ENVIRONMENTAL IMPACT APPRAISAL
of the
PLATEAU RESOURCES ORE BUYING STATION
BLANDING, UTAH

JULY 1979

Docket No. 40-8674

U.S. NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS
DIVISION OF WASTE MANAGEMENT
WASHINGTON, D.C.

ENVIRONMENTAL IMPACT APPRAISAL

of the

PLATEAU RESOURCES ORE BUYING STATION

BLANDING, UTAH

Docket No. 40-8674

JULY 1979

U.S. NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS
DIVISION OF WASTE MANAGEMENT
WASHINGTON, D.C.

CONTENTS

Page

POOR ORIGINAL

928 095

LIST OF FIGURES

LIST OF TABLES

SUMMARY AND CONCLUSIONS

This environmental impact appraisal was prepared by the staff of the U.S. Nuclear Regulatory Commission and issued by the Commission's Office of Nuclear Material Safety and Safeguards.

1. This action is administrative.
2. The proposed action is the issuance of a source material license to Plateau Resources Limited for the presently operating uranium ore buying station (OBS) which has a nominal storage capacity of 71,000 tons (6.34×10^7 kg).
3. Summary of environmental impacts and adverse effects:
   a. Impacts to the area due to the operation of the Plateau Resources Limited OBS has or will result in:
      - A minor increase in suspended particulate matter (fugitive dust) and gaseous emissions from internal combustion engines.
      - A small increase in the background radiation levels in the near vicinity of the OBS. However, radon and ore dust transport will have minimal effect on individuals and the public and will be within federal and state regulatory limits.
      - A temporary loss of 14 acres of potentially agricultural land along with disturbance and alteration of the natural soil characteristics. There will be a suitable reclamation effort following decommissioning to preclude long term impacts on the soil.
      - A loss of 6 ha (14 acres) of old-field vegetation. Destruction of this habitat has resulted in destruction or displacement of some wildlife. Unavoidable impacts due to OBS operation include disturbances to wildlife as a result of noise and human activities and a potential increase in road kills. Fugitive dust and gaseous emissions generated during construction and operation may affect the surrounding vegetation, but the extent of the impact cannot be quantified.

      Although some vegetation and wildlife loss was unavoidable, the loss of individuals is not expected to result in the long-term elimination of any species in the vicinity of the OBS.

   b. Impacts on surface waters and the aquatic habitat and biota due to OBS operation are expected to be minimal or nonexistent. During construction, runoff from the site might have increased sediment transfer to adjacent streams under heavy rainfall conditions. Because runoff streamflow in this area is normally characterized by high sediment content, the effect of this small increase in sediment load would be expected to be inconsequencial. The retention of sanitary wastes in the drainage field, the construction of the runoff diversion/retention barrier around the ore stockpiles, and the lack of any other direct or indirect discharge into adjacent aquatic habitats will protect the aquatic environment from any unavoidable adverse impacts.

   c. No measurable impact on groundwater resource is expected since water use is estimated to be less than 100 acre-ft/year from a formation containing several thousands acre-feet per square mile.

   d. Minor effects on community services are expected because most employees will come from the local area. Operation of the OBS requires about eight employees, with another eight to ten truck drivers eventually employed to transfer ore to the milling facility.

4. License conditions:

On the basis of the analysis and evaluation set forth on this environmental impact appraisal, the staff plans to incorporate into the license issued for the Plateau Resources Blanding OBS the following conditions for the protection of the environment.

a. The applicant is required to control fugitive dust by water spraying, the use of detergent, or other equivalent methods as required to avoid dusting from the ore piles; this will include applying control measures when gusty winds exceeding 40 km/hr (25 mph) are forecast.

b. The NRC staff requires that the applicant provide an earthen berm around the storage pad in order to preclude offsite surface-water contamination in the event of flooding.

c. The applicant shall implement the environmental monitoring program described in Table 6.4 of this document. The applicant shall establish a control program that shall include written procedures and instructions to control all environmental monitoring prescribed herein and shall provide for periodic management audits to determine the adequacy of implementation of these environmental controls. The applicant shall maintain sufficient records to furnish evidence of compliance with these environmental controls.

d. Before engaging in any activity not assessed by the NRC, the applicant shall prepare and record an environmental evaluation of such activity. When the evaluation indicates that such activity may result in a significant adverse environmental impact that was not assessed, or that is greater than that assessed in this environmental appraisal, the applicant shall provide a written evaluation of such activities and obtain prior approval of the NRC for the activity.

e. The applicant shall have an archaeological survey conducted before any new construction is started at the OBS site or before proceeding with any decommissioning activities which might affect artifacts present at the site.

f. If unexpected harmful effects or evidence or irreversible damage not otherwise identified in this environmental appraisal are detected during operation, the applicant shall provide to the NRC an acceptable analysts of the problem and a plan of action to eliminate or reduce the harmful effects or damage.

g. The applicant shall provide for reclamation of the OBS site and ore receiving and storage areas as described in Sects. 3.6.1 and 3.6.2 of this document.

h. The applicant shall provide financial surety arrangements to ensure decommissioning of the OBS site.

5. Conclusions and basis for negative declaration:

The staff has analyzed the environmental impact of the applicant's OBS. It is the judgment of the staff that normal plant emissions or the possible effects of accidents do not constitute a significant addition of radioactive effluents to the environment. The impact for the individual dose commitment at the nearest residence from Plateau Resources normal operations are a slight fraction of the current EPA standard of 25 millirems for the fuel cycle facilities as specificed in 40 CFR 190, and it is concluded that no adverse environmental impact is anticipated from routine operation of the OBS. An analysis of particulate emissions by the staff indicates that annual average concentrations will be about 27 $\mu g/m^3$ compared to the EPA secondary air quality standard of 60 $\mu g/m^3$. Also, staff calculations show that under extremely poor meteorological conditions (5 hr persistant wind direction with class F stability and a wind speed of 2.5 m/sec) the 24-hr average suspended particulate concentration would be about 80 $\mu g/m^3$ as compared to the EPA secondary air quality standard of 150 $\mu g/m^3$ for a 24-hr period. The applicant has nonetheless proposed a monitoring program which is adequate to detect both radiological as well as particulate emissions to ensure compliance with regulatory standards and to keep emissions as low as reasonably achievable.

x

2
/5998

The effects of OBS operation on surface water and groundwater are expected to be minimal or nonexistent.

The applicant has proposed an acceptable reclamation plan and will decontaminate the site for unrestricted use when decommissioning activities are complete.

It is therefore the conclusion of the staff that an environmental impact statement is not required under NRC regulations 10 CFR 51.5(b) nor under CEQ guidelines in 40 CFR 1500.6. As shown in this appraisal, the environmental effects of the proposed license action are insignificant and as provided for in 10 CFR 51.5 c(i), a negative declaration is being prepared in accordance with the requirement of 10 CFR 51.7.

1. INTRODUCTION

By letter dated April 3, 1978, Plateau Resources, Limited, submitted an application for a Source Material License pursuant to Regulations in Title 10, *Code of Federal Regulations*, Part 40, (10 CFR Part 40) in conformance with the Nuclear Regulatory Commission (NRC) branch position for uranium ore buying stations issued in February 1978. This application was for the Plateau Resources ore buying station (OBS) near Blanding, Utah, presently operating under Interim License No. SUA 1326, Docket No. 8674.

In connection with such license applications, 10 CFR Part 51 requires that an environmental impact appraisal be performed to determine whether an environmental impact statement or a negative declaration will be prepared. Part 51 states further that the determination shall be guided by the Council on Environmental Quality Guidelines .40 CFR Part 1500.6. In accordance with these regulations, the staff involved in the Division of Waste Management of the NRC initiated an assessment of the environmental impact of the proposed licensing action. Upon completion of this Environmental Impact Assessment and evaluation of the findings, the staff prepared independently this appraisal on environmental considerations associated with the proposed license in accordance with 10 CFR Part 51, implementing the requirements of the National Environmental Policy Act of 1969 (NEPA) and the President's Council on Environmental Quality (CEQ) guidelines.

The staff (in conducting this appraisal) has used the information provided by the applicant, together with supplementary information from various sources, and has addressed all of the significant environmental factors. These factors include land use, demography, geology, meteorology, hydrology, ecology, effluent controls, environmental monitoring, and accident potential.

The staff visited the Plateau Resources OBS June 20, 1978. After this site visit, some additional information was requested and obtained from the applicant to ensure a thorough understanding of the operation.

1.1 THE PROPOSED ACTION

The proposed action for which the Environmental Impact Appraisal is performed is the granting of a full-term (5-year) Source Material License for the continued operation of the OBS.

1.2 SUMMARY OF OBS ACTIVITIES

The Plateau Resources OBS purchases uranium ore from numerous small independent mines within a radius of about 161 km (100 miles). Virtually all of the mines supplying ore to the buying station have operated intermittently for 20 to 25 years.

The OBS and all associated facilities are located on land privately owned by Plateau Resources, Limited, and has been in operation since August 1977. The stockpiled ore is proposed to be processed in Plateau Resources' SShootering Canyon Uranium Mill to be situated in Garfield County, Utah. The details of buying station operation are given in Sect. 3.

2. THE EXISTING ENVIRONMENT

2.1 CLIMATE

2.1.1 General influences

Although varying somewhat with elevation and terrain in the vicinity of the site, climate can generally be described as semiarid (steppe). Skies are usually clear with abundant sunshine, precipitation is light, humidity is low, and evaporation is high. Daily ranges in temperature are relatively large, and winds are normally light to moderate. Synoptic-scale meteorological influences are relatively weak; as a result, topography and local micrometeorological effects play an important role in determining climate in the region.

Seasons are well defined in the region. Winters are cold but usually not severe, and summers are warm. The normal mean annual temperature reported for Blanding, Utah, is about 10°C (50°F), as shown in Table 2.1. January is usually the coldest month in the region, with a normal mean monthly temperature of about -3°C (27°F). Temperatures of -18°C (0°F) or below may occur in about two of every three years, but temperatures below -26°C (-15°F) are rare. July is generally the warmest month, having a normal mean monthly temperature of about 23°C (73°F). Temperatures above 32°C (90°F) are not uncommon in the summer and are reported to occur about 34 days a year; however, temperatures above 38°C (100°F) occur rarely.

→ 2.1

Table 2.1. Temperature means and extremes at Blanding, Utah[a]

Month	Means						Extremes					
	Daily maximum		Daily minimum		Monthly		Record highest		Year	Record lowest		Year
	°C	°F	°C	°F	°C	°F	°C	°F		°C	°F	
January	3.9	39.1	−9.1	15.6	−2.6	27.4	16	60	1956	−27	−17	1937
February	6.5	43.7	−6.4	20.4	0.1	32.1	19	67	1932	−31	−23	1933
March	11.1	51.9	−3.3	26.1	3.9	39.0	22	72	1934	17	2	1948
April	17.0	62.6	0.9	33.7	8.9	48.1	28	82	1943	12	11	1936
May	22.2	71.9	5.2	41.3	13.7	56.6	33	92	1951	−5	23	1933
June	28.2	82.8	9.6	49.2	18.9	66.0	38	100	1954	−2	28	1947
July	31.7	89.1	13.8	56.9	27.8	73.0	39	103	1931	2	36	1934
August	30.3	86.5	13.1	55.5	21.7	71.0	37	98	1954	6	42	1950
September	26.2	79.3	8.7	47.7	17.6	63.6	35	95	1948	−2	29	1934
October	19.0	66.2	2.7	36.9	10.9	51.6	32	90	1937	−10	14	1935
November	10.4	50.8	−4.4	24.1	3.1	37.5	21	[illegible]	1934	−22	−7	1931
December	5.3	41.6	−7.4	18.6	1.1	30.1	16	61	1949	−24	−11	1935
Annual	17.7	63.8	1.9	35.5	9.8	49.7	39	103	July 1931	−31	−23	February 1933

[a] Period of record: 1931–1960 (30 years).

Source: Plateau Resources, Limited, *Application for Source Material License*, Table 2.2-1, p. 2-6, Apr. 3, 1978.

2.1.2 Precipitation

Precipitation in the vicinity of the Plateau Resources Ore Buying Station (OBS) is light (Table 2.2). Normal annual precipitation is about 30 cm (12 in.). Most precipitation in the area is rainfall, with about 25% of the annual total in the form of snowfall.

