate whether impacts to local communities, individuals and tribes (i.e., Psycho-Social and EJ impacts) have been adequately addressed and to comment on additional work that is required for a revised DEIS to create a comprehensive and thorough record.

Preparation for Comments

19. To prepare for this submission, I reviewed the following documents: The Scoping Document,² DEIS for Roca Honda mine³ with an emphasis on the Abstract and Chapter 3, Affected Environment and Environmental Consequences, Benedict and Hudson (2008)⁴, Blake, (1999), Dawson (1992, 1993, 2011), Dyer et al, (1992), Picou et al. (1997 a and b and 1996) and Shkilnyk (1985).

20. In order to hear first hand from some of the local people to be potentially affected should the mine be built, I conducted an hour long phone interview on April 27, 2013 with three members of the MASE-Coalition, Petuuche Gilbert and Manny Pino from Acoma Pueblo and Teddy Nez from Church Rock on the Navajo reservation. On May 24, 2013 I conducted an hour and one half long phone interview with Jonnie Head and Candace Head-Dylla on the Murray Acres subdivision north of Milan. I also spoke briefly with another MASE member, Paul Robinson and conversed with the Coordinator, Nadine Padilla.

COMMENTS

Overview

21. It is my expert opinion that a revision and re-issued DEIS for Roca Honda mine is required to assure that the Forest Service provides a complete analysis of potentially significant adverse impacts, in particular Psycho-Social impacts, addresses significant omissions and deficiencies and elaborates some important findings in the February 2013 DEIS that are not sufficiently developed, and to assure the full description of mitigation measures to the level that they can be evaluated.

¹ U.S. Forest Service, Environmental Impact Statement for Roca Honda Mine, retrieved from [Hhttp://www.fs.fed.us/nepa/nepa_project_exp.php?project=18431](http://www.fs.fed.us/nepa/nepa_project_exp.php?project=18431)

² Proposed Roca Honda Uranium Mine, Mt. Taylor Ranger District, Environmental Impact Statement Scoping Report, US Forest Service, Cibola National Forest, April 2011.

³ United States Department of Agriculture , Forest Service Southwestern Region. "Draft Environmental Impact Statement for Roca Honda Mine, Sections 9, 10 and 16, Township 13 North, Range 8 West, New Mexico Principal Meridian, Cibola National Forest, McKinley and Cibola Counties, New Mexico." MB-R3-03-25, February 2013.

⁴ Benedict , Cynthia Buttery and Erin Hudson (2008). "Mt. Taylor Traditional Cultural Property Determination of Eligibility." Heritage Resource Report # 2008-03-021 NMCRI#109313, Report# 2008-03-021. February 4, 2008.

The organization of this report and key findings are shared here, with the analysis following in the body of the document under section heads that correspond to the following list.

A. Alternatives: the DEIS fails to develop the No Action alternative to reflect sustainable development options only possible if uranium mining does not re-commence in the ROI. Given the likelihood that approval of Roca Honda mine will make impossible a sustainable development alternative, the "No Action" alternative should be enhanced to give decision makers a clear understanding between a sustainable and uranium mining alternative.

B. Baseline Analysis and Legacy Impact: the DEIS fails to develop the baseline, particularly legacy impacts, as a sufficient basis for understanding the context within which impacts will occur. Legacy impacts are historical, contemporary and future issues. Therefore, Legacy must be addressed as well in the impact section of the DEIS either as a standalone impact or as part of the cumulative impact assessment.

C. Legacy Impacts as Psycho-Social and Cumulative Impact: The DEIS alludes to legacy contamination issues in the ROI relating to uranium mining and milling, but fails to act on the realization that these issues are a source of contemporary significant adverse Psycho-Social impact. An example is developed here to illustrate the point and to model how the revised DEIS should treat the legacy sites in the region as impact as well as baseline. Legacy impacts represent a substantial primary basis for significant adverse primary and secondary impacts associated with the proposed Roca Honda uranium mine.

D. Cultural impact as Psycho-Social Impact: The DEIS gives ample attention to adverse cultural impacts for Native Americans in the ROI but without developing the acute relationship between Cultural and Psycho-Social Impact. For Native peoples, the experience of cultural harm is Psycho-Social impact. Sufficient analysis is offered here to establish that significant and disproportionate adverse impact will be caused by the proposed uranium mining project. A full assessment is required in the revised DEIS to establish this relationship clearly.

E. Conflict as Psycho-Social Impact: The DEIS does not appreciably recognize or address the many layers of community conflict caused by both legacy conditions and by the Roca Honda proposal. These are clear Psycho-Social impacts that need to be reflected in the revised DEIS.

F. EJ as Psycho-Social Impact: Environmental injustices may reflect disproportionate harm or risk to affected populations in myriad ways, but the effects are experienced as Psycho-Social Impacts. The DEIS needs to further develop its analysis of EJ impacts to reflect this fact. Significant and disproportionate adverse impacts are documented here for Native Americans living in the ROI. A full assessment along these lines is required in the revised document.

G. Psycho-Social Impacts: Psycho-Social impacts summarize the ways that people, collectively and individually, are affected by all the other impact categories. Although the DEIS acknowledges such impacts, there is no serious assessment of Psycho-Social Impact offered in the current DEIS. Throughout this document, enough evidence is provided to ascertain that the proposed

action will cause significant adverse Psycho-Social Impact. A full assessment is required in the revised document.

H. Mitigation: The revised DEIS must go beyond listing vague possible mitigations to do the level of analysis that can conclude their feasibility, whether they have worked in the past and what their scope is. While some proposed mitigations may ameliorate some Psycho-Social Impacts, these outcomes tend to be superficial, unproven and uncertain. Other Psycho-Social impacts cannot be mitigated. Significant adverse and disproportionate impacts that cannot achieve mitigation suggest permit denial.

I. New Legacies: Long term, Irreversible, and Irretrievable Impacts are a necessary component of this assessment, currently omitted.

J. Cumulative Assessment: Cumulative Impacts are not systematically addressed, including the full incorporation of foreseeable projects in the region.

K. In conclusion, there is sufficient evidence, justified by this report and by the DEIS, to recommend that the Forest Service select the "no action" alternative and deny requested permits for the operation of Roca Honda mine. At a minimum, the Forest Service should revise and re-issue the DEIS to address the shortcomings discussed herein.

Alternatives

22. The DEIS fails to understand the implications of "No Action." In my view, a no-action alternative means that the proposed action will not occur, but it need not imply a continuation of the status quo. The DEIS assumes both no-action and status quo.

The Alternatives analysis is currently constructed so as to create a false choice between "no action" (i.e. no development) in a region where actions are needed and two "action" (i.e., development) versions of uranium mining. This simplified no development vs. development dichotomy implies that the only development option for the region in question is to mine for uranium. This "uranium mining or bust" perspective is distorting and, of greater consequence, it closes the door on other potential development narratives that would avoid potential adverse impacts associated with uranium mining while still supporting the local economy and providing jobs.

As framed, the Base Case condition is perpetuated with both options: "No action" allows the region's population to continue to live in a contaminated environment while "Action" further compounds legacy contamination with the potential for new pollution from Roca Honda mine in return for some short run job and economic prospects. Either way, the region remains contaminated.

Rather than attracting resources to clean up the mess left behind by the prior uranium mining and milling activities, the proposed action perpetuates the past problems while potentially adding to them. And as the region's own experience shows, there is nothing sustainable about boom bust cycles. In my opinion, therefore, a reopening of uranium mining may well stifle alternative sustainable futures for the region that would chart an alternative path and lock the region into a uranium waste future. That would indeed be an irreversible and irretrievable commitment of resources.

It is hardly my role to chart a sustainable alternative, but some of the elements are evident, including a diverse mix of the following:

- One public scoping participant suggested that local people be trained and put to work cleaning up legacy contamination, what might be termed the "legacy cleanup path."
- The same person also recommended that projects related to renewable energy be implemented.
- There is an existing level of cultural and ecological tourism that might be developed into a much greater foundation for the local economy under the direction of local stakeholders.
- There is a vibrant craft component to the local Native American cultures. Might there be a program to help perpetuate craft traditions matched with modern marketing possibilities?
- Currently, many local people are employed in herding and farming. Might these small scale food production enterprises be enlarged or replicated, employing modern growing and marketing techniques for vegetable and fruit production, as well as grass-fed meat?
- Given the presence of five high profile tribes, the regional definition might even be constructed around traditional sustainable practice and applying traditional approaches to current life.

And, rather than one magic bullet economic development solution, a plan for a diversified, small business approach can be developed and implemented through a regional development program coordinating tribal and non-tribal participants. The DEIS alludes to a "continuation of local and regional governments' efforts to diversify the economic base in the ROI" (DEIS 433) but then fails to discuss these efforts in further detail so that the impacts of the proposed project could then be assessed.

Before the region became divided over the revitalization of uranium mining, there appear to have been efforts along the lines I suggest around recreation and sports events (Blake 1999). Now, as will be reported here, the uranium mining controversy appears to have shut down the ability to discuss alternatives such as tourism (Jonnie Head, below).

The revised and reissued DEIS can act as a Sustainable Planning and Impact Assessment, examining the potential for sustainable outcomes for the region and the potential consequences for a sustainable future from permitting the proposed project (Edelstein, 2011 a and b).⁵ In this series, I demonstrate that the National Environmental Policy Act (NEPA) seeks the creation of a sustainable society. Accordingly, the DEIS/FEIS can be seen as "sustainability forcing mechanisms" that serve as sustainability planning tools. They are tasked with differentiating sustainable from non-sustainable alternatives. The Forest Service should adopt this frame for its revision of the Roca Honda DEIS.

Such a sustainability analysis inherently addresses core issues for psychological and physical health and overall wellbeing among the consideration of social (and economic) sustainability while focusing on every attribute of environmental sustainability affected by the project. The sustainable development alternative would articulate a long term future for life in the region. Projects that have significant

⁵ Michael R. Edelstein. "SEQR and You will Find 'Er: The Integration of Sustainability Planning and Impact Assessment, Part 1." *Environmental Law in New York*, March 2010, 21, 3, pp. 41-47. March 2010.

adverse effects and become substantial obstacles to a sustainable region, accordingly, must be mitigated and/or weigh against permit issuance.

Revised DEIS Response

The revised DEIS needs to set forth a sustainable development scenario within the "No Action" Alternative in order for there to be a meaningful comparison of alternatives between a sustainable future and one dominated by uranium mining and milling and legacy sites. At least one sustainable development alternative needs to be considered. Furthermore, the proposed action needs to be evaluated in the revised DEIS for its potential detrimental effects for long term regional sustainability.

Conclusion

Alternatives: the DEIS fails to develop the No Action alternative to reflect sustainable development options only possible if uranium mining does not re-commence in the ROI. Given the likelihood that approval of Roca Honda mine will make impossible a sustainable development alternative, the "No Action" alternative should be enhanced to give decision makers a clear understanding between a sustainable and uranium mining alternative.

Baseline/Base case

23. The baseline analysis contains a description of the setting and delineation of past and present conditions. But in instances such as this DEIS there is more than a passive baseline; rather, there is an active base case. In other words, "eco-historical" factors such as legacy contamination actively influence Psycho-Social impacts from the proposed project. We need to understand how the project is understood and what it means to people in the ROI. In turn, the perception and cognition of Roca Honda uranium mine will influence the degrees of stress, range of concerns, emotions and responses to the project. There is, thus, no firm dividing line between base case conditions and project impacts. This grey area is illustrated by two examples, social dysfunction and legacy impact.

A. Social Dysfunction and Health

Social dysfunction jumps out as a baseline condition of critical importance. Pervasive social dysfunction is evident in baseline statistics for Cibola and McKinley Counties. Traffic fatality rates are significantly in excess of New Mexico (U.S. Forest Service, 2013, p. 395). Alcohol and drug-related death and injury occur at rates greater than the US (death rates are 3 times the US rate in Cibola and 4 times in McKinley County) and significantly greater than New Mexico or the US. In both counties, self-reported drug use occurs in a third of youth and suicide among youth is as high as it is for adults in McKinley County (U.S. Forest Service, 2013, p.396), with more than 15% in McKinley County reporting having attempted suicide in 2009. Cibola County's rate of depression (at 15.4%) is second in New Mexico and rates of sadness and hopelessness remain constantly high in both counties. Although likely underreported, rates of domestic violence in Cibola County were 9 per 1,000 population in 2007 and 13.2 per 1,000 in McKinley County (U.S. Forest Service, 2013, p.397). Aberrant levels of depression and suicide are found

in both counties (U.S. Forest Service, 2013, p.401). The number of uninsured persons in both counties is higher than the US (16.7%) (U.S. Forest Service, 2013, p.404).

Meanwhile, the local population also has significant health problems to address, including lung cancer. Additionally, health data summarized in the DEIS reveals at least tentative associations between hypertension and proximity to uranium mining (for Navajo), (U.S. Forest Service, 2013, p.388), elevated hospital admission for asthma (U.S. Forest Service, 2013, p.389), elevated incidence of kidney cancer (for Natives) (U.S. Forest Service, 2013, p.390), an association between uranium exposure and kidney damage, particularly for Native and Hispanic diabetics (U.S. Forest Service, 2013, p.391) and elevated levels of obesity and diabetes (U.S. Forest Service, 2013, p.395).

As a base case, we then are concerned with the implications of this condition. Might it mean that there is insufficient coping capacity to deal with major new community stressors, that the community has very high vulnerability? Will the proposed project compound and increase the problem or help to ameliorate it? How will social dysfunction interact with new circumstances caused by Roca Honda mine to generate Psycho-Social Impact?

The DEIS acknowledges that these baseline conditions are likely to be exacerbated by guest workers brought in for the Roca Honda mine.

Of particular concern are alcohol and drug abuse, and associated injuries and mental well-being. These types of health impacts have commonly been experienced in other resource extraction communities across North America....These impacts have also been observed in the ROI during previous uranium development boom periods.... (U.S. Forest Service, 2013, p. 395).

But, lacking any further research and analysis, there is no substantive review of just how significant this adverse impact might be, the complications of cumulative impact or whether this is an EJ issue. While the jobs advantage of a boom cycle is echoed often through the DEIS, the contributions of a boom to already significant levels of social dysfunction are so understated that they might be missed by decision makers.

Revised DEIS

The reissued DEIS needs to be clear with regard to social dysfunction, as with other base case issues, about what the actual potential impacts are, what they mean, and whether they are subject to mitigation.

B. Legacy Impacts

Legacy impacts have a synergistic relationship with the proposed project and serve both as a base case condition and also a main variable of impact. We address the base case here.

In developing a base case, one would routinely study the effects associated with a similar project and generalize to the proposal impacts. In the Roca Honda mine ROI,

there are a plethora of such sites. Counting only unreclaimed sites, the DEIS mentions "500 abandoned mines in Navajo Nation and 97 legacy mines and 5 mills in the Grants Mining District" (U.S. Forest Service, 2013, p. 381). Accordingly, the DEIS acknowledges legacy mining contamination as a contemporary characteristic of the ROI and concludes that "Legacy issues associated with contamination and health and safety impacts from past uranium mining and milling would continue for the foreseeable future" (U.S. Forest Service, 2013, p. 424 and xi).

The DEIS further acknowledges Psycho-Social impacts associated with legacy conditions as potential causes of secondary health and community impacts and response to the uranium mining proposal in the Roca Honda ROI:

- "Legacy issues' ... remain deeply embedded within the social history and collective psyche of these communities, and continue to affect current perceptions and the adaptive potential of both communities and individuals toward new proposed projects. As such, legacy issues act as a social determinant of health and are linked with chronic diseases, social pathologies, and mental health. Ultimately they affect the future trajectory of communities." (U.S. Forest Service 2013, p. 427).
- "The stress and anxiety levels of residents in the ROI and, in turn, the mental, physical, and social health effects of these feelings, are affected by both historical and present-day factors. These factors include the known and the unknown health effects of uranium mining and the large number of unreclaimed and contaminated mine sites within the area. As well, high levels of poverty and the past reality and future possibility of a boom-bust cycle magnify the potential for impacts to mental health in the ROI. Not only are the factors interactive; that is, they can heighten stress and anxiety because they occur together, but the stress and anxiety related to these factors are cumulative and may compound over time. While the interactive and cumulative nature of legacy issues makes future outcomes of communities facing new resource development projects difficult to predict, the complex nature of legacy issues also underscores the importance of developing a deep understanding of these issues, and the need to mitigate stress and anxiety levels associated with them when proposing new projects." (U.S. Forest Service 2013, p. 432).

However, has a "deep understanding" of these issues been achieved in the DEIS and the impacts mitigated? Unfortunately, while admitting that legacy contamination is more than baseline and actually a cause of impact, the DEIS does not pursue these issues further than the above prescient statements. It acknowledges that legacy issues affect perception and that perception can influence Psycho-Social impact, but it offers no explication. And, it sidesteps the conundrum that, if the legacy impacts are continuing and significant, adverse and perhaps unmitigable, there are clear implications of the failure to manage and mitigate these impacts for the permitting of new projects. These omissions must now be addressed.

Moreover, the DEIS confounds the issue at some points by trying to draw a regulatory line between legacy issues and the proposal:

"However, the actions and their consequences associated with these legacy issues are not part of the proposed action and would not occur at the proposed Roca Honda Mine" (U.S. Forest Service, 2013, p. 272);

and

"... there is little or no connection between the legacy health issues of uranium mining and processing in the past, and anticipated health and safety effects from the proposed Roca Honda Mine" (U.S. Forest Service 2013, p. 442).

Even as it disconnects legacy and project health and other effects, the DEIS simultaneously acknowledges that such a connection exists.

"...there would ...be a corresponding cumulative, moderately adverse social impact for those minorities and low-income residents convinced that new uranium mining projects would exacerbate long-standing and unresolved legacy health issues" (U.S. Forest Service, 2013, p. 279);

and

"Risk perception and control over one's environment also has strong ties to health. Legacy issues in the area have created a high-stress environment for receiving a uranium mine. Regardless of the results of air and water quality assessments, there may be some residual concern and stress.... (U.S. Forest Service, 2013, p. 412);

and

The DEIS further acknowledges that the legacy conditions make "its population vulnerable to specific health challenges" (U.S. Forest Service 2013 p. 424).

This ambivalence has to be addressed. From the standpoint of the DEIS, there is no way to separate the legacy impacts and impacts from the proposed project, as the DEIS has acknowledged. Therefore, a comprehensive examination of legacy impact is required. In this declaration, legacy is examined as more than a baseline condition, but as an indicator of impact as well. To underscore that legacy impacts cannot be divorced from the project, a case study will be presented that explores the interaction of the two.

In short, the base case---or the legacy issue---unlocks a great deal of understanding about the myriad facts covered in the DEIS by offering a roadmap to their origins and interrelationships. In turn, these conditions cannot be extracted from the even deeper history of subjugation of the Native American population of the region and continent. What is brought together, then, by a properly constructed base case is a means of relating the marginalization of a good segment of the local population (the basis for the Environmental Justice analysis), the issues of poor mental health and social dysfunction cited in the DEIS, the issues of illness cited as well, and the key issue of "perpetual jeopardy" that allows a continuing cycle of degradation in this area to be masqueraded as economic development. And,

environmental stigma associated with the fact that the contamination legacy is ongoing actively precludes other options until it is fully addressed.

Another of the many legacy issues that belong in the base case should be noted. And that is the history of boom-bust cycles in the region associated with uranium mining. Widespread and large-scale uranium mining and milling in the Grants Mineral Belt went bust in the 1980s when uranium mines and mills shut down (U.S. Forest Service 2013, p. 278).

Legacy impacts encompass historical, contemporary and future issues. They are occurring to the same populations, in the same ecosystems, waters and region. As such, legacy issues presage impacts of the Roca Honda mine. Moreover, the existence of the unreclaimed mines and mills creates an environment where lifescape (perceived health, control, safety of home and environment and trust in authorities) is adversely affected in ways that interact with the response to the proposal and will interact with and perhaps cause impacts that the mine may have.

Revised DEIS

The DEIS fails to develop critical baseline conditions as a base case for predicting impact. Moreover, in the case of the eco-history of prior contamination events, it is necessary to treat these legacy conditions as a standalone indicator of impact in the revised DEIS. A complete baseline assessment should be prepared that can serve as both an indicator of present exposure, a basis for remediation in the current frame and a basis for comparison in terms of monitoring future impacts from the Roca Honda Project and cumulatively from all future mining and milling operations. For example, given the acknowledged threat to ground water, the revised and re-issued DEIS should clearly address what community and private wells in the target region around Roca Honda Mine (including the community and private wells in the Grants Mineral area and in the vicinity of Pueblo of Laguna that currently have uranium in the groundwater as the result of prior mining operations and/or natural occurrence). The same should be done for all other potential risk pathways for the entire region.

Impacts

Legacy as Psycho-Social Impact: The Case of Homestake Mill

24. In my own work on populations living near hazardous sites, whether Native or non-native, it is clear that the burdens of the past live on in myriad dimensions. They represent continuing hazards where clean up has not occurred; a health shadow where people show patterns of illness that they associate with past or continuing exposures; a breach of trust where corporations or government has failed to live up to its responsibility; a source of community conflict where some are deeply concerned with past hazards that others ignore, perhaps because they are newcomers or because they have a vested interest in the problem or because they are unemployed and focused on opportunity; and an impediment to local economy, which is stalled by the Environmental Stigma created by the legacy of contamination. As I note elsewhere, Environmental Stigma serves as a source of Perpetual Jeopardy because an area already contaminated and not cleaned up invites more of the same. From the standpoint of individuals, the lack of progress creates a sense of helplessness and hopelessness,

contributing to social dysfunction. For activists, it creates a sense of wasted effort pushing for actions against intransigent forces of government and recalcitrant and even hostile forces of industry. And the meta-message of all legacy settings is that the Environmental Stigma has become a social stigma; local people are now so marginal, so unworthy, so worthless, that society will leave them living in an environment that is contaminated, unhealthy and degraded without lifting a finger to help.

I spoke about just these issues with Jonnie Head and her daughter Candace Head-Dylla. The Head homestead is located nearby the Homestake Mill Tailings Pile, an in-progress Superfund site.⁶ The Homestake facility was initially built in 1958. The site was added to the Superfund NPL in 1983. The plant was decommissioned and demolished between 1993 and 1995. However, the site continues to contain two mill tailings piles of 170 and 40 acres, respectively 80-100 feet and 25 feet high. Issues under continuing remediation involve addressing groundwater contamination of the aquifer, stabilization of the mill tailing piles and addressing outdoor radon gas exposure in five nearby communities just to the southwest of the site boundary. EPA has concluded that all activities relating to the groundwater and pile stability and cover are under control, although a plume of contamination continues to be generated by the tailings piles and residents continue to be given municipal water to replace their wells. However, because EPA is concerned about radon gas exposure from the site, it continues to monitor communities for outdoor radon. Because radon levels exceed the federal guidance, a Health Risk Assessment is being prepared. Overall, remediation is incomplete and the site is not delisted. No date is specified for completion of remediation.

The Head family moved to the small neighborhood of Murray Acres adjacent to the Homestake site in 1975 and has ten nearby acres. Candace lived there for a few years when in high school and then later returned with her own family to the neighborhood in 1985. The Heads were initially aware but not attentive to what was happening on the property nearby and, assuming things were "maintained and handled" did not view it as a threat. Milton, Jonnie's husband was a uranium miner and she was a realtor. The property had seemed an "ideal spot" to them because they could live in the country, allow their two children to keep and ride horses and have a "4 H life," and irrigate freely from a well for their small farm. In Candace's recollection, *"this was an amazing opportunity to live where there was hay and we did not have to haul water. It was like we moved to heaven."* Candace's schoolmates never talked about the mill, but they had reportedly played as children in the unfenced tailings water. Arriving in town at an older age, for Candace, the mill tailings were just a *"big small hill off in the distance... I never thought about it, it was not in my consciousness."*

One can get a clear sense of how the legacy analysis in the DEIS is deficient by examining how this family's life was transformed over time by the Homestake mill. Figure 1 is taken from an EPA slide show on the Third Five Year Review that addressed radon testing. It is included here because it shows just how close residential areas, including Murray Acres, are to the Homestake site. Accordingly, in retrospect, it is not a complete surprise that within a year of their move, the Heads received a notice in

⁶ Region 6 EPA, Third Five-Year Review Report, Homestake Mining Company Superfund Site (EPA ID: NMD007860935) Cibola County, New Mexico September 2011. Downloaded May 31 13 from [Hhttp://www.epa.gov/region6/6sf/newmexico/homestake_mining/nm-homestake-mining-3rd-5yr_review.pdf](http://www.epa.gov/region6/6sf/newmexico/homestake_mining/nm-homestake-mining-3rd-5yr_review.pdf)

the mail telling them that the well water was unsafe to drink or use for cooking. Jonnie "was almost in shock." Replacement cooking and drinking water was furnished by Homestake in the 10 gallon jugs used with water coolers. She had to haul it into the house and set it on a rack in the kitchen. They did not think about where the water came from until much later, when they were told by someone from Homestake that either the water was filled from hoses in Grants or else or, as Candace quoted her source, "sometimes we even fill them with contaminated water right off the site." The family continued to bath and shower in well water.

Back in 1980-81, in one of my first studies, in Jackson Township, New Jersey, I encountered another neighborhood forced to drink delivered water because of contamination. That was the first time I had to put myself in the position of people interrupted from daily tasks that most of us take for granted. But as awkward and inconvenient as life became, and as deeply untrusting of the delivered water people grew, the core meaning of breaking normalcy is that one is reminded of the reason every time one needs a drink or cooks lunch. The lifestyle alteration involved is not just a change of routine. It is a recognition that one and one's family has been---and may still be---exposed to hazards.



Figure 1: Adjacency to Homestake Superfund site of Murray Acres and other residential communities

The Theory of Environmental Turbulence predicts that, when contamination victims fail to receive adequate help from their social and institutional networks, they eventually turn to each other and form a local organization to advance their understanding, gain support and find efficacy in addressing common interests (Edelstein, 2004). In just this way, the water contamination issue got the Heads and other neighbors to organize as the Blue Water Valley Downstream Alliance. As they explored what was happening, they became interested in how the contamination was being cleaned up. However, they

were not impressed with what was being done. Milton, whose years in the mines gave him considerable experience with managing uranium, testified and critiqued the plans but, as Candace observed, *"they treated him like a nut. And the truth is that all the things he questioned and said would not work have not worked. Every single comment dad made that he had said it wouldn't work or would work differently, he has been correct."*

As in the many other cases I have observed and studied, these experiences serve to delegitimize the process, rob citizens of their confidence and destroy trust in government, corporations and the efficacy of the cleanup.

What happened next is illustrative of what occurs at many Superfund sites. Feeling that they were being ignored by the agencies and corporation, and concerned that they were still using water that they had been told was contaminated, the Heads and their neighbors realized they needed a new strategy to address the situation. Retaining representation, they brought suit against Homestead. Jonnie spent a good deal of time assisting the attorney with research and raising money to pay the bills. At around the same time, EPA named the Homestake Mill a Superfund site. As their lawyer implied, government appeared to have stepped in to take care of all the problems. In the end, they settled the lawsuit for promises of remedies that EPA was requiring anyway. They now believe they were misled by an attorney with ties to the mill to settle for what Homestake already was required to do.

In any case, under the agreement, municipal water from Milan was extended to Murray Acres. They would receive free municipal water for ten years by which time their wells were supposed to be again safe to use.

This was just about the time that Candace moved back to the area with her husband and child. Well aware of the contamination from Homestake, she consulted with her parents. Believing that the settlement and Superfund would address the problems, they reassured her to go ahead. As she recalls,

Our understanding at the time was, gosh, EPA and Superfund have hundreds of smart engineers. There is no way they are going to let this get away from them. And dad you have pointed it out to them. We had such just faith in what all these smart people in government were going to be able to do, and we still believed in the company at that time. Don't you worry, it will all be done. So we moved to the area with our small child.

Assuming that the new water source and Superfund cleanup had resolved the problems, they bought a piece of land in Murray Acres. As Candace describes it,

"Yahoo!!!" We were so exited. The kids could live in the country with animals, be near their grandparents, we have water to irrigate and free water to drink and in 10 years the well will be back. It was like the ideal life---it was just perfect.

However, Candace got drawn into activism on the cleanup in short order. By a strange and unfair twist, some people in their community were never connected to the municipal water and continued to use the contaminated ground water. Candace and Jonnie and others in their group went to public meeting after

meeting informing every involved agency about the people who were not hooked up, but nobody listened. Then in 2009 Candace practically screamed at a new EPA official to get her attention. Before long, EPA had identified 11 families still using well water for their home supply. An inter-agency Memorandum with Homestake brought a municipal water connection to these families. When Homestake acted like they had provided the water, not out of obligation, but "*out of the goodness of their heart,*" Candace and Jonnie were dumbfounded that the corporation had evaded admitting responsibility for the problem.

In the meantime, Milton continued to raise questions about how the clean up was being conducted. Glaring inefficiencies were evident in the coordination between multiple government agencies attempting to share responsibility for parts of the site. It was a case of too many cooks and too little cooking. Cleanup targets were continually pushed back. Candace described the regulatory slide they encountered.

It is very interesting, NRC controls the actual property; EPA has jurisdiction for Superfund outside the boundaries of the site. It was scheduled to be turned back to the DOE in 1997. Every date that they set when this would be cleaned up has been pushed back at least 4-5 years. And now the new target dates for cleanup is 2017. And we have experts who say it will not be cleaned up in 2017 either.

Health issues are a constant lifescape consequence of such contamination events. Regardless of the actual patterns of illness that may be found, it is hard for residents not to understand that their health and the health of their family have been put at risk. It is common for symptoms to be compared and for activists to prepare symptom maps in an effort to identify whether a cancer or other disease cluster exists. Candace and Jonnie had undertaken just such a project in their own area.

When asked about symptoms in their area, Candace recalled that, at the time of the water notification, selenium had been found in the drinking water, and "*...people had hair fall out, and there was local knowledge that there was some kind of problem.*" She then described the illness incidence map she was making. She proceeded to list illnesses and deaths from the community, identifying people by name but also by location (closest to the site or just behind me, etc.).

We have gone around in the neighborhood and we have noticed there is a high incidence of thyroid and of cancers and there is a lot of prostate trouble.

The effort was motivated here, as generally, by the refusal of agencies to do an epidemiological study on the grounds that "*there is no way they could tease out that so many people in the area worked in the mines....*" When ATSDR conducted a drive-by assessment to see who had clean water to drink, they publicly announced that they found a problem. Candace claimed that the public revelation brought an immediate backlash.

