

LESSONS-LEARNED FROM THE 20-YEAR URANIUM MILL TAILINGS REMEDIAL ACTION SURFACE PROJECT

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ABSTRACT

In 1978 Congress directed the Department of Energy to clean up 22 inactive uranium processing sites. In late 1998 the Department of Energy's Uranium Mill Tailings Remedial Action (UMTRA) Surface Project completed the cleanup of the last of these 22 sites and the last of more than 5,300 associated vicinity properties. The Project disposed of more than 40 million cubic yards of material, which is about 80 percent of the volume to be cleaned up by the Department's Environmental Management Program.

Although, the tailings contained small amounts of radioactivity, they posed a real risk because they were located at numerous facilities that were not under DOE control. This marks the completion of the first major cleanup program by the Department of Energy's Environmental Management Program. Over the 20-year span of the Project, important technical and management lessons have been learned that can be applied to other cleanup programs. The Project provides many valuable case studies from the variety of situations addressed over the past 20 years.

INTRODUCTION

One of the first environmental legacies created by the Cold War was uranium mill tailings. Following World War II the federal government created a demand for uranium and purchased all uranium produced by the commercial uranium industry up to 1968. Uranium mill tailings, the large volume of material left from uranium production from ore, was treated like conventional milling waste and with no concern for its radioactive or hazardous material content. As a result, tailings were left at 22 mill sites with little or no controls. Without controls the material was carded off-site by wind and water erosion, ground water was contaminated, and the tailings were used off-site for construction and landscaping. At some locations the off-site use of tailings for other purposes was encouraged.

By the early 1970s the Surgeon General determined that tailings presented a real and significant health risk. In 1972 legislation was passed to clean up private properties in Grand Junction, Colorado, that had been contaminated with tailings. That program (the Grand Junction Remedial Action Project) cleaned up over 600 of these "vicinity properties". It became apparent during that time period that the scope of the tailings problem was not limited to Grand Junction, and that a site-by-site approach would not be sufficient.

In 1978 the U.S. Congress passed the Uranium Mill Tailings Radiation Control Act (UMTRCA) which provided for the clean up of nearly all uranium mill tailings and mill sites in the United States. This Act was one of the first pieces of comprehensive legislation focused on a particular environmental risk and industry. The Act provided a framework for the cleanup and long-term stewardship of the environmental contamination from the production at approximately 50 uranium mills in the United States. The Act consisted of two major titles: Title I dealt with the older or "inactive" sites that produced essentially all of their uranium for sale to the Federal Government and Title II dealt with the newer "active" sites that produced all or a portion of their uranium and thorium for sale to the commercial nuclear power industry. Specifically, Title I directed DOE to

remediate 22 designated sites in 9 states that were no longer operative or licensed as of the date of enactment of UMTRCA, November 8, 1978. These 22 sites were the source of uranium for the development and buildup of the United States' nuclear deterrent after World War II and are the original legacy of the cold war.

Responsibility to implement Title I of the Act was delegated to the U.S. Department of Energy. Thus, the cleanup of uranium mill tailings was one of the first environmental problems that Congress directed the Department of Energy to address. In 1979 the Department of Energy established the Uranium Mill Tailings Remedial Action (UMTRA) Project to clean up the 22 inactive mill sites designated by Congress and the associated vicinity properties at each site. The UMTRA Project eventually became two separate projects--Surface and Ground Water--but the focus of this paper is the Surface Project which was responsible for the cleanup of more than 40,000,000 cubic yards of uranium mill tailings. Table I presents a list of the 22 sites.

The UMTRA Surface Project was one of the first major environmental projects in DOE and the first major DOE cleanup project to be completed. Although the project took longer than originally directed by Congress, and cost more than originally estimated, the Department believes it is a model for successful environmental cleanup. The goal of this paper is to present the factors that contributed to the success of this project, as well as some of the lessons-learned throughout the 20 years of the project.

THE URANIUM MILL TAILINGS RADIATION CONTROL ACT OF 1978

First, we will summarize the problem as it existed in 1978. To acquire uranium for the buildup of a nuclear stockpile, and to provide material for naval and prototype commercial reactors, the Atomic Energy Commission provided incentives and contracts to the private sector to supply uranium concentrate (U308), also referred to as yellowcake. Once this material was produced, it could only be acquired and owned by the Federal Government. Typically, uranium ore was mined and shipped to uranium processing mills owned and operated by the private sector. The U₃O₈ was sold to the Federal Government. As these mills were developed and operated in the 1940's through the late 1960's, the processing residues (or mill tailings) were treated as other mining waste and were left in large piles adjacent to the mills. There was essentially no environmental or health concern with the radioactive content of the tailings. By the late 1960's a link was established between exposure of uranium miners to radon and its decay products and health effects--lung cancer in particular. It was this link that led to a series of studies that culminated in the passage of UMTRCA in 1978.