Table 2.2. Precipitation means and extremes at Blanding, Utah[a]

Month	Total						Year
	Mean monthly		Maximum monthly		Greatest daily		
	cm	in.	cm	in.	cm	in.	
January	3.04	1.20	10.31	4.06	2.64	1.04	1952
February	2.95	1.16	4.39	1.73	2.62	1.03	1937
March	2.38	0.94	5.00	1.97	2.54	1.00	1937
April	2.18	0.86	5.41	2.13	2.69	1.06	1957
May	1.63	0.64	5.11	2.01	2.39	0.94	1947
June	1.39	0.55	5.51	2.17	3.56	1.40	1938
July	2.13	0.84	7.79	3.07	3.35	1.32	1930
August	3.02	1.19	12.59	4.96	5.03	1.98	1951
September	3.02	1.19	9.60	3.78	3.07	1.21	1933
October	3.51	1.38	16.79	6.61	3.94	1.55	1940
November	1.88	0.74	5.21	2.05	2.41	0.95	1946
December	3.20	1.26	9.29	3.66	3.56	1.40	1931
Annual	30.35	11.95	97.03	38.20	5.08	2.00	Oct. 1928

[a] Period of record: 1931–1960 (30 years).

Source: Plateau Resources, Limited, *Application for Source Material License*, Table 2.2-2, p. 2-8, Apr. 3, 1978.

There are two separate rainfall seasons in the region. The first occurs in late summer and early autumn when moisture-laden air masses occasionally move in from the Gulf of Mexico, resulting in showers and thunderstorms. The second rainfall period occurs during the winter when Pacific storms frequent the region.

2.1.3 Winds

Wind speeds are generally light to moderate at the OBS during all seasons, with occasional strong winds during late winter and spring frontal activity and during thunderstorms in the summer. Southerly wind directions are reported to prevail throughout the year. Summaries of wind direction and wind speed distributions are given in Tables A.1 and A.2 of Appendix A.

2.1.4 Storms

Thunderstorms are frequent during the summer and early fall when moist air moves into the area from the Gulf of Mexico. Related precipitation is usually light, but a heavy local storm can produce over an inch of rain in one day. The maximum precipitation reported to have fallen within 24 hr over a 30-year period at Blanding was 5.02 cm (1.98 in.). Hailstorms are unusual in this area. Although winter storms may occasionally deposit comparable amounts of moisture, maximum short-term precipitation is usually associated with summer thunderstorms.

Tornadoes have been observed in the general region, but they occur infrequently (see Sect. 5.1). Strong winds can occur in the OBS area along with thunderstorm activity in the spring and summer. The OBS site is susceptible to occasional duststorms, which vary greatly in intensity, duration, and time of occurrence. The basic conditions for blowing dust in the region are created by wide areas of exposed dry topsoil and strong, turbulent winds. Duststorms usually occur following frontal passages during the warmer months and are occasionally associated with thunderstorm activities.

2.2 AIR QUALITY

The OBS is located in the Four Corners Interstate Air Quality Control Region (No. 14), which encompasses parts of Colorado, New Mexico, Arizona, and Utah. This region has been designated recently as an attainment area for suspended particulate matter, sulfur dioxide, nitrogen dioxide, carbon monoxide, and hydrocarbons, indicating that existing levels of these pollutants are within Federal air quality standards. Because of a lack of adequate monitoring data, the region has been designated as unclassifiable for photochemical oxidants.

There are no major urban or industrial air pollutant sources presently operating in the vicinity of the OBS, and air quality in this area is generally good. However, few air quality monitoring data are available to document actual conditions. The nearest monitoring station operated by the Utah Bureau of Air Quality is located approximately 109 km (68 miles) to the west-southwest at Bullfrog Basin Marina near Lake Powell. Only suspended particulate matter and sulfur dioxide concentrations are measured at this station (Table 2.3). These pollutants are considered to be low relative to Federal and State of Utah air quality standards (Table 2.4). Except for the short-term (24-hr) particulate standard, all reported values were well below Utah maximum acceptable concentrations. The 24-hr violations may have been due to blowing dust associated with conditions of high winds. T2.3 T2.4

Table 2.3. Suspended particulate matter concentrations at Bullfrog Basin Marina

Year	Annual geometric Mean ($\mu g/m^3$)	24-hr concentrations ($\mu g/m^3$)	
		Highest	Second highest
1971	11	529[a]	112[a]
1972	21	600[a]	244[a]
1973[b]			
1974[b]			
1975[c]	14	183	151
1976	15	120	115
1977[d]	20	258	176

[a] Before June 1975, the high-volume air sampler was positioned near ground level [about 0.9 m (3 ft) above the ground]. In June 1975 the sampler was moved to a position about 3 to 4 m (10 to 12 ft) above the ground, as is recommended by the U.S. Environmental Protection Agency. Although indicative of normally higher maximum concentrations nearer ground level, 24-hr maximum concentrations reported for 1971 and 1972 are not directly comparable to Federal air quality standards.

[b] Data collection during 1973 and 1974 was inadequate to allow summary.

[c] Data for 1975 are based on the period from July through December.

[d] Data for 1977 are based on the period from January through September.

Source: Thomas O. Baily, Woodward-Clyde Consultants, Responses to NRC Questions, Sept. 13, 1978.

POOR ORIGINAL

Suspended particulate matter, the major pollutant from the OBS, has been monitored at the site by the applicant since late July 1977. Measured concentrations range from 13 to 132 $\mu g/m^3$, and the geometric mean concentration for the 16 samples reported is 32 $\mu g/m^3$. Although this measurement is well below the 60 $\mu g/m^3$ secondary air quality standard (Table 2.4), the actual geometric mean concentration of total suspended particulates may be higher than 32 $\mu g/m^3$ because the monitoring station is located near the property fence east of the OBS whereas southerly wind directions are reported to prevail throughout the year. Therefore, the staff has required a monitoring program to detect unacceptably high concentrations of particulates (Sect. 6.1).

928 106

Table 2.4. Federal and State of Utah ambient air quality standards

Pollutant	Description	Pollutant standard	
		Primary	Secondary
Total suspended particulates	Solid and liquid particles in atmosphere, including dust, smoke, mists, fumes, and spray	75 $\mu g/m^3$, annual geometric mean; 260 $\mu g/m$, maximum 24-hr average	60 $\mu g/m^3$, annual geometric mean; 150 $\mu g/m^3$, maximum 24-hr average
Sulfur dioxide	Heavy, pungent, colorless gas formed from combustion of coal, oil, and other sources	80 $\mu g/m^3$ (0.03 ppm), annual arithmetic mean; 365 $\mu g/m^3$ (0.14 ppm), maximum 24-hr average	1300 $\mu g/m^3$ (0.5 ppm), maximum 3-hr average
Carbon monoxide	Invisible, odorless gas formed from combustion of gasoline, coal, and other fuels; largest man-made fraction comes from automobiles	10 $\mu g/m^3$ (9 ppm), maximum 8-hr average; 40 mg/m^3 (35 ppm), maximum 1-hr average	Same as primary
Photochemical oxidants (such as ozone)	Pungent, colorless toxic gases; ozone is one component of photochemical smog	160 mg/m^3 (0.08 ppm), maximum 1-hr average	Same as primary
Nitrogen dioxide	Brown toxic gas formed from fuel combustion. Under certain conditions, it may be associated with ozone production.	100 $\mu g/m$ (0.05 ppm), annual arithmetic mean	Same as primary
Hydrocarbons corrected for methane	Known to react with nitrogen oxides to form photochemical oxidants	160 $\mu g/m^3$ (0.24 ppm), 3-hr average from 6 a.m. to 9 p.m.	Same as primary

Source: Plateau Resources, Limited, *Application for Source Material License*, Table 6.1-17, p. 6-54, Apr. 3, 1978.

Another uranium ore buying station, approximately 5.6 km (3.5 miles) south of the OBS, has been operated by Energy Fuels Nuclear, Inc., since May 1977. Preliminary monitoring data at this site agree fairly well with the longer term Bullfrog Basin Marina data.

2.3 TOPOGRAPHY

The site is located on a "peninsula" platform tilted slightly to the south-southeast and surrounded on almost all sides by deep canyons, washes, or river valleys. Only a narrow neck of land connects this platform with high country to the north, forming the foothills of the Abajo Mountains. Even along this neck, relatively deepstream courses intercept overland flow from the higher country. Consequently, this platform (White Mesa) is well protected from runoff flooding, except for that caused by incident rainfall directly on the mesa itself. The land immediately surrounding the OBS site is relatively flat.

2.4 DEMOGRAPHY AND SOCIOECONOMIC PROFILE

2.4.1 Demography of the area

2.4.1.1 Current population and distribution

Compared to most eastern states, Utah is sparsely populated having a 1977 population of 1,271,300 — a 20% increase since 1970. This population represents an overall density of 39.9 persons per square kilometer (15.4 persons per square mile), but nearly 70% of Utah's population lives in the counties of Salt Lake, Utah, and Weber where Salt Lake City, Provo, and Ogden, respectively, are located. San Juan County, where the Plateau Resources OBS is located, has a population of 13,000 — an increase of 35.3% since 1970 — and a density of 4 persons per square kilometer (1.6 persons per square mile).

The closest city to the OBS site is Blanding, and its 1977 population was 3075, up 37% from 1970. Monticello, the county seat, is 56 km (30 miles) north of the site and has 2208 residents, 54% more than in 1970. Between them, these two communities account for nearly 40% of San Juan County's population. Another 46% of the total is made up of Navajo Indians living on or near the Navajo Reservation in southern San Juan County.

2.4.1.2 Projected population and distribution

According to projections prepared by the Utah Agricultural Experiment Station (Table 2.5), Utah's population is expected to rise steadily between now and the year 2000. Both high and low projections assume a gradual decline in mortality and constant fertility. The difference between these projections is that the high figures also assume a positive net migration while the low figures are based on no net migration at all.

Table 2.5. Population projections[a], San Juan, Wayne, and Garfield counties, compared to the State

	1975[b]	1980	1990	2000	Percent increase (1975–2000)
Utah					
High	1,216,843	1,420,553	1,803,985	2,163,927	78
Low	1,206,584	1,302,815	1,484,231	1,655,528	37
San Juan County					
High	12,816	17,373	26,002	33,300	160
Low	12,716	13,954	16,917	19,753	55
Wayne County					
High	1,960	2,660	3,770	4,530	131.1
Low	1,950	2,060	2,310	2,510	28.7
Garfield County					
High	3,480	3,940	4,670	5,960	71.3
Low	3,470	3,760	4,460	5,120	47.6

[a] High projections assume a gradual decline in mortality, constant fertility, and positive net migration. Low projections assume a gradual decline in mortality, constant fertility, and no net migration.

[b] U.S. Census estimation for 1975 indicates that actual population for the State and all three counties was below the "low" projection presented in this table.

Source: *Environmental Report: White Mesa Uranium Project*, adapted from Table 2.2-22, p. 2-62, Jan. 30, 1978.

Utah total population is expected to be somewhere between 1,655,528 and 2,163,927 in the year 2000. These figures represent increases of 37 to 78% respectively from 1975. Utah's actual population in 1975 was approximately 3500 less than the low projection presented in Table 2.5, but the 1977 figure of 1,271,300 falls between both sets of 1975 and 1980 projections (Table 2.5).

Projections for San Juan County indicate a much greater growth rate than for the State as a whole. The high figure, 33,000 in the year 2000, represents a 160% increase from 1975. As with the State, San Juan County's actual 1975 population was less than the low projection given by the Agricultural Experiment Station (Table 2.5).

According to the city manager of Blanding, a population increase of almost 1500 is expected within the next three years, bringing the number of city residents to 4540 by 1981 (Bud Nielson, City Manager of Blanding, Utah, personal communication to Martin Schweitzer, Oak Ridge National Laboratory, July 10, 1978). This estimate represents an increase of 47.6% over the 1977 population and is based on the assumption that the proposed White Mesa uranium mill will be built and will act as a stimulus to rapid growth. Monticello's city manager is also predicting growth, but at a lesser rate than for Blanding. Between now and 1983, an increase of approximately 600 (or 27%) is expected (Richard Terry, City Manager of Monticello, Utah, personal communication to Martin Schweitzer, Oak Ridge National Laboratory, July 30, 1978).

The Blanding airport, north of the OBS site, has plans to expand its existing runway and storage areas by summer of 1979. An increase in flights to and from the facility may accompany these improvements (John Hunt, Manager of Blanding City Airport, personal communication to Martin Schweitzer, Oak Ridge National Laboratory, Aug. 2, 1978).

2.4.1.3 Transient population

Although the permanent population in southeastern Utah is relatively low, this area receives a substantial number of tourists each year (Table 2.6). Capital Reef National Park alone had nearly 0.5 million visitors in 1976. The exact numbers fluctuate from year to year, but the overall trend appears to be toward increasing visitation.