They did it at a time we were complaining that community members still did not have clean water. They said the area is a disaster. It was a real negative report. It plummeted our property values even further.... Homestake jumped down their throats and they retracted.

After people were all hooked up, ATSDR was forced to credit Barrack Gold for providing clean water. "There is no problem. You are good to go."

The inability to resolve uncertainty over health effects was not specific to the Heads. The Native Americans I spoke with also found agencies to equate a lack of proof with there being "no proven connection" between uranium mining and health. The bind created for Native Americans in the uranium belt was described by Manny Pino of Acoma:

I grew up here. This is my home. So we have been impacted by this uranium legacy all our lives. And we live with the effects of it, both economically and psychologically. Acoma never went into uranium mining. We are sandwiched between 2 major areas of uranium mining, our sister Pueblo Laguna to the east and to the west the Grants Uranium Belt/ Ambrosia Lake area. So our people have been affected by it. Even to some extent today, though mining ceased, our people are still stuck with environmental impacts, by the types of poor water resources on the reservation and by the poor health on the reservation that both workers and families face today. It is an unknown cause of all these illnesses that have befallen people not only in Acoma, but all people who live long term in this area, Indians and non Indians. It is an important thing to consider. Even though the state has had decades of uranium mining, there has been little epidemiological study of the effects of the uranium industry and the state knows this. So it is hard for lay people like ourselves to draw upon scientific data that demonstrate that these are the problems that are occurring and have occurred because of the uranium industry, especially the psychological impacts.

Certainly in the perception of both Natives and non-natives of the region, there is a credible connection between exposures and health, justified both by the obvious hazards but also because of the "recreancy" (Freudenberg, 2000) or irresponsibility of the government agencies that purportedly were supposed to be protecting them. There was no reason to assume things would be different with a new generation of uranium mines.

Returning to the conversation with the Heads, we were able to move beyond the impacts on their family from the long period of temporary water supply, the demanded activism, and concerns over drinking polluted water. Another indicator of adverse Psycho-Social impact was evident, namely Environmental Stigma, or the perceived devaluation of contaminated property and those associated with it. As a realtor since the late 1970s, Jonnie was in an interesting position to observe how the local economy was impacted by Environmental Stigma. The Grants area, Candace recalls, "had this reputation as the uranium capitol of the world, so when people would come to the Grants area in general they would say "Do you glow in the dark?" But, more knowledgeable people knew more precisely where the problems were. Thus, Jonnie found a specific Environmental Stigma "in our area, local people knew that we had problems out in Murray Acres and tell people not to live north of Milan..." The thought was finished by Candace: "people were still buying, just not in our area once they found out about the contamination." Thus, the issue did not initially impede Jonnie's work as a realtor, although it made it difficult for those living near Homestake to sell and move away.

This loss of investment and value is something that Jonnie thinks about as she becomes older.

I am 72 years old....we are encouraged to save for our old age and retirement and all of my money and all the hard work, you know I did real estate for 21 years and my husband worked hard his whole life and all our investments are for nothing. It hurts to know that my neighbors---the people in Grants I have known since 1957, friends and neighbors or at least neighbors, people I have worked with and so on, do not understand the frustration that you feel when all of your money and hard work is in a place that you know in your heart you cannot get your investment back from and the water will be allowed to deteriorate and therefore in the years to come will probably never be able to be used again.

As an added illustration of the problem, Candace has been trying to sell her house but, unable to, she has been forced to leave her husband and child behind as she moved to a new job.

While the Homestake Mill Superfund site affected sales and values in the areas north of Milan, another form of Environmental Stigma was also in play. Thus, Jonnie's real estate business thrived on sales in other areas until affected by another dimension of the contamination problem, her activism.

I didn't start having problems until we started attending meetings and asking questions of EPA and NMED [the New Mexico Environment Department] and started getting very vocal about we see what you are doing as a problem; that is when I began to see problems at my office.

Then a community backlash against her activism slowed her business down. This kind of "don't shake the grapes" response is not uncommon when the contamination event, itself, is not overly visible but the response to the situation by those most caught up in it attracts media attention and makes the problems much more public. Environmental Stigma, like all stigmas, requires visibility to have an effect.

At the time, agency documentation of the Homestake Mill Superfund site suggested that everything was under control and there was no reason to avoid buying there. Essentially replicating the rationalization that had allowed Candace to move back herself, some people purchased property despite the Superfund designation. One such case was John Boomer, an artist who arrived in January 2001 and exercised what he thought was due diligence before he bought.

He wanted to know what was going on, so he looked at the EPA fact sheet. And they always paint a rosy picture, EPA and NRC. And he did not think it would be a big problem. It did not seem a problem; you wouldn't think so from what EPA posted for public information.

What was John Boomer's subsequent reading of the situation? It turns out that Mr. Boomer was interviewed in January 2011 for the EPA's third Five Year Review of the Homestake Mill Superfund site. Table 1 presents an excerpt of the interview summary filed by John Moloy of the U.S.A.C.O.E. and appended to the EPA review.

A second member of the Bluewater Valley Downstream Alliance (BVDA) was also interviewed by Moloy in January 2011 for the Third Five Year Review. Art Gebeau's excerpted comments are displayed in Table 2. Such agency interviews corroborate this assessment.

Like the Heads, Mr. Boomer and Mr. Gebeau sought to work with fellow community members to try to address the situation they found themselves in. But by becoming activists, their efforts threatened to polarize the very community they sought to help. That was certainly the case with Jonnie and Candace.

Community conflict is one constant outcome of such events because, while those driven to become activists are frustrated at the failure of agencies to undo the damage that previously permitted facilities have caused, others in the community want to squelch controversy at any cost, do not understand or care about the threat or have vested interests that bring them to support their understanding of their own best outcome. The vague belief in jobs and improved economy are the most common of the latter. As activists query, research, confront, demonstrate, oppose and publicize, the unifying fabric of community is threatened even as their actions are intended to protect health and environment beneficial to all.

Table 1: INTERVIEW RECORD: Summary of Conversation with John Boomer, Property Owner

1. What is your overall impression of the project (since 2006 Five-year Review)?
 - Gives Homestake (HMC) a grade of D-
 - Does not think the remediation is effective – it’s dilution instead of treating the water
 - Mr. Boomer referenced a breach of one of the evaporation ponds in the 1980s as the reason for elevated uranium levels recently detected in soils in his backyard
 - There are a lot of unanswered questions – for example, regarding irrigation and how clean water is being pumped into contaminated water – it’s mixing with a little bit of treatment

2. What effects have site operations had on the surrounding community?
 - Concerned with the affects that contamination from this site will have when combined with discharge from other mining operations proposed for the area
 - Impacts are the spread of the plume, initially going to the edge of the HMC property, and that no one really looked for the plume downgradient
 - Remediation has divided the community – those that speak up against are ostracized

3. Are you aware of any community concerns regarding the site or its operation and administration?
 - Yes, see above responses
 - Have grown to mistrust a lot of HMC’s efforts....

6. Do you have any comments, suggestions, or recommendations regarding the site’s management or operation?
 - Would like to see the large tailings pile moved and isolated – moving the site would show responsibility and provide relief to the community
 - Would like to see the source removed and to see a feasibility study on the effort
 - If existing remedial system continues, would like to see additional monitoring system established in the community – possibly every one-half mile
 - Would like to see better monitoring in front of the plume and would like to see a plan for this monitoring
 - Would like independent analysis of the alluvial floodplain to set a baseline for other mining operations proposed for the area (five more mining companies trying to obtain permits to mine for uranium in the Mount Taylor area)
 - Gives HMC a grade of D- on community education

Table 2: INTERVIEW RECORD: Summary of Interview Art Gebeau, Property Owner

1. What is your overall impression of the project (since 2006 Five-year Review)?
 - Poor – Homestake (HMC) got off to a terrible start and the remediation cannot be handled
 - The major problems are water, radon, and blowing dust
 - Homeowners have found residue on their cars as much as one-half mile away from the spray irrigation
 - The center pivot irrigation has started new areas of contamination
 - HMC is trying to dilute as a means of treating the problem
 - The reverse osmosis treatment facility should be enlarged

2. What effects have site operations had on the surrounding community?
 - The issues with water, radon, and blowing dust have taken away our enjoyment of life, particularly close by
 - Taken away the use of our wells and imposed costs on us from water supplied by the city of Milan

3. Are you aware of any community concerns regarding the site or its operation and administration?
 - Definitely so – BVDA joined with MASE (Multicultural Alliance for a Safe Environment) and both are represented by the Southwest Research and Information Center...

5. Do you feel well informed about the sites' activities and progress?
 - Not from HMC
 - EPA has been good in the last year or so and this interview is a positive step – three or four years ago we wouldn't even be sitting here
 - NRC promotes but doesn't regulate the industry
 - Any economic relief will have to come from EPA and not the New Mexico Environment Department – EPA seems to be the one chance people have

6. Do you have any comments, suggestions, or recommendations regarding the site's management or operation?
 - HMC has not done their job – they ignored their job
 - Corporately, HMC is owned by the largest gold mining company in the world – and a little more money should be spent to do the job right – it would be a drop in the bucket to what they [Barrick] are making
 - Would like to see the large tailings pile moved to an appropriate place in the area – moving can be accomplished by slurring or a conveyor belt
 - HMC should take the same approach as was used at Durango, Colorado and Moab, Utah and move the tailings pile
 - HMC has not gotten out in front of the problem – they have a poor knowledge of the geology of the area – they put in injection wells and pushed the groundwater plume out away from the HMC property

Jonnie Head recalled that the conflict even crept into her tiny community of Murray Acres. And, within the overall Milan-Grants area where there is strong demand for jobs, "*they feel we are making waves... So we are not very well liked right now.*" This is a continuing pattern. Economic development had been

captured by the uranium industry, and many people had a difficult time conceiving of any alternative future. At the moment of our interview, Jonnie Head had just backed down from her plan to convince the Chamber of Commerce to examine tourism as an alternative future direction over uranium mining. A major employer had announced they were leaving the state, making the timing bad, and "*they already don't like us...and we are really not going to be popular.*"

Hearing her mother say this, Candace offered an analysis of the nuance in her mothers' way of talking that gave a snapshot of the understated Frontier culture while getting at local conflict hidden beneath her words.

Mom says that in kind of a light way, that is our culture. We try to laugh off and put things in a shell that are not pleasant. So she can say it in a laughing way, but it would shock you to feel the level of animosity she would encounter for doing that. It is bad enough in our own community, and it is certainly worse in the larger community.

Such activists are driven to act for the community yet often reviled for their efforts. Candace went on to explain her theory for why some community members support the proposed mine, revealing a "boom psychology."

When you step back and look at this, well, a lot of middle class people moved here when the mines came in during the uranium boom. And we were carrot farmers before that, loggers, Homesteaders that kind of thing. And then came this big boom and some people got filthy rich out of the whole thing. And people who scrabbled their way up to the middle class, they watched these people get rich...off of the mine supply and the housing and all the various things that make a boom town. And now, all the people who through wage work have reached middle class, they think "I know how this was done. I watched how this was done." A lot of them are business people, and they think, "If we have another boom, I know how to exploit it. If we could just get this thing going." So your biggest supporters [of new uranium mines] are middle class who think, "Give me the chance, I am ready to exploit. Give me the opportunity." And they do not want to think about anything else like what we would do if we brought in tourists.

This group, Candace suggested, is not after jobs. "*If you ask them if their kids or grandkids will work in the mines, the response is 'no my kids are not going to be in mines.' So who are these jobs good for? Who?'*" She noted that even residents eager to build fences along our southern border supported importing labor from Mexico to work in the mines.

Whatever the causes, the dynamic of community conflict in a small region where everyone knows everyone else is hurtful, as Jonnie Head acknowledged.

It hurts to know that my neighbors---the people in Grants I have known since 1957, friends and neighbors or at least neighbors, people I have worked with and so on, do not understand the frustration that you feel when all of your money and hard work is in a place that you know in your heart you cannot get your investment back from and the water will be allowed to deteriorate and therefore in the years to come will probably never be able to be used again.

In short, the economic downturn that the larger community feels has already been very much experienced by those most impacted by legacy sites.

But, do these legacy effects carry forward to the Roca Honda project, presaging how the proposed mine would impact people in the region? For Candace Head-Dylla, whose property is approximately five miles from Mt. Taylor, legacy issues are central to her concerns. There are several dimensions of legacy referred to. First, is the legacy of fear, distrust and marginalization.

It is like you spewed toxic contamination in an area that affects people's ability to live there safely. And that fear projects out into your family, like I worry about my daughter and grandkids health, so you have this ongoing fear about the exposure that you have already. And before anyone has even addressed that exposure in a real way, you say we will do it again and do it better this time. They haven't even figured out how to clean up the last mess. And they say they will do this without causing a mess, but that has not been proven anywhere. And I think our experience proves their inadequacy, their ineptitude. And our experience is also an absolute proof of their disregard for human life, their disregard for the health and welfare of the people in the area. They care absolutely nothing about us. We are expendable people!

A second dimension of legacy is the idea that new uranium projects would be undertaken before prior projects have been cleaned up and the environment restored, as also expressed by Candace.

More local uranium mining means more potential for nuclear contamination. That's a disaster for our kids, our grandkids, it is just wrong on every level. And if Roca Honda comes in, now you have more people who are going to be exposed because there is no way to mine it carefully.... And all it does, if you let industry come in before they have even cleaned up the mess they created in the first place, then the battle is completely lost.

This eco-historical perspective appears to be shared by both Native and non-native residents of the Roca Honda region of impact. These people have lived with the consequences of prior uranium extraction and processing for more than a generation. For new mines to be permitted without addressing unfinished legacy work reinforces two dreaded outcomes: that the legacy cleanup will never be finished and that a precedent is set for future irresponsibility, degradation and contamination. These outcomes are anathema to activists who have virtually made it their life mission to see cleanup and restoration occur, a profound violation of what they have learned about becoming stewards and taking responsibility for the landscape for future generations. It is antithetical to any sustainable impulse. It is also in complete contradiction to the language of the National Environmental Policy Act, the authority for the DEIS.

In such instances, considerable control over life is lost to contamination events and lifestyle may be dominated by them. People must deal with the stress of such situations and cope with the demands made upon them.

The fact that local property owners such as the Heads, Mr. Boomer and Mr. Gebeau are so versed in Homestake itself is a good indicator of impact. These are people who intended to spend their time in more conventional ways and live normal lives. Instead, they have been forced to become immersed in a

Legacy issue that has not gone away. They have had to devote their efforts, create a local organization that has been maintained for several decades and network and join regional organizations in an effort to end the Homestake legacy. The fact that the site is now thirty years on the Superfund NPL itself makes a generational statement. A 35-year-old mother with children in High School moves to Murray Acres in 1975, a year before notice of water contamination, and now, at age 73, Jonnie Head has spent more of her life dealing with Homestake Mill than she spent before she came into its pull. And the Homestake mess is not over yet. It is possible that the Homestake debacle will outlive her. It may end up being one of the major influences on her entire adult life.

And considerable emotion is also roused by the press of life in a contaminated community. During my interview with Candace and Jonnie Head, Candace ended one of her reasoned statements by suddenly blurting out "*.... I hate the NRC. I hate the EPA. You have no idea the animosity I feel for those people.*" She then went for a cup of coffee to regain her composure. While she was gone, Jonnie explained how the family has been treated by the major agencies over the years.

I think that NRC is totally pro-industry. They are rude to us at meetings and are not concerned about us at all. EPA smiles and nods and acts like something wonderful was going to happen to us and nothing ever does. I have no faith---none--in my government agencies any more. And this has worn on me for all these years trying to do something that is gonna make a difference for future generations and myself and feeling totally frustrated by the effort because I see nothing improving.

Jonnie then went on explain how she has felt throughout this whole protracted ordeal over Homestake, "*It is a continual lump of lead in the pit of your stomach because you know it is there all the time.*" Ever practical, she added at the end, "*but life goes on.*" Candace, having returned, was compelled to explain this addendum as reflecting the psychology of stoicism and pragmatism indicative of the frontier culture.

When you hear my mom say that, you have to understand that my family has for many generations been living on the frontier. My family came here in the 1600s and it has continually pushed the frontier. So there is a stoicism you really can't understand. So "life goes on." Every day we are trained not to be cry babies or to be weak, but to be stoic and not to go on about troubles. Dad suffers the health effects of spending a lifetime in the mines and then to have what you saved and worked for taken away from you, if you give in to that, you will be crazy, stark raving. So the way we deal with that is to keep doing something proactive, that is what we do with the organization and with MASE, and just keep working. That is what we are trained to do, that is what our culture does.

It was also a culture accustomed to deprivation.

We are the kind of people who were always are on edge and used to harsh conditions. And that is definitely true of the Native American communities we work with. And we are used to the deprivations of hauling water and having to scrounge for things and we are used to that. And that may be the only thing that makes us able to resist and not go stark raving mad.

As Candace continued, she noted that frontier people were fundamentally independent of government even as government was seen as serving its best interests.

It's a culture, and that is true of many of the people in our community, we never really were dependent or thought much about the U.S. government. Most the families were on the fringe of the U.S. government until the last two generations. We were always beyond the reach. But we thought that the U.S. government was back there. And it was concerned and capable and good and it was concerned about the health of the people. But this experience certainly took all of that away.

Of the first generation to go to college in her family, Candace also recognizes that the frontiersman's lack of education allowed them to be exploited despite their seeming independence and to be used to exploit others. This realization is now so central to her thinking that she has become a Professor of Literacy to prepare people to not be so exploitable. With education, she suggests, she came to understand the history of colonialism and exploitation. Now, working in MASE, she has come to understand a much bigger picture of the frontier dynamic.

We were the poor people when the richer white people came and colonized this area and said we need some more white people around to support our exploitation. We are the people who were sent in as Homesteaders because we were too dumb to make a living for our families. We did not know what was happening when we came out. But now that we work with MASE, we understand that we were used to exploit these Native American groups. And we are all being exploited by larger powers who we hardly understand and barely recognize.

And now informed, the stoicism and ability to persevere allows them to take on these larger powers, despite the mismatch of resources.

If you even sit down and ever think of the atrocities. And think about a company that netted 4.4 billion in 2011 being unwilling to just clean the mess they made in that community. And...these are the things we talk about all the time in MASE....all these new companies coming in, they have unlimited funds and yet they can't see their way clear to clean up these little communities, which shows how truly unimportant we are. And our government is in a sort of collusion with these corporations---I don't know if they see it this way---against us. If we don't persevere, make some jokes and laugh off it off, and just keep putting one foot in front of the other, I don't know what we would become. You just have to keep doing it.

But the psychological costs can be daunting. Candace recalled going to a hearing in Gallup several years ago with Larry King and another war veteran, Teddy Nez. "We were talking about how it weighs on you psychologically in a way. And Teddy said that he has flash backs to his service experience and it starts a whole cascade of emotion. And once you start down that path and it is almost you don't want to start down that path because it is too overwhelming." Candace had never been to war like Teddy, yet she could relate completely to his experience of trauma. It would be interesting to know how many people have traumatic symptoms because of legacy exposures throughout the region, regardless of culture. The DEIS needs to burrow into the legacy consequences to get sense of such how deeply the ROI's

population has been scarred---in whatever way---by those 2000 abandoned mines in the Navajo Nation and 97 legacy mines and 5 mills in the Grants Uranium belt, and many more outside.

There are other reasons to fear Roca Honda despite the potential for contamination. Candace also sees the project as a threat to future sustainable water supply because of its heavy demand for water. As Candace Head-Dylla stated.

And what about New Mexico, a place that is going to desperately need water in the future. Desperately! I don't think anybody understands just how desperate that future will be. There has already been all of this contamination and now for the Roca Honda site you are going to be using all this water, supposedly it will be cleaned up. I have heard that story before about them cleaning it up. So all this water that could have been used to supply water for people in the future is going to be dumped....The mining is over in 15 years and ... the water we could have used in the aquifer is just gone. It is a complete disaster. It is so short sighted, and that makes you crazy too, because, could we just project out the life of the mine is 20 years and talk about the water supply?

Again NEPA is instructive in foreseeing the conflict of short run versus long term interests. Recognizing that our short term society makes decisions ignoring the long term, NEPA particularly stressed the importance of paying attention to long term, irreversible, irreplaceable and cumulative effects.

In this context, where the approval of Roca Honda or any other similar project is deemed fundamentally wrong, the hearings and process becomes another level of stressful conflict beyond, yet intensifying, the community conflict. Moreover, the battle over the uranium mine pits forces even outside the NEPA processes against each other that have very different resources. The mining companies can afford to promote their project both within and outside the process in a manner that local activists can hardly match. Candace Head-Dylla elaborated on this point.

They have just overwhelmed us. And they start supporting the boy scouts and supporting baseball teams and giving money to the schools. They did not do a hell of a lot of that before, but they will to fight a PR campaign against us. We cannot fight the PR campaign they wage against us. For years nothing and then, when we make a fuss, they say "don't kick us, we are such good guys." They can buy local support. And once the people have those jobs, they are bought and paid for.

The Environmental Impact Statement, as envisioned by Congress, is the only level playing field that can assess and weigh the issues at play. It will only do this if the "hard look" expected of it is achieved.

Legacy Impacts for Native Americans

25. Legacy impact also affects Native American residents of ROI, as the discussion of Teddy Nez above suggests. And the legacy analysis inevitably intercedes with the history of uranium mining in the region. The DEIS describes an oral history and photographic record about the Navajo uranium miners where the lives of 25 Navajo people impacted by uranium mining are described, including physical and

mental health impacts and mistreatment by the U.S. government and mining companies in the first years of the original uranium boom. Among the revelations were the plight of widowed miners' wives, their poverty and depression and how wives were exposed to uranium themselves when husbands' clothes were washed. Perhaps the point of greatest hurt exposed by the exhibition was the realization that the government already knew the dangers before these disasters occurred but failed to disclose them (U.S. Forest Service, 2013, pp. 429-30).

Beyond such memories, there is a more concrete reminder of the contamination, namely the 500 abandoned mines just on the Navajo reservation and many unremediated sites in the Grants Mining District; the Jackpile Mine on the Pueblo of Laguna; the United Nuclear Corporation Superfund site located on the southern border of the Navajo Indian Reservation; and, of course, the Homestake Mining Company Superfund site in Milan. (U.S. Forest Service, 2013, pp.430).

There is much meaning in this contaminated landscape also, the defilement of the sacred and the implicit marginalization of the inhabitants of the region that would allow these sources of contamination to be caused and then to remain unremediated. My informant, Manny Pino of Acoma, shared what this meant to him:

Most importantly the historical legacy of having our traditional territories left with this contamination and the psychological trauma of having the federal government, and the state government and in some cases our tribal government not responding to the aftermaths of the impacts of mining.... Psychologically as those working on this hit obstacles, people become frustrated and give up. People accept the fact that no one is going to do anything for us. And how do you convince the industry, government that these are real live issues that create historical trauma over time?

If past mining was allowed to contaminate, and the contamination has not yet been fully reclaimed and the environment restored as much as fifty years later, by what calculus might local people conclude that new uranium mining will be subject to meaningful regulatory enforcement and reclaimed? If there were to be a demonstration that government and industry are worthy of trust to restore the affected environment, then the legacy issues would be long gone. But they are not.

These issues of recreancy create another source of "psychological trauma from impacts to our spirituality," according to my informant Manny Pino. At the root of Mr. Pino's observation is the local evidence that Native American's beliefs are not accorded the same protections as the religions of non-natives.

When our spiritual traditional cultural beliefs are infringed upon by institutions like the law, that creates a psychological trauma for us because there is legal precedent that already puts us in a defeated position. So if we take these things to court we are going to lose. So that is a psychological impact too. So we have to consider new legal strategies to protect a basic first amendment right that other spiritual foundations have upheld for them. So that is part of the psychological trauma too for our tribal decision makers. How do we protect our sacred sites when already the federal court has downplayed our spirituality? To make institutions like the law

understand that our spirituality is equal to everybody else's---Catholics, Jews, all the other populations, has been one of the most impossible fights for indigenous peoples.... In the Lyng case Sandra Day O'Connor said that the First Amendment does not apply to Indians.

Moreover, the courts apply rubrics to Native claims in accordance with Western thought that totally misconstrue how Natives understand the world. Manny Pino offered a concrete example, citing a case where "there is already a precedent in the federal court that our first amendment rights don't get the same response as non-Indians get." The case involved a proposal to use sewage tainted water to make snow at the Snow Bowl ski resort in the San Francisco Peaks. Pino explained,

...the courts have...quantified our spiritual beliefs to make it linear not holistic. For example, when we say that there is an attack on a spiritual place, it is the tribe's responsibility to show substantial burden to that site or to that place we consider holy. Substantial burden! Despite the fact that we have shown desecration in the Snow Bowl case their legal response was that it is only 1 % mountain, you Indians still have 99%. They don't see the mountain as a holistic entity or as a living entity. They try to quantify and separate it. And, psychologically, like I said, our tribal decision makers, working with our tribal lawyers have to overcome that obstacle.

In sum, these instances demonstrate to the Native Americans that they lack the same legitimacy and recognition, and therefore the same rights to carry out their beliefs than the dominant society reserves for itself and its own beliefs.

The DEIS fails to fully explore the baseline legacy of contamination affecting the environment and population of the larger project area. A detailed listing and mapping of contamination sites is required as well as a discussion of the health and risk factors associated with each and an examination of the impediment which each mounts to the lifestyle, lifescape and spiritual lifestyle of the Native inhabitants of the region.

Similarly, the DEIS fails to fully explore and explain the degree of Psycho-Social damage evident for local people as the result of the uranium mining history in the region, its impact on health, hopelessness and social dysfunction and the concrete fact that people today live with a substantial and hazardous contaminated legacy due to uranium mining a generation or more ago. In my opinion, this burden is a significant---perhaps the most significant---barrier to the ability of the region's population to break out of the cycle of misery that has a pall over the Mt. Taylor area.

As already noted, the DEIS does acknowledge these impacts (U.S. Forest Service 2013, p. 432):

Stress and anxiety levels of residents in the ROI and, in turn, the mental, physical, and social health effects of these feelings, are affected by both historical and present-day factors, which include known and unknown health effects of uranium mining and large number of unreclaimed and contaminated mine sites within the area.

My informant Manny Pino, a resident of the Acoma reservation, confirmed just this connection.

I think the correlation with historical trauma, with intergenerational trauma, as a result of uranium mining has not only impacted our physical health but also our psychological health, our mental well being in correlation to the destruction of our sacred site and the environment, and most importantly our water. I know I speak for the Diné and the Laguna Pueblo when I say that water is the lifeblood of existence.

Likewise, a baseline of health impacts is needed. Residents are acutely aware of health problems in their communities, the identification of cancer clusters, and believe that there is a direct connection to uranium mining and anticipate that similar impacts will occur if mining restarts. It does not help that mostly Native miners serve as the core population upon which the relationship between radon gas exposure and lung cancer was established. My informant Manny Pino brought this connection between health and mining legacy up during our conversation.

The cancer clusters in our community have caused a tremendous psychological trauma, not only for those impacted directly but also for non-mining populations to address.

Although I did not discuss the matter with my informants, implications of such tragedies may well have different meanings within a traditional Native frame than in the Western one (Csordas, 1989).

In the same vein, a mixture of traditional ritual and contemporary demonstration were held in 2010 at the site of the Churchrock uranium spill at the former United Nuclear Corporation mine site. Just after the 1979 Three Mile Island nuclear disaster, almost a million gallons of contaminated wastewater was released into the Puerco River. Still not cleaned up after years of trying every method offered by government, a traditional Diné approach was employed to spur reclamation. Larry King, one of the leaders, spoke about the need for compensation, removal of mine wastes, reclamation and restoration of the land, monitoring and relocation of residents still living in the contaminated wash of the river (Berry 2010).

As this effort to heal while furthering cleanup suggests, the legacy for Native American residents of the ROI exerts a significant adverse impact that is not only continuing but in some cases not even begun to be addressed. Just as the legacy impacts for non-natives, these open wounds cannot but affect the Psycho-Social impacts of a new chapter in uranium mining in the region.

Cumulative Legacy Impacts

26. The Cumulative Legacy effect must also be considered. The Homestake Mill is only one of the uranium legacy issues in the micro-region. These are elaborated in the EIS and in EPA documents and shown on an EPA map appended as Figure 2. As recalled by Candace Head-Dylla, they include the Jackpile site where the largest open pit uranium mine operated on Laguna land nearby Acoma, the Ambrosia lake area, the Red Water Pond Community on the Navajo Nation. At Crownpoint, a new proposal for an "in-situ leach mine" received an aquifer exemption that will use groundwater in an area the Navajo Nation identifies as a future drinking water source. Churchrock, discussed just above, site of the largest uranium mill tailings spill in the nation in 1979, with releases "*approaching Chernobyl*," is not cleaned up yet. New problems have emerged at Blue Gap community and Mariano Lake. In the land

grant community of San Mateo, a nearby mine has caused problems with groundwater. With a community supporting a mining revitalization, others are leaving. A small site in Haystack was the final item on the list. And, this is just two people's recollection of the regional problems. That local region, itself, is set amongst a larger region of similar challenges. Dawson (2011) reports that in the Navajo Nation alone, there were four uranium processing mills and approximately 1,200 uranium mines.