A major factor in the success of the Project was the authorizing legislation itself. Title I of UMTRCA is concise, only several pages in the United States Code. However, it was very well crafted to address the environmental and health risks associated with the tailings and did a very good job of delegating the responsibilities.

The 22 UMTRA sites were owned and operated by the private sector. Because the sites were operated before the hazards were identified and before the cleanup requirements were passed, Congress essentially relieved the generators of all liability for cleanup. By 1978 some of the sites had changed ownership and some companies were no longer in the uranium business. If the owners had been left with the responsibility to clean up the sites, even with financial assistance, the viability of these firms to perform the cleanups would have varied.

Another unique aspect of UMTRCA was its relation to other environmental cleanup laws. UMTRCA created a unique definition for waste at Title I sites. The tailings and all other wastes associated with the original processing of ore at the sites were defined to be "residual radioactive material" and all of the wastes were allowed to be disposed of in the tailings disposal cells. Thus, DOE did not have to implement RCRA or CERCLA requirements to conduct the UMTRA Project. The primary exceptions were a few occasions when RCRA or TSCA wastes were encountered at vicinity properties, and it was clear that the hazardous materials were not originally from the milling process. In those cases the hazardous components were managed under the proper authority.

UMTRCA allowed the owners of vicinity properties the option to participate in the program. These were normally called "owner refusals properties" which meant that at some point in the process the owners decided not to allow DOE to proceed. This ranged from not allowing DOE to perform on-site surveys, not allowing the cleanup to be performed, to not allowing post-cleanup verifications to be performed. Although most owners welcomed the cleanup of their properties, several hundred owners declined to participate in the Project.

STAKEHOLDER PARTICIPATION

An important feature of UMTRCA was the role of the States, Tribes, and stakeholders. Although DOE was responsible for conducting the cleanups, the States and Tribes were delegated specific responsibilities. Eighteen of the 22 sites were located in eight States, and four sites were on Native American lands. DOE entered into a cooperative agreement with each State or Tribe--these were basically contracts that spelled out each party's responsibilities.

The success of the Project was due in part to the Act's requirements for participation by the States, Tribes, and local stakeholders. The Project entered into cooperative agreements with 10 States and 2 Indian Tribes. (UMTRCA was amended later to direct DOE to cleanup vicinity properties at a Title II site in South Dakota, and DOE designated two processing sites in North Dakota that were later removed from the Project.) In most of the communities local citizens' groups were formed to provide liaison between the Department and the local community. As UMTRA progressed, citizen participation and input grew. Stakeholder input was a major factor in disposal cell siting and tailings transportation decisions.

A unique aspect of the Project was that UMTRCA directed that the host State for each site pay 10 percent of the costs of remedial engineering, construction, and site acquisition. The rationale was that the States had benefited economically from the uranium production, and therefore should assume some of the financial liability for the cleanup. This was a big factor in the success of the project because it gave each State a vested interest in the selection of the remedy and its cost. In most States this responsibility was delegated to the State health department, which in turn would have to request the State's 10 percent cost share from the State legislature. This was particularly significant for Colorado which has 9 sites, and work that spanned the entire life of the Project. The Colorado sites also accounted for nearly 60 percent of the total UMTRA Project cost. As the Project continued, the States realized that the work created jobs and income, the value of which normally exceeded the State's cost share.

The States were also required to acquire the former millsites--in some cases, sites were purchased outright and at others access agreements were obtained for the duration of the cleanup and were returned to the owners after the cleanup. This was beneficial because the property acquisition processes for the States were often more direct. For sites that have been purchased, the States transfer

title to DOE after cleanup if the disposal was on the same site, but if the tailings were moved off-site the States are allowed to retain the site for public purposes such as parks and recreation.

The UMTRCA directed that stakeholders be involved in the decision-making process for the UMTRA Project. The States and Tribes were partners with the Department of Energy in implementing the Project and were instrumental in facilitating the relationship between the Department and local stakeholders. Citizens groups were formed at most of the sites, and at some sites became quite active.