Table 2.6. Visitor statistics, recreation areas in southeastern Utah[a]

Area	Visitors (thousands)					
	1972	1973	1974	1975	1976	1977 (January–September)
Glen Canyon National Recreation Area	60.8					
Canyonlands National Park	60.8	62.6	59.0	71.8	80.0	67.3
Manti-La Sal National Forest (visitor days)[b]	105.3	100.9	88.7	76.4		NA[c]
Capital Reef National Park	272.0	311.2	234.0	292.1	469.6	364.2 (through August)
Hovenweep National Monument[d]	12.1	12.0	11.0	13.2	19.4	16.2
Natural Bridges National Monument	58.5	42.7	40.3	48.4	71.9	67.1

[a] Data refer to actual visitations for each area except Manti-La Sal National Forest. Here, data indicate recreation visitor days. A visitor day is the equivalent of one person entering an area for 12 hr.

[b] Data refer to the Monticello Ranger District only.

[c] Indicates data not available.

[d] Data refer to the Square Tower Ruin Unit, near Blanding.

Source: *Environmental Report: White Mesa Uranium Project*, Table 2.2-5, p. 2-20, Jan. 30, 1978.

2.4.2 Socioeconomic profiles

2.4.2.1 Social profile

Housing

Blanding: In recent years, the supply of housing in Blanding has been increasing. From 1972 to 1975, approximately 12 new units were added each year, but in 1976 that figure rose to 37.[1,2] In 1977, 43 new dwelling units were added, and this accelerated rate of construction appears to be continuing (Bud Nielson, City Manager of Blanding, Utah, personal communication to Martin Schweitzer, Oak Ridge National Laboratory, July 10, 1978). Mobile homes in this area are often found on individual lots in single-family neighborhoods as well as in actual mobile home parks.

At present, the demand for new housing is keeping up with the number of residences available, and the vacancy rate is very low. Although obtaining financing for new construction has been a problem to date, there are approximately 200 lots available for single-family houses in Blanding to accommodate future growth. There are also around 25 current vacancies in a local mobile home park (White Mesa ER, p. 4-18). The supply of rental units in Blanding, as in many small cities, is low (White Mesa ER, p. 2-50 Docket No. 40-8671).

Monticello: The supply of housing in Monticello five years ago had been increasing at approximately six units per year.[3,4] In 1977 this figure jumped to around 60 units per year, and between 60 and 80 new units are expected to be constructed in 1978. The demand for housing has not yet exceeded the supply, and thus no surplus in single-family housing has developed (Richard Terry, City Manager of Monticello, Utah, private communication to Martin Schweitzer, Oak Ridge

6

National Laboratory, July 20, 1978). An expected annexation will double the size of the city and provide room for at least 150 more single-family homes. Approximately 35 vacancies now exist in local mobile home parks (White Mesa ER, p. 4-18).

As in Blanding, rental housing is scarce. A 23-unit apartment building is currently being constructed in town to accommodate some of the demand of this kind of housing (Richard Terry, City Manager of Monticello, Utah, private communication to Martin Schweitzer, Oak Ridge National Laboratory, July 20, 1978).

Public services

Blanding: The city of Blanding provides several public services. Water is obtained from surface runoff and underground wells, and a 0.11-m^3/sec (1800-gpm) sewage treatment plant is operated by the city. Consumption in 1976 averaged 0.24 m^3/sec (547,000 gpd). The current system is adequate to handle moderate population increases, and improvements are being planned to handle the influx of new residents expected by 1981 (Bud Nielson, City Manager of Blanding, Utah, personal communication to Martin Schweitzer, Oak Ridge National Laboratory, July 20, 1978).

Sewage treatment is provided through a lagoon system, and improvements are planned for the near future. Electricity is provided through a city-owned distribution system; the city also provides solid waste collection and disposal. Propane gas is available through two private distributors, but there is no natural gas service (White Mesa ER, p. 2-47). Local streets are maintained jointly by the city and the county (Marian Bayles, Treasurer of San Juan County, Utah, private communication to Martin Schweitzer, Oak Ridge National Laboratory, July 25, 1978).

Blanding has a full-time police force of three officers and an auxiliary force of eight, and a volunteer fire department provides fire protection. Health care is available through the 36-bed San Juan County Hospital in Monticello, a 31-bed nursing home in Blanding, and two local doctors, one public health nurse, and one dentist. There is also a mental health clinic in town with one full-time therapist.

Two elementary schools and one high school serve Blanding. The combined capacity of the elementary schools is 750 students, with 630 currently enrolled. With 874 students, however, the high school has 174 students over planned capacity. The opening of two new schools in the region is scheduled for the near future, which should ease the current overcrowding (White Mesa ER, p. 2-48).

In terms of recreation, Blanding has four public parks and access to both the San Juan County Library and the several national parks, forests, monuments, and recreation areas listed in Table 2.6. The San Juan County Library is located just north of Blanding (Marian Bayles, Treasurer of San Juan County, Utah, private communication to Martin Schweitzer, Oak Ridge National Laboratory, July 25, 1978).

Monticello: Water is supplied by surface runoff and groundwater, and, as in Blanding, there is a city-operated water treatment plant. Improvements to the water supply system are being undertaken to raise its overall capacity (Richard Terry, City Manager of Monticello, Utah, private communication to Martin Schweitzer, Oak Ridge National Laboratory, July 20, 1978). Primary and secondary sewage treatment is provided by a local digestor plant, and future improvements are planned here as well (White Mesa ER, p. 2-51Docket No. 40-8671).

The city of Monticello distributes electricity supplied by Utah Power and Light to city residents. The transmission system is now at capacity, but Monticello's city manager has said that the city is currently considering ways to expand its service area. Natural gas is available through the Utah Gas Service. Monticello currently operates a waste disposal service, and street maintenance is a joint responsibility of city and county. Police and fire protection is provided by the three full-time police employees and one part-time police employee. They are aided by the County Sheriff's Department and a volunteer fire department with three trucks (White Mesa ER, pp. 2-53 and 2-54).

The San Juan County Hospital (mentioned earlier) is in Monticello as well as a small mental health clinic with one therapist and one outreach worker. There is also a public health nurse in town.

7

There are an elementary school and a high school in town, both of which are currently operating at about two-thirds of their peak capacity. The elementary school, which can handle 550 students, now has 365 enrolled. The high school, designed for 500, serves 370 students.

Recreational facilities consist of a city park, a public golf course, and the national areas listed in Table 2.6.

Culture

Religion is a strong influence in southeastern Utah. The predominant Church of Jesus Christ of Latter Day Saints stresses within its beliefs the values of family life, education, and marriage and provides a focus for community life. A large Navajo Indian population in this part of the State, largely concentrated in southern San Juan County, has its own cultural heritage. As shown in Table 2.7, almost half of the county's residents are nonwhite, and most of these are Navajos. The neighboring counties of Garfield and Wayne, however, are almost entirely white.

Table 2.7. Selected demographic characteristics, San Juan County, compared to Utah (1970)

	San Juan County	Wayne County	Garfield County	Utah
Total population	9,606	1,638	3,157	1,059,273
Race				
White	5,153	1,630	3,157	1,033,880
Other (%)	46.4	0.5	0	2.4
Education				
Median school years completed (population 25 years and over)	10.7	12.1	12.2	12.5
Percent of population with less than 5 years	27.0	1.2	0.3	2.0
Percent of population with 4 years of college or more	8.8	8.9	8.7	14.0
Age				
Median age	18.0	27.3	26.4	23.0
Percent under 5 years	13.9	7.4	8.2	10.6
Percent 5–17	36.0	35.4	32.6	29.6
Percent 18–64	45.6	49.3	49.4	52.5
Percent 65+	4.5	7.9	9.8	7.3

Source: *Environmental Report: White Mesa Uranium Project*, Tables 2.2-4 and 2.2-21, pp. 2-19 and 2-61, Jan. 30, 1978.

Table 2.7 also compares the age and educational attainment of the three counties and the State as a whole. From this comparison, it can be seen that San Juan County residents, on the average, are younger and have completed fewer years of school than their counterparts. Although only 4.5% of San Juan County residents are 65 and over, almost 20% of Bluff's inhabitants fall into this category (White Mesa ER, p. 2-55), marking the town as a retirement community.

The communities in the vicinity of the proposed mill are distinguished by a wide variety of policies concerning alcoholic beverages. Although liquor is served in several Monticello clubs and restaurants, Bluff allows only beer, and Blanding is completely "dry."

2.4.2.2 Economic profile

Between 1970 and April 1978, the number of nonagricultural payroll jobs in San Juan County increased by over 1000 — from 1786 to 2952 (Table 2.8). The relative importance of the various economic sectors also shifted in that period. Services stayed nearly the same; the relative

8

928 111

Table 2.8. Nonagricultural payroll jobs in San Juan County

	1970 average	Percentage of total	1974 average	Percentage of total	April 1977	Percentage of total	April 1978	Percentage of total	Change in percentage April 1977–April 1978
Nonagricultural payroll jobs	1786	100.0	2364	100.0	2820	100.0	2952	100.0	4.7
Manufacturing	143	8.0	199	8.4	185	6.6	197	6.7	6.5
Mining	381	21.3	681	28.8	890	31.5	936	31.7	5.1
Construction	114	6.4	98	4.2	142	5.0	155	5.2	9.2
Transportation, commerce, utilities	110	6.2	128	5.4	157	5.6	168	5.7	7.0
Trade	278	15.6	314	13.3	400	14.2	424	14.4	6.0
Finance, insurance, real estate	1	0.1	0 (est.)	0	25	0.9	27	0.9	8.0
Services	193	10.8	236	10.0	303	10.7	322	10.9	6.3
Government	565	31.6	708	29.9	718	25.5	724	24.5	0.8

Source: Utah Department of Employment Security, Research and Analysis Section, adapted from *Quarterly Employment Newsletter of Southeastern District of Utah*, First Quarter 1978.

928 112

importance of trade, transportation, construction, and manufacturing declined slightly, and the significance of finance, insurance, and real estate rose a little. The importance of mining and government changed dramatically, however. Total employment in government services declined from 31.6 to 24.5%, while mining climbed from 21.3 to 31.7% of the whole.

Because total employment increased so greatly, the absolute number of jobs rose in all categories. The largest jump by far, however, was in mining, which shifted from 381 jobs in 1970 to 935 in April 1978.

The above figures prove that mineral extraction is extremely important to San Juan County, and uranium production is a very substantial component of this sector. In fact, San Juan County is the largest producer of uranium in Utah, and this activity has increased dramatically since 1975 (Larry Trimble, Utah Geological and Mineral Survey, private communication to Martin Schweitzer, July 17, 1978). Natural gas and crude oil are the other important resources being produced here (White Mesa ER, p. 2-32).

Tourism is also an important part of San Juan County's economy, a part that has been increasing steadily in recent years. Between 1975 and 1977, tourist room sales increased by 32.5%.

Between 1973 and 1977, per capita income for the State of Utah rose by 44%, from $4100 to $5900. Increases in per capita income for San Juan County did not meet the standards of raises elsewhere. Income in 1973 was $2400, 58.5% of the State average, while 1977 income was $3400, or 57.6% of the State figure.

The number of retail and wholesale establishments and their sales are shown in Table 2.9 for San Juan County and the cities of Blanding and Monticello. Since 1967, county wholesale and retail sales have both nearly tripled.[5] Retail sales are almost evenly divided between Blanding and Monticello, together accounting for 94.3% of the county's retail activity.

T2.9

Table 2.9. Retail and wholesale activity in San Juan County, Blanding, and Monticello (1976)

	San Juan County	Blanding	Monticello
Number of retail establishments	101	35	40
Retail sales	$15,300,000	$7,150,000	$7,280,000
Number of wholesale establishments	9	3	3
Wholesale sales	$ 5,600,000	NA[a]	NA

[a] NA: Information is not available.

Source: Utah Industrial Development Information System, *Economic Facts for San Juan County, Blanding, and Monticello*, 1977.

In 1977, San Juan County levied an ad valorem tax of 16 mills on the assessed value of all property in the county for the general fund. An additional 40 mills was collected for the county school district and a final 2 mills for the countywide water conservation district. The communities of Monticello, Blanding, and Bluff also levied an extra 15, 21, and 10 mills, respectively, on the assessed value of all property within their corporate limits. Finally, the Monticello and Blanding Cemetery Districts each collected 2 mills on all property within those district boundaries. Mines and mills are subject to the above taxes as is all other real property. The total amount collected from all these funds combined was $5,126,748 (Marian Bayles, Treasurer of San Juan County, Utah, personal communication to Martin Schweitzer, Oak Ridge National Laboratory, July 25, 1978), two-thirds of which went to the County School District.

In addition to the property tax, San Juan County also received $87,496 in sales taxes. Blanding and Monticello received $43,337 and $65,155, respectively, from property taxes.

9
2661

San Juan County handles its financial affairs through a number of separate funds, the largest of which is the general fund. Within this fund, the property tax comprises the single largest source of revenue, accounting for slightly over 33% of the 1977 total. Shared revenues from the State of Utah contributed another 20.1%, and Federal shared revenues and in-lieu-of-tax payments added another 15.3%.