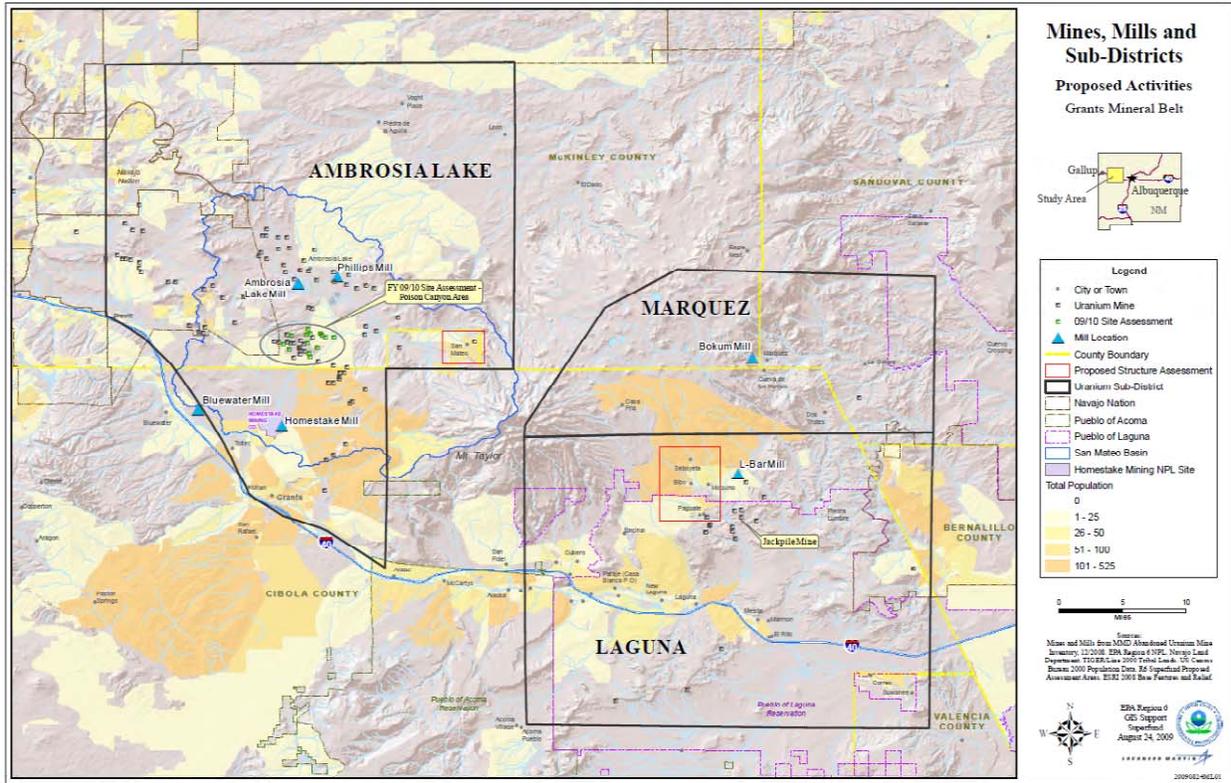


Figure 2: Cumulative Uranium Legacy Grants Region (Source: EPA, 2011)

In sum, legacy issues are widespread and a significant part of the regions' present and future, in addition to its past. At a minimum, they are a necessary part of a cumulative impact assessment. But from the stand point of Psycho-Social impact assessment, they represent the context within which many of the region's people live---Native and non-native alike. Different cultural groups and different communities may handle the situation differently.

The question always asked when there is a situation of Perpetual Jeopardy is whether people's experience with past exposure has allowed them to normalize or become used to similar situations. Perhaps these people are already adapted to this context and one or a few more uranium projects will not matter. The alternative hypothesis is that the population's resources and coping capacities are spent. Continuing battles and contamination events will tax them beyond their capacities and additional exposures will further sap their health. In my examination of the region to date, I see ample evidence of the latter situation. The legacy of contamination represents stress and wear on the population over a protracted time. Short of depopulating the region, I do not believe that it is sound from either an ethical

or a psychological perspective to expect more. Jonnie Head said it well. *"And are we tired of it? We are tired to death of it."*

It been demonstrated that there are significant adverse Psycho-Social Legacy impacts likely to influence the consequences of developing the Roca Honda mine. In the revised DEIS, the Forest Service must examine legacy issues as a full fledged area of adverse impact regarding the Roca Honda Mine. Legacy issues affect the same population, environment and ecosystem that will be impacted by the proposed uranium mine. Roca Honda can not escape from this consideration because it is contextually surrounded by legacy factors and it will bump up against them no matter which way it turns.

From the standpoint of the region's population, the systematic change that was wrought to the local environment by uranium mining previously has cast a significant "risk perception shadow"⁷ over every aspect of life in the region ever since and it colors the anticipatory fears held for new uranium mining projects.⁸ The DEIS acknowledges such fears and their potential consequences, even as it discounts their justification for new mining:

While actual contamination of water, air, and soil is predicted to be minor at most, perceived contamination on the part of Native Americans and others, along with actual changes to water and land from the project in the vicinity of sacred lands, especially within the context of uranium mining and milling legacy issues, may have real effects on the mental and physical health of some community members.

Legacy impacts are not a function of perception alone, but rather a reality that is perceived. While the DEIS concludes that new mines will not contaminate their environments significantly, the perception of risk or threat from new facilities (the anticipatory fear) is based on experience, which is negative. There is negative set for uranium mining for locals well versed in the legacy impacts. Desperation for jobs by some does not necessarily imply that no risks are seen, just that out of need they will be tolerated or accepted as a tradeoff for the ability to support one's family. In my experience, such tradeoffs should not be viewed as endorsements for the project, but rather a choice among bad alternatives. It is, in fact, hard to speak about volition among people for many of whom there are no meaningful choices.

As noted under alternatives, despite the fact that employment is one of the most compelling arguments made for the mine, the DEIS fails to present an alternative economic development plan based on different development paths. The work of local development agencies to create alternatives is overlooked. The effect of legacy contamination on the ability to develop the region in environmentally and culturally safe ways, that is environmental stigma, is not explored. Nor is the effect of new uranium mines on current or future potentials for alternative economic development paths, most importantly, sustainable development paths. The revised DEIS should include such an analysis, identifying the issues of external versus local employment and boom/bust effects for each alternative.

⁷ This term was coined by Rich Stoffel but he credited the concept to me.

⁸ That is not to say that there is no support for uranium mining among the population, but that whatever support occurs may be influenced by the lack of alternative development scenarios offered.

In short, people are neither free of the legacy impacts of the prior era, which are concrete, nor fear for the proposed facility that arises from the emotional legacy of their eco-historical context.

The Revised and Re-issued Response

A revised and re-issued DEIS must offer detailed and clear data and analysis for the impacts of "legacy issues" for current health and safety, mental health and psychological well being, as well as for social dysfunction, environmental stigma and other indicators of negative impact for the communities to be affected by uranium mining. The Forest Service must make a clear assessment of legacy as an indicator of impact in its revision of the DEIS.

Mitigation of Legacy Impact

27. The revised DEIS should include not only public comment on the findings regarding legacy issues, but also involve community outreach to be certain that community members understand the results. Further, community involvement should allow impacted community members to participate in discussions of what, if any, remedial activities are required to address baseline cumulative legacy impact and to establish trust for a monitoring and action protocol for addressing future impacts, backed by sufficient bonding to enable rapid remediation and provision of safe drinking water for all affected individuals and communities.

A program of community oversight of groundwater testing should be developed for the Project, if it is approved. The revised DEIS should review the literature on such programs and provide an analysis of options. In my own work, I have experimented with community oversight for facilities, discovering that there is considerable potential to give communities real efficacy in assuring that future problems do not occur through monitoring programs and clear repercussion for violations. Such programs work best when they are designed during the impact assessment process as a mitigation measure and are made into permit requirements.

Contamination from discharged water and air pollution from radon and uranium dust should be addressed in a parallel manner. Baseline ambient, indoor and groundwater radon readings should be done throughout the affected area, with the applicant required to fund any necessary remedial activities in order to meet applicable guidance or standards. Such findings should be included in the revised DEIS and should serve as the basis for data feedback to the community. These data will also serve as a baseline for future contamination associated with the Roca Honda mine or cumulative impacts from all permitted facilities. The same is true for ambient radon. A survey should be taken for the revised DEIS reporting legacy and baseline Uranium contaminated particulate matter (PM). The baseline will serve as a trigger for remediation of current legacy conditions, which should be funded by the applicant as part of any permit issued as well as a baseline for comparison to future releases. The data should be shared with the regional public and long term monitoring for both radon and uranium PM should be built into the party of interest process to be investigated for the revised DEIS.

And, given the apparent perception that cancers and other health effects in the region are related to the uranium mining legacy, a baseline health and epidemiological study should also be included to chart the

extent of illness and clarify the contribution from mining and to serve as a baseline for any future study of permitted new facilities. Included should be a discussion, census and health review of Radiation Environmental Compensation Act recipients. An analysis of downwinder historic impacts should also be included.

Cultural Impacts are Psycho-Social Impacts

28. As I have noted already, in my view, most Native Americans and other indigenous peoples are in double jeopardy when their environment is contaminated and/or degraded. They suffer the same impacts as everyone else because they share the same environments and live modern lives. But at the same time, their beliefs, rituals and practices, and relationships and connections to the surrounding world give them a higher and even more critical layer of vulnerability. Moreover, because they live simultaneously in these two realms, one overlaid on the other, they are vulnerable to dual impacts that can have synergetic and multiplicative effects. Simultaneously, the individual has a self perspective informed by contemporary thought and a collective awareness (or Self) informed by the tribe and communication with forces in nature. These selves may be in harmony or conflict, but it is likely that disruption in one realm may reverberate to the functioning of the other. In particular, our interests here are both with impacts to self and also impacts to Self. The former are impacts shared by all victims of toxic exposure. The latter are impacts for people for whom the individual is firmly embedded in community and environment, as depicted in Figure 3.

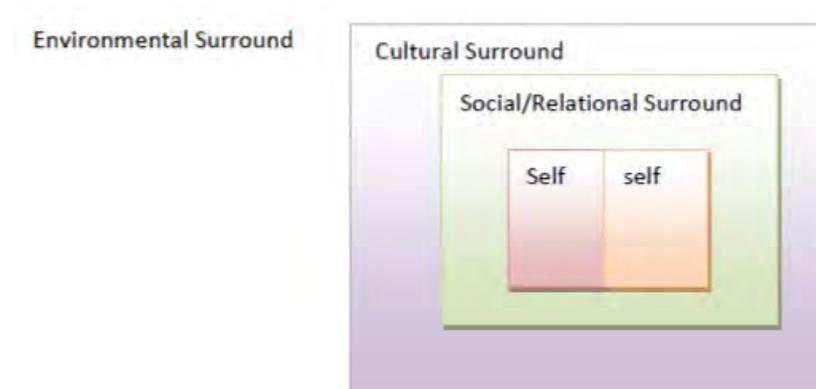


Figure 3: Two dimensions of a Native Person embedded in social and environmental context

Source: Author

Ironically, the DEIS spends little time on self, for Natives and non-natives alike, with the latter being almost completely ignored by the document. In contrast, there is considerable attention to issues related to Self, or the indigenous component of psycho-social impact that differentiates Natives from non-Natives. However, the consideration of Self is cloaked in safe terminology, namely the topic of "cultural impact." This neutral term disguises the fact that the topics discussed are central to the individual and collective identities and psychological wellbeing of the members of the Navajo, Hopi,

Acoma, Laguna and Zuni nations. Therefore, the DEIS is deficient because it fails to analyze these “cultural impacts” as Psycho-Social impacts.

Importantly, the boundary of self and Self are blurred in the eyes of the Native person, as the DEIS notes.

The involved tribes consulted for this EIS do not make a clear distinction between what others call “sacred” and “secular.” In tribal communities, terms such as sacred, spiritual, ceremonial, religious, and ritualistic do not distinguish an activity, place, or object into a realm that is separate from daily life. The activities, places, and objects given these descriptors “are pervasive in these tribal communities and in their ways of living and thinking, and are seen by the tribes themselves as inseparable from their daily activities.” DEIS, p. 320.

The DEIS relies heavily upon ethnographic sources in its discussion of Cultural Impact. In my view, the DEIS does a sound job of referencing these sources and integrating them into their review and drawing appropriate Cultural Impact conclusions. The failure of the DEIS here is that these same conclusions are not understood as also pertaining to Psycho-Social impact. Instead, they are discussed in a manner that erroneously suggests that unmitigable significant adverse cultural effects have no direct impact on behavior, understanding and management of life and emotional wellbeing.

I agree with the fundamental conclusion of the DEIS that adverse impact to the cultural and historical values of the Native Americans affected by the proposed Roca Honda mine would be **significant and unmitigable**. Anticipating the discussion of Environmental Justice, I add that it would also be disproportionate.

Specifically, the DEIS makes these projections for both action alternatives, that for Acoma, Laguna, Zuni, Hopi, and Navajo, adverse impact would be caused for "tribal cultural resources and practices related to the sacred character of Mt. Taylor" and for "the Mt. Taylor TCP," causing "irreparable harm to surrounding tribes and their traditional cultural practices." A "perceived impact" would occur "upon the Spirit Beings associated with the TCP" and "direct physical impacts to four historic properties" would occur due to construction disturbance, particularly in Alternative 2. In sum, "impacts ...on cultural resources would be significant, and would result in an adverse effect to historic properties." And "cumulative effects of both action alternatives in combination with other past, present, and reasonably foreseeable future actions would be adverse and significant, exacerbating loss of integrity of Mt. Taylor TCP." (U.S. Forest Service, 2013, p. x).

These strong findings need to be unpacked. Such phrases as adverse impact to "tribal cultural resources and practices" and "irreparable harm to surrounding tribes and their traditional cultural practices" translate readily into Psycho-Social impact on individuals and groups. The collectivity of the Self is undermined and the ability to carry out the very actions that define oneself as Native are blocked. This cannot but create a crisis of both Self- and self-definition, contributing to the grim statistics such as cited by the DEIS for high alcoholism and drug use, suicide, poor health and social dysfunction. Tribal members are disempowered to carry out their responsibilities to local spiritual powers, protect sacred places and carry out the rituals that allow for communication with the greater surround.

The land is sacred because it is the repository of ancestors who came before and who are now alive in and through a healthy environment. By extension, all of nature is alive, related, a family. Devastation of the land is devastation of family, the losses mourned as loss of a beloved person would be. And to be stripped of this living surround is to be left existentially alone, cut off from the intergenerational chain, in a sense an orphan left with no guidance.

An important clarification may be helpful here. While followers of most Western religions believe in the otherworldly condition of one God in heaven, which then becomes the ultimate destination, this earth being but a temporary stopping place, native beliefs place many "gods" right here on earth. They are place-rooted spirits and, as a result, cannot easily suffer relocation. One of the threats of contamination of the local environment is that the local tribes would be forced to relocate or, alienated from the land, would voluntarily do so. At a minimum, as the DEIS acknowledges, local tribes' activities on Mt. Taylor would become constrained or prohibited. Pilgrimages to gather sacred plants or carry out sacred rituals would be disturbed. Such an outcome for a native person and people is catastrophic.

Local tribes have not been relocated. Instead, they have stayed put while their surround is emptied of spirits and the requisite opportunities and context for communicative exchange with them here on earth. The view of sacred Mt. Taylor, inspiring to all but defining for Native-Americans, is degraded. And, in a generic manner, their environment and homes are inverted from safe to unsafe places.

The DEIS shares the cultural devastations that create these outcomes in great detail. In the process, they have revealed a great deal about the resulting Psycho-Social impacts. Table Three, appended at the end of the document, helps to translate cultural impacts into Psycho-Social impacts, using the language of the DEIS. The left column reflects beliefs about Mt. Taylor and their vulnerability to defilement. The middle column reveals the direct impacts predicted in the DEIS. The right column extracts the direct impacts to behaviors and understandings and suggests the conditions that have a strong likelihood of resulting in stress, distress and trauma for the Native Americans who hold Mt. Taylor sacred.

In the remaining section on cultural impact, I address the Psycho-Social impacts on local resource dependent communities, the meaning accorded to a threat to water and the critical question of whether cultural and other impacts are mitigated by the tradeoff with uranium mine-related jobs.

A. Local Resource Dependency.

The DEIS acknowledges the importance of certain plants and animals for Native belief. These are revered and respected, considered even as relatives, by Native people in the area. Sometimes, particular plants and animals are collected from Mt. Taylor (and other sites) for use in rituals and ceremonies. The location of sacred or essential plants and animals may be a deeply guarded secret. Paths to sacred gathering places, just as to other sacred sites, is among the teachings imparted to children and initiates. The DEIS can say more about such practices without violating privacy. It acknowledges, as discussed under cultural impacts, that the Roca Honda mine will impede and to some degree endanger gathering activities. Native Americans will be forced to look and travel elsewhere to gather and some species required for rituals may not be readily found. It is also implied that activities can be restored after reclamation and replanting. However, even were populations of plants and animals to be restored to an

area, they might not be viewed as replacing what was lost and, if a multi-decade interruption occurred in access to sacred places, the knowledge and skills associated with gathering might also be lost.

The DEIS summarizes the importance of gathering for Native culture:

Plants, animals, water, and minerals are collected for food, fuel, medicine, and ceremony and the locations of these items are pantry, medicine cabinet, and sanctuary, all at once. However, natural resources are not the only material resources to be used by the tribes. Animals and plants are included in songs, prayers, and histories; play an integral role in stories needed to pass along important tribal lessons; and are sometimes intermediaries between the people and the Spiritual Beings. The wholesale integration of natural resources into the cultural practices and identity of the tribes is demonstrative of the significance of these resources to the ethnographic landscape. Because natural resources are used in various forms in ceremonies and ritual, there is a need to maintain pristine sources of these materials in order for rituals to work....collecting resources for ritual or ceremonial use...is often a religious event....Prayers are conducted for the well-being of animals and, in turn, the animals are depended upon for the people's spiritual welfare....The land provides the resources that are necessary for the cultural life of the tribes to continue and flourish and, in turn, these resources are used in rituals that bind the people to the land. (U.S. Forest Service 2013, p. 319).

At the same time plants and animals serve as a significant part of the local diet for both Natives and non-natives, although the DEIS has little to say on this point and certainly presents no statistics.

Environmental contamination has been shown to have potentially disproportionate effects on resource dependent communities (Dyer et al, 1992). The FEIS needs to provide details on hunting and gathering and bush foods in the local diet, and the effects of the baseline legacy and proposed project on those preferring to hunt, fish and collect their foods. Likewise, the ecological web is not discussed in detail and therefore the impact of the project for food chain relationships is not shown, including loss of predators and prey species and bio-accumulation. Likewise, the health effects of lost food dependency is vital, implicated as it has been with the diabetes epidemic in tribal populations.

The combination of jobs and restricted ability to hunt, fish and gather due to contamination offers little choice but for locals, including Natives, to shift the remaining vestiges of their reciprocal societies substantially to a cash exchange economy. This shift, although well underway due to historical forces, is part and parcel to the disintegration of local societies, as well as shifts in diet and poor health.

B. Psychological Importance of Water.

For Native Americans, water is viewed in a similar way to all others, as a requisite, without which nothing else can happen. However, simultaneously, water has further significance in this particular cultural context. It is "integral to earth, plants, animals and humans" and "...the common link that joins the spiritual world, the clouds, the mountain, and the people." Mt. Taylor is, in turn, viewed as a ..."spiritual beacon for moisture," and is accordingly the subject of many rituals and practices (U.S. Forest Service 2013, p. 319; Blake, 1999).

The DEIS reports that places associated with water, such as springs and natural water catchments, are viewed not just as important contemporary sources of water, but as a source of water for ancestors. The water gains importance because its path comes from the interior of the mountain where the Spiritual Beings reside. Such sites are important to belief and ritual because they are seen as maintaining the crucial balance of the cosmos through their renewal, and water is collected to bring back for ceremonial or medicinal purposes. Plants and insects associated with water also play an important cultural role. The DEIS notes that "The involved tribes view the proposed project area, Mt. Taylor, and the larger ethnographic landscape as an integrated whole" (U.S. Forest Service 2013, p. 319-20).

C. Job Tradeoffs.

Are these adverse impacts mitigated in a tradeoff for jobs, as the DEIS implies at several junctures, or is the jobs issue only the tradeoff in the minds of impact assessors with economically based cost-benefit analysis bias? Here, again, the DEIS gives considerable guidance, even if it fails to heed this guidance in viewing jobs as a potential tradeoff.

On one hand, we are told that Acoma, Laguna, Zuni, Hopi, and Navajo have an "intimate spiritual relationship with the landscape and specifically with Mt. Taylor TCP (which includes the mine area)...[where] traditional practitioners ... collect plants, stones, minerals, pigments, soil, sand, and feathers," catch eagles, hunt game and birds, make place offerings, and visit shrines and springs." (U.S. Forest Service 2013, p. 275). The DEIS predicts that "The proposed action would potentially entail adverse impacts to the quality of life for environmental justice communities in the study area....For some tribal members, mining is tantamount to desecrating a sacred site. Tribes also express particular concern about water—both the potential for its contamination and/or waste. Negative mental health impacts stemming from other realities or perceptions associated with the mine could also occur....Tribal environmental justice communities... [have] the potential...to experience adverse effects to general health and wellbeing... adverse mental health impacts would occur to tribal environmental justice communities due to mine development so close to spiritually significant Mt. Taylor." On the other hand, these significant negative impacts combine with minor health risks and are partially offset by jobs and economic opportunity over the anticipated 20 years of the project before going bust (U.S. Forest Service 2013, p. 275-6).

The DEIS is unrealistic in its optimistic expectations for the healing benefit of employment in the mines.

Jobs and income are strongly associated with a number of beneficial health outcomes such as an increase in life expectancy, improved child health status, improved mental health, and reduced rates of chronic and acute disease morbidity and mortality. (U.S. Forest Service 2013, p.106).

Given uranium production's toxic and health legacy, however, one has to question whether this paragraph applies to being a uranium miner. It certainly would not be very descriptive of outcomes from the first generations of uranium mines in the region. But the "employment solves all" argument seems to be the only positive spin the authors of the DEIS had available to offset adverse impacts to Environmental Justice and mental well being.

Moreover, the DEIS labors to weave these factors together. Thus, the DEIS lists "potential economic effects on minority and low-income populations ...[as] a long term, moderately beneficial, cumulative impact related to environmental justice." Offset by "...a corresponding cumulative, moderately adverse social impact for those American Indians concerned about Mt. Taylor, and for those minorities and low-income residents convinced that new uranium mining projects would exacerbate long-standing and unresolved legacy health issues.... Beneficial and adverse cumulative effects would be significant." (U.S. Forest Service 2013, p.279).

The problem with the DEIS formulation is that the very jobs that would provide the economic benefit touted by the DEIS are the same category of jobs which caused so much illness in the prior round of uranium mining. While it may be true that modern mines are better in affording safety, there cannot but be doubt in the local community over this enticement. Thus, there may not be much positive in the tradeoff for some. This ambiguity is illustrated by my informant Manny Pino.

...the economic impacts also caused psychological impact and trauma. Despite the fact that we got wages from mining, we have to ask ourselves, was it all worth it? And if we decide that it was not worth it, what is our legal recourse to say no to the industry when the economic prospects of this country are in a recession and everyone is looking for jobs? We as indigenous people face these psychological impacts because the resources are on our land.

The DEIS tends to dismiss concerns over the health impacts of mining as overblown. Yet, there is no basis to trust a new generation of mining for uranium in a place so scarred by the last generation. And adding in the cultural impacts, one finds a basic incompatibility between the rural/Native lifestyle and the industrialization of place.

In conclusion, it is the consequence of this analysis, that Cultural impacts can be understood, from the perspective of their effects on individuals, groups and tribes, as Psycho-Social impacts. As I was reminded in my interviews, Native Americans are traumatized because they cannot protect their sites of spiritual importance under current law. From my background in working with Indigenous peoples and the background literature I have read in the course of my career, this is a completely plausible construct, analogous to the destruction for a western person, not of their localized place of worship, which is replaceable, but rather destruction of holy places fundamental to their entire belief system: For a Jew--- the Western wall, for a Muslim, Mecca, for a Christian, Bethlehem. Even then the jeopardy is not equivalent, because the Western Wall is not part of the daily lives of most Jews and Muslims make one Hajj in their lifetime. For the tribes in the project area, Mt. Taylor is as sacred as the other sites but additionally it is proximate and part of daily life and periodic ritual. It sits on the horizon as a never ending presence. To look up and see an inspiring view imbued with so much meaning has been a sustaining element of Navajo, Zuni, Acoma and Laguna existence. That this view might, instead, symbolize the pillage of those values, risks the inversion of meaning, Self and self. The devastation is thus not only to the religion but also to the lifestyle of the person affected, to their basic understandings and fundamental assumptions and to their ability to cope and be emotionally whole.

In sum, the basis of my conclusion rests on the fact that, for Natives for whom traditional belief and ritual are important, and who hold sacred the Mt. Taylor site, a new generation of uranium mining represents a threat to personal and collective identity and responsibility, severs relationships (perhaps permanently) with forces in nature that are vital (alive, not just important) to Natives in a way non-natives cannot recognize.

Conflict: Family and Community, Trauma Within and Trauma Outside

29. One unanticipated secondary impact of a controversial project proposal coming on top of a legacy of contamination is community conflict, and the conflict is itself a source of direct and secondary impact. We previously saw this in the Homestake case study. But it is also evident in the experience of Native Americans in the ROI. Manny Pino explained the situation that Environmental Justice communities face when they find themselves in the minority opposing a project supported by a job-hungry majority.

[As] you see with border towns, whether it be Grants, Flagstaff or Farmington, when one population is perceived as being against jobs, it [causes] accelerated environmental racism in the community. Another thing you see with the non-Indian populations, they are clearly divided where you have a pro development population that clearly expresses itself as pro development. I know we have seen that in Grants. They will oppose us on every aspect that in their mind impacts the development process. Like the traditional designation of Mt Taylor, if you were at that state hearing, all Indians are on one side of the gym and all non-Indians are on the other. You see the community or the county divided with that whole process. With the land grant people, the same thing, you will see a divided population. And with that population, it will probably be a more pro development population.

Manny went on to discuss why the circumstances invite conflict.

When you are living downstream and in your backyard is one of the worst nuclear accidents in history, and no one responds to your needs, divisiveness is going to occur. In some ways, personal agendas, personal initiatives, jealousy, all of these things occur within our family environments, our community environments, that is a divisiveness that is yet to be measured.

He went on to suggest that the actions of the uranium mining companies served to further divide communities under the guise of helping them by attempting to buy the loyalty of some residents.

With the Indian community, the companies have used economic enticement, like offering scholarships to land grant students to have them approach the development in a more pro or positive way.... It does not help when the company in the Churchrock community comes in and uses economic black mail using money to entice the pro-development faction of the population. That divides families even more because of the psychological trauma that we encounter in the family and community level....[it] causes depression within the individual. How historically in the past have we measured that as an impact of uranium development?

Divisiveness even shows up in unlikely places. Thus, even mechanisms designed to address legacy health impacts are seen as creating undesired outcomes. For example, the Radiation Exposure Compensation Act has helped compensate uranium miners for their illnesses, but does not address members of their families and communities who became sick. As a result, in Manny Pino's words, the act "...does not do anything for those who do not qualify," in fact creating a situation where "there are haves and have nots."

When the community and environmental conflict is internalized, as it often is for activists, it can become a source of family conflict. Another informant, Teddy Nez of Churchrock in the Navajo Nation, mentioned earlier by Candace Head-Dylla, described how health is another source of conflict, turning to the difficulties in his own life to explain.

A Vietnam combat veteran, he spoke about traumas often reserved for discussion of war time experience, but in the context of the uranium mining legacy for local Native peoples. That does not suggest that trauma from environmental exposures has an equivalent cause as found in the extreme adverse environmental conditions of war. Rather, environmental contamination and all of the social upheaval it causes may well bring about the same forms of trauma. The flashbacks and dreads may be different, but they are still flashbacks and extreme fears. The application of psychological trauma to such situations began with sociologist Kai Erikson applying the work of psychologist Robert Jay Lifton on victims of the atomic bombs dropped on Japan to the human-caused mine tailing disaster in West Virginia known as the "Buffalo Creek Flood" (Erikson, 1976). Subsequently, it has become common to see measures of Post Traumatic Stress Disorder (PTSD) employed to capture traumatic reactions either at the time of the trauma or post-trauma. In the case of the neighboring tribes and non-Natives around the uranium mining areas in New Mexico, my informants reported conditions of active as well as post traumatic states brought on by the mining experience.

Thus, Teddy Nez described himself as 100% disabled and homeless at the moment and suffering from both current and post traumatic stress syndromes and disorders reflecting the human health impact of the uranium mine legacy as well as the environmental health impact "to the soil, water, vegetation, air and sacred sites and cultural values, livestock and so forth." It appears, from his description, that as he has suffered from health problems stemming from the situation; he became estranged from what presumably was once a supportive family. Journalist Autumn Spanne described some of the dynamics that may have contributed to breaking the family in a piece written in 2008 and how uranium mining trauma invaded the Nez family.

The uncertainty and fears about living with long-term, chronic exposure to radiation have affected Nez's family not only physically but psychologically. Their reactions remind Mr. Nez, a Vietnam veteran, of the symptoms of post-traumatic stress syndrome that he and his comrades suffered after their combat experiences during the war. People in his family are on edge, easily startled and angered at times. At other times, they feel numb, unable to express emotions toward friends and loved ones. Some family members try to avoid reminders of the fact that they live just a few yards from contaminated soil that's 50-120 times normal background radiation levels.

But it's no use – not talking about it does not remove the fears from their minds – fears about loved ones who are sick, about the damage already done and about whether their children have been placed at future risk. The burden of guilt and worry and lack of control creates a relentless pressure. That worry creeps into their sleep: they experience vivid, intense nightmares about the mines and about disease, where the earth that is supposed to nurture them becomes a dangerous no man's land. Those who are old enough to remember the time when the mines were in operation have waking dreams and flashbacks in which they hear the dull, dreadful roar of the generators and the rumble of uncovered trucks that used to haul off tons of radioactive soil, billowing across the valley and settle on their land.

This background provides context for Teddy's blunt description of what happened.

I broke up with my family. It is hard to say that. But I got a situation right now. It is the kind of thing we refer to as current stress and it became like a disorder to me. That is when I left the family.

In a situation over which he had little control, he became caught between his wife's desire for him to act and members of his community, who wanted to silence him.

The health impact divides the family and divides communities. I have PTSD from the mining itself. Researchers have found that there is a risk of high blood pressure, kidney disease diabetics and respiratory system and skin disease. That is what I am experiencing right now. It has led to the division of the family itself; so we are divided that way...we look at waste in our front yard every day when we get up and ...that... thought sticks with us. My wife, she says to me, "How come we just talk about it, and don't do something about it." I tried. But the community says I am doing this in my own best interest. The community, we are divided on culture and our perception and the way we perceive things.

When I told Teddy that I understood what he was saying, Teddy rejected the notion.

People say I understand, but no one knows what I experience internally. But people say, "I know you. I understand you. I understand your problem." No one knows but me. But there is trauma inside me. I am the only one who knows how I feel inside. I break down a lot.

Spurred by the Roca Honda application, trauma that has lain dormant since the heyday of uranium mining in New Mexico has revived, compounding the issues for those caught up in it. At its core, their stress stems from the belief that families are currently exposed to high levels of radiation, as Teddy explained:

The information that we have is that there is evidence of existing radiation above the background, twice, 300 times background that we live with. These are things that cause a lot of other anxiety and goes into stress between the community and family itself. Anxiety!