Stakeholder participation is a given in all environmental cleanups today. However, at the beginning of the Project DOE had limited experience in this area. Traditionally nuclear weapons operations were classified and in some communities there was limited understanding of DOE's mission.

UMTRA sites were a totally different situation. They were never owned or operated by DOE, and the sites, especially in the smaller communities, had been major employers in the 1950's and 1960's. Members of the community were familiar with the sites and had not considered them to be a risk. One of the first jobs was to communicate the potential risks of the tailings to the local communities - in some communities the long-time familiarity with the tailings made it difficult to communicate this risk. DOE provided information on the potential health risks, and as awareness grew, people became more concerned about the presence of the tailings in their community.

Originally DOE had planned to remediate most of the tailings at the original processing sites, but eventually 13 of the 22 sites were moved to more remote locations. The decisions to move the tailings during the early years of the Project were often based on public pressure to move the material - later in the Project DOE decided to move most of the sites located in populated areas or along rivers and streams. Stakeholders also participated in decisions on the selection of the off-site disposal areas, the mode and route for hauling tailings offsite, and the hours of operation of the remedial actions.

REGULATORY BASIS AND RISK

A unique aspect of the Project was that the U.S. Environmental Protection Agency (EPA) was given the responsibility to develop the regulatory standards for the UMTRA Project, but the Nuclear Regulatory Commission was given the responsibility to enforce the standards and was the Department's regulator.

The EPA standards were linked to risk, but their enforcement and the development of the site-specific remedies was not based on risk directly. The standard (40 CFR 192) is a performance standard; i.e., it established criteria for cell performance, and the objective of the regulatory process was to demonstrate to NRC that the engineered design could meet the EPA requirements for containment of radiation and protection of the environment.

The EPA standards were designed to achieve several objectives. The most fundamental was to isolate the tailings from the environment. This was achieved by placing the tailings in essentially permanent disposal cells consisting of several layers of natural materials. The radioactive elements of concern were uranium, radium, radon, and their decay products. The key design feature of each cell was the radon barrier which was designed to have a low permeability for radon gas such that most of it would decay to solid elements before it could diffuse into the environment. The standard allowed two approaches to compliance: (1) design the cell for a minimum off-site exposure; or (2) design the cell

for a minimum radon flux. The latter approach was used because it was more straightforward to demonstrate that the engineered barriers could achieve a radon flux standard.

The other major concern was protection of ground water resources. The chemicals used to extract the uranium were not fully recovered during processing and they, along with metals and other elements, both radioactive and nonradioactive, contaminated ground water at most of the sites. Radon barriers were typically constructed of clays because of their ability to attenuate radon and their low permeability for water. Thus, the requirements for radon attenuation and water infiltration were met with the same layer. In order to protect the radon barrier, additional layers were added depending on the particular environment of the cell and the availability of materials. Drainage layers were usually added to preferentially divert most precipitation off of the cell before it could reach the radon barrier. Frost protection was also added to protect the integrity of the radon barrier. Most cells were covered with rock for erosion protection, although a few have vegetative covers over all or part of the cell. Selecting rock that was durable, economical and available was one of the biggest design challenges at some of the sites --at several sites it became necessary to haul rock from a considerable distance to meet the NRC's durability requirements.

The EPA standard required that the disposal cells have a useful life of up to 1,000 years but no less than 200 years if the longer term was impractical. Because of the desire to achieve the 1,000 year durability, rock erosion protection was normally chosen, because from an engineering standpoint it was easier to demonstrate that rock would withstand the elements for 1,000 years with limited maintenance, as opposed to a vegetative cover. UMTRCA directed the federal government to be the permanent custodian of the disposal cells. As the long-term custodian, DOE chose a conservative approach that will achieve long-term durability with limited maintenance requirements.

The early part of the project included research efforts on cell design, cover materials, radon attenuation, moisture infiltration, and frost protection. As the Project continued, design, build and performance experience resulted in changes in design and siting. Each of the sites was unique and required different approaches to deal with site geology, climate, and available construction materials. In 1987 the EPA proposed revisions to ground water protection standards that required changes to designs for subsequent cells.