The largest expenditure for San Juan County in 1977 was for road maintenance, amounting to slightly over one-half of total county funds. Other large outlays were 11.2% for health services and 6.4% for the Sheriff's Department.

The fiscal year ending in June 1977 recorded the largest source of revenue for the City of Blanding's general fund as being the sale of a general obligation electric-, water-, and sewer-improvement bond issue, yielding $225,000. This source was followed by slightly over $55,000 from sales and use taxes and a little more than $44,000 from property taxes. Federal revenue sharing and waste collection and disposal fees were the other major sources of funds, each contributing about $18,000 to the total. Utility operations were financed through a separate fund.

Blanding's major expenditures in the same year were for public utility capital improvements and police expenses, each of which cost less than $50,000. Street maintenance cost about half this amount, and waste collection and airport funds made up the last of the major expenditures.

As in Blanding, Monticello has a separate fund for operating public utilities. In 1976, $150,000 from the sale of revenue bonds was expended for improvement of the local water system (Richard Terry, City Manager of Blanding, Utah, private communication concerning Monticello City Audit, 1977, to Martin Schweitzer, Oak Ridge National Laboratory, July 30, 1978). Slightly over half of the city's nearly $119,000 in general fund revenues for the fiscal year ending June 1977 came from sales and use taxes, while property taxes contributed another 30%. Unlike the county, both Monticello and Blanding receive more of their general funds from sales taxes than from property taxes. The largest expenditure in 1977 was the $40,000 spent on police protection. This figure was followed by the $16,000 spent for administrative purposes.

2.4.2.3 Transportation

A system of two-lane paved highways and unimproved roads accounts for virtually all transport of people and products in and out of San Juan County. Although Blanding, Bluff, Monticello, and Canyonlands National Park have small municipal airports, there is no rail, bus, or commercial air service here (White Mesa ER, p. 2-30 Docket No. 40-8671).

U.S. Route 163 receives a greater amount of traffic than any other road in the county. This highway runs between I-70 on the north [approximately 161 km (100 miles) from the proposed mill] and U.S. Route 160 in Arizona to the south; the highway passes through Monticello, Blanding, and Bluff. The heaviest traffic in the county is on this artery just north of Monticello, where the average daily vehicles were about 2685 in 1975. More recent figures indicate a 43% increase in traffic in this area between 1975 and 1977 (White Mesa ER, p. 2-30).

Traffic volumes on Utah Route 95 from the Blanding area to Hanksville are much lighter but have been increasing in recent years. From 1975 to 1977, an increase of 33% was observed on Highway 95 south of Hanksville (White Mesa ER, p. 2-30 Docket No. 40-8671). U.S. Route 666 from Monticello to Cortez, Colorado, also carries a significant amount of traffic.[6] All of the roads in this area carry a substantial amount of out-of-state traffic.

2.5 LAND USE

2.5.1 Land resources

Southeastern Utah is known as the Canyonlands area; an arid climate and rugged terrain have limited permanent settlement of this region. Large rock formations and narrow canyons are characteristic of the area, and these, combined with the Indian ruins found here, are increasingly attracting tourists. However, much of this area is very isolated, and the population density is extremely low (Sect. 2.4.1.1).

2.5.1.1 Land ownership

Nearly 1.2 x 10^6 ha (3 x 10^6 acres), comprising almost 60% of all land in San Juan County, is federally owned. Approximately two-thirds of this land is administered by the U.S. Bureau of Land Management for multiple uses, such as mineral extraction, timber production, and wildlife management. Another one-fifth of the Federal land is managed by the National Park Service, and slightly less than one-sixth is under the control of the U.S. Forest Service (White Mesa ER, p. 2-25). Designated areas are Glen Canyon National Recreation Area, Canyonlands National Park, and Natural Bridges National Monument.

Approximately 0.5 x 10^6 ha (1.25 x 10^6 acres) in San Juan County, 25% of the total area, is Indian land. Nearly all of this territory is part of the Navajo Indian Reservation, but a small portion belongs to the Ute Mountain tribe. The State owns 6.5% of San Juan County, leaving only 8.3% in private hands.

Because of the arid nature of this area, the primary agricultural use of the non-Federal property is rangeland. Less than 10% of the non-Federal sector is cropland. Dry farming prevails in San Juan County. This county also has more non-Federal land in forests than do other local counties and less land devoted to urban and transportation uses.

The land near the OBS is primarily agricultural — used for grazing and some farming. In addition to the uranium ore buying station currently operated near the site by Energy Fuels Nuclear, Inc., nonagricultural land uses in the area include the Blanding airport, a small commercial establishment, a part of the Ute Mountain Indian community of White Mesa, and several structures connected with the U.S. Army's Blanding Launch Site.

2.5.1.2 OBS ownership

The surface area of the project site is currently owned by Plateau Resources, Limited.

2.5.1.3 Farmlands

The Federal government owns approximately 85% of the land in San Juan County (Application for Source Material License ER, Table 6.1-2). The majority of this land is administered by the U.S. Bureau of Land Management. The land, classified as multiple-use, is leased for grazing, oil and gas exploration, and mining claims, and is also managed for wildlife and recreation. About 40% of this land is used for grazing. Range condition of these lands is considered to be poor.

Private and State land in the county (approximately 8 and 6% respectively) is devoted almost exclusively to agriculture. Aridity has a pronounced effect on agricultural land uses. The growing seasons are extremely variable in this region, and annual average evaporation rates are more than five times the annual average precipitation.[7] As a result, grazing is the predominant land use in the county; dry farming does produce some crops, primarily pinto beans. The rugged terrain, characteristic of the region, also limits agricultural croplands.

2.5.1.4 Urban areas

The communities of Blanding and Monticello are within 48 km (30 miles) of the OBS site and have been discussed in detail in Sects. 2.4.1.1, 2.4.1.2, and 2.4.2.1. These communities have a number of regulations governing land use, including zoning, subdivision regulations, and building codes (Bud Nielson, City Manager of Blanding, Utah, and Richard Terry, City Manager of Monticello, Utah, personal communications to Martin Schweitzer, Oak Ridge National Laboratory, July 10, 1978, and July 20, 1978, respectively).

2.5.2 Historical and archaeological resources

There are no cultural sites on or adjacent to the OBS that are included in or are being considered for inclusion in the *National Register of Historic Places*. Many archaeological remnants of Indian culture exist in the area. If the applicant proposes expanding OBS operations, an archaeological survey will be required in the area of expansion. If artifacts are found, they will be salvaged. This same procedure will be followed during decommissioning.

2.6 WATER

2.6.1 Surface water

2.6.1.1 Surface-water description

The OBS is located on White Mesa, a gently sloping plateau that is physically defined by the adjacent drainages which have cut deeply into regional sandstone formations. Runoff from the mesa is conducted by the general surface topography to either Westwater Creek, Corral Creek, or Cottonwood Wash. The OBS itself is located on a section of White Mesa that slopes gently to the south-southeast. Runoff from the OBS follows this slope and flows into Corral Creek, which joins Recapture Creek and flows into the San Juan River approximately 34 km (21 miles) to the south. The San Juan River flows westward and is a major tributary of the Colorado River. The Corral Creek drainage basin and the major streams in the vicinity of the OBS are illustrated in Fig. 2.1. Table 2.10 shows the drainage areas in the OBS region.

The Cottonwood Wash watershed drains 860 km^2 (332 sq miles), and its headwaters are in the Manti-La Sal National Forest. Its overall basin slope averages 3%. From October 1964 to the present period of record, the average annual runoff (total stream yield per watershed area) from the 531-km^2 (205-sq miles) Cottonwood Wash basin was 14 mm (0.57 in.), measured at United States Geological Survey (USGS) gage No. 0937870. A maximum 48-mm (1.87-in.) runoff yield was recorded for the period October 1972 through September 1973 and a minimum yield of 3 mm (0.13 in.) for the period October 1970 through September 1971 (White Mesa ER, p. 2-137).

The Recapture Creek watershed drains 518 km^2 (200 sq miles) and has its headwaters in the Abajo Mountains. Its overall slope averages a little over 3%. From October 1965 to the present period of record, the average annual runoff yield for the Recapture Creek basin was 99 mm (3.9 in.), measured at USGS gage No. 09378630 [9.9-km^2 (3.8-sq mile) drainage area]. A maximum runoff yield of 411 mm (16.2 in.) was recorded between October 1972 and October 1973 and a minimum runoff of 13 mm (0.5 in.) between October 1970 and October 1971 (White Mesa ER, p. 2-137 Docket No. 40-8671).

Except for a small portion of Westwater Creek northwest and upgradient of the OBS, all the streams in the vicinity are intermittently active, responding to spring snowmelt and local precipitation. Local porous soil conditions, topography, and low average annual rainfall [30 cm (11.8 in.)] cause this intermittent activity (White Mesa ER, p. 2-168). The perennial section of Westwater Creek begins near the road running west of Blanding to a point about 2.5 km (1.5 miles) northwest of the OBS. Water for this section probably stems from seepage from a nearby irrigation canal (Johnson Creek Canal), irrigation discharge, and aquifer recharge.

Storm runoff in these ephemeral streams is characterized by a rapid rise in the flow rates, followed by rapid recession that is primarily due to the small storage capacity of the surface soils in the area (Sect. 2.8). For example, on August 1, 1968, a flow of 581 m^3/sec (20,500 cfs) was recorded in Cottonwood Wash near Blanding. The average flow for that day, however, was only 123 m^3/sec (4340 cfs). By August 4, the flow had returned to 0.5 m^3/sec, or 16 cfs (White Mesa ER, p. 2-135). Drainage areas in the project vicinity are summarized in Table 2.10. Flow data are not available for the two smaller watercourses closest to the project site (Corral Creek and Westwater Creek) because these streambeds carry water infrequently and only in response to local heavy rainfall. These streams carry water for approximately two to three months a year (White Mesa OBS ER Docket No. 40-8675; applicant responses).

Many farm ponds are located both north and south of Blanding. The water in these ponds is maintained through a combination of rainfall, snowmelt, and intermittent supply (through canals) from Johnson and Recapture creeks and by groundwater pumping.

Two springs are located approximately 1.6 km (1 mile) south-southeast of the OBS and flow into upper Corral Creek. One of these springs has been dammed and forms a small irrigation pond that is downgradient of the OBS.

POOR ORIGINAL

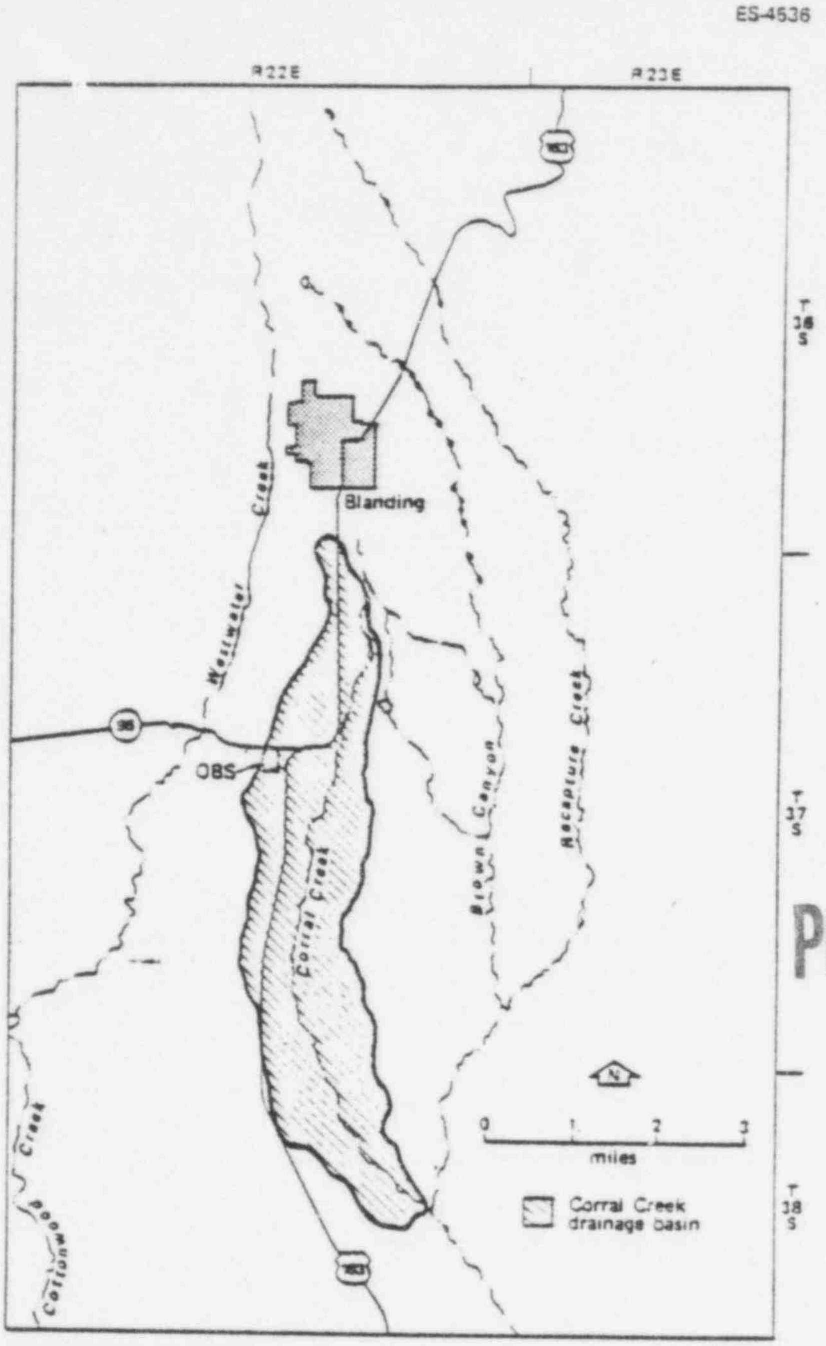


Fig. 2.1. Streams in the vicinity of the OBS. Source: Plateau Resources, Limited, *Application for Source Material License*, Docket No. 40-8674, Apr. 3, 1978, Plate 2.3-1.