Autumn Spanne elaborated this point from her interview with Nez in 2008.

The entire family is suffering psychological stress as they see loved ones succumb to cancer, respiratory problems and a host of other suspicious symptoms. They are caught between protecting their health, and protecting their culture and family life – an undesirable choice, to say the least. They've waited decades for information and for action. They do not want to have to choose between their health and their way of life. What they want is long term protection.

But there are secondary impacts to such beliefs, unwanted implications. If it is so dangerous, maybe they will not be able to visit the land. Maybe they will even have to leave altogether. Teddy Nez describes the fear that their connection to their sacred environment will be broken.

Let me see now, the word spirituality. The health impact is contamination of soil, water, vegetables, air. If you look at the constitution of U.S., where it says freedom of religion. If we took a look at environmental health impact, contaminating water and soil, those are our herbs, those are what use for our healing. When those are damaged, it damage our way of belief, and we have to go elsewhere for miles to find vegetation to cure our anxiety. People say, why not just move. Relocation is the worst word; it hurt a lot of people in different ways. We are connected to Mother Earth and the environment itself there. When they move us out, it creates more stress syndrome and more disorder.

Autumn Spanne (2008) also recorded concerns about forced departure in her interview transcript.

Residents of Red Water Pond Road say that they have been traumatized by watching their loved ones suffer with disease, and by the knowledge that they are living – day in and day out – surrounded by radioactive air, water, vegetation and soil. They feel that their land and physical well-being has been invaded. They fear relocation, a powerfully charged word that is heavy with the history of forced removal of Native peoples from their land. Mr. Nez's family exists in a state of limbo, uncertain of how long they'll be able to remain on their beloved homeland, where the family has lived for at least seven generations. They fear that, if they're forced to move, they will not be able to continue their way of life, with children raised among grandparents who can pass down their traditions.

Already some of the younger generation has left. They are reluctant and sad to do so, but those who have left are also unwilling to knowingly place their children in harm's way. No one told their parents and grandparents of the dangers of the mines. In good conscience, some of the younger adults say, they cannot knowingly subject their children to these dangers. But their decision to leave forces an enormous sacrifice. They are losing the closeness, the cohesiveness of their family and their traditions. They are forced to sacrifice their children's cultural education to protect their health.

If these dilemmas create stress for adults, Teddy Nez observed, even children get caught up in the trauma and conflict. First, the loss of a safe environment poses a dilemma for fathers wanting to pass on traditions to their children.

We are suffering sociological stress. One of the areas we did not talk about, we make sacrifice for our children. But with environmental contamination, we want to continue teaching, passing information from generation to generation. But, there is a gap that I see in my area. The mining companies they say just move out and it will resolve the problem. So, it will separate the children from the contaminated environment. But the cultural teachings? It will break the cycle.

The conflict evidenced by this dilemma then surfaces as a trauma for children at school, as Teddy Nez explained, becoming manifest as a pervasive loss of control.

Our children in class in school, simple things trigger stress and disorder. For example, when our children are sitting in class and they hear the word uranium, it sets them back. Living among the mines, this is what you get. When children get to this stage in the classroom with everybody else, it creates a disorder. They are sitting in class taking a test, and they are falling behind and things like that. I see it with my grandchildren.

Autumn Spanne (2008) also described what was happening to children in the area around the Roca Honda mine site.

Children, meanwhile, respond to simple triggers, like hearing the word "uranium" at school, and even the word "yellow," which calls to mind uranium yellowcake. These simple, seemingly harmless words distract them from their schoolwork as they obsess about whether their family and animals are safe. Nez's 12-year-old grandson checks their sheep, concerned that some appear to be turning yellow as they graze at the edge of the contaminated arroyo, no more than a stone's throw from their home.

So what then is the alternative? Nez explains:

That is the way we are and the way we live. And we want [the land] decontaminated or healed. We want healing to ...the environment and human health.... I talk to government and they say "reclamation," and I say restore. Reclamation to me is just putting a band aid on it. Restoring is actually fixing it.

Another source of conflict is over whether the mine will operate as promised. Paul Robinson, another MASE affiliated group member with whom I spoke, suggested that the permit for Roca Honda mine has been sought not to mine it, but to protect the right to mine and to make the mine profitable for the owner to sell to a new buyer. Robinson described the reality of uranium mining in the area, namely a tendency for mines to be permitted and then wait for the price of uranium to rise high enough to warrant mining. As a result, the mine operation could become further protracted than what the application suggests while offering much less steady employment than promised.

Manny Pino elaborated the point by cautioning of the vulnerability created from becoming too dependent on the applicant.

In the mining history of Appalachia among poor whites and white communities, when the companies, just leaves you with their mess, there is a psychological question of how do you deal with it, living in a contaminated community.

This is also what happened in his own community when mining went bust the first time, as Manny Pino explained.

All we have to do is look at the previous legacy of uranium mining and their economic, social, health, responsibilities to the workers. As soon as the industry saw the economic benefits go down, they packed and were gone. There was no afterthought for the workers, no responsibility felt that they had to address. As multinational corporations, they just went to other countries to create the same mess they created in the Grants mining district. How can you forget that part of history when they were totally irresponsible to the needs of the working population? What is worse is that those decisions that were made for "pro development" jeopardized people just because of where they lived. Some people did not earn one penny yet they faced all of the impacts just like the workers.

The previous legacies from the companies is null and void. We don't want that to happen again. The jobs are short lived in this industry. It does not matter if it is oil, or gas, or uranium. That is the pattern of development. They are here today and gone tomorrow.

Here today and gone tomorrow is the antithesis of the Native relationship to the land, based on local knowledge and a total communication with place. There is a danger that this too may be lost.

Environmental Justice Impacts are Psycho-Social Impacts

30. The DEIS concurs that there are five Native tribes present in the impact region that are Environmental Justice populations and spends a great deal of time listing cultural effects as indications of potential violation of Environmental Justice. Table 4 shows census data demonstrating the sizable populations of Native Americans in the region of interest. Ironically, the DEIS ignores the fact that there is also a sizable Hispanic population. No real analysis occurs for the latter group. A further omission is any substantive discussion of class and poverty, also indicators of Environmental Justice. Finally, there are reportedly many children on the Navajo, Acoma, Laguna, and Zuni Reservations, children being recognized as a generic EJ population (U.S. Forest Service, 2013, p. 276).

Place Percent of Population	Grants	Cibola County	Gallup	McKinley County	New Mexico
American Indian	16.9	41	43.8	75.5	9.4
Hispanic/Latino	52.1	36.5	31.7	13.3	46.3

Table 4: EJ Components of the Project area population (data from U.S. Forest Service, 2013, p. 280)

Cultural impacts have already been demonstrated to be a subset of Psycho-Social impact. Cultural impacts are cited in the DEIS as examples of Environmental Injustice. To close this loop, for my purposes,

Environmental Justice impacts are also viewed as Psycho-Social Impacts. In fact, the entire social legacy of mistreatment and confinement of Native Americans creates a strong backdrop to their victimization during the first wave of uranium mining. The tribes have been unable to prevent or effectively address the degradation and environmental stigma they suffer from the legacy impacts. It remains to be seen whether they will be heard on the administrative determinations to follow from the DEIS.

For the tribes, two simple conclusions can be drawn that summarize the EJ issue:

1. Uranium mining involves an historical environmental, health and Psycho-Social impact that has disproportionately affected Native Americans living in the project area.
2. Degradation of Mt. Taylor disproportionately affects Native peoples for whom it is culturally sacred and vital to their psychological wellbeing.

Because there are five tribal peoples in the areas of project impact that are collectively organized, it is easy to forget about other populations that may not speak with one voice. The region has an apparent EJ Hispanic population and a substantial white population. Besides tribal peoples, there are "land-granters" in the area. And then there is the conventional property owning or renting population. The considerable poverty and statistics of social dysfunction may also reflect these groups but clearly affects them.

As an expert, I am currently learning about these groups. It is clear that they share the same eco-historical and contemporary legacy burdens as the Native American population. And they clearly are stakeholders with regard to the proposed Roca Honda uranium mine capable of enjoying benefits but also sharing significant adverse impacts. These populations are substantially ignored by the DEIS. We have considerable ethnographic and other sources of information about the Native American population, but everyone else falls through the cracks.

Revised DEIS Response

The revised DEIS needs to offer substantial base case and impact consideration to the effects on non-native populations in the project area even as it improves its consideration of Native Americans. How are the non-native populations affected by the legacy issues and the status quo (i.e., no action)? Who wins and who loses if the project is approved? And in what ways? Are non-natives attracted to the Mt. Taylor region for its natural beauty? How do they earn livelihoods? Is the integrity of the land important to them in ways that parallel Native American interests? This is an entire section of the DEIS that was never written. It needs to be in the revised DEIS.

Psycho-Social Impact

31. The DEIS acknowledges that "even after the implementation of recommended mitigation measures, adverse significant impacts are likely to remain in the areas of groundwater, cultural and historic resources, environmental justice, human health and safety, and legacy issues." (U.S. Forest Service, 2013, p. 1). Psycho-Social impacts cannot be good when these other areas are bad.

In fact, adverse Psycho-Social impacts have been documented in this report involving legacy issues, cultural impacts, EJ and individual community and institutional dynamics relating to the proposed Roca Honda mine. Basically, Psycho-Social Impacts occur anytime that there are significant adverse changes to people's basic understandings of life (lifescape) and lifestyle, increased experience of stress and loss of coping capacity and they are subject to environmental stigma and anticipatory fears. This can be set off by baseline conditions as well as project impacts and certainly their interaction.

Lifescape is affected because people evidence physical and psychological health problems as individuals and social dysfunction as a community. The sense of personal or collective control over life is eroded because the most significant issues driving the quality of local life are not in the hands of local people and, for Natives, even the spirit beings that reflect the powers of place are in jeopardy. The security of home and community has been eroded by social dysfunction and conflict, contamination, poverty and illness. The sense of safety of the environment has been nullified by the legacy of contamination and degradation, affecting local resource consumption that is a major shadow part of the regional economy; even as the role of place and nature in the spiritual life of local natives has been threatened in every imaginable way. And the trust in government, mining companies and others to be protective, something that Native Americans may not have much of to begin with, has been undermined for all local people by the failures in the early conduct of mining, in the cleanup of legacy wastes, in the failure to restore the local environment, in the failure to fully acknowledge and help all harmed by the legacy of mining and contamination, and by the process of considering whether to begin a new mining chapter when the old chapter has not been closed.

For example, Many Navajo lived close to mines or uranium facilities and the toxic legacy rendered both home and environment unsafe and insecure. As a more culturally-bound case in point, for Dine' (Navajo) people, the uranium legacy (and proposed new mining) is a continuing reminder of the violations of traditional warnings by tribal medicine people "that certain substances of the earth that are harmful to people should not be disturbed." When such disturbance occurred (and new disturbances are threatened), there is a further violation of "Dine' medicine peoples' interpretation of natural law to maintain harmony and balance (hozho)" (Dawson and Madsen, 2011, p. 634). Perhaps as a reflection of losing that balance, one researcher found that 68% of the Navajo surveyed agreed with the statement, "I sometimes wonder if I have health problems because of the effects of radiation" (cited in Dawson and Madsen, 2011, p. 622).

Lifestyle is affected because normal life activities may be constrained by a contaminated environment and water sources are perceived to be contaminated and off limits. The ability to practice rituals is severely impeded or prevented, preventing Native Americans from participating in practices in nature. Ambient stressors are created, including project traffic, noise, visual degradation, that intrude on every aspect of life, requiring adaptations and adjustment. Uranium mining related meetings and demands must be attended to, capturing time and attention and causing more stress. All of these constraints to normal life have meaning. Certain stresses set off an experience of annoyance, despair or trauma.

As a case in point, the legacy of potentially and known uranium-related illness has led to the growth of Navajo civil society organizations that undertake studies of sickness and death in an effort to conduct

the epidemiological investigations that government has not done and to create a basis for compensation for death and illness. Dawson and Madsen (2011) refer to one of these, the Uranium Radiation Victims Committee, consisting heavily of wives and family members of dead uranium workers pushed to become activists. In order to carry out their activism, they were forced to violate traditional norms of the Navajo, including speaking to these authors about lost family members (p. 631).

Traditionally, the Navajo do not speak of the dead, as it is taboo; however, the authors found that the workers' and families' concerns were so great that it overrode this taboo, and they were willing to vocalize their concerns.

Likewise, there was traditionally no word in Navaho for "radiation." Now it has become a serious preoccupation (631).

Another example cited by these authors is that of problems some Navajo have had receiving compensation under the Radiation Exposure Compensation Act (RECA) because, in their traditional world, they lacked marriage and birth certificates. The search for compensation has plunged many people into a world of bureaucracy with which they now must grapple.

The emotional life is easily captured, as well, by the prospect of new uranium mining, bringing up feelings connected to past experience with the industry. Traumatic reactions are caused by current as well as past events related to uranium mining. Additionally, for natives, the current and recent trauma must be seen in the context of the entire trauma of conquest and subjugation over the past centuries. Concern for health has been reinforced by actual patterns of illness that has been directly associated to mining and exposure to uranium and its decay products. Issues of anticipatory fears and environmental stigma also take their toll on life, as was seen from the Homestake case study.

Community conflict and Environmental Stigma are caused by a further dynamic of contamination events. The DEIS makes frequent mention of the perceptions of residents in the ROI, but it fails to closely examine how the entire perceptual world of contamination victims is different than that of people from outside the situation, including, in most cases, the people who write Environmental Impact Statements. The concept that "outsiders do not understand" became a core tenet in the Theory of Environmental Turbulence while I was in residence at Oxford University (Edelstein, 2000). My focus there was on the realization that toxic victims enter a realm of altered lifescape, lifestyle and emotion that is so at odds with the understanding of those still living "normal lives" that the latter cannot really grasp the reality of the victims. Much the same pertains to victims of war (including soldiers), rape, disaster and other calamity. The inability of larger society to recognize, support and address their injustice is hampered by the fact that the experience of the victim is so altered from the expectations held by others---and likely held also by the victims before they were harmed.

The problem of outside understanding extends considerably beyond the DEIS. Natives and non-natives alike in the ROI have suffered from the multiple effects of living in a contaminated environment without sufficient concern on the part of the larger, outside community to help them create a situation of restoration and healing, to paraphrase one of my informants. One form in which Environmental Injustice is manifest is when regulatory neglect allows contaminated environments to be perpetuated rather than

cleaned up and restored. The concept "outsiders do not understand" becomes a major factor in Superfund cleanup and applies to the Mt. Taylor region with regard to legacy contamination and degradation. Agency action is determined by politics, budgets, lawyers and experts and proceeds at its own pace. People in the situation, raising children and trying to restore some semblance of normalcy in their lives, rarely see that pace as responsive to their needs.

Beyond the separation of the culture of toxic victimization and the culture of normalcy lies a second cultural divide of relevance here. Outsiders also do not understand Native belief and practice. In our larger Western/European society, we have superficial relationships with nature, which we view as subservient to Humans and as a realm of resources for our exploitation. This view is pervasive, and is evident, for example, in the Forest Service's mission to promote exploitation of resources on its lands. The difference in perspective was captured by a Laguna poet Leslie Marmon Silko writing about Mt. Taylor (cited by Blake, 1999).

Mount Taylor towering dark blue with the last twilight.

They [ranchers] only fool themselves when they think it is theirs.

The deeds and papers don't mean anything.

It is the people who belong to the mountain.

Native Americans living in the ROI thus face the double task of being understood as people living in a contaminated region and Native Americans living in a contaminated region. They face a double layer of separation in their desire to have their needs and concerns understood.

For Native and non-native residents of the ROI, there is a legacy of contamination, ill physical and mental health, failed trust, unsafe homes and environment and loss of control, curtailed activity and emotional and social dysfunction resulting from historical uranium mining. This eco-historical context, even without the cultural issues, creates the basis for significant adverse Psycho-Social impact. In my expert opinion, all of these unmitigable significant adverse impacts converge to undermine the Psycho-Social health of the local populations. These are not separate or separable impacts, but rather ones that synergistically unite in affecting the individuals, families, neighborhoods and communities of the region by undermining the very underpinnings of meaningful and healthy life (See Figure 4).

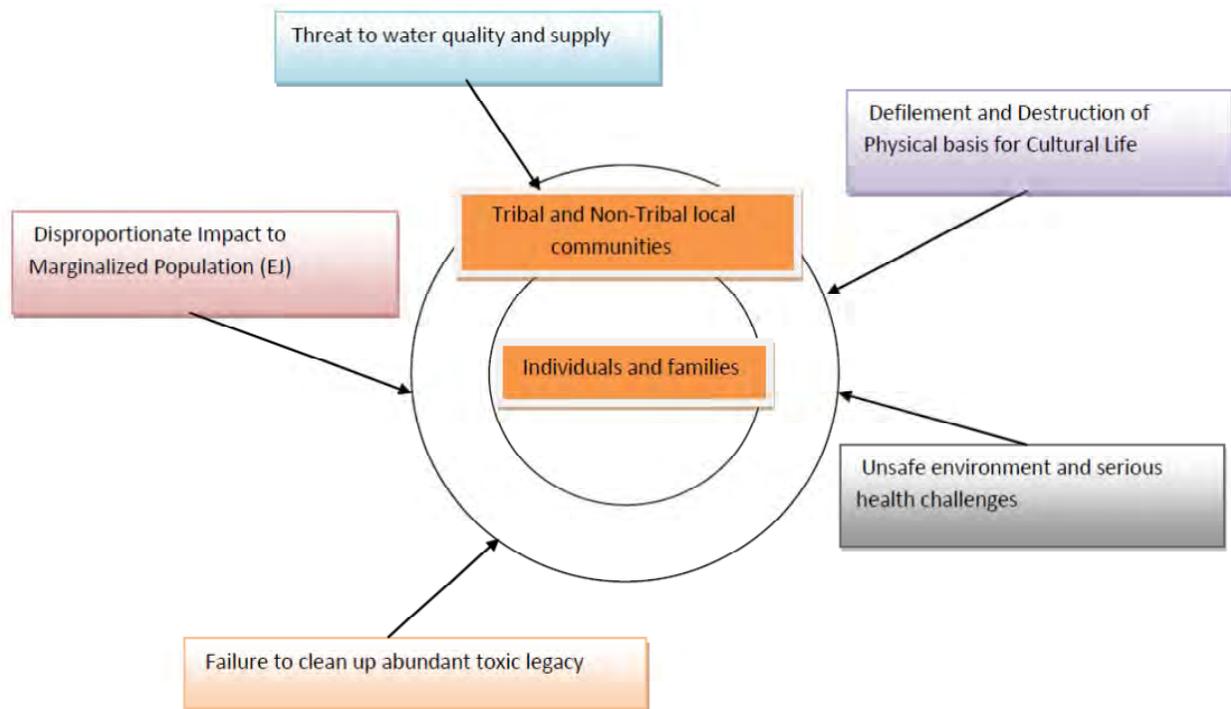


Figure 4: Unmitigable Significant Adverse Impacts Converging on the Psycho-Social Wellbeing of Local Populations to the proposed Roca Honda Mine. Source: Author

This view of Psycho-Social impact is consistent with the analysis in the DEIS, which does a reasonable job of charting the turf, even if it does not group impacts under one labeled indicator.

Uranium mining, milling, and health impacts related to soil, air, and water contamination remain an area of concern for some residents in the study area....it is likely that the mental health of residents in the ROI is being affected by past, present, and the idea of future mining activities (U.S. Forest Service, 2013, p. 432).

Similarly,

perceived contamination on the part of Native Americans, along with actual changes to water and land from the project in the vicinity of sacred lands, especially within the context of uranium mining and milling legacy issues, may have real effects on the mental and physical health of some community members. (U.S. Forest Service, 2013, p. 415).

Likewise, the "likely cumulative impacts resulting from past, current, and future developments in the ROI" include the potential for "exposures to environmental contaminants," "exacerbation of mental health impacts related to perceived contamination," "further mental health impacts to Native community members due to exploitation of land and water resources," "exacerbation of health

disparities," and "social pathologies (e.g., alcohol and drug abuse, violence, child neglect)" (U.S. Forest Service, 2013, pp. 432-3).

In its summary, the DEIS concludes, with regard to tribal environmental justice communities that "adverse mental health impacts of moderate magnitude would occur ... due to mine development so close to spiritually significant Mt. Taylor" (U.S. Forest Service, 2013, p. 276). It is unclear how only a moderate rating is given when the consequences of development impacts to social dysfunction in Native culture are so well documented (see, for example, Shkilnyk, 1985).

Overall, the DEIS does not employ the term Psycho-Social impact or treat it as an independent indicator, it tends to refer to Psycho-Social impacts in diffuse terms such as "mental health" and provides no detail on how these impacts occur. Nonetheless, the elaboration and introduction of these topics in the DEIS is, in my view, in the right direction. The DEIS, however, fails to go far enough to present and analyze the complex set of interactive factors that affect psychological wellbeing in the ROI, and falls far short of the required "hard look" or even the "deep understanding of these issues" that the DEIS itself acknowledges is needed. There is a need for a thoroughly revised section in the reissued DEIS to achieve this.

Revised DEIS Response

Psycho-Social impact is a major indicator of how the Roca Honda mine will affect local communities and, by its nature, it tends to integrate or cumulate other impacts affecting ROI residents. It is the responsibility of the Forest Service to take a hard look at such impacts, in this instance developing the "deep understanding" of Psycho-Social impacts that the DEIS itself calls for. The revised and reissued DEIS should provide a thorough analysis.

Proposed Mitigation for Psycho-Social Impact

32. Having noted many impacts now grouped under the indicator Psycho-Social, it is incumbent that the revised DEIS articulate potential mitigation, including a comprehensive list and analysis of measures needed to mitigate adverse lifescape and lifestyle impacts such as stress, anxiety and psychological harm, community conflict and social dysfunction, Environmental Stigma and anticipatory fear associated with the proposed project. The analysis needs to be sufficient to conclude whether mitigations will work and whether specific impacts are subject to amelioration through mitigation or not.

The DEIS already suggests some mitigating steps for these psycho-social impacts.

A. Community Empowerment.

The DEIS alludes to "transparency in planning..." and "involvement of affected communities in development of project operations and decommissioning plans around issues of importance to the community (e.g., water, land, air contamination; remediation commitments)" (U.S. Forest Service, 2013, p. 433). These are reasonable suggestions but they need to be taken beyond the superficial level at which they are presented. How will transparency be achieved and to whom will information be transparent? Then there is the issue of involvement. How is it done? Whom is involved? Whom do they

represent? What powers of oversight do they have? Do they have monitoring powers and resources? Do they have enforcement powers?

In my work, as noted, I have had occasion to experiment with and study the functioning of local "parties of interest" processes where community members exercise various degrees of oversight over potentially hazardous facilities. If potential mitigations are to be considered, there needs to be a thorough review of the best cases for such mitigations, whether the conditions for those best cases pertain to the project context, whether they fully address the impact and whether they have impacts of their own. Too many times I have seen such efforts falter because resources are not provided, representatives have no power, agencies do not commit the resources to also participate, representatives cannot keep up the demands over time, and so on. And then there is the question of whether the involvement of locals gives the aura of community control when in fact the participation does not adequately change the situation. This does not mean that community involvement and oversight is a bad idea. It is excellent when it is properly conceived, designed with the stakeholders, resourced and supported and empowered. The revised DEIS needs to adequately chart this turf.

The point is that these ideas for mitigation are themselves not mitigations. To become mitigations, much additional consideration is required.

B. Protective Actions.

The DEIS speaks of "continued cleanup and monitoring of contaminated mine sites and finalizing cleanup efforts in a timely manner," " strong commitment to the highest standards of health and safety at uranium mine and mill worksites," and " continued study of the environmental and human health effects of uranium mining, as well as a commitment to commence a comprehensive study of the community human health impacts of uranium mining" (U.S. Forest Service, 2013, p. 433). Again, these are important ideas, but they acknowledge that mitigations legitimate the underlying impact. In other words, the idea of continued cleanup acknowledges that cleanup is not achieved. The idea of health and safety standards acknowledges that lapses in adhering to such standards translate into health and safety threats. And continued health study acknowledges a health legacy that has never been adequately defined but yet exists.

The problem with these, and all, mitigations is that they can be rhetorical or substantive. If rhetorical, they help to rationalize decisions to permit facilities where acknowledged impacts will occur unabated. If substantive, they still may fail, revealing the impacts. To succeed, they need to be substantive and also feasible, working in the specific context and actually mitigating the impacts of concern. Much more detail about best cases, their applicability, and the risks are needed.

Let me be clear, community empowerment and protective actions are required if the Roca Honda mine is to be permitted. But, even if they are accomplished and maintained at the highest standard, they do not prevent the possibility of the impact should they lapse, be insufficient or should unexpected events intervene.

The issues of clean up and health research are a different matter. Rather than seeing these as steps of mitigation after a permit is issued, given the legacy impacts, cleanup and clarification of health risk should be achieved as a precondition for the consideration of new uranium mining permits, if for no other reason that these conditions are necessary for the independent monitoring of the impacts of any new facilities.

The DEIS also does not discuss in detail Emergency Response planning associated with uranium mining and the instant proposal. This needs to be laid out in great detail in the revised DEIS. Emergency response is a form of mitigation of impact, something that is most often neglected in the EIS process.

Revised DEIS Response

The mitigation discussion in the revised and re-issued DEIS must close the loop on identified significant adverse impacts. Mitigations discussions should present "best case" examples, evaluate their applicability to this context, and set forth detailed conditions under which the mitigation might work and its likely effectiveness in addressing the entire impact. Because a mitigation is only effective if it is tailor made for the impact it is offsetting, enough detail needs to be presented. And because the absence or failure of mitigation frees the impact to occur unabated, a proposed system for monitoring impact and abatement needs to be included.

New Legacies

33. Long term, irreversible, and irretrievable impacts are a necessary component of this assessment, but are currently omitted. In fact, given the legacy issues in the region, these questions end up being some of the most critical impact assessment questions of all.

Revised DEIS Response

The DEIS must be revised to discuss long term, irreversible, and irretrievable impacts.

Cumulative Assessment

34. Cumulative Impacts are not systematically addressed, including the full incorporation of foreseeable projects in the region. It is necessary to understand what other uranium projects are under application and contemplated and what the potential is for future projects in the region. Likewise, other types of projects may also influence the cumulative climate of the project and need to be considered in detail.

Revised DEIS Response

Cumulative impacts must be fully assessed in the revised DEIS to include all planned and potential interacting projects with the Roca Honda application

Conclusions

35. Having identified significant adverse Psycho-Social impacts for the Roca Honda project, my recommendations can be succinctly summarized.

A. I recommend that a revised DEIS be prepared. While there are some excellent parts of the Roca Honda DEIS, the overall document fails to meet the test for a competent Environmental Impact Assessment. Because so many of the unresolved and confounded issues involve matters where further investigation and public input is required, I do not recommend approval of the DEIS and progression to preparation of an FEIS. And, because the changes required involve the document as a whole, I do not recommend a supplemental DEIS. Under the circumstances, and given the controversial nature of the proposed project, a revised and reissued DEIS with full opportunity for public review is appropriate.

B. There is an insufficient analysis of psychological impacts and their coherent integration in the DEIS. The Forest Service must revise and re-issue the DEIS in order to remedy the insufficient analysis of impacts and their coherent integration in the current DEIS. In particular, Psycho-Social impacts (incorporating Legacy, EJ, and Cultural Impacts) need to be fully developed as an indicator of impact and subjected to a "hard look" by the revised DEIS. The research and analysis need to provide decision makers and the public with a clear view of the significant adverse effects of the proposed project so that they fully comprehend the implications and tradeoffs involved in permitting it to occur. While NEPA leaves to the decision maker the task of valuing the findings and trading off the impacts to determine an outcome, the DEIS must take the analysis to the point where the significant adverse impacts and disproportionate significant adverse impacts have "weight." Key indicators of impact, including Psycho-Social Impact, are obscured in the DEIS even though there is actually a fair amount of information dispersed throughout the document. Sometimes impacts are accorded weight in the DEIS, but the method for doing so appears to be arbitrary and subjective, the application inconsistent and sometimes contradictory. Integration is also important. It must be explained to decision makers that the various indicators of impact do not act in isolation, but rather they have a synergetic relationship. When one weaves the pieces together, the dazzler that results is a compost effect of many directions intersecting.

C. A real comparison of alternatives is required. As noted the alternative comparison underlying the DEIS creates a false development versus no development dichotomy that implies that the status quo will continue if the project is not approved and that the legacy of contamination is a constant in both conditions. In the revised DEIS, a no-action alternative based upon sustainable development and cleanup, reclamation and restoration should be offered to create a real comparison. It is consistent with and perhaps required of NEPA, to develop a sustainable alternative and to consider the implications of the proposed project for a sustainable future.

D. A Base Case analysis is required. A Base Case analysis is required to show how baseline conditions serve as foundations for potential project impact. In particular, questions of legacy, culture and social dysfunction should be developed in this way.

E. Legacy must be treated as an impact. Legacy must be treated as an impact, not just a baseline or background condition, because it drives so many other secondary impacts. In particular, the implications of Legacy impacts for Psycho-Social health should be considered.

F. Cultural impacts should be Assessed as Psycho-Social Impacts. Impacts do not necessarily belong in one box, as the DEIS demonstrates with their use of cultural impacts to discuss EJ. The same thing is true for cultural impact and Psycho-Social impact. For Native Americans, as the DEIS concedes, culture is not separate or separable from life. Therefore, the implications for behavior, cognition and emotion need to be understood at both the base case and impact levels of analysis. The DEIS considers cultural impacts to not be readily subject to mitigation, which I concur with. But the full implications of this conclusion need to be set forth so that they are understood by decision makers and the public.

G. Social Conflict Must be Assessed. One of the significant impacts of the proposed project, found even in its proposal and review, is its contribution to family, community and regional conflict. The revised DEIS must fully address this impact and seek means of mitigation.

H. EJ Must be fully examined. An excellent discussion of EJ impacts for Native Americans is offered but almost none for other groups or for the young or the poor. Moreover, the implication of the discussion, even for Native Americans, is not fully developed. Jobs are loosely thrown around as a tradeoff for a host of adverse impacts, but there is no analysis upon which to be certain that benefits will reach those not impacted. A hard look discussion is required of the revised DEIS.