The basic goal of the Project was to reduce risks to human health and the environment. However, the reduction in risk achieved by the project varied widely from site to site. As part of the National Environmental Policy Act requirements for each site, health effects (estimated fatal cancers over the next 100 years) were calculated with and without the remedy, and worker and public risks during construction were also estimated. At most sites the baseline risks were very low - these are the risks if nothing were done to isolate the tailings. This was generally the case because many of the sites were remotely located or the urban density adjacent to the site was low. However, several of the sites had significant risks, in particular Grand Junction, Colorado and Salt Lake City, Utah.

At most locations, the most direct risks were from tailings that were no longer at the original mill sites. The off-site contaminated properties, which were called vicinity properties were found in the communities at each of the 22 mill sites. By the end of the Project over 5,300 vicinity properties were remediated, including more than 4,000 in Grand Junction. Vicinity properties were the result of wind or water erosion but mostly from the use of the tailings for construction materials. The Title I sites operated during a period when there was no risk associated with the tailings. In many of the communities, access to the tailings was not controlled and at some sites use of the tailings was even encouraged. For example, in Grand Junction the mill operator left a front-end loader on the site and

allowed anyone to come on site and remove as much of the material they desired. Use of the tailings ranged from landscaping of residential homes, sand traps in a golf course, fill around homes and businesses, bedding for utilities in public streets, and government building and schools. As noted above, this pervasive use of tailings led to enactment of legislation in 1972 to address the problem in Grand Junction, but as it became apparent the problem was much larger, this led to the passage of UMTRCA in 1978.

The UMTRA Project was warranted in terms of risk. Although the health risks were from low levels of radioactivity, traditional risk models estimate that up to 1,300 fatal cancers have been prevented by the UMTRA cleanups over the next 100 years. The generic Environmental Protection Agency (EPA) standards under which the UMTRA Project operated were performance-based and did not recognize different levels of risk at the sites. However, compliance with the generic standards resulted in a very wide range of economic cost/health benefit ratios -- similar approaches to long-term disposal were required for tailings located in urban areas as well as for tailings in remote locations. In contrast, the UMTRA ground water standards, discussed in a separate paper, are based on a risk-based approach and provide a variety of compliance strategies that do not necessarily require active cleanup if the risks are acceptable or diminishing. Although this approach may appear to be inconsistent it was not. The radioactive source term from the tailings does not diminish significantly over time because of the low decay rates for uranium and radium. However, once the source term has been removed and/or isolated in a disposal cell - the radiation risk is effectively controlled. In contrast, once the source term is controlled there is very little or no contamination of ground water, and at many sites ground water contamination will attenuate by natural forces.

The perception of risk was often different than the actual risks. Table II shows for each site the estimated baseline risk, the risk after cleanup, the cost for each site and the unit cost of risk reduction at each site. Overall, the UMTRA Project spent about \$1.1 million per avoided health affect, a reasonable amount. But, as the table shows, the range varied widely from site to site.

The EPA standards resulted in a consistent approach to cleanup and containment, but this consistency resulted in the deployment of remedies that were not necessarily cost effective at all sites. Thus, from a "business" standpoint, less aggressive remedies might have been used if a risk-based standard had been the regulatory basis. However, risk and risk perception are often different, and less aggressive remedies might not have been as durable and might not have been as publicly acceptable. Because communities became more involved and knowledgeable over the life of the Project, it would have been difficult to implement remedies that would have been perceived as not being equally protective.

The Uranium Mill Tailings Radiation Control Act directed DOE to designate for cleanup 22 sites named in the Act. A year after enactment, DOE designated two additional sites, both in North Dakota. These two sites were not uranium processing sites in the traditional sense -- they were mass reduction plants that burned uranium-bearing lignite, and the resulting ash was shipped to other Title I sites for recovery of the uranium. As a cost-sharing partner, the North Dakota legislature never appropriated the State's share of the cleanup costs. North Dakota never fully agreed that the risk was significant, and in 1996, the State requested that the designations for the two sites be revoked. DOE evaluated the risks at the sites, consulted with the NRC and the EPA, and agreed that the risks were low. In the spring of 1998 DOE revoked the designations, and regulatory oversight for the two sites transferred to the State.

PUBLIC AND WORKER HEALTH AND SAFETY

As shown in Table II, the predicted nonradiological fatalities at about one-third of the sites during construction were of the same order of magnitude or more than the avoided health effects of performing the remedial action. Radiation protection of workers and the general public was of concern, but due to the low levels of radiation, significant protective measures were not normally required. Air monitoring was conducted during remedial action and total dose was calculated for workers. The tailings and unpaved haul roads were sprayed with water during construction to suppress dust and to enhance compaction of the tailings in the disposal cells.