2.6.1.2 Surface-water quality

The occurrence of perennial surface water in the vicinity of the OBS is extremely limited. Water quality data available for surface water in the general area of the OBS and for the San Juan River are given in Tables 2.11, 2.12, and 2.13. These water samples, although obtained from an area approximately 14 km (8.8 miles) to the west of the OBS, are similar in their characteristics to samples obtained in Westwater Creek, Cottonwood Wash, and Corral Creek (White Mesa ER, p. 2-158 Docket No. 40-8675).

Table 2.10. Drainage areas of project vicinity and region

Basin description	Drainage area	
	km^2	sq miles
Corral Creek at confluence with Recapture Creek	15.0	5.8
Westwater Creek at confluence with Cottonwood Wash	68.8	26.6
Cottonwood Wash at USGS gage west of project site	≤531	≤205
Cottonwood Wash at confluence with San Juan River	≤860	≤332
Recapture Creek at USGS gage	9.8	3.8
Recapture Creek at confluence with San Juan River	≤518	≤200
San Juan River at USGS gage downstream of Bluff, Utah	≤60,000	≤23,000

Source: *Environmental Report: White Mesa Uranium Project,* Table 2.6-3, p. 2-136, Jan. 30, 1978.

Table 2.11. Surface water quality at Station 11 on the San Juan River

The period of record (often discontinuous) for the data is 1968–75.

Parameter[a]	San Juan River		
	Minimum	Mean	Maximum
Major constituents			
pH, standard units	7.4	8.2	9.1
Specific conductance, micromhos/cm	285	671	1300
Calcium	45	95	120
Magnesium	5	22	105
Sodium	19	51	110
Bicarbonate		251[b]	
Sulfate	95	202	419
Chloride	8	16	35
Minor constituents			
Iron	0	0.24	1.00
Total suspended solids			
Total dissolved solids	215	518	1075
Phosphate[c]	0	0.17	0.80
Nitrate[d]	0	0.75	1.80
Fluoride	0.20	0.49	1.10
Boron	0	0.70	0.26
Alkalinity			
Potassium			

[a] All measurements are given in milligrams per liter unless otherwise noted.

[b] Estimated from mean cation-aniun balance.

[c] Given as milligrams of phosphorus per liter.

[d] Given as milligrams of nitrogen per liter.

Source: Plateau Resources, Limited, *Application for Source Material License,* Table 6.1-13, p. 6-45, Apr. 3, 1978 Docket No. 40-8675.

POOR ORIGINAL

Table 2.12. Major water quality constituents and nutrients

All units in milligrams per liter unless otherwise noted.

Parameter	Sample site[a]											Water quality criteria			
	C	D	E	F	B	A	A'	OBS Well #1	OBS Well #2	Lake Powell (8-19-77)	San Juan River, mean (1968–1975)	Utah Class C	EPA livestock	EPA water supply intake	Federal interim drinking
Total solids	65	544	105	2630	6630	5328	711								
TDS	40	262	94	256	670	1006	168	2915	380	689	518	500			
SS	25	282	11	2374	5960	4322	543			15					1
Turbidity (JTU)	30	>150	26	450	>150	>150	>150	5.0		0.8					
COD	8.0	32.3	48.4	113	80.6	113	32.0			7.8					
Specific conductance	80	183	173	500	450	1350	285	4520	575	870	671				
pH (units)	6.90	7.03	7.45	7.35	7.32	6.83	7.28	7.25		8.4	8.2	6.5–8.5		5.0–9.0	
Hardness	48.6	255.1	95.8	343.5	505.4	768.5	143.8	2080.0	2.0	288					
Alkalinity	33.6	71.8	79.2	208	138	446	90.1	284	275	119					
HCO_3	40.97	87.55	96.6	253.6	163.3	543.9	109.9	346.5	~335[b]	143	251				
CO_3	0	0	0	0	0	0	0	<0.01		1.4					
SO_4	8	19	3	35	90	380	47	1840	75	315	202	250		250	
Cl	1.0	3.9	1.3	13.5	6.9	32.5	4.6	64	6	62	16	250		250	
Ca	16	33	31	67	58	110	37	556	2.0	65	95				
Mg	1.5	34.8	3.3	28.0	43	67	6.7	155.6	0.5	29	22				
Na	0.3	8.3	1.1	11.1	30.6	146	24.1	103	150	82	51				
K	0.7	4.5	3.7	3.2	7.8	20.0	4.3	5.8	~10[b]	3.4					
SiO_2								13.5							
NO_3–N	0	1.0	0.6	1.8	1.6	1.8	0.9	0.05	<0.01	0.6	0.75	10	100	10	10
NH_3–N	0.04	0.17	0.11	0.28	0.48	0.28	0.13		0.2	0.1				0.5	
K–N	0.3	10.7	0.11	1.70	8.5	1.70	1.52			0.1					
NO_2–N	<0.1	0.2	<0.1	<0.1	0.1	<0.1	<0.1			0.1			10	1.0	
OPO_4–P	0.1	0.3	0.1	0.1	0.1	0.2	0.2			0.1					
PO_4–P	0.7	1.4	0.6	0.8	1.1	0.9	1.1	0.42	<0.2	0.5	0.17				
Eh (mV)	−23	−17	−49	−42	−1	−61	−54			+130					
Total U, ppm	0.019	0.003	0.023	0.022	0.016	0.049	0.024	0.047		.006					

[a] Site designations include C (Comb Ridge Pool), D (Buck Brush reservoir), E (Buck Brush pond), F (Buck Brush spring), B (Cottonwood creek), A (Brushy Basin spring), and A' (Brushy Basin pool).

[b] Not determined, estimated value on the basis of comparative information.

Source: Plateau Resources, Limited, *Application for Source Material License*, Table 6.1-14, p. 6-47, Apr. 3, 1978.

POOR ORIGINAL

928 119

Table 2.13. Trace elements and other particles in water samples from the OBS area

All units in milligrams per liter unless otherwise noted.

Parameter	Sample site[a]											Water quality criteria			
	C	D	E	F	B	A	A′	OBS Well # 1	OBS Well # 2	Lake Powell (8-19-77)	San Juan River, mean (1968–1975)	Utah Class C	EPA livestock	EPA water supply intake	Federal interim drinking
Fe	0.13	0.67	0.17	2.11	5.76	20.9	0.58	0.420	0.08	0.2	0.24	0.3		0.3	
Mn	0.02	0.089	0.02	0.49	2.97	4.46	0.09	0.015	<0.01	<0.001		0.05		0.05	
F	0.09	0.42	0.21	0.46	0.58	0.63	0.28	0.34	0.4	0.53	0.49	1.4–2.4	2.0		1.4–2.4
B	0.3	0.2	0.5	0.4	0.4	0.4	0.3	0.065	<0.02	0.3	0.70		5.0	1.0	
Al	0.4	5	0.8	10	30	30	4	0.06		1			5		
As	0.01	0.02	0.01	0.01	0.07	0.03	0.01	<0.001	<0.01	<0.01		0.05	0.2	0.1	0.05
Cr	0.001	0.005	0.002	0.004	0.012	0.012	0.001	0.001	<0.02	0.003		0.05	1.0	0.05	0.05
Cu	0.004	0.009	0.004	0.015	0.040	0.018	0.009	0.005	0.01	0.002		1.0	0.5	1.0	
Sr	<0.1	0.2	<0.1	0.5	0.7	4.7	0.3			0.6					
V	0.01	0.04	0.02	0.08	0.05	0.11	0.02			0.01			0.1		
Fn	<0.01	0.02	<0.01	0.02	0.07	0.15	0.04	0.62	0.03	<0.01		5.0	2.5	5.0	
Sb	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			<0.01					
Ba	0.2	6.4	0.4	0.8	5.6	3.4	0.5	0.150	<0.05	0.5		1.0		1.0	1.0
Be	<0.001	<0.001	<0.001	0.001	0.014	0.022	0.001			<0.001					
Br	0.20	0.22	0.19	0.34	0.55	1.53	0.25			0.22					
Cd	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001		0.01	0.05	0.01	0.01
Co	<0.01	0.02	<0.01	<0.01	0.03	0.03	<0.01			<0.01			1.0		
Ti	<0.01	0.02	<0.01	0.01	0.02	0.02	0.01			0.01					
Pb	<0.001	<0.001	0.001	0.002	0.009	0.008	<0.001	<0.001	<0.05	<0.001		0.05	0.1	0.05	0.05
Hg	0.0008	0.0008	0.0008	0.0007	0.0023	0.0010	0.0006	<0.0002	<0.0002	0.0005			0.001	0.002	0.002
Mo	0.001	0.001	<0.001	0.001	0.002	0.002	<0.001		<0.01	0.002					
Ni	<0.01	0.01	<0.01	<0.01	0.02	0.01	<0.01			<0.01					
Se	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	0.005	<0.01		0.01	0.05	0.01	0.01
Ag	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	<0.01	<0.01		0.05		0.05	0.05
Sn	3	3	1	1	<1	2	1			2					
Others – 1	0.42	0.34	0.38	0.47	0.31	0.01	0.47			0.46					
CN								<0.01				0.2		0.2	
Fecal coli	<1	800	<1	<1	7600	156	300			<1		2000	1000	2000	
Total coli	200	1300	100	100	9200	<1	800			<1		5000	5000	10000	1.4
Fecal strep	500	300	200	200	5300	12100	400			<1					

[a] Site designations include C (Comb Ridge Pool), D (Buck Brush reservoir), E (Buck Brush pond), F (Buck Brush spring), B (Cottonwood Creek) A (Brushy Basin spring), and A′ (Brushy Basin pool).

Source: Plateau Resources, Limited, *Application for Source Material License*, Table 6.1-15, p. 6-48, Apr. 3, 1978.