I. Psycho-Social Impacts Must be Considered. The DEIS unsystematically discusses many elements of Psycho-Social impact, and it would greatly benefit from an integrated and systematic review of this indicator in the revised document. Much of the content is drawn from other impacts, but the power of this indicator is that it can make clear just how people are and will be impacted by the proposed project. This focus is required if the full consequences of the project are to be understood and potentially mitigated. A fully developed Psycho-Social impact review will help to explicate the critical issues with many other indicators explicitly discussed in the DEIS.

J. Mitigation is Inadequate. Mitigations for the impacts discussed in the DEIS are inadequate and need to be substantively developed in the revised DEIS. Currently, discussion of mitigation consists of random lists lacking the substance required to ascertain whether they in fact serve to ameliorate the impact. Because significant adverse impacts require a serious mitigation effort, the current DEIS does not meet this test. In the prior discussion, I recommended the reference to best cases and their applicability. Mitigation steps need to be clearly articulated to the point that the decision maker can required them in permits or otherwise implement them effectively. When mitigation is unlikely to work for an impact, the implications need to be spelled out very clearly so that the decision makers understand.

K. The Cumulative Impact Assessment is Inadequate. Although cumulative impacts are discussed, I did not see a thorough review of all the uranium mining and milling projects proposed or

anticipated or an assessment of the potential for such projects in the region. I also did not see a discussion of other projects that interact with uranium development.

L. Long term, Irreversible and Irretrievable Commitment of Resources Need to Addressed.

In lieu of Strategic (Policy) Assessment, the long term, irreversible and irretrievable impacts of the proposed project are required to be assessed by NEPA. In this case, given the long-lived pollutants and the legacy of contamination, the assessment is critical.

The elephant in the room regarding the Roca Honda project is unstated in the DEIS. Some projects determine the future of a region, and this is one of them. Perhaps the view is that the uranium lands of New Mexico and beyond are already sacrificed and that their population is living in a sacrifice zone that is an ideal location for more of the same. In contrast, if this is a land trending toward reclamation and sustainable development, then our thinking is otherwise. Right now, the region and its people are in limbo. The revised DEIS must consider the potential that the Roca Honda mine is a turning point for the future of the region. If there is to be a revitalization of mining and a perpetuation of legacy problems, then perhaps the implication is that people are removed from the land, even if it is sacred, because we would have to admit that their safety and their sanity there is imperiled.

M. No Action is the Credible Alternative. It is my view that significant adverse Psycho-Social Impacts will occur if Roca Honda uranium mine is permitted, harming the psychological wellbeing and health of residents of the ROI. Given the significance of the adverse legacy issues, the adverse Environmental Justice findings and the significance of the adverse cultural impacts, the indicator of Psycho-Social impacts is a useful way of organizing the cumulative effects for the ROI population. Demonstrated is that, rather than a path toward a sustainable and healthy future for the environment and people of the region, a decision to permit will risk significant adverse effects that may undermine sustainability and health far into the future.

Therefore, although I have primarily thought about one integrative indicator of impact regarding the proposal, I believe that there is a sufficient basis for me to recommend the No Action alternative, with the implied denial of permits and operational plans. In my view, if the people of the region are to be considered, the focus must be made to address legacy impact issues and to chart the sustainable development of the region with a long term view toward the health of environment, people, economy and culture.

Dated: June 11, 2013.



Dr. Michael R. Edelstein, PhD

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Appendix 1: Table 3: Psycho-social impacts due to cultural impacts

Source: Author. All references unless noted are to US Forest Service, 2013 (DEIS).

Tribe	Belief/Deseccration	Physical Impact	Psycho-Social Impact
Hopi			Mt. Taylor visited for conducting ceremonies and other religious activities, and for collecting materials. DEIS p. 305.
Hopi	Mining is man’s intent,... when used on a natural resource such as uranium, ...is deseccration to the sacred landscape.... Uranium in its natural state is a blessing and is part of the earth....bringing uranium to the surface... is viewed as exploitive and would cause harm. DEIS p. 343.	The mountain is considered a living being, and mining is akin to hurting a living being. Uranium drilling and mining activities would threaten sacred landscape features and harm the spiritual heart of the mountain. DEIS p. 343.	Impacts to important locations would have local impacts for the Hopi people; it would affect their spiritual and emotional energy. ...prayer must be positive...the individual must be focused and able to drive away disturbance. Having in mind the knowledge and thought of the impending disturbance or intent to disturb through drilling and mining would alter the ability to conduct prayer and ceremony in a manner it is intended to be done. It would make it very hard for the Hopi people, particularly the traditional practitioners and those engaged in ceremonial activity, to carry on in a manner that is essential for them as Hopi to be Hopi. DEIS p. 343.
Hopi	Exploratory drilling and mining for uranium ... (have) an adverse impact and...harm...the Hopi people. To impact important elements of a people’s faith is to deseccrate the whole of the faith. To deseccrate the Mt. Taylor landscape would place a substantial burden upon the culture of katsina and the Hopi people as a whole.		"The tribe fears that continued and cumulative deseccration of sacred landscapes such as Mt. Taylor would ultimately lead to their prayers and ceremonies becoming simply a performance with no true link to the sacred place. Physical alterations and impacts to the mountains such as Mt. Taylor would

	Katsina is fundamental to Hopi culture. Peaks such as San Francisco Peaks and Mt. Taylor are the home of the katsinas. DEIS p. 343.		irreparably harm the cultural practices of the Hopi, and affect the very core of their cultural identity and essence of what it means to be Hopi." DEIS p. 343.
Hopi		...the proposed project would adversely affect the Mt. Taylor TCP, ... prehistoric sites that fall within the boundary of the Mt. Taylor TCP... human remains may be encountered...Medicinal plants...may also be affected." Also concerned about use of large amounts of water, harm to environment and contamination of the Mt. Taylor area. DEIS p. 343.	Cumulatively, "the proposed project ... cause irreparable harm to the Hopi people and their traditional cultural practices (by) ...adversely affecting the core of Hopi cultural identity and essence of what it means to be Hopi; adversely affecting the Katsina; impacting the integrity of the mountain's sacred landscape; and diminishing the power or effectiveness of prayers and ceremony. DEIS p. 343.
Navajo Nation	Mt. Taylor is one of four sacred mountains that bound Dinétah, or the traditional Navajo land. DEIS p. 304. Uranium is meant to remain where it is, buried in the earth. It is believed that uranium changes when it is brought to the surface; extracting uranium contaminates and poisons the surface. It is believed that once uranium is extracted, it would poison humans and other living resources such as plants and water, and cause illness. DEIS p. 344.	health issues and degradation of the environment, ...Contamination and depletion of groundwater and springs, DEIS p. 344.	[Will] adversely impact the Mt. Taylor TCP, an area that plays a vital role in Navajo oral tradition, cultural identity, and continuity of traditional cultural practices. DEIS p. 344. The mountain and its mesas were used historically for homesteading, sheep herding, hunting, gathering of food and materials, and for conduct of traditional healing ceremonies.... Collection of food and materials and conduct of ceremonies continues in the Mt. Taylor area today DEIS p. 304.
Navajo	Drilling or digging into the earth is considered misuse and is viewed in a negative way because of the	...if plants are misused, they will move away... Digging into the earth is also believed to alter the	The older practitioners speak of how uranium drilling changed the landscape and plant growth.

	impacts it has upon the plants. Digging and removing earth from Mt. Taylor is akin to removing an organ from a living being. DEIS p. 344.	otherwise beneficial effects of other land treatments intended to regenerate the growth of plants. DEIS p. 344.	Practitioners were forced to move their traditional activities away from the impacted areas. DEIS p. 344.
Navajo		displacement of plants and traditional activities, contamination of plants and water, loss of integrity (in a spiritual sense), and noise and visual impacts. DEIS p. 344.	These impacts would themselves accumulate to result in disruption, alteration, and forced displacement of traditional practices. Impacted areas would lose their integrity and become less effective, and practitioners would not be able to use those areas as they once did. Once an area lost its integrity, the ceremonies would no longer be effective and a patient would not be healed. DEIS p. 344.
Navajo	Navajo believe that contamination of these areas anger the Holy People. DEIS p. 345.	In anger, they withhold moisture (rain and snow), hinder plant growth, and allow the springs to dry up. DEIS p. 345.	The approach to Mt. Taylor and the traditional activities of a practitioner all rely upon going to certain places, such as springs. If the springs are dry, it requires a practitioner to find a different route and begin the pilgrimage over again. These impacts to traditional practices in turn impact the efficacy of the prayers or medicine being conducted. DEIS p. 345.
Navajo		The mining of uranium has contributed to a reduction of Navajo traditional use of the San Mateo area. Chanters are leery of using the area because of the impacts that these extractive activities have had upon the natural resources (plants and water) and the overall loss of spiritual integrity of	This has resulted in the displacement of some traditional activities. Traditional practitioners have said that the San Mateo area no longer possesses as much power as it once did. The chanters and practitioners began shifting their activities in the latter half of the 20th century

		the area. DEIS p. 345.	due to impacts and contamination that were occurring in the San Mateo area. The chanters began to see a pattern between use of plants and water, and subsequent illness and death of some Navajo, and suspected that some of the resources that were being collected and used were contaminated by uranium mining in the area. DEIS p. 345.
			Mt Taylor used as a storehouse where Diné collect plant medicines and other natural resources for ceremonies, including soil for the all-important Mountain Soil Bundle of Blessingway, a type of ceremonial bundle. DEIS p. 320.
Acoma	Mt. Taylor is viewed as critical to the cultural survival of Acoma, and the watershed is critical to the physical survival of Acoma. Mt. Taylor is perceived as a living, breathing entity. The mountain possesses more than cultural significance. It is the source of water (springs and streams). DEIS p. 344.	... to the Acoma people, water is a cultural resource as well. Water is the life blood of their community and inextricably linked to their survival in both a physical and cultural sense. DEIS p. 345.	Historically used the slopes and mesas surrounding Mt. Taylor for hunting, collecting of food, fuel, and other materials, and for religious activities, as well as for sheep herding, continuing to today DEIS p. 305-6. The mountain.... is essential for the spiritual and economic well-being of the Acoma people, and they are dependent upon it for these reasons. This concern encompasses health-related issues, environmental degradation, and traditional cultural concerns, which are all interrelated. DEIS p. 345.
Acoma		(San Jose river flows)... fed by permanent springs, flows through or near pueblo lands...mine dewatering would deplete	Water from the San José is used each spring for religious purposes. DEIS p. 345.

		the aquifers, move water from one basin to another and thereby take water that they depend on, and affect the flow of water in springs. DEIS p. 345.	
Acoma		contamination of water that is relied upon for domestic, agricultural, and ceremonial uses ...adverse groundwater impacts would eventually migrate downstream to Acoma before they can be mitigated or detected. DEIS p. 345.	
Acoma	Spiritual places are altered by activities that impact the earth, ... these cultural impacts cannot be mitigated by simply moving drill locations or facilities in order to avoid physical impacts to a particular site. DEIS p. 346.	Activities such as drilling and mining that impact the earth ...have an impact on the integrity of the area... diminished regardless of whether or not the work is designed to avoid physical impacts to archaeological resources.... DEIS p. 346.	...uranium development would affect the next generation's relationship with the mountain. DEIS p. 346.
Acoma		"Water, pilgrimage trails, shrines, archaeological sites, locations where certain plants, animals, and minerals traditionally have been harvested, and viewsheds... violations of sacred blessing places, and disturbance of subsurface archaeological deposits that are not yet identified. Depletion of water from the aquifers as a result of dewatering the proposed mine... threat to Horace and Gummi Springs, as well as other springs on Mt. Taylor...vital to the economic, social, and cultural identity of the pueblo.	

		...contamination of the water that remains" DEIS p. 346.	
Acoma	"... the proposed mine would result in the severing of relationships between cultural resources, relationships that have accrued over time, that are essential for each property's meaningfulness and integrity. Direct disturbance of the ground would impede the flow (DEIS p. 346) of blessings that move across the landscape following watercourses and people. DEIS p. 347.		"If [Mt. Taylor] is disturbed in ways that endanger its well-being, the people's personal and community ritual to protect their world, in turn, will be interrupted. Should such an awful consequence occur because the exchange of blessings between Acoma Pueblo (the center) and [Mt. Taylor] (the edge) becomes impeded, the world will change. If Acoma's people are unable to fulfill their sacred obligations as stewards, the world might experience upheaval" DEIS p. 346.
Acoma	"...a fundamental injury would be inflicted upon Mt. Taylor because of the proposed project." DEIS p. 247.		"Because Acoma and its landscape are so inextricably linked, disturbances that threaten the integrity of Mt. Taylor would also imperil Acoma's traditional culture, cohesiveness, and continuity. The long-term consequences that Acoma would suffer because of the proposed project would be irreversible, and the loss of meaningful cultural relationships, without material manifestations, could not be mitigated." DEIS p. 347.
Laguna		"...there are direct and indirect impacts of uranium activity, that all actions are cumulative, and that no matter how small the physical impacts are, the overall affects would be widespread. Impacts to specific	Historical Laguna use of Mt. Taylor "included the area of the proposed mine project northwest of the mountain proper for hunting, gathering of materials, and ceremonial use, as well as extensive sheep herding," no longer practiced (DEIS p.

		locations are believed to affect the whole of Mt. Taylor. ... Protection of the water supply, both surface and groundwater, is a core issue and concern..." DEIS p. 347.	305). "The contamination of groundwater is a major concern for the pueblo. This contamination can transfer to the plants and animals and evergreens, rendering them unpure and unfit for traditional use. Contamination and altering of the vegetation would make it unavailable to the traditional practitioners." DEIS p. 347.
Laguna	"Drilling and mining activities for uranium are considered by the pueblo to be a disturbance to the mountain, and a desecration of the mountain. To desecrate Mt. Taylor is dangerous and could lead to unforeseen problems, and ultimately extinction." DEIS p. 347.	[the project] "would result in severe and dire impacts to the Mt. Taylor TCP and the traditional cultural resources and practices of the Laguna." DEIS p. 348.	"The disturbance causes by drilling and/or mining would stop religious leaders from the various kiva groups from using some of their areas to collect herbs for healing. If an area becomes unusable due to impacts or contamination, the practitioners would need to find new locations to do their collection." DEIS p.347.
Laguna	"Impacts anticipated to the mountain include excavation within the mountain, the removal of earth, ore, and water, disturbance of cultural sites, and the alteration of the ecosystem." DEIS p. 348.	"The impacts would profoundly and fundamentally alter the integrity of Mt. Taylor. The pueblo believes that these anticipated impacts could not be mitigated." DEIS p. 348.	"The desecration of the mountain would directly harm the Spiritual Beings that are associated with the mountain, and the relationship of the people with them. Even when shrines on the mountain are left physically intact, the mining underground would harm the "lifeline" beneath it that connects the shrine to Laguna and other sacred places. The spiritual insult and disrespect to these places may not ever be fixed. DEIS p. 348.
Laguna	"Permanent impacts include the destruction of archaeological sites, the removal of earth and water beneath Mt. Taylor,		"...long-term impacts include the continued exclusion of Lagunas from their traditional landscape, changes to the viewshed,

	disturbance of ancestral human remains, and the disrespect shown to the spirits and beings that make Mt. Taylor of such irreplaceable value to the Laguna people." DEIS p. 347.		ecosystem shifts, and compromises to the physical health and wellbeing of animal, plant, and human life that come in contact with the uranium ore."
Laguna	" The most dramatic impact to natural resources is seen to be the mine's plan for dewatering. At Laguna, it is seen as an insult to Mt. Taylor, the natural world, and the Laguna people. Dewatering is equated with draining the "lifeblood" of the mountain." DEIS p. 348.		"Laguna practitioners use all areas of Mt. Taylor to collect natural materials for use in rituals and ceremonies. The... destruction of habitat, the alteration of the local ecosystem, and further limitations on land access would impact Laguna religious practitioners who depend on Mt. Taylor to perform ceremonial, subsistence, and collection activities. The ecosystem would be impacted for decades, and even for the animals and plants that survive the mining operations, Laguna traditionalists would likely be concerned about the purity of these resources and question whether they would be healthy to consume." DEIS p. 348.
Laguna	"... archaeological sites would be destroyed, ...looted, some petroglyphs defaced, and ancestral human remains disturbed.... all archaeological sites within the APEs would be impacted." DEIS p. 348.	Any archaeological site within the viewshed of the mining infrastructure would mean that visiting the site would compel all visitors to see and, thus, think about the mine, ... negative impact on the integrity of the sites...even when archaeological sites are physically preserved.... DEIS p. 348.	"In many cases, the holistic context of a site would be ruined, and the whole experience of that traditional landscape would be altered. These impacts would fundamentally alter the ability of Lagunas to obtain and share important information about their history, prehistory, traditions, and culture." DEIS p. 348.
Laguna	"...impact of the mere presence of the proposed mine on the traditional	"In addition to a direct impact to the viewshed in the region, the project	"Although they may not see the project on a daily basis, the

	religious practices associated with Mt. Taylor." DEIS p. 348.	would impact the Lagunas on the other side of the mountain ho maintain their "spiritshed." Laguna defined "spiritshed" as a spiritual line-of-sight." DEIS p. 348.	knowledge that this project is destroying their sacred land would dramatically and negatively affect the Laguna sense of harmony between humans and their environment. This, is turn, would negatively affect the Lagunas' communication with the mountain, their "spiritshed," and the Laguna traditionalists have no religious mechanism to make amends or correct these offenses." DEIS p. 348.
			The life force or spirits of the ancestors still reside within the materials and locations at these sites... these sites provide a place to communicate with the ancestors. Tribal people reconnect with spirits of the deceased through offerings, and these reconnections are believed to replenish the land....each site [has] a heart. DEIS p. 318.
Zuni		"...uranium activity in the past...caused significant health issues and these problems continue today." DEIS p. 348.	For Zunis, Mt. Taylor "served as a boundary, was used for farming and grazing, and for...hunting, plant, animal, and mineral collecting, and for religious observances." By the mid- and late-1800s, Zunis began to be cut off from their traditional use of Mt. Taylor, but now used the mountain for hunting, collecting, and religious activities...."(DEIS p. 305) ".... concern and frustration over the fact that tribes would be left to deal with the aftermath of this extractive activity." DEIS p. 348.

Zuni		<p>"...impacts arising from mining projects, such as impacts to archaeological sites, development of new roads allowing access into previously remote areas, damage to their cultural landscape, disruption and displacement of traditional cultural and ceremonial activities, and the impacts to the mountain itself, not just on the surface but from extraction of materials." DEIS p. 348.</p>	<p>"Religious societies within Zuni collect and use resources from Mt. Taylor for their ceremonies. The collection of seeds and other materials (forest products, minerals, pigments, feathers, etc.) has a direct bearing on any given society's ability to conduct their ceremonies, and some items must come from specific places on the mountain. Access restrictions and impacts to the environment within Zuni's cultural landscape represent a constant erosion of their ability to practice their religion." DEIS p. 348.</p>
Zuni	<p>"The mine's infrastructure and activities would directly "interrupt" the land's beauty, the viewsheds of the historic mountain, and its sacredness." DEIS p. 348.</p>	<p>"Some longterm (if not permanent) impacts include the continued exclusion of Zunis from their traditional landscape, changes to the viewshed, ecosystem shifts, and the physical health and well-being of animal, plant, and human life that comes into contact with uranium ore." DEIS p. 348.</p>	
Zuni	<p>"...the proposed project would adversely impact those qualities and characteristics that the Zuni people ascribe to Mt. Taylor as a living being, and that make it a NRHP-eligible TCP. It would fundamentally alter the integrity of the mountain and its natural and cultural landscape. The mining activity and infrastructure would directly diminish the land's beauty, the viewshed, and the sacredness of the mountain. The removal of</p>	<p>"The permanent impacts include the destruction of archaeological sites and shrines, removal of earth and water beneath Mt. Taylor, disturbance of ancestral human remains, and the disrespect shown to the spirits and beings that make the mountain of such irreplaceable value to the Zuni people." DEIS p. 348.</p>	<p>"These impacts would damage the Zuni relationship with the total landscape of the mountain, and alter the ability of the Zunis to use Mt. Taylor to obtain, share, and honor important information about their history. The Zunis believe that Mt. Taylor and all ancestral sites are rooted in Zuni traditions and are still vitally needed today to ensure the survival of Zuni culture. Site impacts raise subsequent concerns about</p>

	<p>millions of gallons of water would drain the “lifeblood” of the mountain. Desecration of the mountain through extraction of ore, disturbance of the surface, and degradation of the ecosystem would also directly harm the Spiritual Beings that are associated with the mountain." DEIS p. 348.</p>		<p>the well-being of the Zuni ancestors’ spirits and the living. The destruction of ancestral sites, the alteration of the traditional landscape, and the disrespect shown to the ancestors would seriously impact the freedom of Zuni cultural practices, beliefs, and ceremonies. Further limiting access to the landscape would impact Zuni practitioners who depend on Mt. Taylor to perform ceremonial, subsistence, and collection activities. Ceremonies and rituals by Zunis continue to reaffirm their connection to these ancestral places and the reasons why Zuni people are still here and have a rightful claim to the landscape. Even when shrines and other holy sites are left physically intact, the mining underground will harm the “lifeline” beneath them that connects the shrines to Zuni Pueblo and other sacred places. In this way, even shrines some distance from the mine would suffer adverse impacts." DEIS p. 348-9.</p>
<p>Zuni</p>	<p>Archaeological sites in the Mt. Taylor area validate Zuni traditional histories and, as such, are considered to have been left there by Zuni ancestors for a specific purpose: to serve as Zuni markers on the landscape. For the Zuni people, archaeological sites are imbued with religious and cultural values that are alien</p>	<p>The Zuni foresee destruction of archaeological sites and shrines, defacement of petroglyph sites, impacts of vibrations from the traffic and blasting, disturbance of ancestral human remains, and vandalism and looting of archaeological sites, all as a result of the proposed</p>	<p>The construction of the mine infrastructure and its activities would impact the archaeological sites by changing the settings in which these archaeological sites are situated, destroying archaeological materials, and altering the feelings of place and spiritual associations. Even where archaeological</p>

	<p>and intangible to western-trained scientists of Federal land managers.... The Zuni Tribe considers that the presence of a mine constructed in an area encompassing so many sacred ancestral sites would be disrespectful and damaging. DEIS p. 350.</p>	<p>project. They note that some of these impacts have already occurred to the sites. DEIS p. 350.</p>	<p>sites are physically preserved, the building of substantial infrastructure nearby would indirectly impact these “saved” sites. In many cases, the whole context of a site would be ruined, the whole experience of that traditional landscape would be altered. DEIS p. 350.</p>
Zuni	<p>... removal of water for the proposed mining project would be an affront to the mountain’s meaning as a spiritual beacon for moisture. DEIS p. 350.</p>	<p>The extraction of water would impact springs and other sources of water on Mt. Taylor, both in terms of drying up water sources and contamination. DEIS p. 350.</p>	<p>Water from Mt. Taylor is used by religious practitioners. Water is collected from springs and used for mixing pigments for religious materials, for offerings, for plantings, and for consumption with medicines. Thus, impacts to water supplies would, in turn, impact religious practices on the mountain. There is also the concern that contamination from the mine operations would make available water unusable for consumption or other religious uses. DEIS p. 350.</p>
	<p>Construction of the mine facilities would result in damage to physical features within the Mt. Taylor TCP’s setting that contribute to its historic significance. The natural and cultural landscape in and surrounding the proposed project area contributes to the context and historical significance of the Mt. Taylor TCP. These changes would include the removal of vegetation, disruption to wildlife, changes to landforms, and physical</p>	<p>...the natural ecosystem, the plants, and animals, would be impacted by the proposed project through displacement, habitat loss, dewatering, and potentially contamination ... The impacts to the ecosystem would last for decades, and it may never fully recover even with rehabilitation. ..these impacts from the proposed project would be severe and dire, and they do not think that the permanent impacts can be mitigated. DEIS p. 350.</p>	<p>Zuni religious men are intimately interconnected to animals; medicine men specifically pray to animals and prayer sticks are prepared for animals. The mine is an offense to the Zuni because they depend on these animals for their own spiritual welfare. Thus, the proposed mine would affect the welfare not only of the animals but of the Zuni people as well. The impacts of the proposed mine anticipated by Zuni would discourage the productive harmony</p>

	<p>damage to archaeological resources. This damage to the features within the setting would range from long term to permanent, and would be moderate to severe in magnitude. DEIS p. 351.</p>		<p>between the Zunis and their environment, undermine the Zunis' efforts to protect the environment and biosphere, diminish the health and welfare of the Zuni people, and devalue the Zunis' understanding of ecological systems and natural resources important to the Zuni Tribe. DEIS p. 350.</p>
	<p>Construction of mine facilities and infrastructure and earth-moving activities would introduce modern facilities and activity into a largely undeveloped landscape that retains a substantial amount of its historic natural and cultural integrity. This would result in the introduction of visual and audible elements out of character with the Mt. Taylor TCP. DEIS p. 351.</p>	<p>These elements would derive from modern facilities, vegetation removal, dust, machinery, and traffic.... the scenery and viewshed currently retain the ... historic sense of place, which is a significant historic feature of this property. Some of these effects would be temporary and others long term, and would range from minor to severe in magnitude. DEIS pp. 351 – 352.</p>	<p>Further disruption of this setting would affect the Mt. Taylor TCP, the context and integrity of the property, and a person's appreciation and understanding of the historical context and significance of the property. DEIS p. 352.</p>
	<p>During the operational phase of the proposed project, indirect physical disturbance of historic properties could occur ... potential for physical damage to buried archaeological resources ... DEIS p. 352.</p>	<p>The effects from erosion, inadvertent damage, vandalism, and illegal artifact collecting, and damage to newly discovered properties, would be permanent and could range from negligible to severe. ... effects would derive from general onsite activity, use of large machinery and equipment, onsite traffic, and heavy haul traffic along Highway 605. Some ...temporary and others long term... range from minor to moderate...DEIS p. 352.</p>	<p>Operational activities at the mine would continue to introduce visual and audible elements out of character with the Mt. Taylor TCP, further affecting the setting of this historic property DEIS p. 352.</p>
Zuni		Reclamation activities	Reclamation activities at the

		<p>have the same potential for physical damage to historic properties as operational activities. ... These effects would be permanent and could range from negligible to severe. DEIS p. 352.</p>	<p>mine would continue to introduce visual and audible elements out of character with the Mt. Taylor TCP, further affecting the setting of this historic property. DEIS p. 352.</p>
<p>Common Impacts</p>	<p>Mt. Taylor has an integral relationship with the beliefs and traditional cultural practices of the involved tribes and it is critical to the maintenance of the cultural identity and transmittal of their beliefs. It is this relationship that contributes to the property's significance. DEIS p. 353.</p>		<p>The action alternatives would result in the disruption, alteration, and displacement of traditional cultural activities that are critical to the continuity of cultural beliefs and practices of these tribes. In the view of the involved tribes, changes to the traditional practitioners' ability to conduct their traditional cultural activities would lessen the overall effectiveness of their prayers, medicine, and healing ceremonies, thereby impacting the traditional practices and diminishing their value. DEIS p. 353.</p>
	<p>These impacts and changes would affect the TCP by diminishing the property's integrity of relationship. In the view of the tribes, Spirit Beings and their association with Mt. Taylor are integral to the spiritual and cultural beliefs of the tribes and play a vital role in the view of the mountain as a powerful living, breathing entity. These beings provide vital resources such as rain, snow, plants, and wildlife that allow the tribal communities to survive and prosper. DEIS p. 353.</p>	<p>The proposed project would have an impact upon the Spirit Beings associated with the TCP. The action alternatives threaten the relationship between the Spirit Beings and the mountain. It is believed that mining for uranium is an activity that would anger the Spirit Beings who reside on or travel to the mountain, and impact the relationship of the Beings to the mountain, the people, and the traditional cultural practices associated with the mountain. These impacts</p>	<p>The Spirit Beings' presence and protection on the mountain is essential for contemporary prayers, medicine, and healing ceremonies to be successful.... Impacts to Natural Resources with Cultural Value Interrelationships between cultural resources and natural resources give a landscape meaning through their association with a people's history and cultural identity. DEIS p. 353.</p>

		would also affect the TCP by diminishing the property's integrity of relationship. DEIS p. 353.	
	Throughout the tribal consultation and the ethnographic assessments, the involved tribes have expressed the importance of springs to traditional cultural practices and to the significance of the Mt. Taylor TCP. Springs do provide a source of water. However, their importance to the tribes truly stems from their association with the mountain and the supernatural realm. Springs are considered a conduit or portal for prayers and blessings to reach the Spiritual Beings. The water and associated vegetation from springs is considered to have spiritual significance and is used for ceremonies and rituals. DEIS p. 354.	[At least one spring would be severely impacted]	The potential that any changes could occur to the springs is a concern to the tribes. Because of the very important and sacred role of springs in the traditional cultural and religious practices of the tribes, the integrity of springs is paramount to the success of those practices. To cause changes to a spring, no matter how small, could impact the ceremonies and rituals associated with that spring, and subsequently result in detriments to the health and well-being of the tribe and its people. DEIS p. 354.
	Aquifers are considered part of Mt. Taylor, and are part of the cycle whereby the mountain and the Spiritual Beings provide water to the people. DEIS p. 354.	During construction of the Roca Honda Mine, the shafts would pass through two aquifers that contain sufficient groundwater to require some degree of dewatering...DEIS p. 354.	The provision of water by the mountain is directly influenced by and influences the traditional cultural practices conducted on the mountain. DEIS p. 354.
	Plants and animals play an important role in the traditional cultural practices and beliefs of the involved tribes.... The involved tribes foresee long-term impacts to the Mt. Taylor spiritual landscape as a result of the impacts to wildlife and vegetation. The long-term impacts of an impacted ecosystem on the	...there is concern by the involved tribes that the rehabilitation may not completely repair the damage caused by the proposed mine. DEIS p. 354.	The health and well-being of these wild populations is not only important from a subsistence point of view, but also from the viewpoint of supplying specific materials for rituals, acting as messengers to Spiritual Beings, and acting as healers. Tribal people send wildlife prayers and blessings and, in return, they

	<p>traditional cultural practices of the tribes are a concern. The spiritual well-being of the mountain, and the spiritual relationship between the people and the Spiritual Beings of the mountain, would be impacted by the changes to the ecosystem, and it is unknown if those impacts can be repaired. It could result in a permanent impact. DEIS p. 354.</p>		<p>provide for the spiritual welfare of the people. DEIS p. 354.</p>
	<p>Both action alternatives are expected to result in [cumulative] adverse effects to historic properties, including the Mt. Taylor TCP, and significant impacts to other important cultural resources and to traditional cultural practices. DEIS p. 359.</p>	<p>These [cumulative] impacts and effects would include physical damage to the resources, and damage to physical features within the setting of the resources, resulting from activities conducted during construction, operations, and reclamation phases. The introduction of visual and audible elements out of character with the resources would also impact the resources. These impacts would derive from the surface activities conducted during all three phases, from the presence of modern facilities in the rural environment, and from the changes to the natural landscape....These overall impacts would be significant. DEIS p. 359. [Other] projects, when taken together, have ground disturbing activities, facility development, ore extraction, dewatering, and surface activities associated with them ... similar in type,</p>	<p>Traditional cultural practices would be affected due to physical disturbance of the cultural and natural resources in the project area during construction, operation, and reclamation. Impacts to practices would also occur from extraction of ore, dewatering, and the surface activities being conducted. DEIS p. 359.</p>

		<p>magnitude, and duration to those of the proposed RHR mine. DEIS p. 360.</p>	
	<p>Archaeological sites not only document and provide evidence of tribal histories, they are considered to be sacred for a number of reasons. Sacredness of the sites is rooted in the oral traditions and religious knowledge of the tribes, and these sites provide a place to communicate with the ancestors. From this perspective, destruction of even one site is considered sacrilege, as that site is not replaceable or interchangeable with any other site; it is unique and plays a distinctive role in the tribes' beliefs. DEIS p. 361.</p>	<p>... considering the cultural values of archaeological sites, the cumulative effect of the Roca Honda Mine project would be significant. DEIS p. 361.</p> <p>The largest visual impact would be from viewers on Mt. Taylor. (DEIS p. 106)</p>	<p>Archaeological sites provide a tangible connection to history and place, commemorate the lives of the ancestors, and impart specific information about tribal histories and culture, all of which help to shape and inform tribal identity. Archaeological sites are viewed as key to the retention and transmission of traditional culture and history. Each archaeological site is believed to contain records of events, instructions from ancestors, and reminders from ancestors to current generations and, therefore, has a teaching purpose. DEIS p. 361.</p>
		<p>"Even though the proposed mine may occur in only a small fraction of the viewshed from Mt. Taylor, its mere existence in the viewshed would be enough to impact the aesthetic experience for these tribal users. DEIS p. 368.</p>	<p>The addition of [yet] another mine to past projects would further impair the relationship of the tribes with the mountain and its landscape, further impacting the beliefs and practices associated with the mountain and its place within the traditions of the tribes. Either of the action alternatives would further disrupt American Indian cultural and religious activities on Mt. Taylor and impact the integrity of the mountain. The "cumulative burden" is on the tribes who have and would continue to suffer from the lasting cultural and environmental consequences</p>

			<p>of mineral extraction in this area. The proposed project would contribute to the furtherance of the degradation of the resources and the tribes' relationship with those resources and Mt. Taylor and its landscape, and would result in a significant cumulative effect. DEIS p. 361.</p>
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Table Three: Psycho-social impacts due to cultural impacts

Source: Author; table content quoted from US Forest Service, 2013 (DEIS)

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EDUCATIONAL BACKGROUND

Degree Work:

B.S., Psychology, University of Pittsburgh, 1970 (Magna Cum Laude)

Ph.D., Social Psychology, SUNY at Buffalo, 1975

Title of Dissertation: "The Influence of Privacy Preference, Situational Demands, Socio-Economic Status and Sex upon Perceptions of Crowding and Preference for Settings of Varied Privacy Potential."