Even though the project was managed as a radioactive cleanup activity, the fundamental work was large-scale earth moving; and the primary risks to workers were the normal industrial hazards associated with operation of large equipment. Unfortunately one worker lost his life during the project - a maintenance person on a rock screening machine. Following that accident in 1992 and several other fatalities at other DOE Environmental Management sites, the Department developed a new culture of worker safety and increased its requirements and safeguards for worker protection.

Following this accident, additional health and safety personnel were assigned at each of the sites. Emphasis was placed on working safely and additional training was required of all workers. An area of particular concern was highway safety. At several of the sites, the tailings were hauled by truck to more remote disposal sites on public roads. At several of these sites DOE worked with the State to upgrade roads for the increased volume of traffic and traffic guards were often used at intersections. Truck safety was a major concern and periodic inspections were required to assure that brakes and other safety features were installed and operating safely.

All of these safety measures added to the cost of the Project, but the additional expense was justified because the performance of the work should minimize public and worker risks. The UMTRA Project was able to achieve safety records that exceeded national figures as well as safety performance at other DOE sites.

PROJECT COST, SCOPE AND DURATION

A common aspect in most cleanup programs is that it is more complicated, takes longer and costs more than originally estimated. The UMTRA Surface Project was no exception, but in retrospect given the uncertainties at the beginning of the project these increases not excessive.

As the project was planned in the late 1970's and early 1980's the EPA and the DOE made estimates of what it would cost to remediate the 22 sites. Early estimates were in the range of several hundred million dollars. Congress had directed in UMTRCA that the cleanups be completed within 7 years of the date that EPA issued the final standards -those standards were issued March 7, 1983.

At that time the Department had never undertaken an environmental cleanup the size of UMTRCA. The mill sites were still owned by the uranium producers and thus were not DOE property. Most of the sites were essentially abandoned. Some were fenced and some were not. Since there were no environmental requirements during the operation of the mills there were incomplete or non-existent records on the tailings. Thus, the Department had to begin from "square one" in characterizing each site. This is contrast to most DOE cleanup projects that are on sites that have been under continuous government control throughout their entire operating lives.

As noted earlier, the scope of the UMTRA Project increased and evolved over the 20-year life of the program. Most of these scope changes have been discussed throughout this paper. One of the most significant is that the tailings from more than half of the sites were relocated to more remote locations, whereas the original planning had assumed that most sites could be remediated in place. In 1987, when only a handful of sites had been completed, the EPA revised the regulatory standards to require additional protection of ground water resources at the sites. This increased the complexity and cost of the cell designs, and was also one of the reasons the tailings from more sites were relocated - in particular many of the sites located on rivers or streams. Another unknown at the beginning of the project was the quantity of tailings and other contamination at the sites. It was common that the quantity of tailings was greater than originally estimated, contamination often had migrated beneath the tailings, other debris or building foundations were encountered during the actual cleanup, and the number of vicinity properties at most sites was greater than estimated.

Of course another factor that contributed to increased project costs was time. Although Congress directed that the cleanups be completed within seven years of the date that EPA issued its standards for the Project, it became clear almost immediately that more time would be needed. The Department's authority to conduct UMTRA remedial actions was extended three times, eventually to September 30, 1998. Remedial actions took more than eight years longer than originally projected -- from the original Congressionally mandated completion date of March 1990 to the actual remedial action completion date of September 1998.

From the original estimates of several hundred million dollars to the final cost of over \$1.4 billion, the cost of the Project obviously grew. However, due to the duration of the Project and the impact of inflation, the real increases were not as high as the above numbers suggest. In 1995 the Government Accounting Office conducted a review of the Project and concluded that cost grew about 37 percent, from a mid-1980's baseline to the near final baseline at the time the report was prepared, when all costs were converted to constant dollars. Given the significant changes in scope, these increased costs were not unreasonable.

CONCLUSIONS

The Uranium Mill Tailings Remedial Action Project was one of the first environmental cleanup projects performed by the Department of Energy and it is the first major cleanup program to be completed by the Department. The Project has faced many of the challenges common to cleanup programs today: uncertainty in the magnitude of the problem; public misunderstanding of the risks, growing public interest and involvement, and program costs, scope and schedule that exceeded original estimates.