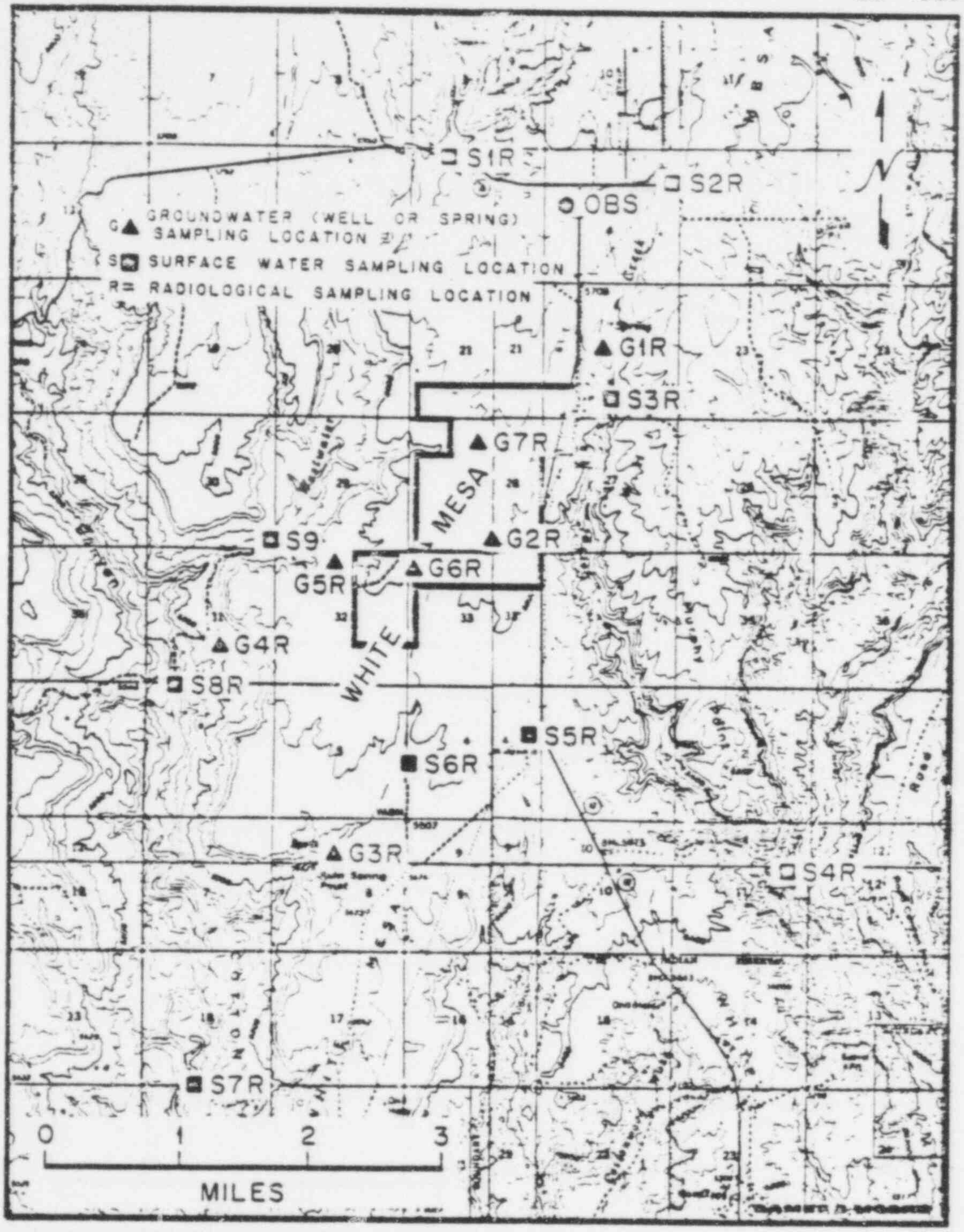


Fig. 2.2. Preoperational water quality sampling stations in the project vicinity. Source: U.S. Nuclear Regulatory Commission, *Final Environmental Statement Related to Operation of White Mesa Uranium Project*, Docket No. 40-8681, May 1979, Fig. 2.5.

POOR ORIGINAL

In general, the surface water is typically of poor quality. Calcium (the dominant cation) and carbonate and sulfate (the dominant anions) cause the water to be hard (mean 309 mg of $CaCO_3$ per liter). The water is turbid with high concentrations of dissolved (mean 357 mg/liter; Stations A-E) and suspended (mean 1930 mg/liter) solids. Some of the water samples registered relatively high values of some trace elements [e.g., barium (6.4 mg/liter; Station D) and mercury (2.3 μg/liter, Station 6)], which are elements typical of the groundwater of this area and are often found in high concentrations in regional surface waters (White Mesa ER; applicant responses). These trace elements perhaps accumulate in surface water by seepage of groundwater into local watercourses and by evaporative concentrations. These high values are not necessarily caused by human disturbances of the environment. The water samples from the San Juan River often indicate high levels of iron, sulfates, and total dissolved solids (TDS).

Surface-water samples taken close to the OBS (Fig. 2.2) in another study (White Mesa FES) indicate similar poor water quality. Water in Westwater Creek was characterized by high TDS (mean 674 mg/liter) and sulfate levels (mean 117 mg of SO_4 per liter). The water was typically hard (total hardness measured as $CaCO_3$, mean measured as 223 mg/liter, and an average pH estimated as 8.25). Water samples taken just below the dammed irrigation pond in Corral Creek indicated very high levels of TDS, averaging well over 3000 mg/liter, with moderate sulfate levels of 42 mg/liter. High levels of mercury and iron were also reported for surface water.

2.6.1.3 Surface-water utilization

Water use in the vicinity of the OBS is largely for potable and agricultural uses. Water is conducted to the area by two canals that transport water from upper Johnson Creek and the upper reaches of the main stem of Recapture Creek. The Johnson Creek canal approaches Blanding from the north and terminates just north of town; the Recapture Creek canal runs along the creek for about 5.6 km (3.5 miles) and approaches Blanding from the northeast. These canals supply water for only a limited period each year. Water is also provided by the numerous farm ponds in the areas that are runoff or aquifer-fed. Surface-water use on or near the OBS and regional use of water from the San Juan River are given in Tables 2.14 and 2.15.

Table 2.14. Water use of San Juan County, 1965

Use	Consumption	
	$m^3 \times 10^3$	Acre-ft
Irrigated crops (5000 acres)	6,785	5,500
Reservoir evaporation	123	100
Incidental use[a]	1,603	1,300
Municipal and industrial[b]	2,220	1,800
Minerals[b]	1,357	1,100
Augmented fish and wildlife[b]	123	100
Total	12,211	9,900

[a] Incidental use of irrigation water by phreatophytes and other miscellaneous vegetation.

[b] Includes evaporation losses applicable to these sources of depletion.

Source: *Environmental Report: White Mesa Uranium Project*, Table 2.6-5, p. 2-142, Jan. 30, 1978.

2.6.2 Groundwater

Recharge of local groundwater aquifers occurs from seasonally variable rainfall infiltrating along the flanks of the Abajo, Henry, and La Sal mountains and along the flanks of folds. Recharge water originates also from precipitation on the flat-lying beds where it percolates into the groundwater region along joints.

In the White Mesa area, 39 wells with appropriate applications are on file with the Utah State Engineer's Office. All 39 wells lie within an 8-km (5-mile) radius of the project site, and

Table 2.15. Current surface water users in project vicinity

Name	Address	Application date	Application number	Quantity	
				m^3/sec	cfs
		Corral Creek			
Fred Halliday	Blanding, Utah	August 12, 1971	40839	0.5	0.014
		Cottonwood Creek or Wash			
William Keller	Moab, Utah	November 12, 1907	1647	1.0	0.028
Hyrum Perkins	Bluff, Utah	June 22, 1910	3322	5.49	0.156
U.S. Indian Service	Ignacia, Colorado	March 12, 1924	9486	1.18	0.033
U.S. Indian Service	Ignacia, Colorado	March 24, 1924	9491	0.738	0.021
U.S. Indian Service	Ignacia, Colorado	March 24, 1924	9492	0.298	0.008
Kloyd Perkins	Blanding, Utah	April 13, 1928	10320	1.455	0.041
W. R. Young	Blanding, Utah	October 22, 1928	104935	0.0015	0.00004
W. R. Young	Blanding, Utah	October 23, 1928	10496	0.0022	0.0006
W. R. Young	Blanding, Utah	October 22, 1928	10497	0.002	0.00005
San Juan County water Conservation district	Monticello, Utah	October 10, 1962	34666	12,000 (acre-ft)	1.48×10^7
Earl Perkins	Blanding, Utah	April 16, 1965	36924	5.0	0.142
		Westwater Creek			
Seth Shumway	Blanding, Utah	January 7, 1929	10576	0.005	0.002
H. E. Shumway	Blanding, Utah	Segregation date: February 28, 1970	37101a	0.7623	0.022
Preston Nielson	Blanding, Utah	Segregation date: October 22, 1970	37601a	0.2377	0.007
Parley Redd	Blanding, Utah	Claim date: October 16, 1970	Claim 2373	0.015	0.0004
Kenneth McDonaid	Blanding, Utah	Change of Appropriation: June 12, 1974	42302	1.0	0.028

Source: *Environmental Report: White Mesa Uranium Project*, Table 2.6-5, p. 2-141, Jan. 30, 1978.

all but one draws water from the Dakota and Morrison formations. Most of these wells produce less than 55 m^3/day (10 gpm) and are used for domestic, irrigation, and stock-watering purposes. The remaining well, drilled to a depth of 548.6 m (1800 ft) by the Energy Fuels Nuclear mill site, withdraws water from the Navajo Sandstone.

As is the case throughout most of the Four Corners region, the Blanding area depends largely on groundwater for its water supply. A porous soil, underlain by the Dakota Sandstone on top of a regional aquiclude (the Brushy Basin Member of the Morrison Formation), provides the Blanding area with a near surface source of groundwater. This situation is somewhat uncommon in the highly dissected south-central portion of the Colorado Plateau.

In the immediate vicinity of the OBS, only the Dakota Sandstone and the Salt Wash Member (including the Westwater Member) are significant aquifers. The Entrada and Navajo formations contain larger quantities of water, but their depth prohibits common exploitation, in use for domestic water supplies (Fig. 2.4).

Comb Ridge and the Abajo Mountains are significant areas of recharge for the Salt Wash and deeper aquifers. General gradients of groundwater movement in these aquifers follow the regional structure, and the water discharges ultimately in the vicinity of the San Juan River.

Because the Brushy Basin Member acts as an aquiclude to the Salt Wash Member in the uplands, the primary recharge areas for this aquifer in the vicinity of the OBS are Brushy Basin Wash to the northwest of Blanding, Cottonwood Creek to the west and southwest of the town, and the upper reaches of Montezuma Creek, especially along Dodge and Long canyons.

Plateau Resources received a permit to appropriate groundwater from the Utah Department of Natural Resources in 1977. A well (OBS Well No. 1) was drilled to the Dakota Sandstone aquifer; however, the water quality was too poor for domestic use at the station. Another

928 123

well (OBS Well No. 2) was drilled adjacent to Well No. 1 into the lower Salt Wash Member of the Morrison Formation and now provides water to the OBS. Well No. 1 was not capped to provide a water quality sample source.

2.7 GEOLOGY, MINERAL RESOURES, AND SEISMICITY

2.7.1 Geology

2.7.1.1 Regional geology

The proposed project site is near the western margin of the Blanding basin in southeastern Utah. Thousands of feet of marine and nonmarine sedimentary rocks have been uplifted, moderately deformed, and subsequently eroded. North of the site is the Paradox fold and fault belt; to the west, the Monument uplift; to the south, the San Juan River and the Tyende Saddle; and to the east, the Canyonlands section merges with the Southern Rocky Mountain province (Fig. 2.3). The area is characterized by deeply eroded canyons, mesas, and buttes formed from sedimentary rocks of pre-Tertiary age. Regionally, elevations range from about 900 m (3000 ft) to more than 3350 m (11,000 ft). With the exception of the deeper canyons and isolated mountain peaks, the average elevation is approximately 1500 m (5000 ft). F2.3

Exposed sedimentary rocks in southeastern Utah have an aggregate thickness of about 1800 to 2100 m (6000 to 7000 ft) and range in age from Pennsylvania to Late Cretaceous. A local stratigraphic section is shown in Fig. 2.4. F2.4

Shoemaker noted three origins of the structural features seen in the project area: (1) structures related to large-scale regional epeirogenic deformation (Monument uplift and Blanding basin), (2) structures formed by diapiric deformation of thick evaporites, and (3) structures formed from magmatic intrusions (Abajo Mountain).[8]

2.7.1.2 Blanding site geology

The proposed site is located near the center of White Mesa. The nearly flat surface of the mesa has a thin veneer of loess and is underlain by resistant sandstone caprock. Surface elevations across the site range from 1690 to 1720 m (5550 to 5650 ft). The maximum relief between White Mesa and the adjacent Cottonwood Canyon is about 230 m (750 ft).

White Mesa is drained to the west by Cottonwood Wash and Westwater Creek and to the east by Recapture Creek. These intermittent streams flow into the San Juan River. In the project area, exposed rocks are of Jurassic, Cretaceous, and Pleistocene-Recent age. The Jurassic to Upper Cretaceaous rocks is represented (in ascending order) by the San Rafael Group, the Morrison Formation, the Burro Canyon Formation, the Dakota Sandstone, and the Mancos Shale. The rocks are primarily cross-bedded sandstones, conglomeratic sandstones, claystones, and mudstones, with some sandy shales and limestones. Cenozoic rocks include eolian loess, stream-born alluvium, colluvium, and talus.

The structure of White Mesa is very simple. The Dakota Sandstone and Burro Canyon Formation are essentially flat with gentle undulations and are commonly jointed. Two joint directions are found usually perpendicular to each other.

2.7.2 Mineral resources

2.7.2.1 Uranium deposits

Two types of uranium mineralization exist in the region: (1) tabular deposits nearly parallel to the bedding of fine-grained to conglomeratic sandstone lenses and (2) fracture-controlled deposits. None of the fracture-controlled deposits have yielded large production.[9] The tabular deposits occur in the Chinle, Morrison, and the Cutler formations. Vanadium is a common by-product of most uranium produced from the Morrison Formation. Principal uranium minerals are urannite and coffinite.