Non-degree Advanced Training:

Graduate School Professional Development Program, National Training Laboratories, 1972-3

Workshop on the use of Natural Resource Inventories in Local Planning, Cooperative Extension Service, winter, 1978
 Advanced SEQR (New York State Environmental Quality Review Act) Workshop, New York Land Institute, 1981

Reducing Radon in Structures Workshop, New York State Energy Office, 1986

The Preparation and Review of Environmental Impact Statements, the White House Council on Environmental Quality and New York State Bar Association, November 16-18, 1987

Workshop on the Statistical Package for the Social Sciences, Ramapo College, May 1989

Faculty Training Workshop on GIS (Geographical Information Systems), Ramapo College, October 1998, September 2004.

PROFESSIONAL WORK RECORD

Ramapo College of New Jersey

Initial Appointment: September, 1974, Instructor; Promotion to Assistant Professor, 1975; Tenure, 1979; Sabbatical Leaves, Fall, 1984, 1991-92, Spring 2001; Fall 2009; Promotion to Associate Professor, 1985; Promotion to Full Professor, 1990. Range Adjustment Promotion, 2001.

State University of New York at Buffalo

Visiting Professor, School of Architecture and Environmental Design, State University of New York at Buffalo, 1972-4.

Consulting and Grant Projects

Project Director, Trust for Mutual Understanding Grant to Institute for Environmental Studies, Ramapo College, "Exchanging the Lessons of the Aral Sea Disaster." 2011. Exchange of scholars addressing the ramifications of the Aral Sea disaster. Led team of Americans visiting Uzbekistan in May/June 2011, with visit from Uzbek team October 2011.

Attachment A

Fulbright Visiting Scholar Grant written for 2009-2010. Hosted Dr. Abror Gadaev of Samarkand Architectural and Engineering Institute.

Project Director, N.J. Board of Public Utilities Grant to Institute for Environmental Studies, Ramapo College, "Renewable Energy and Green Design." 2007-2008.

Project Director, Trust for Mutual Understanding Grant to Ramapo College, "Empowering Russian and American NGO's to Address Issues of Future Sustainability." 2002-2004. Exchange of scholars and activists addressing issues of contamination in Russia and the U.S. Led team of Americans visiting Russia in July/August 2002 and hosting visiting Russian team in November 2002. Senior editor for resulting volume.

Member of team assembled by University of Mississippi to develop guidelines for post-Katrina social science research. 2006.

Project Director and prepared report with Ali "Kate" Higgins, "*Inherit the Earth: The Sustainable Living Pioneers. A Program for Greening Phase Seven and Ramapo College's Commitment Toward Sustainable Campus Housing, February 1, 2002.*" Funded by the Ramapo College Foundation.

Consulted to the Oversight Committee for the medical monitoring fund for the Lipari Landfill, winter 2002.

Agency for Toxic Substances and Disease Control/ Environmental Research Group. Prepared chapter for a volume on stress reduction approaches for use in training professionals to work in contaminated communities. 1999-2000.

Project Director, Trust for Mutual Understanding Grant to Ramapo College, "Informing Environmental Decision-making: Environmental Impact Assessment in Russia and the U.S." 1999-2000. Exchange of scholars and activists using environmental impact assessment; linking University courses to actual field environmental assessment projects. Visited Russia from December 1999 through February 2000 and hosted visiting Russian team in September/October 1999. Authored final project report, March 2001 and co-authored and edited project volume to be published in Russian and English in 2002.

Project Director, "New Jersey Higher Education Partnership for Sustainability." Project funded by the Geraldine Dodge Foundation, Spring 1999. Directed the organizational development phase of an on-going project.

Fulbright Visiting Scholar Grant written for 1998-1999. Hosted Dr. Maria Tyschiachniouk, St. Petersburg, Russia.

Participated in sustainability exchange project funded by the Trust for Mutual Understanding which involved a study tour of western Russia and participation in conferences in Washington and St. Petersburg, summer 1998.

Crawford, Multari and Clark Associates. Consultant in the preparation of Socioeconomic Impact Assessment on the alternative remedial approaches to the Unical oil spill in Avila Beach, California, 1997.

Fund for the Improvement of Post-Secondary Education (FIPSE). Project Director for Four-year long grant awarded to Ramapo College of New Jersey entitled "Ecological Literacy and the Undergraduate Curriculum." 1994-8.

Native Lands Institute. Assessment of the psycho-social impacts of the loss of water from Wak Village on the San Xavier Reservation of the Tahono O'odham People. Initial field study completed summer of 1994. Second field visit January 1996. Continuing project.

U.S. Department of Energy. Prepared report: "Mitigating Environmental Stigma and Loss of Trust in the Siting of Hazardous Facilities" for the Yucca Mountain Studies Series, 1991-2.

Church World Service. Prepared study guide to accompany video: Three Parables for the Technological Disaster Task Force. 1990.

Impact Assessment, Inc. Psychosocial Impact of the "Oiled" Communities. Research consultant to project studying 24 communities affected by the Exxon Valdez oil spill. 1989-1990.

New Jersey Department of Health. "Final Project Report: The New Jersey Ozone Notification Program Evaluation." Prepared on behalf of the Ramapo Institute for Environmental Studies. February 15, 1989.

Impact Assessment, Inc. Member of the Washington State Study of the SocioEconomic Impacts of the proposed high level nuclear waste repository in Hanford, Washington. Responsible for examination of historic effects on "downwinders." 1986-87.

Center for Social Impact Assessment. Member and project team leader of the Mississippi State Study of the SocioEconomic Impacts of the proposed high level nuclear waste repository, Richton Dome, Mississippi. 1984-86. Wrote Implementation Plan, Preliminary and Final Plans of Study for the Psychosocial Impact project as well as two reports: "Modeling Mississippi" and "PsychoSocial Impacts on the Community."

Buffalo Organization for Social and Technological Innovations, Inc., 1972-3. Psychological Consultant. Reports include "Constructo-Tubes: Preliminary Concepts, Components and Curriculum Units," "Some Preliminary Thoughts on Evaluating Constructo-Tubes," "An Evaluation Design for OIS (Office Interior System)," "Hauserman Office Interior System: Recommended Evaluation Program," "Outline of Hauserman's On-Site OIS Evaluation Program," "A Look at Five Different Decision Rules" and "Discussion Leader's Handbook" (co-authored for PAK---Planning Aid Kit produced for NIMH).

Toxic Tort Projects

Eric Jantz, Esq. New Mexico Environmental Law Clinic. Retained on behalf of MASE Alliance.org (Multi-Cultural Alliance for a Safe Environment) to prepare comments on the adequacy of the Draft Environmental Impact Statement prepared by the U.S. Forest Service for the proposed Roca Honda Uranium Mine in addressing psychosocial impacts for native and non-native stakeholders.

Richard Webster, Esq. Public Justice, appearing on behalf of Hudson River Sloop Clearwater. Prepared expert report "The Environmental Justice Implications Associated with the Re-permitting Of the Indian Point Nuclear Power Complex, Buchanan, NY," September 1, 2011, offered as testimony before the Atomic Safety and Licensing Board hearing over the re-permitting of the Indian Point Nuclear Complex. "Rebuttal to Respondents' Testimony on the Re Environmental Justice Contention," June 27, 2012. Provided testimony before ASALB on October 23, 2012.

Joel Kupferman, Esq. New York Environmental Law and Justice Project. Presented affidavit for *St. Nicholas Houses vs. The City of New York, NYCHA, et al.* on the Psychosocial and Environmental Justice Impacts from the loss of forest and gathering and recreational facilities and the addition of a school building, a through-street and a residential tower to the St. Nicholas Project, Harlem. July 2011.

Jennifer Klimek, esq. and Ackroyd LLP. Expert on behalf of various citizens in permit hearing for Shell Waterton 68 gas well and facilities. Retained to assess the psycho-social impacts of prior gas well and pipeline development in the Beaver Mines, Alberta area and report on the potential impacts of their expansion proposed by Shell through this project. Submitted report "Anticipated Psycho-Social Impacts To Proximate Residents and Recreationalists From the Shell Waterton 68 Project" and testified at hearing before Alberta Energy Resource Conservation Board in October 2010.

Ackroyd LLP. Citizens for Responsible Development, intervention into permit hearing for the TOTAL Tar Sands Upgrader. Retained as expert to evaluate the proposed Emergency Response Plan and prepared report "Habits of the Heartland: Home/Farmland vs. Industrial Zone: An Evaluation of the Emergency Response Plan for the Proposed TOTAL Upgrader," Report to the Alberta Energy Resources Conservation Board. May 10, 2010 (112 pages). Testified at hearing in Fort Saskatchewan, Alberta June 8-10, 2010.

Skinner Law Firm. Joy v. Richmond American Homes of W. Va. Retained to prepare testimony in case where residents were exposed to geologic radon gas in homes outfitted with radon removal systems, 2009-2011. Settled.

McRoberts, Roberts & Rainer. John D. Gale vs. New England Gas Company. Consulted on case in Tiverton, R.I. involving residential exposure to Coal Gasification Wastes, 2006-7. Settled.

Tousley Brain Stephens PLLC. Albano v. Scott Real Estate Investments, Inc. Preparation of testimony and report regarding residents of an apartment complex contaminated with asbestos during remodeling. 2005-6. Deposed, May 2006. Case settled before trial.

Scott Thornton, Esq. and Michael Sussman, Esq. Preparation of testimony for Leland et al v. Moran et al. Prepared report "Psycho-social Impacts Associated with the Ellenville Scrap Yard: Stress and Health Threat and Loss of Enjoyment of Home and Property along the Beerkill," August 2001.

Murray & Murray. Retained as an expert in order to prepare testimony for the case Bettis v. Reutgers-Nease involving the contamination in eastern Ohio of the Middle Fork of Little Beaver Creek and its floodplain with chemicals including Mirex and subsequent ecosystem, wildlife and human exposure issues. Prepared report entitled "Psychosocial Impacts Associated with the Contamination of the Middle Fork of Little Beaver Creek, January 7, 1999." Deposed. Case settled.

Shabel and Shabel. "Preliminary Report: Psycho-Social Impacts Associated with Tullytown Landfill for New Jersey Residents in the Florence Township Area." April 19, 1998.

Riddell, Williams, Bullitt & Walkinshaw. Branin V. Asarco. Conducted extensive field study of the psycho-social impacts resulting from contamination due to the Asarco smelter, Ruston and N. Tacoma, Washington. 1994-5. Deposed. Case settled.

Riddell, Williams, Bullitt & Walkinshaw. Sunshine Properties et al v. Port of Bremerton et al. Conducted initial review of issues relating to impacts of historic and current dumping on community conflict in a trailer park. Case settled.

Melat, Pressman, Ezell & Higbie, LLP. Dodge v. Cotter. Field reconnaissance study conducted in Canyon City, Colorado. 1994.

Lambert and Nelson. Beach v. UNISYS. Conducted study and prepared report "The Social and Psychological Impacts Resulting from the Earhart Superfund Site, Bristol, Tennessee." Deposed, 1992. Case settled.

Riddell, Williams, Bullitt & Walkinshaw. Prepared expert testimony regarding Overlook Rim V. City of Tacoma, 1991. Deposed and testified at trial.

Milberg, Weis, Bershad, Specthrie & Lerach. Consultant regarding Penny Newman, et al v. J.B. Stringfellow, Jr. et al., 1991.

Garrod Associates. Prepared affidavit in support of the petition by Pickering/Ajax Citizens Together for the Environment for judicial review of social and community impacts of the proposed Toronto P-1 landfill site. 1990.

Short, Cressman and Burgess. Abelman, et al vs. City of Seattle. Retained to prepare testimony regarding psycho-social impacts of Kent Midway Landfill, Deposed. 1990. Case settled.

McLain, Lee, Esq. Mary Green, et al vs. Marathon Petroleum, et al. Prepared testimony regarding the psycho-social impacts resulting from the Texas City hydrofluoric acid spill of 1987. Deposed. Testified at trial, Galveston, Texas, November 1990.

Baumeister & Samuels. Lewis vs. General Electric Co. et al. Prepared report entitled "Psychosocial Impacts on the Lewis Family from the Caputo Landfill." 1989. Case settled.

Niewald, Waldeck, Norris and Brown. Slaughter et al. vs. Farm & Home Savings Association et. al. Preparation of testimony on the psychosocial impacts upon adjacent residents to the BRIO/DOP Superfund Sites, Houston, Texas. Deposed. 1988-89.

Milbank, Tweed, Hadley & McCloy. Application of CECOS International for the sixth expansion of the Secure Chemical Residue Facility, Niagara Falls, N.Y. before the New York State Department of Environmental Conservation. Prepared prefiled testimony entitled "The Psychosocial Impacts of the Proposed SCRF #6 of the CECOS Hazardous Waste Disposal facility." Testified at administrative hearing as witness for "The Concerned Citizens Organizations." 1988.

Bricklin and Gendler. Ammons et. al. vs. Great Lakes Chemical. Investigated impacts on residents of Birdsvew, Washington resulting from EDB contamination of the groundwater. Deposed. Testified before the Washington State Supreme Court, Mt. Vernon, Washington. Oct. 1987.

Hogan, Smith and Allspaugh. Floyd Wilhoit et al vs. Olin Corporation and Tennessee Valley Authority. Deposed regarding psychological impacts of DDT exposure in Triana, Alabama area. 1985-86. Case settled.

Martin and Snyder. Cito vs. Monsanto. Prepared report entitled "Stigmatizing Aspects of Toxic Pollution" for trial involving the effects on a dairy and milk processing business of PCB contamination. Deposed. 1984.

Gordon and Gordon. Quaglia vs. Barrier Chemical et. al. Prepared report entitled "Family Disintegration in the Aftermath of toxic Exposure" describing effects of industrial pollution on lives of an adjacent family. Deposed. 1983. Case settled.

Gordon and Gordon. Kordus vs. J.I.S. Industrial Services et. al. Prepared report entitled "The Loss of Livelihood through Toxic Exposure" describing the effects of an industrial landfill upon an adjacent nursery/homestead. Deposed. 1983.

Bailey and Broder. Prepared report "Stress and TMI." Fall 1983.

Kreindler and Kreindler. "Ayers v. Jackson Twp." Prepared report entitled "The Social and Psychological Impacts of Groundwater Contamination in the Legler Section of Jackson, New Jersey." Deposed. 1981-82.

Town of Goshen, N.Y. Administrative hearings on the application for expansion of Al Turi Landfill, Inc. before the New York State Department of Environmental Conservation. Prepared report entitled "The Social Impacts of Al Turi Landfill, Inc." Testified at administrative hearing, 1980.

PUBLICATIONS

Books:

Edelstein, Michael R, Astrid Cerny and Abror Gadaev. *Disaster By Design: The Aral Sea and Its Lessons for Sustainability*. Vol. 20 of *Research in Social Problems and Public Policy*. London: Emerald, 2012.

Edelstein, Michael R., Maria Tysiachniouk, Ph.D. and Lyudmila V. Smirnova, Ph.D. (Eds.) *Cultures of Contamination: Legacies of Pollution in Russia and the U.S.* Vol. 14 of *Research in Social Problems and Public Policy*, Elsevier, 2007.

Edelstein, Michael R. *Contaminated Communities: Coping with Residential Toxic Exposure (Second Edition)*. Boulder, Co.: Westview Press/Perseus Books, 2004.

Jonathan Reisman, Polina Agakhaniants, Maria Tysiachniouk and Michael R. Edelstein (Eds.), *Public Participation in Environmental Impact Assessment in Russia and United States*. Publishing Group of the Research Institute of Chemistry of St. Petersburg State University, 2002.

Edelstein, Michael R. and William Makofske. *Radon's Deadly Daughters: Science, Environmental Policy and the Politics of Risk*, Rowman and Littlefield, 1998.

Edelstein, Michael R. *Contaminated Communities: The Social and Psychological Impacts of Residential Toxic Exposure*. Boulder, Co.: Westview Press, 1988. Paperback edition issued in 1989.

William Makofske and Michael R. Edelstein (eds.), *Radon in the Environment*, Parkridge, N.J.: Noyes Science Publications, 1988.

William Makofske and Michael R. Edelstein (eds.), *Radon in the Environment*, Ramapo Institute for Environmental Studies, 1987.

Video:

"The Ecological Literacy Project, Ramapo College of New Jersey." Executive Producer for 20 minute video summary of the four-year project funded by the Fund for Improvement of Post Secondary Education. Produced and Directed by Jennie Bourne.

"A Time of Challenge." 1996. 1 hr., 45 min. Video edited from 52 hours of tape providing a summary of the content of the First Mid-Atlantic Environmental Conference. Focus is on the challenge to the environmental paradigm mounted by the 104th Congress.

Articles and Chapters in Print:

Edelstein, Michael R. "Death And Rebirth Island: Secrets in the U.S.S.R.'S Culture of Contamination," pp39-54 in Michael R. Edelstein, Astrid Cerny and Abror Gadaev (Eds.). *Disaster By Design: The Aral Sea and Its Lessons for Sustainability*. Vol. 20 of *Research in Social Problems and Public Policy*, London: Emerald Group, 2012.

Edelstein, Michael R. "Disaster By Design: The Multiple Caused Catastrophes of The Aral Sea," pp. 107-157 in Michael R. Edelstein, Astrid Cerny and Abror Gadaev (Eds.). *Disaster By Design: The Aral Sea and Its Lessons for Sustainability*. Vol. 20 of *Research in Social Problems and Public Policy*, London: Emerald Group, 2012.

Edelstein, Michael R. "Aral Sea Demise As a Dry Run For Climate Change: From Cumulative to Cascading Impacts," pp. 427-454 in Michael R. Edelstein, Astrid Cerny and Abror Gadaev (Eds.). *Disaster By Design: The Aral Sea and Its Lessons for Sustainability*. Vol. 20 of *Research in Social Problems and Public Policy*, London: Emerald Group, 2012.

Edelstein, Michael R. "Educating for Sustainability." *International Journal of Decision Ethics*. VII.3, Summer, 2012, pp. 67-80.

Edelstein, Michael R. "The Psychology of the New Warming War: Paradigm Writing as the Task of Educational Psychology" in Tatiana Andreschenko (Ed.) *Proceedings of the Conference, "Educational Psychology for the 21st Century."* Volgograd State Pedagogical University, Volgograd, Russia. September 14-16, 2011.

Edelstein, Michael R. "Privacy and Secrecy: Public Reserve as a Frame for Examining the BP Gulf Oil Disaster" in S. Maret (Ed.). *Government Secrecy. Research in Social Problems and Public Policy: Volume 19*. Evergreen Publishers, 2011. Note this article won the Emerald Publishing Journal Submission Award for 2011.

Michael R. Edelstein. "SEQR and You will Find 'Er: The Integration of Sustainability Planning and Impact Assessment, Part 1." *Environmental Law in New York*, March 2010, 21, 3, pp. 41-47. March 2010.

Michael R. Edelstein. "SEQR and You will Find 'Er: The Integration of Sustainability Planning and Impact Assessment, Part 2." *Environmental Law in New York*, April 2010, 21, 4, April 2010.

Michael R. Edelstein. "Ecological Literacy: Damaged Environments and Damaged Children," pp. 33-36 in Denuse Bauerova (ed), *Social Networking*. Ostravea, Czech Republic: Innovation of Education Institute, Faculty of Economics, VSB Technical University, 2009.

Michael R. Edelstein. "Sustainable Campuses and Institutions: The Need to Lead and the Transformation to a New Social Paradigm," pp. 37-43 in Denuse Bauerova (ed), *Social Networking*. Ostrava, Czech Republic: Innovation of Education Institute, Faculty of Economics, VSB Technical University, 2009.

Michael R. Edelstein. "Social Learning, Sustainability and the Importance of Social Networking," in Denuse Bauerova (ed), *Social Networking*. Ostrava, Czech Republic: Innovation of Education Institute, Faculty of Economics, VSB Technical University, 2009.

Michael R. Edelstein. "The New Warming War: Challenges of Shifting to a Sustainable World Paradigm" pp. 51-53 in *Ecological Problems of the Global World*, Herald of the International Academy of Sciences (Russian Section), Special Issue, , Moscow, Russia, 2009.

Michael R. Edelstein. "Changing Global Language, Meaning and Action: Moving Past Lip Service toward a Sustainable World," pp. 385-389 in V. Kurasić (Ed.), "Current Issues of Linguo-didactics and Linguistics: Core Meaning, Trends, and Perspectives." Volgograd, Russia: Volgograd State Pedagogical University, 2009.

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Janice Hastrup, Sherilyn N. Thomas and Michael R. Edelstein. "Fear of Cancer in a Rural Appalachian Community Following Notification of an Environmental Hazard," pp. 93-116 in Edelstein, Michael R., Maria Tysiachniouk, Ph.D. and Lyudmila V. Smirnova, Ph.D. (Eds.) *Cultures of Contamination: Legacies of Pollution in Russia and the U.S.* Vol. 14 of *Research in Social Problems and Public Policy*, Elsevier, 2007.

Michael R. Edelstein and Maria Tysiachniouk. "Psycho-Social Consequences Due to Radioactive Contamination in the Techa River Region of Russia," pp. 185-204 in Edelstein, Michael R., Maria Tysiachniouk, Ph.D. and Lyudmila V. Smirnova, Ph.D. (Eds.) *Cultures of Contamination: Legacies of Pollution in Russia and the U.S.* Vol. 14 of *Research in Social Problems and Public Policy*, Elsevier, 2007.

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Lyudmila V. Smirnova and Michael R. Edelstein. "A Liquidator's Story," pp. 361-372 in Edelstein, Michael R., Maria Tysiachniouk, Ph.D. and Lyudmila V. Smirnova, Ph.D. (Eds.) *Cultures of Contamination: Legacies of Pollution in Russia and the U.S.* Vol. 14 of *Research in Social Problems and Public Policy*, Elsevier, 2007.

Michael R. Edelstein and Catherine McVay Hughes. "Coming Clean After 9/11: The Continuing World Trade Center Disaster," pp. 409-446 in Edelstein, Michael R., Maria Tysiachniouk, Ph.D. and Lyudmila V. Smirnova, Ph.D. (Eds.) *Cultures of Contamination: Legacies of Pollution in Russia and the U.S.* Vol. 14 of *Research in Social Problems and Public Policy*, Elsevier, 2007.

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Edelstein, Michael R. review of "Deep Ecology: Living as if Nature Mattered" by Devall and Sessions and *Deep Ecology* by Tobias, *Journal of Architectural and Planning Research*, Vol. 4 (1), 1987, 77-80.

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Edelstein, Michael R. and William Makofske. "The Karst Topography of Southern Orange County: An Analysis of the Relationship between Soluble Bedrock, Land Use and Land Use Policy." *New York Land Report*, December, 1984.

Edelstein, Michael R. "Contaminated Children: Toxic Exposure in Jackson, New Jersey." *Childhood Quarterly*. January, 1983.

Edelstein, Michael R. "The Social Impacts of Residential Exposure to Toxic Waste." *Social Impact Assessment*, 79/80, April-May, 1983.

Edelstein, Michael R. "Answer to the Editor's Question, 'What Does an Environmental Psychologist Find Interesting about Toxic Wastes?'" *Design Research News XI*, 3, March, 1981.

Edelstein, Michael R. "Energy, Conservation and Lifestyle" in Joel Kameron (Ed.), *The Social Dimensions of Energy Options*. Mahwah, N.J.: Ramapo College of New Jersey, 1980.

Edelstein, Michael R., "Bergen County as an Environment for High School-Aged People." *Childhood City Newsletter*, Teen-Environment Issue, Vol.16, April, 1979.

Edelstein, Michael R., "The Real Energy Crisis: Lifestyle and the Prospect of Changing Patterns of Energy Use." *Ramapo Papers*, Vol. 11, No.3, 1979.

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Edelstein, Michael R., Joel Kameron, Matina Colombotos and Syrell Lehman. "Psychological Impact of Traffic and Attendant Factors of Air Pollution, Noise and Safety, as well as Green Space Availability in the Town of Paramus, N.J." in Richard Graham (Ed.), *An Applied Natural Resource Inventory of the Borough of Paramus, New Jersey*. Paramus: Paramus Environmental Commission, 1975.

Editorial Work:

Edelstein, Michael R., Ph.D., Astrid Cerny Ph.D. and Abror Gadaev, Ph.D. *Disaster By Design: The Aral Sea and Its Lessons For Sustainability*. Vol. 20 of *Research in Social Problems and Public Policy*, Emerald, forthcoming 2012. Principle editor and author.

Edelstein, Michael R., Ph.D. Maria Tysiachniouk, Ph.D. and Lyudmila V. Smirnova, Ph.D. Eds. *Cultures of Contamination: Legacies of Pollution in Russia and the U.S.* Vol. 14 of *Research in Social Problems and Public Policy*, Elsevier, 2007. Principle editor and author.

Radon in the Environment, with William Makofske, 1988.
Childhood Quarterly, January, 1983. Edited issue on children and environmental hazards.

Manuscript review for MIT Press, Westview Press, University of California Press, Columbia University Press, University of Arizona Press, *American Psychologist*, *Environment and Behavior*, *Journal of Health Psychology*, *Environmental Design Research Association*, *Impact Assessment Bulletin*, *Journal of Social Psychology*, *Research in Social Problems*, *Public Policy*, *Social Science and Medicine*, *Qualitative Sociology*, *Sociological Inquiry*, *Social Science Research*, *Journal of Environmental Psychology*, *Journal of Community Psychology*, *Human Organization*, *Political Ecology* and for various authors.

PAPERS

Conference and Professional Presentations:

"Adverse Impacts of Alberta's Intensive Energy Production and Associated Regulatory Processes," paper presented at the International Association of Impact Assessment (IAIA). Calgary, Alberta, May 16, 2013.

"Psycho-Social Impacts of Gas and Tar Sands: Projects and Process." Invited address, University of Alberta, Edmonton, Alberta, May 9, 2013.

"Shooting the Message: Rachel Carson, Human Causation and a Malevolent Environment," paper presented to the Symposium on Silent Spring, Ramapo College of NJ, December 2, 2012.

"An Academics Observations of Rio." Workshop: After Rio+20: What Comes Next?, Ramapo College of NJ, October 15, 2012.

"Lessons of the Aral Sea for Students of Diplomacy." Invited address at the Institute for Economics and Diplomacy, Tashkent, Uzbekistan, September 13, 2012.

"Creating A Sustainable Entrepreneurial Sector In Uzbekistan." Invited address to the International Conference on Entrepreneurship and Small Business. Tashkent, Uzbekistan, September 14, 2012.

"The Importance of Bioregional Thinking." Invited presentation at the Mountain Symposium, Rio+20 Earth Summit, Rio de Janeiro, June 18, 2012.

"Coming Clean about Cleanup." Invited presentation to the workshop "Social, Psychological and Economic Impacts of Superfund and Other Contaminated Sites." Sponsored by National Institute for Environmental Health Science and the Brown University Superfund Research Program. May 9, 2012. Brown University, Providence, R.I.

"Commentary on the film "Living Downstream." Invited presentation for the Bard Environmental Policy masters Program, Annondale-on-Hudson, N.Y. April 17, 2012.