Uranium mill tailings were one of the most unique environmental legacies of the cold war because of their sheer volume and the fact that they were disposed of in the environment with little or no controls. The basic success of the UMTRA Project is that the tailings have been consolidated and isolated and no longer pose a threat to public health and the environment.

REFERENCES

1. Uranium Mill Tailings Radiation Control Act of 1978 (as amended), Public Law 95-604 (92 Stat.3021), (42 USC §7901 et seq), November 8, 1978.

2. 40 CFR 192, Standards for Remedial Actions at Inactive Uranium Processing Sites, U.S. Environmental Protection Agency.
3. Uranium Mill Tailings: Cleanup Continues, but Future Costs are Uncertain, GAO/RCED-96-37, December 1995.

TABLE I: UMTRA SURFACE PROJECT SITE DATA

UMTRA Project Site	Remedial Action Completion Date	Disposal	Cubic Yards of Contaminated Material (thousands)	Contaminated Land (acres)
Monument Valley, AZ	3/94	Off-site	925	83
Tuba City, AZ	5/90	On-site	1,631	327
Durango, CO	5/91	Off-site	2,533	127
Grand Junction, CO	8/94	Off-site	4,425	114
Gunnison, CO	12/95	Off-site	796	68
Maybell, CO	9/98	On-site	4,100	214
Naturita, CO	8/98	Off-site	399	247
Old Rifle, CO	10/96	Off-site	661	88
New Rifle, CO	10/96	Off-site	3,096	238
Slick Rock, CO (UC)	10/96	Off-site	547	92
Slick Rock, CO (NC)	10/96	Off-site	85	47
Lowman, ID	6/92	On-site	126	30
Ambrosia Lake, NM	6/95	On-site	5,162	612
Shiprock, NM	9/86	On-site	2,800	130
Lakeview, OR	10/89	Off-site	944	116
Canonsburg, PA	12/85	On-site	265	79
Falls City, TX	7/94	On-site	6,019	593
Green River, UT	12/89	On-site	382	48
Mexican Hat, UT	2/95	On-site	2,558	250
Salt Lake City, UT	6/89	Off-site	2,710	128
Riverton, WY	9/90	Off-site	1,793	140
Spook, WY	9/89	On-site	315	21
Totals			42,430	3,894

Note: UC = Union Carbide; NC = North Continent

TABLE II
ESTIMATED COST AND CANCER DEATHS PREVENTED BY THE UMTRA
PROJECT BASED ON FY-98 FEDERAL UMTRA BUDGET

Site	Excess Cancer Deaths Prevented by Remedial Action	Predicted Nonradiological Fatalities	Actual Nonradiological Fatalities	Total Deaths Prevented	Total Project Cost \$Millions	Cost/Death Prevented \$Millions
Grand Junction, CO	589	0.35	1	588	256.3	0.44
Salt Lake City, UT	313	0.14	0	313	75.0	0.24
Rifle, CO	40	0.36	0	40	94.9	2.4
Durango, CO	22	0.025	0	22	63.1	2.8
Canonsburg, PA	15.0	0.	0	15.0	35.8	2.4
Gunnison, CO	6.5	0.052	0	6.5	63.2	9.7
Riverton, WY	5.6	0.55	0	5.6	45.6	8.1
Falls City, TX	2.3	0.040	0	2.3	56.7	25
Shiprock, NM	2.0	0.	0	2.0	22.9	11
Tuba City, TX	1.9	0.070	0	1.9	34.9	18
Mexican Hat, UT	1.3	0.029	0	1.3	53.2	41
Naturita, CO	0.91	0.072	0	0.91	59.8	66
Lakeview, OR	0.27	0.022	0	0.27	32.6	120
Ambrosia Lake, NM	0.086	0.20	0	0.086	39.0	450
Monument Valley, AZ	0.016	0.012	0	0.016	23.3	1,500
Lowman, ID	0.013	0.0070	0	0.013	14.9	1,100
Green River, UT	0.007	0.024	0	0.007	21.5	3,100
Slick Rock, CO	0.003	0.085	0	0.003	53.1	18,000
Maybell, CO	0.003	0.063	0	0.003	39.1	13,000
Spook, WY	0.002	0.019	0	0.002	10.3	5,200
SITE TOTALS	1000	2.22	1	999	1,105.2	1.1
VICINITY PROPERTIES	290	0.019	0	290	345.2	1.2
GRAND TOTALS	1290	2.24	1	1289	1,450.4	1.1