928 1246/1203

ES-4537

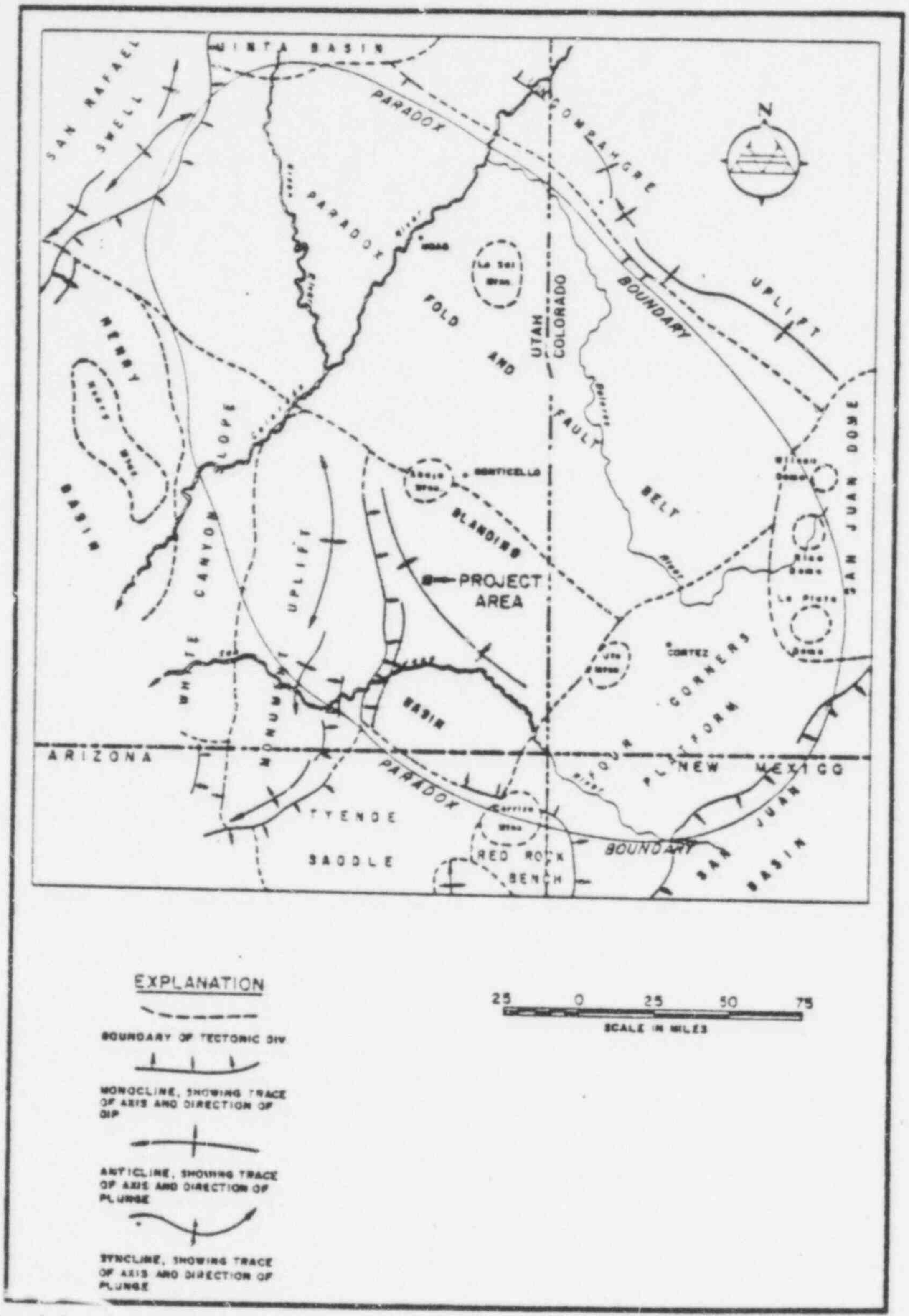
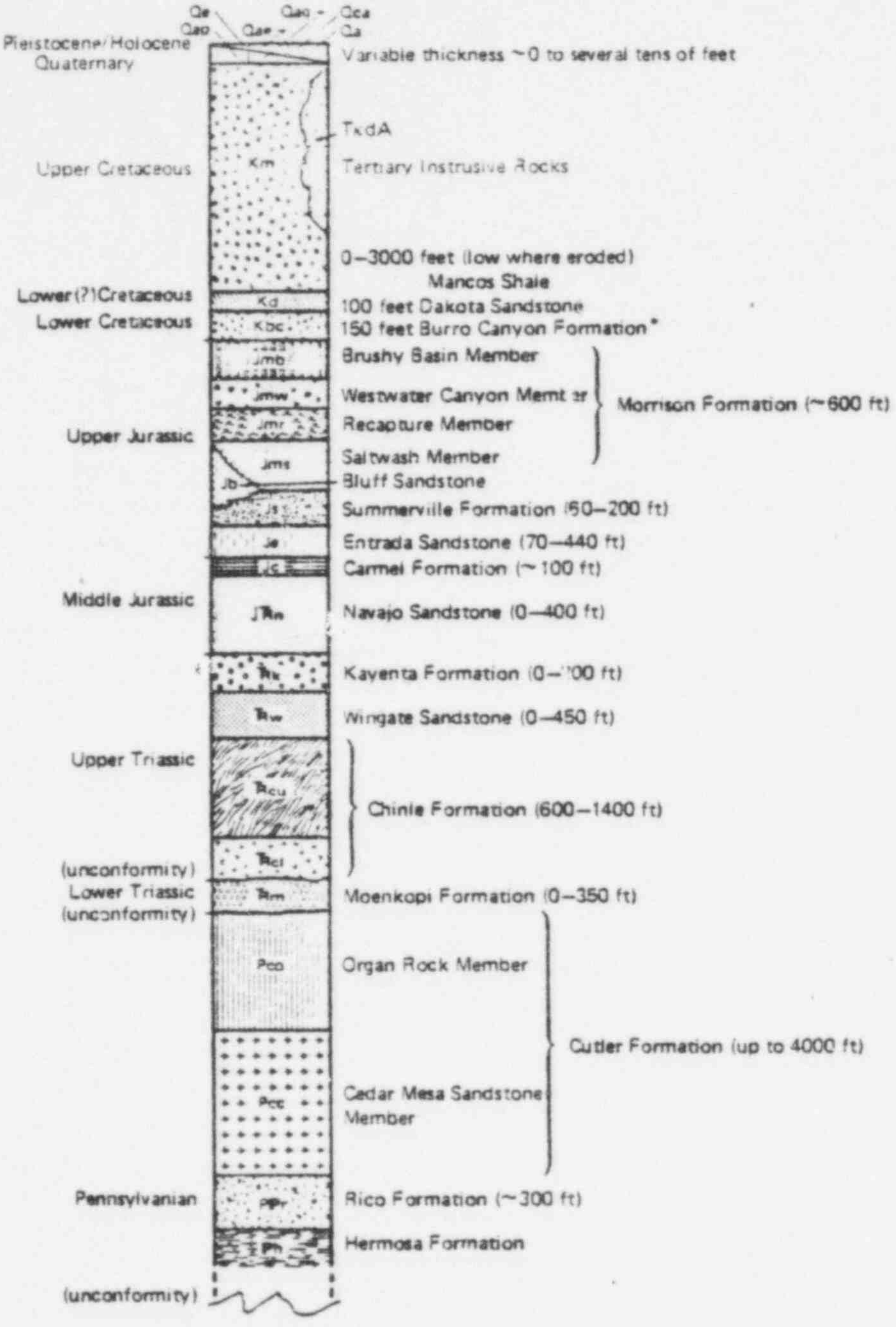


Fig. 2.3. Tectonic index map. Source: Energy Fuels Nuclear, Inc., *White Mesa Uranium Project: San Juan County, Utah*, vol. 1, Docket No. 48-8681, Jan. 30, 1978.

928 125

POOR ORIGINAL



*For thicknesses below Burro Canyon, see stratigraphic description table.

Fig. 2.4. Stratigraphy in the region of the OBS. Source: Plateau Resources, Limited, *Application for Source Material License*, Docket No. 40-8674, Apr. 3, 1978, Fig. 2.4-3.

2.7.2.2 Other mineral resources

Seven wildcat oil wells were drilled in an area about 6 km (4 miles) west of the proposed site. All were dry and were subsequently abandoned.

Thin, discontinuous beds of impure lignite and coal up to 0.6 m (2 ft) thick occur throughout the Dakota Sandstone. Although several of these coal beds have been mined on a limited scale in the Blanding area, most of the coals are too impure for commercial use.[10]

Copper deposits are associated with the fracture-controlled uranium-vanadium deposits in the Abajo Mountains and with some sedimentary deposits. The copper content may be as high as 3%. Sand and gravel deposits are mined on the east and south slopes of the Abajo Mountains for pavement construction material.

Water is produced from wells drilled to the Burro Canyon Formation and the Dakota Sandstone. This water is commonly mineralized and in some localities is unfit for human consumption.[11] Deep wells drilled to the Entrada Sandstone and Navajo Sandstones yield potable water.[9] Several springs in the project vicinity discharge groundwater from the Burro Canyon Formation.

2.7.3 Seismicity

Within a 320-km (200-mile) radius of the site, 450 seismic events occurred between 1853 and 1977. Of these, at least 45 had an intensity of VI or greater on the Modified Mercalli Scale.

Within a 160-km (100-mile) radius of the project area, 15 earthquakes have been recorded. Of these, only one had an intensity of V; the rest were IV or less. The nearest event occurred in Glen Canyon National Recreational Area, about 70 km (43.5 miles) northwest of the proposed site. The next closest event occurred about 94 km (58.5 miles) to the northeast. The event of intensity V occurred on August 29, 1941, east of Durango, Colorado. It is doubtful that any of these events would have been felt in the vicinity of Blanding.

Based on the region's seismic history, the probability of a major damaging earthquake occurring at or near the proposed site is remote. Algermissen and Perkins[12] indicate that there is a 90% probability that horizontal acceleration of 4% gravity (0.4 *g*) would not be exceeded within 50 years.

2.8 SOILS

Soil in the region of the OBS is classified as Monticello series;[13] the soil has been formed from windborn deposits. Such soils are normally well drained, but the presence of caliche and underlying mancos shale may allow canals and unlined farm ponds in the area to hold or transport water without appreciable loss as would normally be expected in eolian soils (ER, Fig. 2.4-5).

With the well-drained soils, relatively flat topography (Sect. 2.3), and low precipitation (Sect. 3.2.1), the site may be considered to have a low potential for water erosion. The OBS area, however, is considered to have a high potential for wind erosion, particularly when the soil is barren.[14]

According to the applicant (Application for Source Material License ER, Sect. 2.4), soil in the vicinity of the OBS is moderately deep to deep and is neutral to moderately alkaline. The surface layer, approximately 20 cm (8 in.) deep, is dark reddish-brown and has a texture of very fine sandy loam. The reddish-brown subsoil tends to be silty. Because of the relatively low fertility and lack of organic matter in the soil, appropriate fertilizer applications and mulching to aid in establishment and growth of vegetation would be beneficial.

2.9 BIOTA

2.9.1 Terrestrial

2.9.1.1 Flora

The potential natural vegetation of the area is classified by Küchler[15] as juniper-pinyon woodland. Such vegetation consists of open groves of needleleaf evergreen low trees with varying

17

928 127 [illegible]

mixtures of shrubs and herbaceous plants. Dominants would be Utah juniper (*Juniperus osteosperma*) and pinyon pine (*Pinus edulis*). Common associates would be big sagebrush (*Artemesia tridentata*), rabbitbrush (*Chrysothamnus* spp.), Indian ricegrass (*Oryzopsis hymenoides*), and blue grama (*Bouteloua gracilis*).