"The Human costs of Alberta's Energy Production." Invited address to the Community Psychology Program, Wilfrid Laurier University, Waterloo, Ontario, Ca., March 5, 2012.

"Diversity, Justice and Inclusion" Participation in panel discussion with journalists Jan Barry and Ben McGrath and Chuck Stead. Antioch New England, Ph.D. Program in Environmental Studies, Hilburn, N.Y., February 24, 2012.

"Educating for Sustainability" Invited address to the International Conference "Upbringing of an Educated and Intellectually Advanced Generation as the most important condition of sustainable development and modernization of the country." Tashkent, Uzbekistan, February 17, 2012.

"The Aral Sea as a Disaster." Invited presentation, Tashkent Financial Institute, Tashkent, Uzbekistan, February 13, 2012.

"The History of Sustainability at Ramapo College." Invited presentation to the "Creating a Sustainable Campus Workshop" organized by NJHEPS and Kean University, Ramapo College of NJ, December 2, 2011.

"Why is Environmental Cleanup So Slow?" Chair and participant in panel discussion with Walter Mugdan, EPA, journalist Jan Barry and Chuck Stead. Ramapo College, October 4, 2011.

"Psychological Perspectives: Educating for Sustainability." Volgograd State Pedagogical University, September 14, 2007. Keynote address to the conference Educational Psychology for the 21st Century, Volgograd State Pedagogical University, September 14, 2011.

Edelstein, Michael R. "A Confluence of Major Disasters: The Aral Sea Disaster in Perspective." Concluding talk to the conference "Exchanging Lessons of the Aral Sea Disaster I." Samarkand, Uzbekistan, June 9, 2011.

“Collaboration in Interdisciplinary Research: Preparing Environmental Students for the Real World.” Paper presented at the Fairfield University conference on Collaboration in Interdisciplinary Research, June 3, 2010.

“Ecological Literacy: Damaged Environments and Damaged Children, invited paper presented at the Conference Sunflower 2009, Celadna, Czech Republic, November 11, 2009.

“Sustainable Campuses and Institutions: The Need to Lead and the Transformation to a New Social Paradigm,” invited paper presented at the Conference ICT Bridges 2009, Celadna, Czech Republic, November 11, 2009.

“Social Learning, Sustainability and the Importance of Social Networking,” invited paper presented at the Conference Silesian Moodle Moot 2009, Celadna, Czech Republic, November 12, 2009.

“The New Warming War: Challenges of Shifting to a Sustainable World Paradigm,” invited paper presented at the conference *Ecological Problems of the Global World*, M.A. Sholokhov Moscow State Humanitarian University, October 26, 2009, Moscow, Russia.

“Revisiting Our Earth Legacy.” Invited Keynote Address, Volgograd State Pedagogical University, Volgograd, Russia, November 20, 2009.

“Changing Global Language, Meaning and Action: Moving Past Lip Service toward a Sustainable World.” Invited paper, Volgograd State Pedagogical University, Volgograd, Russia, November 21, 2009.

“Environmental Turbulence and Environmental Literacy as Theoretical Frames for the Transition to a Sustainable Society.” Invited presentation to the program in Sustainable Urban Environments, NYU, September 30, 2009.

“Leading the New Sustainability Paradigm.” Invited presentation to the COPLAC Session: “Innovations in Sustainable Education.” AAC&U Annual Conference, Seattle, Washington, January 22, 2009.

“College as a Macrocosm.” Faculty Resource Network. San Francisco, Ca. November 21, 2008.

“The Masters in Sustainability Studies.” Presentation with Wayne Hayes at the American Association for Sustainability in Higher Education, Raleigh, N.C. November 10, 2008.

“Integrating Sustainability into the Curriculum: The Ramapo Experience.” Presentation to the COPLAC Summer Meeting, Ashland, Oregon, June 21, 2008.

“A Climate for Change: The role of Environmental Psychology and Design in bringing about Eco-Social Transformation.” Four hour intensive program presented to the Environmental Design Research Association’s 39th Conference, Veracruz, Mexico, May 28, 2008.

“Transitioning To Sustainability in a Time of Living on Thin Ice.” Invited address. National Environmental Partnership Summit, Baltimore, Md., May 22, 2008.

“Sustainability as Revolution: A Framework for Campus/Community Action.” Invited opening address, conference of the Sustainable Business Institute, Fairleigh Dickinson University, Madison, NJ, May 2, 2008.

“Efforts to Overcome Environmental Stigma: The Case of the New Jersey Meadowlands.” Seminar presented to the Anisfield School of Business, Ramapo College of New Jersey, April 2, 2008.

“Creating a Sustainable Future for the Hudson Valley.” Invited lecture. Hudson Highlands Nature Museum. Cornwall-on-Hudson, October 25, 2007.

“Sustainable Campuses.” Invited address. Caldwell Symposium on Environmental Concerns. Caldwell College. September 30, 2007.

“Transforming Our Campuses into Leading Institutions for Sustainability” Invited address to the COPLAC Session: Roles of Sustaining Democracy, Sustaining the Environment: The Liberal Arts Mission. American Association of Colleges & Universities, New Orleans, Louisiana, January 19, 2007.

“Lessons from the Pencor Masada Oxynol Facility Siting Effort in Middletown, NY.” Conference: Managing Solid Waste Sustainably. Sponsored by the New York City Bar Association. December 4, 2006.

“Infusing Ecological Literacy into the Curriculum: The Ramapo Model.” COPLAC Conference. Asheville, North Carolina. June 10, 2006.

“The Contribution of Blowback to the Psycho-Social Impacts for the Residential Community of Lower Manhattan after the WTC Disaster.” Paper presented with Catherine McVay Hughes to the Society for the Study of Social Problems, Philadelphia, August 14, 2005.

“Policy Blowback: Lapses in Risk Communication, Precaution, Research and Response and Their Consequences for Local Community Trust in the Aftermath of the World Trade Center Disaster.” Paper presented with Catherine McVay Hughes to the Society for the Study of Social Problems, Philadelphia, August 14, 2005.

“Valuing Indigenous Impacts: Culture and Contamination---Environmental Pollution as Cultural Contamination.” Paper presented at the International Association for Impact Assessment, Boston, June 2, 2005.

“Teaching Environmental Impact Assessment.” Paper presented at the International Association for Impact Assessment, Boston, June 2, 2005.

“Sustainability Planning and Impact Assessment: An Update.” Paper presented at the International Association for Impact Assessment, Boston, May 31, 2005.

“Psycho-Social Impacts Amongst a Neglected Population: The Residential Community of Lower Manhattan after the WTC Disaster.” Paper presented with Catherine McVay Hughes. International Association of Environmental Epidemiologists, New York, August 4, 2004.

“Lapses in Risk Communication, Precaution, and Response and Their Consequences for Local Community Trust in the Aftermath of the World Trade Center Disaster.” Paper presented with Catherine McVay Hughes and George Thurston, International Association of Environmental Epidemiologists, New York, August 3, 2004.

“Cultural, Environmental and Community Impact as Psychological Impacts,” paper presented in the symposium “Environmental Pollution and Cultural Pollution: Impacts to Native Peoples Due to the Contamination of Place.” Environmental Design Association, Albuquerque, New Mexico, June 3, 2004

“Social Remediation: Adapting Humans to a Contaminated Environment.” Paper with Dr. Lyudmila Smirnova. Presented in the session “Contamination and Cleanup in Cross Cultural Perspective.” Environmental Design Association, Albuquerque, New Mexico, June 3, 2004.

“Psychological Consequences as a Translation of Indigenous Cultural, Environmental and Community Impacts.” Eastern Psychological Association. Washington D.C. April 17, 2004.

“Program Based Study Abroad: The Environmental Studies Experience,” panel presentation for the 2003 COPLAC Conference on “Global Education and Civic Engagement,” Saturday June 21, 2003, Mahwah, New Jersey.

“Comparison of Russian and American Approaches to Addressing Contaminated Communities.” Address to the Summer Interdisciplinary School: “Development of Civic Initiatives in Contaminated Communities.” August 10 2002, St. Petersburg, Russia.

“Mobilization of Communities in Polluted Territories.” Paper presented to the conference “Paths to Success in Addressing the Problems of Pollution.” August 2 2002, Cheliabynsk, Russia.

“Thoughts on 9/11 and the Cultural Acceptance of Risk: Cross Cultural Considerations of Americans and Russians.”

Paper co-presented with Lyudmila Smirnova to the World Congress of Sociology, July 10, 2002, Brisbane, Australia.

“9/11, Contamination Events, Paradigmatic Thought and The Prospects for a Sustainable Future.” Paper presented to the International Congress of Applied Psychology, July 8 2002, Singapore.

“Sustainability Planning and Impact Assessment.” Paper presented to the International Association of Impact Assessment. June 20, 2002, the Hague, Netherlands.

“Greening Phase VII: Social Design for Sustainability. Workshop for the Environmental Design Research Association Conference, paper co-presented with Nancy Mackin and Kate “Ali” Higgins, March 24, 2002, Philadelphia, Pa.

Understanding Public Attitudes toward Environmental Impacts.” Paper presented to the Environmental Design Research Association Conference, March 23, 2002, Philadelphia, Pa.

“Environmental Stigma: the Social Impacts of Water Contamination” Invited address, American Water Works Association, New Jersey Section. Thursday March 21, 2002. Trump Plaza, Atlantic City, N.J.

“Ecological Literacy” Keynote address. Conference of the New Jersey Higher Education Partnership for Sustainability. Drew University, Madison, New Jersey, October 15, 2001.

“From ‘Daa’ to ‘Da: Thoughts on Teaching and Doing Sustainability.’” Invited address and demonstration of pedagogical techniques. The CEP-Russia Environmental Policy Institute, St. Petersburg Russia, June 20, 2001.

“Innovation and Siting Dilemma: Thoughts on the Stigmatization of Projects, Good and Bad.” Invited plenary paper to the conference hosted by Goteburg University: “New Perspectives in Siting Controversy,” Glumslöv, Sweden, May 17-20, 2001.

Invited participant in the working conference of U.S. and European Environmental Sociologists: Risk: Searching for Vocabularies that Work, New Orleans, March 9-11, 2001.

“Environmental Impact Assessment as a Comparative Framework for the roles of NGOs, Government and Private Sector Activity in Russia and the U.S.: Public Policy and Pedagogy.” Paper presented at the Association for Research on Nonprofit Organizations and Voluntary Action,” November 16-18, 2000. New Orleans, Lo.

“Contaminated Environments: Implications for Children’s Well-Being and Health.” Invited address to the New York Association of School Psychologists: 2000 Conference Mastering the Millennium, Adam’s Mark Hotel, Buffalo, New York, October 20, 2000 and included in the conference proceedings as pp. 102-109.

“Educating in a Hyper-Contaminated Environment: The Case of the Volgograd Ecological Gymnasium.” Paper second-authored to Ludmila Smirnova and presented by Dr. Smirnova at the New York Association of School Psychologists: 2000 Conference Mastering the Millennium, Adam’s Mark Hotel, Buffalo, New York, October 20, 2000 and included in the conference proceedings as pp. 102-109.

“Ramapo College’s Eco-Literacy Project.” Poster presentation at the Second Nature Northeast Regional Workshop: Shaping a Sustainable Future: Best Practices in Higher Education, Trinity Conference Center, West Cornwall Connecticut, October 12-15, 2000.

“Educational Foundations for Anticipatory and Participatory Social Learning: A Case Study in Ecological Literacy.” Paper second-authored to Ludmila Smirnova and presented by Dr. Smirnova as a poster session at the

Second Nature Northeast Regional Workshop: Shaping a Sustainable Future: Best Practices in Higher Education, Trinity Conference Center, West Cornwall Connecticut, October 12-15, 2000.

"A Comparative Picture of Public Involvement in Environmental Decision Making." (With Maria Tysiachniouk, Smolney College, St. Petersburg, Ru. and Paulina Agakhaniants, St. Petersburg Society of Naturalists, St. Petersburg, Ru.). Paper Presented by Dr. Tysiachniouk at the Conference of the Interdisciplinary Environmental Association, Montreal, Canada, June 23, 2000.

"Citizen Participation and Environmental Impact Assessment: The American Experience and Its Implications for Russian Practice." Keynote address to the conference on Public Participation and the Environment, Pestova, Russia, January 14, 2000.

"Thoughts on the Success of Environmental Assessment in Russia." Keynote Address at the Conference on Environmental Impact Assessment in Russia, St. Petersburg, Russia, January 21, 2000.

"Ecological Literacy and the Importance of Interdisciplinarity." Keynote to the convocation of faculty, Volgograd State Pedagogical University, Volgograd, Russia, February 2, 2000.

"Environmental Impact Assessment as a Pedagogical Model." Address to the faculty of science, Volgograd State Pedagogical University, February 4, 2000.

"The Potential for Sustainability Planning and Impact Assessment As An Integrated Process." Paper presented at the International Association for Impact Assessment conference, Glasgow, Scotland, June 1999.

"Uncivil Action: The Social and Psychological Consequences of Environmental Contamination," Earth Day lecture at the University of Buffalo, April 19, 1999.

"Three Mile Island: the Legacy of Twenty Years," address given at Penn State Capital Campus to mark the 20th anniversary of the Three Mile Island Disaster, March 24, 1999.

"Sustainability Planning and Impact Assessment," paper presented at the conference "Democracy in Action: Sustainable Communities in Russia and the U.S., August 26, 1998, Center for Independent Social Research, St. Petersburg, Russia.

"The Challenge of Implementing Sustainable Planning in a Troubled American City." Paper presented at the 4th Interdisciplinary Conference on the Environment, Washington D.C., July 10, 1998.

"Outsiders Just Don't Understand: The Need for Contextual Inquiry About Life in the Contaminated World." Paper presented at the workshop on Risk and Society, Oxford Centre for the Environment, Ethics and Society, Mansfield College, Oxford, England, June 29, 1997.

"Crying Over Spoiled Milk: Contamination, Visibility and Expectation in Environmental Stigma." Paper presented to the Annenberg Conference on Risk, Media and Stigma, March 23, 1997, Philadelphia, Pa.

"Ecological Literacy." Presentation to the Environmental Psychology Program, CUNY, March 19, 1997, New York City.

"The Lessons of Geologic Radon" Paper presented to the Society for Risk Analysis. December 9, 1996, New Orleans, Louisiana.

"The Dynamics of Local Environmental Activism." Invited paper and workshop conducted with Liana Hoodes for the Environment and Technology Division of the Society for the Study of Social Problems, New York City, August 17, 1996.

"The Contamination of Place." Paper presented at the Environmental Design Research Association Conference, Salt Lake City, Utah, June 14, 1996.

"Ecological Literacy." Paper presented with Mary Ann Sorensen-Allachi and Wanda Kosinski at the Environmental Design Research Association Conference, Salt Lake City, Utah, June 16, 1996.

"Psychological Impacts of Contamination." Panel presentation at the invitation of the Agency for Toxic Substances and Disease Registry, Atlanta, Ga., September 11-13, 1995.

"Left in Limbo: Obstacles to Recovery from Toxic Contamination." Paper presented at the Society for the Study of Social Problems, Washington, D.C., August 19, 1995.

"Cities as an Anchor for Sustainable Development," panel presentation to the conference "Newburgh, N.Y.: People and Places," August 12, 1995.

"Ecological Literacy and Ecopsychology," presentation during the panel "Ecoliteracy" Learning to Think Ecologically." First Mid-Atlantic Environmental Conference, Ramapo College of New Jersey, April 8, 1995.

Participant in workshop of the working group on Psycho-Social Impacts of Toxic Exposure, New Orleans, La., Jan. 7-9, 1995.

"Psycho-Social Impacts of Contamination and the Toxic Tort." Invited address to the Environmental Law Session of the Colorado/Kansas Trial Lawyers Association Convention, Snowmass, Colorado, August 12, 1994.

"Ecological Directions for Environmental Psychology." Paper presented at the Environmental Design Research Association, San Antonio, Texas, March 14, 1994.

"Stigma in Toxic Communities." Invited address to the "Fourth Scientific Assembly for Environmental Health." Washington D.C., September 17, 1993.

"Inversion of Nature: Contamination in an Appalachian Community." Paper presented at the Environmental Design Research Association, Chicago, Ill., April 2, 1993.

"When Alternative Energy is Kapu: Native Hawaiian Culture and Geothermal Energy Development." Paper written with Deborah Kleese. Presented at the Environmental Design Research Association, Chicago, Ill., April 1, 1993.

"Trouble in the Troposphere: The Other Ozone Problem." Paper written with and presented by William Makofske at the Environmental Design Research Association, Chicago, Ill., March 30, 1993.

"Clearing the Air: Implications of Atmospheric Ozone for Human Behavior." Presented at the Environmental Design Research Association, Chicago, Ill., March 31, 1993.

"The Role of Social Science in Understanding People's Perceptions of Environmental Problems and Developing Environmental Policy." Invited paper presented at the New Jersey Department of Environmental Protection and Energy, November 12, 1992.

"The Role of Psychology in Causing and Addressing Ecological Denial," invited address to Division 34, American Psychological Association, Annual Conference, Washington, D.C., August 17, 1992.

"Psychological Impacts in Contaminated Communities," invited opening address at the conference "Psychological Impacts in Contaminated Communities," sponsored by the New York State Department of Health and the Agency for Toxic Substances and Disease Registry, Rensselaerville, N.Y., June 8, 1992.

"Emerging Coalitions for Environmental Issues---Some Considerations." Workshop paper presented at the annual conference of the Environmental Design Research Association, Boulder, Colorado, April 10, 1992.

"Social Impacts of Interconnected Social and Ecological Systems," invited address, Bard College Masters in Environmental Studies Program, Annondale-on-Hudson, November 2, 1991.

"The Dynamics of NIMBY in the 1990's: Communication Problem or Cultural Challenge?" Invited presentation at the First Annual Conference of the National Association of Environmental Communicators: "Communicating in the Environmental Decade." Chicago, Illinois, October 11, 1991.

"Author Meets the Critics: Michael Edelstein Contaminated Communities", presentation and discussion with panel of critics, Environment and Technology Division of the Society for the Study of Social Problems, Cincinnati, Ohio, August 23, 1991.

"The Cultural Relativity of Impact: Native Hawaiian Opposition to Geothermal Energy Development" presented with Deborah Kleese at the conference "Technology and Environmental Responsibility: A New Age for Impact Assessment," Champaign-Urbana, Ill., June 10, 1991.

"Perceiving Risk---What do People Worry about and Why." Invited paper presented at the conference "Regulating Risk: The Science and Politics of Risk," National Safety Council, Washington D.C., June 24-5, 1991.

"NIMBY as a Healthy Response to Environmental Stigma Associated with Hazardous Facility Siting." Invited paper presented at the conference "Hazardous Materials/Wastes: Social Aspects of Facility Planning and Management," Toronto, Canada, October 3, 1990.

"Contaminated Communities: Psychological Response to Toxic Environments," invited address to the Rockland County Psychological Association, Bear Mountain, N.Y. May 6, 1990.

"Local Activism and Environmental Ethics," invited paper at the conference: Ethics and Environment. Cornell University, Ithica, N.Y., April 30, 1990.

"Active Citizenry as the Basis for Responsible Environmentalism," invited address presented at the conference: Responsible Environmentalism. New Jersey Institute of Technology, Newark, N.J. April 27, 1990.

"Environment and Behavior in a Policy Context---The Cases of the New Jersey Ozone Warning Program and the Social Impacts of I- 287." Paper co-presented with Nadine Christopher and David Greene at the Environmental Design Research Association, Champaign- Urbana, Illinois, April 8, 1990.

"Social and Psychological Issues Relating to Possible Claims of Adverse Health Effects from Dioxin." Invited paper presented at the Dioxin Claims and Litigation Course, Executive Enterprises, Inc., Washington D.C., November 28, 1989.

"Forcing a Critical Perspective on Technology: The Role of Community Opposition to Facility Siting." Invited paper at the Second International Conference on Industrial & Organizational Crisis Management, New York University, November 4, 1989.

"Stigma and Hazardous Waste Siting" Invited paper presented at the conference Hazardous Waste '89: Strategies for Site Cleanup. Washington State University, Spokane, Washington, September 18, 1989.

"An Overview of Psychosocial Impact Issues from the CECOS Hazardous Waste Siting Hearings and Other Cases". Invited paper, American Psychological Association conference, New Orleans, Louisiana, August 12, 1989.

"Psychosocial Impacts in Hazardous Waste Permit Hearings." Paper presented at the International Association for Impact Assessment, Montreal, Ca., June 27, 1989.

"A Longitudinal Study of Social and Environmental Impacts of the Extension of Route I-287 in Northern, New Jersey." Paper co-presented with Nadine Christopher, International Association for Impact Assessment, Montreal, Ca., June 25, 1989.

"The Psychological Basis for the "NIMBY Response," invited paper presented at the Fourth National Environmental Health Conference, Department of Health and Human Services, San Antonio, Texas, June 22, 1989.

"Psychosocial Issues in Hazardous Waste Siting," invited presentation," Polytechnic Institute of New York, May 3, 1989.

"Impacts on the Family from Toxic Exposure." Invited paper presented at the Conference of the American Orthopsychiatric Association, New York City, April 2, 1989.

"Image of Community and the New Jersey State Plan." Invited presentation to the Conference Bergen 2000, Paramus, N.J., January 26, 1989.

"Psychosocial Issues in the Perception of Radon Gas Exposure." Paper co-authored with Margaret Gibbs and Susan Belford presented at the EPA Radon Symposium, Denver Co., October 20, 1988.

"Results of the Orange Environment, Inc. Radon Testing Program." Paper co-authored with William Makofske presented at the EPA Radon Symposium, Denver, Co., October 20, 1988.

"Further Thoughts on a Theory of Environmental Stigma: Community Image in the Cases of Radon Gas Exposure." Invited paper presented at the American Sociological Association conference, Atlanta, Ga., August 26, 1989.

"Toxic Impact Assessment" Paper presented at the Conference of the International Association for Impact Assessment, Griffith University, Brisbane, Australia, July 7, 1988.

"The Need for an Ecopsychology: Recreating Ecological Balance," with Deborah A. Kleese. Paper presented at the conference "People's Needs/Planet Management: Paths to Co-existence." Environmental Design Research Association, Pomona, Ca., May 15, 1988.

"Ecology and Environmental Psychology," invited paper presented at the conference "People's Needs/Planet Management: Paths to Co-existence." Environmental Design Research Association, Pomona, Ca., May 12, 1988.

"Disaster Revisited: Bhopal and Chernobyl---What are the Lessons?" Master Lecture, Ramapo College of New Jersey, March 23, 1988.

"Radiation in the Home: Radon Gas." Invited paper presented at the First Global Radiation Victims Conference, New York City, September 29, 1987.

"A Framework for Examining Psychosocial Impacts of Toxic Exposure in LDC's." Paper presented at the International Workshop on Impact Assessment for International Development, Barbados, West Indies, June 1, 1987. Also served as invited resource person for the working session on toxic and hazardous wastes.

"Toward a Theory of Environmental Stigma," paper read for me by Linda Schneekloth at the Environmental Design Research Association, Ottawa, Canada, June 1, 1987.

"Institutional Roles in the Development of a State Radon Response Program," invited paper presented to the Radon Forum sponsored by the Washington State Energy Extension Service, Spokane, Washington, May 6, 1987.

"Psychological impacts of radon gas exposure: preliminary findings," with Margaret Gibbs and Susan Belford, presented by Dr. Gibbs at the conference "Radon in the Environment," May, 1986, Ramapo College.

"Psychological consequences of radon in the home," with Margaret Gibbs and Susan Belford, presented by Dr. Gibbs at the Natural Hazards Research Center Workshop, Boulder, Co., July, 1986.

"Radon and the Home," invited paper presented at the annual conference of the Environmental Planning Lobby, Albany, September, 1986.

"Social and Psychological Impacts on the Community," invited presentation to the Hazardous Waste Conference sponsored by Vermonters Organized for Clean-up, Saturday, May 4, 1985.

"Person and the Environment: The Case of Toxic Exposure," paper presented at the Environmental Design Research Association. New York City, June 11, 1985.

"Evaluating Alternatives to Land Disposal--A Psychological Perspective," presented at the conference on Urban Impact Assessment, New York City, June 14, 1985.

"Psychosocial Impact Assessment of Residential Toxic Exposure -- An Overview," paper presented at the Conference of the International Association of Impact Assessment, Utrecht, The Netherlands, June 28, 1985.

"Social Impacts and Social Change: Some Initial Thoughts on the Emergence of a Toxic Victims Movement," paper presented at the conference of the International Association of Impact Assessment, New York City, May 25, 1984.

"Toxic Exposure and the Inversion of Home," paper presented at the International Conference on Environment and Action, Berlin, West Germany, July 28, 1984.

"Toxic Exposure: Field research and Expert testimony, invited paper presented at the Society for the Study of Social Problems, San Antonio, Texas, August 26, 1984.

"A Community Perspective on the Problem of Enforcement," invited paper presented at the conference Environment '84, Albany, New York, October 20, 1984.

"Perception of Health and other aspects of Quality of Life as a Function of Residential Exposure to Toxics," invited paper presented at the Environmental Defense Fund conference, "Toxics in Your Community," Silver Bay, New York, October 14-16, 1983.

"Key Findings and Methodological Issues in the Study of Communities Exposed to Toxic Pollution," paper presented at the Environmental Design research Association, College Park, Maryland, April, 1982.

"Social and Psychological Impacts Associated with Exposure to Toxic Chemicals via Drinking Water," paper presented at the conference, "Social Impact Assessment: The State of the Art," Vancouver, B.C., October, 1982.

"Analysis of Case Studies of the Relationship between Communities and Regulators," paper presented at the conference, "Social Impact Assessment: The State of the Art," Vancouver, B.C., October, 1982.

"Assessing Social Impacts as Part of the SEQR Review of Environmental Impact Statements," paper presented at the New York State Association of Conservation Commission conference "New Economics; New Environment?" in Saratoga Springs, New York, November 6-9, 1981.

"Changing Energy-Related Values: A Suggested Process," paper presented at the Environmental Design Research Association, Charleston, South Carolina, March, 1980.

"The Role of Psychology in Interdisciplinary Environmental Thought," invited presentation, Bard College, Annondale-on-Hudson, 1980.

"The Person-Environment Relationship: Implications for Education," paper presented at the Environmental Design Research Association Conference, Buffalo, New York, June, 1979.

"Participatory Futurism: Ideology or Reality," paper presented at the Ramapo Center for Future Studies seminar, May 9, 1978.

"The Role of Environmental Design in Preparing for an Ecological Future," paper presented at the Environmental Design Research Association, Tuscan, Arizona, April, 1978.

"Lifestyle and the Prospect of Changing Patterns of Energy Use," paper presented at the Toward Tomorrow Fair, Amherst, Massachusetts, June 17, 1978.

"High School Aged in Bergen County," paper presented at the Environmental Psychologists of Northern New Jersey, Ramapo College, May 13, 1978.

"Chinese History and Lifestyle as a Context for Shadow Theater," paper presented at the Seminar on Chinese Shadow Theater, July 8, 1978.

"Participatory Futurism: Merging the Evolution of the Future with the Process of the Present," invited paper presented at the Conference on the Conditions of the Future and Their Implications for Education, Technical University, Berlin, Germany, November 23-26, 1978.

"Traffic and Residential Quality," Paper presented at the conference, Environmental Psychologists of Northern New Jersey, Ramapo College, Spring, 1976.

"Dispositional and Situational Components of Privacy Preference," paper presented at Environmental Psychologists of Northern New Jersey, Ramapo College, Spring, 1977.

"Designing the Future: Toward a Participatory Society," paper presented at the Toward Tomorrow Fair, University of Massachusetts, June, 1977.

"Toward an Equilibrium Society," paper co-presented with William Makofske, Ph.D., at the Toward Tomorrow Fair, University of Massachusetts, June, 1977.

"The Complexities of Cultural Survival: Considerations on the Perpetuation of Traditional Chinese Shadow Theater," paper presented to the Forum of Ideas Lecture Series, Ramapo College, September, 1977.

Other Academic Presentations:

"Sustainability in the Mid-Hudson." Presentation to the Museum of the Hudson Highlands. November 20, 2007.

"The Most Contaminated Place on Earth," Culture Club Presentation, Ramapo College.

"The Sustainable Campus." Presentation with Bill Makofske to the Institute for Environmental Studies, 2003

"Lessons from Russia." Presentation to the Institute for Environmental Studies, March, 2000.

"Reflections on the Adams Center Hazardous Landfill," Cable Access Conference Presentation on Live Television at Indiana University-Purdue University Fort Wayne as part of the series on "Trash TV," with Caron Chess from Rutgers University, May 23, 1994.

"Water as a Driving Environmental Concern," keynote address, Earth Day Celebration, Orange County Community College, April 21, 1991.

"Geothermal Energy and Native Hawaiian Values." Presentation before the Institute for Environmental Studies, Ramapo College of New Jersey, December 5, 1990.

"Pele versus Geothermal Energy," Earthday Presentation at Ramapo College, April 19, 1990.

"Global Environmental Problems as a Force for Thinking About One Earth," talk to the International House, Ramapo College, April 19, 1990.

Workshop rapporteur, Technology and Global Sustainability Workshop, Center for Technology Studies, New Jersey Institute of Technology, January 8-12, 1990. Gave daily integrative wrap-ups of conference.

Discussant, workshop Teaching Environmental Psychology: Textbooks, Topics and Techniques. American Psychological Association conference, New Orleans, Louisiana, August 12, 1989.

Invited participant of the Social Science Work Group, Workshop on Evaluating Risks to Human Health Associated with Exposure to Toxic Chemicals in the Great Lakes Basin Ecosystem, Great Lakes Program, Niagara-on-the-Lake, Ontario, April 19, 1989. Co-authored workgroup report.

Discussant, two Master Lectures on AIDS, Ramapo College, Fall, 1989.

Discussant, master lecture programs on Appropriate Technology, Population Growth, Medicine and World Health, World Energy Trends and The Year 2000, Ramapo College of New Jersey, Spring, 1985.

Guest on Ramapo Roundtable Television Programs addressing global toxic contamination, world energy trends and the Global 2000 Report, Spring 1988.

Resource person and facilitator, working group on toxic and hazardous wastes. International Workshop on Impact Assessment for International Development, Barbados, West Indies, June 1987.

Guest, Ramapo Roundtable, New Jersey Network Television program on environmental perception, Spring, 1987.

Guest, Ramapo Roundtable, two New Jersey Network Television programs on opposition to siting radium-contaminated soil, Fall, 1986.

Discussant, advocacy and research, panel at the Environmental Design Research Association Conference, Atlanta, Georgia, April, 1986.

Guest lecturer, Johnson State College, Johnson, Vermont, April 28, 1986.

Discussant, session on Perception of Radon Risk at the conference "Radon in the Environment," May, 1986, Ramapo College.

Invited Participant, workshop on family stress, National Conference, Citizens Clearinghouse for Hazardous Wastes, Arlington, Va., May, 1986.

Discussant, program on Human Rights and the Environment, Master Lecture Series, Ramapo College, April 24, 1985.

Session introduction, "Social Impact Assessment and the New York State Environmental Quality Review Act," conference on Urban Impact Assessment, New York City, June 14, 1985.

Discussant, two Master Lecture programs on the Dilemmas of Technology, Ramapo College, Fall, 1985.

"PsychoSocial Impacts of a High Level Nuclear Waste Site," Presentation of research plan, Scoping Conference on the Social and Economic Impacts of a High Level Nuclear Waste Repository in the Richton Dome, Perry County, Mississippi; Jackson, Mississippi, October 11, 1985.

Guest, Ramapo Roundtable, New Jersey Network Television program on social impacts of toxic exposure, Fall, 1985.

Guest, Ramapo Roundtable, New Jersey Network Television program on radon gas exposure, Fall, 1985.

"Responding to Technological Hazards," workshop co- presented with Margaret Gibbs, Ph.D. at the Environmental Design Research Association Conference, San Luis Obispo, Ca., July 2, 1984.

Discussant, program on Environmental Law, Ramapo College, October 17, 1984.

Session leader for "Arousing Citizen Involvement" for conference "Citizen Training Workshop on Toxic Wastewater Controls in the Hudson Valley," Bear Mountain, New York, January 16, 1982.

Opening presentation for "A Citizen Workshop on Toxic Industrial Wastewater Control in Northern New Jersey," Ramapo College, May 8, 1982.

Discussant, session on Participatory Design and Handicapped Housing, Environmental Design Research Association, Charleston, South Carolina, March, 1980.

"Energy and Society," program co-presented with Joel Kameron, Ph.D. Summer Semester Television Series, Summer, 1979.

"Authoritarianism and Democratization: A Case Study of Ramapo College," Master Lecture presentation, Ramapo College, Spring, 1979.

"The Difficulty of Getting Specific," paper presented as part of the Master Lecture Series, Ramapo College, November, 1977.

Conference Leadership:

Developed, organized and running the series "Creating a Sustainable World: voices of Expert Practitioners." Spring 2013 with seven programs, by Helen Ross, Harris Gleckman, Shebazz Jackson and Josephine Popagni, Jaimie Cloud, Michael Klemens, Kevin Lyons and Liz Walker.

Developed and organized one day conference "Igniting New Jersey Climate Action." Ramapo College of N.J., Mahwah, N.J., April 13, 2012.

Developed, organized and running the series "Creating a Sustainable World: voices of Expert Practitioners." Spring 2012, a series of six major programs on sustainability, Ramapo College of New Jersey. Featured speakers were Carla Sunshine Koppel, Michael Klemens, Fred Kirschenmann, Nora Bateson, Neil Seldman and Anthony Cortese.

Developed, organized and ran the conference "Exchanging Lessons of the Aral Sea Disaster," Ramapo College of New Jersey, Mahwah, N.J., October 27, 2011 as part of the grant by that name funded by the Trust for Mutual Understanding.

Developed, organized and ran the conference "A Climate for Change" and the event "Green Meets Green" which also included a major exposition of green products and services. November 30 and December 1, 2007. The event was funded by the New Jersey Board of Public Utilities. The focus was the sudden main streaming of green given the public acceptance of the climate crisis and the need to frame that crisis as part of the overall effort to achieve a sustainable society.

Environmental Justice After Katrina. Two day conference coinciding with the conference of African American Professorate and Earth Day 2006. Ramapo College of New Jersey.

Organized with Stephen Couch the session "Blowback and the World Trade Center Disaster." Society for the Study of Social Problems, Philadelphia, August 14, 2005.

Organized the session "Environmental Pollution and Cultural Pollution: Impacts to Native Peoples Due to the Contamination of Place." Environmental Design Association, Albuquerque, New Mexico, June 3, 2004

Organized the session "Informing Environmental Decision Making: Environmental Impact Assessment in Russia and the United States" at the Association for Research on Nonprofit Organizations and Voluntary Action," November 16-18, 2000. New Orleans, La.

Co-Organized and co-chaired the Fourth Mid-Atlantic Environmental Conference, April 23-25, 1998. Chaired the Session on Global Climate Change and Energy, Transportation and Planning.

Co-organized and co-chaired the Third Mid-Atlantic Environmental Conference, "What Works for Sustainable Communities." April 12-14, Ramapo College of New Jersey. Chaired the session on "Exemplary Models of Ecological Literacy"

Organized the session "Contamination of Place," Environmental Design Research Association, Salt Lake City, Utah, June 14, 1996.

Co-organized and co-chaired the Second Mid-Atlantic Environmental Conference, "Starting Sustainability." April 12-14, Ramapo College of New Jersey. Chaired the session on "Is the Proposed Sterling Forest Community a Sustainable Community?"

Co-organized and co-chaired the First Mid-Atlantic Environmental Conference, "A Time of Challenge." April 7-9, Ramapo College of New Jersey. Chaired the session on Ecological Literacy.

Co-organized and co-chaired sessions on Energy and Environment and on Emerging Coalitions on Environmental Issues, Environmental Design Research Association, Boulder, Colorado, April, 1992.

Co-Organized and Co-Chaired conference for decision makers on the Dutchess Quarry Cave Archeological Site, Orange County Community College, September 17, 1991.

Organized and chaired session entitled "Assessing Impacts on Indigenous Peoples" at the International Association for Impact Assessment, Champaign-Urbana, Ill., June 10, 1991.

Organized and chaired session, "Psychosocial Impacts from Hazardous Waste Siting: Moving Beyond NIMBY." Conference: "Hazardous Materials/Wastes: Social Aspects of Facility Planning and Management", Toronto, Canada, October 3, 1990.

Organized and chaired symposium "Critical Issue---Defining Psychological Impacts in the Judicial Review of Toxic Hazards", American Psychological Association conference, New Orleans, Louisiana, August 1989.

Organized and chaired session "Toxic Impact Assessment" for the International Association for Impact Assessment conference, Montreal, Ca., June 1989.

Organized and chaired session "Toxic Impact Assessment" for the International Association for Impact Assessment conference, Brisbane, Australia, July 1988.

Co-organized and co-chaired a major three-day conference, "Radon and the Environment." Ramapo College of N.J., May, 1986.

Organized and chaired session on "Social Impact Assessment and the New York State Environmental Quality Review Act," at the conference on Urban Impact Assessment, June, 1985.

Organized and chaired Session on "Environmental Design and Ecological Consciousness --are they Compatible"? Environmental Design Research Association, New York City, June, 1985.

Organized and chaired session on "Social and Psychological Impacts of Toxic Exposure: Toward Theory and Action," International Association for Impact Assessment, Utrecht, the Netherlands, June 28, 1985.

Organized and chaired workshop "Responding to Technological Hazards," Environmental Design Research Association, San Luis Obispo, Ca., July 2, 1984.

Co-organized and chaired conference on "Toxics and Community," Orange County Community College, September 18, 1984.

Organized and chaired session on "Key Findings and Methodological Issues in the Study of Communities Exposed to Toxic Pollution," at the Environmental Design Research Association, College Park, Maryland, April 17-20, 1982.

Co-organized conference, "A Citizen Workshop on Toxic Industrial Wastewater Control in Northern New Jersey," Ramapo College, May 8, 1982.

Organized and Chaired sessions on "Protecting Communities from Regulators" and "The Social Impact Assessment of Toxic and Hazardous Materials," at the conference "Social Impact Assessment: The State of the Art," Vancouver, B.C., October, 1982.

Organized and chaired sessions on "Community Action in the Solution of Toxic Problems" and "Love Canal: A Case Study in the Health and Social Impacts of Toxics on a Community," during conference on The Social Dimensions of the Toxic Waste Problem, Ramapo College, April 3-4, 1981.

Organized and chaired conference "The Karst Topography of Southern Orange County," Goshen, New York, October 5, 1981.

Co-Chaired (with Min Kantrowitz) session on "Energy and Behavior," Environmental Design Research Association, Charleston, South Carolina, March 2-6, 1980.

Chaired Session on "Lifestyle and Conservation," Social Dimensions of Energy Options conference at Ramapo College, March 31-April 1, 1979. Conference co-organizer.

Session Chair, Environmental Design Research Association, Tucson, Arizona, April, 1978.

Organized and chaired conferences, Environmental Psychologists of Northern New Jersey, Spring, 1976; Spring and Fall, 1977 and Spring, 1978, Ramapo College.

ACADEMIC ADMINISTRATION

Program Administration and Curriculum Development:

Director, Institute for Environmental Studies, 2005 continuing; Convener, Environmental Studies Program, 1997-2009; Convening group member for Masters in Sustainability Studies, 2010-2013; Curriculum Committee for Masters in Sustainability Studies 2007-2008 (co-developed program for college and state review); Prepared five year review of Environmental Studies program, 2004-5; Prepared new program brochure, 2005; Prepared program website, 2005; Project Director, Trust for Mutual Understanding Grants, 2002-2003 and 1999-2001. Prepared draft application to Phi Beta Kappa for Ramapo chapter, 2000. Prepared the Successful Submission to the Templeton Foundation on Career Development, 1999. Project Director, New Jersey Higher Education Partnership for Sustainability, 1999; wrote Five-Year Review and coordinated outside evaluation, June 1998 and facilitated program revision. Project Director of Ecological Literacy Project, 1994-8; liaison in evolving program efforts with Frost Valley YMCA, 1995-6; leader of effort to develop a Masters in Sustainability Studies, 1996-9; negotiator for effort to develop joint masters program with NJIT, 1990-1994; Convener, Environmental Studies Program, 1986-1992; prepared 5-year review, 1992; guided Environmental Program through outside review, 1988-89; facilitated major revisions of the ES majors, 1988-89; negotiated letter of commitment for ES, 1988-present; Associate of the Institute for Environmental Studies, 1985- present; Feasibility study for articulation agreements for environmental programs and community colleges, 1986; various articulation and program coordination negotiations, 1980-present; exploring intra-and inter-campus options for environmental graduate programs, 1989-present; Assistant Director, School of Environmental Studies, 1982-4; preparation for program evaluation,

1982; chaired space planning committee, 1980-81; Chair of School of Environmental Studies Curriculum Committee, 1976-77 and 1980-82; various recruiting events, 1979-current; designed program brochure (1980-1), and catalogue copy, 1982, 1985, 1988, 1991, 1999.

Campus Governance Activities:

Member/advisor to campus climate committees, 2008; Chair, Sustainable Buildings and Grounds Committee: 2003-2007; Member of the Interdisciplinary Pillar group, 2007; Member of the Academic Structure Exploratory Committee: 2004; Member of the Course Load Adjustment working groups (CLA I and II), 2003; Member of the Sustainability Center Planning Committee, 2001-2010. College Seminar Committee, 2001; Member, Middle States Community Relations Committee, 1999; Member, General Education Committee, 1993-95. Head, College Mission Committee, 1992; Founder, Council of Conveners, 1990; Academic Committee, 1985-6; Led opposition to 4/3 credit shift, 1984; to strong Deans and to restricting collaboration across schools, 2003-2004; Master Planning Committees, 1982-4; contributions to Commission on Long Range Planning, 1977 and President's Commission, 1978; member of Faculty Assembly, 1975-6

Personnel Activities:

Chaired hiring committee for new faculty member in Environmental Studies, spring 2009; SSHA Promotions Committee member, 2007; Chaired hiring committee for Sustainability Educator Position, 2003; Chaired All-College Promotions Committee, 2003 and 1976; School of Social Science and Human Services Personnel Committee, 2002-3, 1985-1998; Chair, 1989 to 1991. Environmental Science search committee, 1998. Chaired search for faculty line, Spring 1992. Chaired Unit Career Development Committees, School of Environmental Studies, 1982-4; School of Environmental Studies Personnel Committee, 1975; Dean's Search Committee, 1975.

Student Development Activities:

Adviser to the Environmental Alliance, 1995-2010; Organized campus climate activities 2007-2008. Supervised student involvement in Green-Meets-Green conference and expo, 2007. Project work under the Sustainable Campus plan project, 2003. Project work under the Greening the Village project, ranging from recycling to landscaping, 2002 and continuing. Project work under the Environmental Literacy Project included various projects relating to the Alternative Energy Center, the College Seminar, Earth Day and the Mid-Atlantic Environmental Conference, 1994-8. Conservation Week Address, March 15, 1992; College Seminar Core Group, 1987-91. Organized numerous advisement programs for environmental students, 1980 to present; organizer "joint environmental tutorial program," 1980-2, Faculty tutor, supervised peer tutorial program, principal environmental freshman advisor, 1980-3 and principal environmental sophomore advisor, 1981-3; organized environmental graduation party, 1979; co-organized Tenth Year Celebration, 1981; designed and initiated self-help group for graduating seniors, 1992, 1980; advisor to Van Horne House---the Environmental House---1981-2; also numerous activities at the Alternative Energy Center, Earth Day events and other programs. Pine Hall Committee, 1987; chaired Student Services Faculty Liaison Committee, 1977-80; co-created first Ramapo student orientation program, 1977-78; co-planned and ran first two orientation programs, 1978 and 1979; initiated Student Leadership Training Program, 1979; Campus Housing Committee member, 1979-80; advisor to Human Relations Club, 1978-82; trainer for twice-yearly Human Relations Programs, 1976-82; advisor to publication Alternative Foundations, 1979; project adviser to PIRG, 1981; advisor to Earth Day, 1984, etc.; advisor to Food Cooperative 1985-1990; ran workshops for Drop-in-Center, 1974, Alternative Energy Center, 1976 and Resident Assistants, 1985.

Campus Development Activities:

Fund raising chair, member of design team and project director for the Ramapo College Sustainability Education Center project, 2002-2003 and continuing; Chair of new project review for the Sustainable Buildings and Grounds Committee, 2003-2004; Sustainability Center Design and Development, 2001; Co-Chair and co-founder of Health and Safety Committee (since 1985) and Campus Sustainability Team (1998-2001). Critique of the Barrie Center location, 1995. Guided campus response to I-287 project bisecting campus, 1987-1996; work on noise abatement requirements led to NJDOT decision to erect multi-million noise barrier along Ramapo campus; Instigated review of fire/ emergency procedures, 1989 to 2000; Campus Development Committee, 1985-8; planning input through class activities for Art Gallery, 1985, new Day Care Center, 1984, The Lodge, 1977 and Pine Hall, 1979- 80; Faculty representative on the New Dormitory Planning Committee, 1980; supervised class-based participatory design and construction of Day Care Playground, 1978. Core faculty, Alternative Energy Center, 1974-2000.

Faculty Development Activities:

Project director for the Environmental Literacy Project; work with faculty from the College Seminar Program, the College English faculty, the Basic Math faculty, the History faculty, etc. 1994-8. Founder and active participant Center for Future Studies, 1976-81 and Institute for Environmental Studies, 1985-present; organized conferences on Energy, 1979, Water, 1980, Toxics, 1981, Energy, 1983 and Radon Gas, 1986; First Mid-Atlantic Environmental Conference 1995, Second Mid-Atlantic Environmental Conference, 1996; third Mid-Atlantic Environmental Conference, 1997; fourth Mid-Atlantic Environmental Conference, 1998. Green Meets Green Conference and Expo, 2007; Environmental Justice, 2008; Lessons of the Aral Sea, 2011; Environmental Institute Speakers Series 2010-2012; MASS Expert Practitioner Speaker Series, 2012-2013. "Igniting New Jersey Climate Action," 2012.

Participation in scores of Master Lectures and Ramapo television programs and faculty discussion forums.

Bargaining Unit Activities:

Grievance consulting, 2001. Organized and chaired or co-chaired campus Health and Safety Committee, 1985-2003; Officer Ramapo AFT: President, 1983-4, Secretary, 1975-6 and Vice President, 1976-9; conducted review of personnel procedures, drafted proposed revisions and co-negotiated Faculty Handbook, 1976-8; local negotiating committee, 1984-87; Founded and Edited Raft Newsletter, 1974-79.

COURSES TAUGHT SINCE 1983

100 Level:

Environmental Studies (20x); College Seminar (8x)

200 Level:

Social Ecology (x3); Technological Mythologies (1x); World Sustainability (15x).

300 Level:

Environmental Psychology (31x); Psychology of Social Process (2x); Sustainable Communities (15x)

400 Level:

Environmental Assessment, lecture/field research (25x); Environmental Justice in a Contaminated World (Seminar) (2x); Practicum in Environmental Education (2x); Environmental Seminar (9x) (topics—Sustainable Organizations, Community Sustainability, Radon Gas, River Profiling, Citizen Participation and Environmental Regulation, Towards an Ecological Society, Ecological Literacy, Environmental Justice); Senior Seminar on Environmental Justice (2x); Senior Seminar: Impact of Technology (4x); Psychology Seminar: Community and Environment (1x).

Note: In summer 2009, a study abroad version of Environmental Psychology was offered for a month in Venice, Italy.

Graduate:

MASS (Masters in Sustainability Studies): Foundations of Organizational and Social Process: Social Change for Sustainability. Fall 2010, Sustainability Studio Fall 2011, 2012; Expert Practitioners, Spring 2012, 2013.

Community and Environment: Education for Citizenry, course taught for the Masters in Educational Technology, summers 2000-1 and spring 2003.

Dissertation Committees in Progress: Chuck Stead, Antioch NE 2011 and continuing, Alejandra Bozzolosco, Montclair University, 2011 and continuing; Anett Sasvari, Uppsala University, Sweden; 2011-continuing; Susan Olsen, Walden University, 2011 and continuing;

Franchesca Scarfuta, University of Naples, Italy, 2010-2-12.

Served on the Dissertation Committee for Susan Maret, Union Graduate School, 1999-2002.

Outside reader for thesis of Ina Basserabia, Volgograd State Pedagogical University, 1999.

Served on dissertation committee for Tara McGee, Ph.D., Australian National University, 1996.

Served on dissertation committee for James Stapleton, Ph.D., Union Graduate School, 1984-6.

COMMUNITY WORK

POLITICAL WORK

Democratic Candidate for County Executive, 2005, Orange County New York. Ran on sustainability platform. Earned 40% of vote.

ENVIRONMENTAL WORK

Principal Organizational Roles (partial):

Founder and President of the Board, Orange Environment, Inc., a not-for-profit, tax-exempt organization, 1982-present; OEI's mission is to promote sustainability and the integrity of the communities and region of Orange County, N.Y. Activities include development of permaculture training program, 2012-13, principle focus on new Solid Waste Management Plan for Orange County, 2010-12; cumulative impact assessment training for Orange County Planning Department and numerous SEQR workshops, continuing. Yearly training on sustainability for Leadership Orange, 2000 and continuing. Challenge to Mohawk casino impact assessment contributed to project withdrawal, 2007-8. Successfully litigated clean water violations, Wallkill STP 2005. Organized and conducted planning workshops for the new Orange County plan, 2003 and wrote green paper on a Sustainable Orange County. Collaborated with Middletown, N.Y. on RFP that led to Pencor-Masada waste to ethanol project. Plaintiff in several environmental law suits, including Orange Environment, Inc. v Orange County (re Orange County Landfill violations of the Clean Water Act and Resource Conservation and Recovery Act, 1992-1999. Settlement negotiated in 1999 created, among other benefits, a \$750,000 fund for the Wallkill River) and (re Harriman Sewer Treatment Plant violations of the CWA, 1997-8; settlement required corrective procedures). Intervener, in adjudicatory hearings over the proposed Expansion of Al Turi landfill, 1998-9 (prevailed leading to closure of facility); Orange County Landfill Expansion, 1987-8 (prevailed); the Orange County Water Loop Project, 1990 (led to project cancellation); the renewal permit for Revere Smelting, Inc., 1995 (won innovative public oversight process); Sterling Forest Development Corporation, 1995 (helped force Sterling forest Corporation to sell land for new state park). Negotiated landfill permit for Orange County Landfill that set important precedents for compensation of communities and residents adversely impacted by the facility; founder and participant in "OCSLP" (Orange County Sanitary Landfill Parties of Interest), 1984-6, 1989-1992; founder of the Wallkill/RSR CAC, 1994.

Member, Town of Goshen Environmental Review Board, 1979 to 1988; Founder and President, Goshen Area Resources Association, 1980-84; Organizer, Wallkill Valley Land Conservancy, 1982-4 (now merged into the Orange County Land Trust).

Other Organizational Roles:

Advisor to the Village Mayor, Goshen, NY, 2007; Member of the Water Planning Committee of the Orange County Department of Planning, 2003; Member of the Mayor's Advisory Committee on Port Development, Newburgh, New York, 1997-8. Co-developed Fall 1996 Community Discussion Course on Discovering the Landscape, Goshen Library; Collaboration in running a community training program on Natural Resource Inventory Studies, Winter, 1980; design workshop for play facility for Project Headstart, Paterson, N.J, July, 1978; co-organizer, session leader and evaluator for the Warwick Town Meeting, June, 1976; facilitator of community communications project in Wykoff, N.J. in 1975; Member, Mid-Hudson Community Development Committee, 1978-80; founder, County Liaison for Environment and Resources (CLEAR), 1981.

Community Talks (sample items for scores):

Impacts of Fracking, Universalist Church, 2010; Orange County Community College, Commentary on the play "An Enemy of the People" 2006; Orange County Community College, February 2000. Orange County Earth Day High School Program, April 1999 and 1998; Leadership Orange Speaker 2007, 2006, 2003, 2002, 2001, 2000, 1999, 1998 and 1997; address to Goshen High School merit scholars, 1998; "The Historical Context of the Pencor/Masada Proposal," talk presented April 19, 1997 at Orange County Community College; Panel presentation to the Orange Leadership Conference, April 11, 1997; Keynote Address, Stewart Reserve Coalition Annual Dinner, May 8, 1995; Invited Address, Cornwall High School, May 8, 1992; Wetlands Forum, March, 1992; Goshen Intermediate School, March 1992; Orange County Chamber of Commerce, February 1992; Community Relations Council, Jewish Federation of Greater Orange County, October 20, 1991; Walden Day, Walden, New York, August 17, 1991. Goshen High School, May 16, 1990; February 12, 1991; Orange County Earth Day Celebration, April 20, 21, 22, 1990; April 20, 21, 1991; Warwick Middle School, February 9, 1990; League of Women Voters Forum on

Recycling, September 28, 1989; Middletown Interfaith Council, September 24, 1989; Toward an Environmental Agenda for Orange County, October, 1989; Opening address, First Annual Mastadonathon, July, 1989; Sugar Loaf Community Foundation, June 1989; Scholars Tradesman Bookstore, April 1989; Ramapo Valley Rotary, May 19, 1989; Wawayanda Homeowners Association, October 1988; Unitarian Society, October 9, 1988 and January 16, 1987; St. Anthony's Hospital Health Fair, April, 1986; the Greater Middletown Citizen's Council, March 17, 1983; Middletown High School, June 2, 1981.

Testimony at Legislative Hearings (Partial):

Testimony on Wallkill flooding at two public hearings, 2007-8. Testimony on NYRI project, 2007. Testimony on casino development on five occasions, 2005-2007; Scoping testimony on proposed Superior/Hudson Valley Landfill, September, 2000; Testimony against proposed expansion of Al Turi Landfill, Inc., October, 1998; Testimony on Proposed Orange County Jail, June 1996. Testimony on Turi Landfill Superfund Site, May 1996. Testimony on the proposed development of Sterling Forest, June, 1995. Testimony on Superfund Reauthorization, submitted to Senator Frank Lautenberg October 1993. New York State Assembly Environmental Conservation Committee, Wallkill, N.Y., March 20, 1992, hearings on State Superfund Program. Testimony before the Federal Aviation Administration regarding airplane noise, Newburgh, N.Y., December 5, 1991. U.S. Army Corps of Engineers, hearings under the Clean Water Act on the Application of the Orange County Water Authority, Pine Bush, N.Y., September 12, 1991. Orange County Water Authority, hearings on the taking of land by eminent domain for the Orange County Water Loop, Goshen, N.Y. August 13, 1991. New York Department of Environmental Conservation, hearings on the proposed Orange County Water Authority project, Pine Bush and Goshen, N.Y., March, 1991. New York Department of Transportation, hearings on the Draft Environmental Impact Statement for Development of the Stewart Airport Property, Newburgh, N.Y., November 28, 1990. New York State Senate Minority Committee on Indoor Air Pollution, Monroe, N.Y., October 11, 1990. Orange County Legislature, hearings on the Draft Solid Waste Plan, October 10, 1990. New York State Greenway Commission, West Point, N.Y., September 18, 1990. New York State Minority Committee on Solid Waste, Goshen, N.Y., August 27, 1990. Health monitoring of Revere Smelting and Refining (RSR) of Wallkill, N.Y., before the New York State Department of Environmental Conservation, December 18, 1989. Orange County Scoping Hearing on the Generic Solid Waste Plan; November 21, 1989. New York State Greenway Commission, Newburgh, New York, November 17, 1989. Turi Landfill Expansion Scoping Hearing on the Draft Environmental Impact Statement, before New York State Department of Environmental Conservation, November 15, 1989. "Illegal Disposal of Wastes in the Hudson Valley." Testimony presented to the Environmental Conservation Committee, New York State Assembly, September 21, 1989, Tuxedo, New York. New York Senate Minority Committee on Radon, Newburgh, New York, March 2, 1989 and in New York City, November 22, 1988. Orange County recycling program, 1988. Social Impacts of electrical transmission lines, before U.S. Army Corps of Engineers, April 2, 1985. Alternative Landfill Siting Plan, Orange County Legislature, October 2, 1985. Participation on the board receiving testimony on Superfund effectiveness for the New Jersey Grass Roots Organization, Sayerville, New Jersey, April 28, 1984. "A Psychological Perspective on Community Health Information on Toxic Sites," testimony before the New York State Assembly Committees on Health and Environmental Conservation, New York City, May 4, 1984. "A Community Perspective on Organized Crime Involvement in Waste Disposal," testimony before the New York State Assembly Committee on Environmental Conservation, September 21, 1984. New York State Assembly Committee on Environment and Conservation, April 14, 1983. Draft Environmental Impact Statement on the sale of Glenmere Lake before the Orange County Department of Planning in January and May 1982.

Media:

Scores of newspaper articles and op-ed pieces; hundreds of media interviews with local, national and international press (print, radio, television).

GRANTS, SUPPORT AND AWARDS

Grants:

"Exchanging Lessons of the Aral Sea Disaster," 2010-2011. Grant received from the Trust for Mutual Understanding. Project Director.

Fulbright Visiting Scholar Grant to bring Abror Gadaev to Ramapo for academic year, 2009.

Project Director, N.J. Board of Public Utilities Grant to Ramapo College, "Renewable Energy and Green Design." 2007-2008.

"Empowering Russian and American NGO's to Address Issues of Future Sustainability." 2002-2004. Grant received from the Trust for Mutual Understanding. Project Director.

"Greening the Village," 2001-2002, grant from the Ramapo College Foundation, Project Director.

"Informing Environmental Decision-making: Environmental Impact Assessment in Russia and the U.S." 1999-2000. Grant received from the Trust for Mutual Understanding. Project Director.

"New Jersey Higher Education Partnership for Sustainability." Project funded by the Geraldine Dodge Foundation, Spring 1999. Project Director.

Fulbright Visiting Scholar Grant to bring Maria Tysiachniouk to campus, 1999.

"Environmental Literacy and the Undergraduate Curriculum." Grant received from the Fund for the Improvement of Post-Secondary Education (FIPSE) for 1994-8. Project Director.

Fellow, Center for Technology Studies, New Jersey Institute of Technology, Fall 1989, 3 credits release time.

"New Jersey Ozone Notification Program Evaluation." Project funded by the New Jersey Department of Health. Principal investigator. 1988-89.

Travel grants from the Trust for Mutual Understanding, 1998; World Bank, 1988; The Netherlands, 1985; West Berlin, 1978.

Grants received by Orange Environment include \$60,000 for the Wallkill River Action Plan (New York State, Orange County and the Kaplan Fund), and a \$5,000 New York State grant for radon programming.

Institutional Support:

Meadowlands Fellowship: 2006, 2007.

Separately Budgeted Research Grants from Ramapo College: 2008; 2001; 1990-1, 1989-90, 1988-89, 1987-88, 1986-87, 1985-86, 1984-85, 1982-83, 1981-82. Career Development grant, Spring 1995.

Ramapo College Foundation grants for research on radon gas exposure, 1986 and 1987, for student travel to the International Association for Impact Assessment conference in 1989, for the First and Second Mid-Atlantic Environmental Conferences, 1995 and 1996, for the San Xavier Research Project, 1996, for travel, 1998 and for speakers for the Green Meets Green event, 2007.

Sabbatical Leaves, Fall, 1984, 1991-2, 2001, Fall 2009.

Special Recognition and Awards

Emerald Publishing Journal Submission Award for 2011 for best journal article for "Privacy and Secrecy: Public Reserve as a Frame for Examining the BP Gulf Oil Disaster."

Florence Thomas' Award, Ramapo College, 2005.

Recognition for special service to Ramapo College for blocking the Truck Weigh Station Project, October 2000.

Special recognition for service to the college, Ramapo College of New Jersey, Spring, 1999.

Granted Certificate of Environmental Leadership and Named to Environmental Grassroots Hall of Fame by the Citizen's Clearinghouse for Hazardous Wastes, May 16 1993.

Faculty Advisor to students winning first prize for the Environmental Expo awards contest, 1989 and 1987; runner up, 1988, 1990.

"Faculty Advisor 1989," Environmental Management Competition, Environmental Expo Advisory Board and the New Jersey Department of Environmental Protection.

"Faculty Advisor 1987," Environmental Management Competition, Environmental Expo Advisory Board and the New Jersey Department of Environmental Protection.

American Institute of Architects Research Award [To Bosti, Inc. for Pak (Planning Aid Kit) Project], 1973.

Herbert A. Lehman Fellowship, 1970-74.

Coro Foundation Fellowship, 1970 (declined).

Stanton Chapman Crawford Award (University of Pittsburgh).

Phi Beta Kappa, Phi Theta Kappa, Phi Eta Sigma and Chi Lambda Tau (University of Pittsburgh).