The natural vegetation occurring presently within a 40-km (25-mile) radius of the site is very similar to that of the potential, characterized by pinyon-juniper woodland intergrading with big sagebrush communities. Much of the land in the OBS vicinity is under cultivation (Fig. 2.5), with crops consisting primarily of pinto beans, alfalfa, and pasture grasses (Application for Source Material License ER, Sect. 6.1.3). The pinyon-juniper community is dominated by Utah juniper with some pinyon pine as a codominant or subdominant tree species. The understory of this community, which is usually quite open, is sparse and generally contributes less than 2% (Application for Source Material License ER, Sect. 6.1.3). This understory is composed of grasses, forbs, and shrubs that are also found in the big sagebrush communities (Application for Source Material License ER, Table 6.1-8). The sagebrush grass communities, approximately 4.8 km (3 miles) south of the OBS, are dominated by big sagebrush and blue grama. Common associates include Utah serviceberry (*Amelanchier utahensis*), four-wing saltbrush (*Atriplex canescens*), rabbitbrush, Mormon tea (*Ephedra torreyana*), snakeweed (*Gutierrezia sarothrae*), Indian ricegrass, and galleta (*Hilaria jamesii*). Sagebrush grass communities are located on low flatlands and serve as important winter range for deer. Cover values, approximately 24%, are relatively high compared with other vegetation types in the area.[16] Abandoned agricultural land contains many of the same species as the pinyon-juniper and sagebrush grass communities as well as weedy species such as Russian thistle (*Salsola kali*), common lambsquarters (*Chenopodium album*), and other species that are invaders on disturbed sites (Application for Source Material License ER, Table 6.1-8). The facility site, located on abandoned cultivated land, supported many of these same species prior to construction of the OBS (Application for Source Material License ER, Sect. 6.1.3).

In addition to the pinyon-juniper, sagebrush grass, and agricultural habitat in the vicinity, cottonwood (*Populus* sp.), tamarisk (*Tamarix pentandra*), and willow (*Salix exigua*) trees are abundant along Corral Creek and Recapture Creek to the east and Westwater Creek to the west (Fig. 2.5). Also, a single cottonwood tree is associated with a small catch basin located adjacent to the southeast corner of the OBS fence. The catch basin, which has been fenced to prevent access, may be considered to be an ephemeral pond containing water only after moderately heavy rain.

Because of the removal of natural vegetation for agricultural development, none of the proposed endangered plant species[17] that have documented distributions in San Juan County[18] are expected to occur on the facility site or near the immediate vicinity.

2.9.1.2 Fauna

Based on the applicant's literature review, at least 116 species of terrestrial vertebrates may occur in the vicinity of the OBS (Table 2.16). Agricultural land and pinyon-juniper woodland, the predominant habitats within a 4.8-km (3-mile) radius of the site (Fig. 2.5), may provide habitat for 57 and 46 vertebrate species respectively. The sagebrush grass communities are expected to provide suitable habitat for 114 of the 116 vertebrate species in the area of the OBS. T2.16

A total of four species of amphibians and 14 species of reptiles may exist in the area. Although none are expected to occur in large numbers, the sagebrush lizard (*Sceloporus graciosus*), side-blotched lizard (*Uta stansburiana*), western whiptail lizard (*Cnemidophorus tigris*), gopher snake (*Pituophis melanoleucus*), red-spotted toad (*Bufo punctatus*), and tiger salamander (*Ambystoma tigrinum*) are some of the more common reptiles and amphibians expected to occur around the OBS (Application for Source Material License ER, Table 6.1-9). Based on the comparison of the number of species that could potentially occur in a particular habitat and the number that is expected in the region, the sagebrush grass communities provide the most suitable habitat for amphibians and reptiles, with pinyon-juniper next and agricultural land least of all.

Of the 72 species of birds expected to appear in the vicinity of the OBS, nearly all may occur in the sagebrush grass communities — 50% on agricultural lands and about 30% in the pinyon-juniper woodlands (Table 2.16). Some of the species expected to be most commonly associated with agricultural fields near the OBS include the turkey vulture (*Cathartes aura*), red-tailed

18 [illegible] 928 128

POOR ORIGINAL

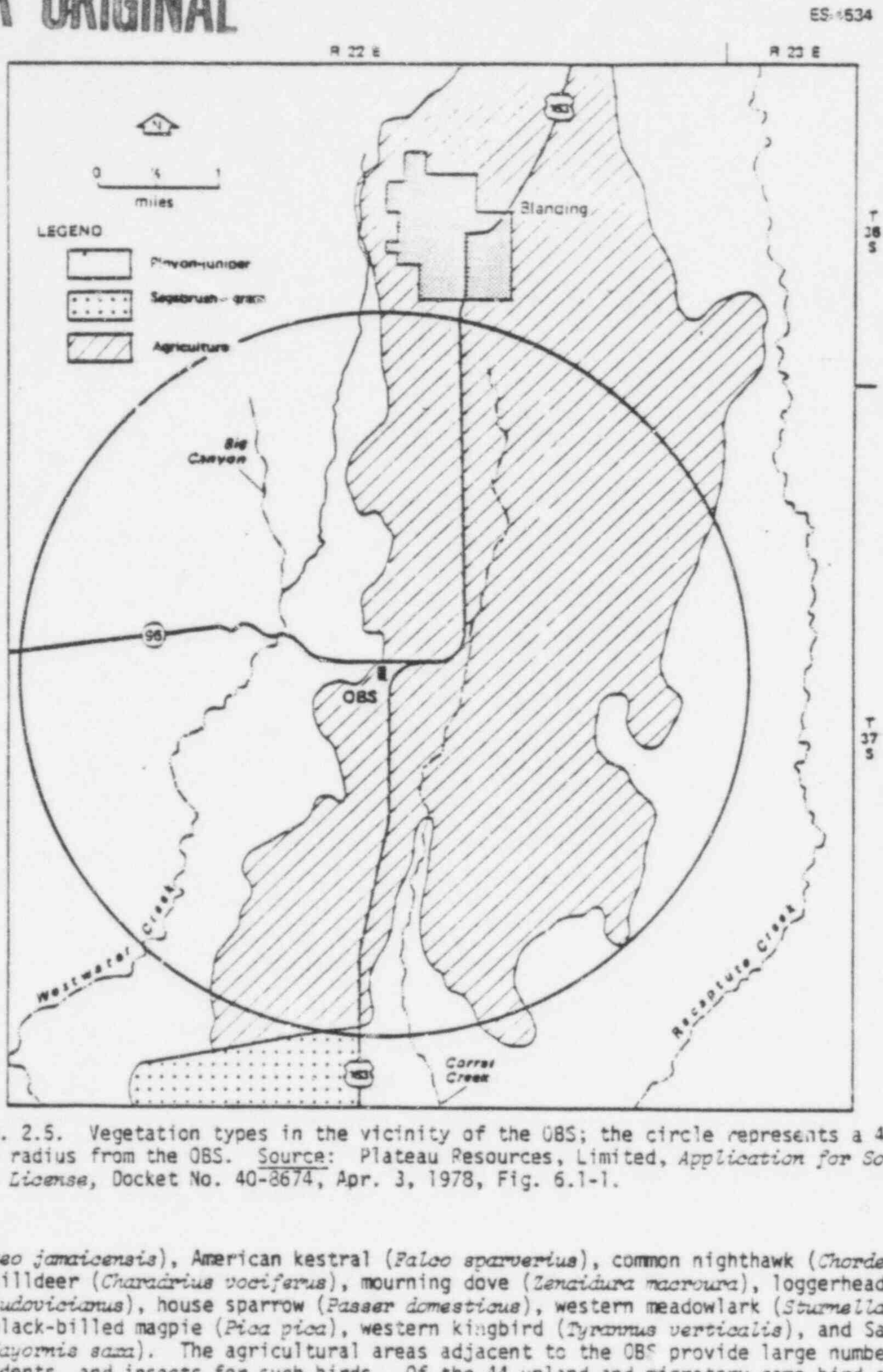


Fig. 2.5. Vegetation types in the vicinity of the OBS; the circle represents a 4.8-km (3-mile) radius from the OBS. Source: Plateau Resources, Limited, *Application for Source Material License*, Docket No. 40-8674, Apr. 3, 1978, Fig. 6.1-1.

hawk (*Buteo jamaicensis*), American kestral (*Falco sparverius*), common nighthawk (*Chordeiles minor*), killdeer (*Charadrius vociferus*), mourning dove (*Zenaidura macroura*), loggerhead shrike (*Lanius ludovicianus*), house sparrow (*Passer domesticus*), western meadowlark (*Sturnella neglecta*), black-billed magpie (*Pica pica*), western kingbird (*Tyrannus verticalis*), and Say's phoebe (*Sayornis saya*). The agricultural areas adjacent to the OBS provide large numbers of seeds, rodents, and insects for such birds. Of the 44 upland and migratory game bird species in southeastern Utah,[19] only the mallard duck (*Anas platyrhynchos*), gambel's quail (*Lophortyx gambelii*), chukar (*Alectoris graeca*), and mourning dove are thought to frequent the area of the OBS (Application for Source Material License ER, Table 6.1-9). The dove is the only species occurring with any regularity.

Nearly all of the 26 mammalian species expected to occur in the vicinity of the OBS demonstrate a habitat affinity for sagebrush grass communities (Table 2.16). These diverse faunal populations

Table 2.16. Number of vertebrate species expected to occur in the vicinity of the OBS

Class	Habitat			Total
	Agriculture	Sagebrush grass	Pinyon-juniper	
Amphibians	1	4	1	4
Reptiles	4	14	7	14
Birds	36	71	21	72
Mammals	16	25	17	26
Total	57	114	46	116

Source: Modified from ER, Table 6.1-9.

result from the wide variety of potential food sources present in this vegetation type. Conversely, the agricultural lands and pinyon-juniper vegetation support a much lower species diversity because of the lack of adequate cover and diversity of food sources.

Rodents, rabbits, and carnivores are the dominant groups of mammals expected to occur in the region of the OBS (Application for Source Material License ER, Table 6.1-9). The species expected to be most abundant include the deer mouse (*Peromyscus maniculatus*) Ord's kangaroo rat (*Dipodomys ordi*), pinyon mouse (*Peromyscus truei*), Colorado chipmunk (*Eutamias quadrivittatus*), black-tailed jackrabbit (*Lepus californicus*), desert cottontail (*Sylvilagus auduboni*), and coyote (*Canis latrans*).

Agricultural lands, such as those adjacent to the OBS, are characterized by few species of mammals but do not have necessarily low densities. Although sufficient cover is generally present on cultivated land during portions of the year, the monotypic nature of the habitat and frequent disturbances because of cultivation often restrict the area to species that are well adapted to these disturbed habitat conditions. Examples of species that can utilize agricultural habitat and that are expected to be abundant near the OBS include the deer mouse, western harvest mouse (*Reithrodontomys megalotis*), striped skunk (*Mephitis mephitis*), black-tailed jackrabbit, and coyote.

Two mammalian game species[19] occur in the region of the OBS: desert cottontail and mule deer (*Odocoileus hemionus*). Both species are common with a stable population trend for the desert cottontail and an increasing population trend for the mule deer.[19] According to the applicant, most of the deer within the Blanding area summer in the Blue Mountains, 24 to 32 km (15 to 20 miles) north of the OBS (Application for Source Material License ER, Sect. 6.1.3). During the winter months, the deer migrate to lower elevations, primarily into sagebrush grass communities. Winter dear use in the project vicinity, as measured by browse utilization, is among the heaviest in southeastern Utah [61 days of use per hectare (25 days of use per acre)] in the pinyon-juniper-sagebrush habitats.[20] Although the OBS lies within the boundaries of important winter range for deer,[16] suitable stands of browse species [e.g., sagebrush, bitterbrush (*Purshia tridentata*), and mountain mahogany (*Cercocarpus montanus*)] are not present near the OBS as a result of agricultural land uses.

The American peregrine falcon (*Falco peregrinus anatum*) and bald eagle (*Haliaeetus leucocephalus*) are two endangered species[21] whose ranges include the OBS and vicinity. The peregrine falcon preys principally on passerine birds, waterfowl, and shorebirds.[22] Lack of significant aquatic habitat in the project vicinity indicates a low probability of occurrence for this species. Similarly, the bald eagle is primarily found around large bodies of water and would be very unlikely to use the project site.

2.9.2 Aquatic biota

Aquatic habitat at the project site temporally varies from extremely limited to nonexistent because of the aridity, topography, and soil characteristics of the region and the consequent scarcity of perennial surface water. One very small catch basin is located on the project site, but it only fills during spring and fall when there are particularly heavy periods of rainfall. This basin represents the total aquatic environment on the project site; when active, it probably provides extremely temporary habitat for algae, insects, other invertebrate forms, and amphibians. It may also provide a water source for small mammals and birds at this time (Sect. 2.9.1). Such ephemeral catch and seepage basins are typical and numerous to the northeast of the project site and south of Blanding. The catch basin located on the project site is extremely small, and its temporary nature relegates it to minimal import in providing aquatic habitat. It represents, essentially, a terrestrial habitat.

Aquatic habitat in the project vicinity is similarly limited. There is a small irrigation pond approximately 50 m (165 ft) in diameter that is formed by the damming up of a small spring in Corral Creek about 1.6 km (1 mile) downdrainage from the OBS to the southeast. Biota samples of this environment have not been taken by the applicant. The staff did not observe the presence of any fish in this small pond during the site visit. The three adjacent streams (Corral Creek, Westwater Creek, and an unnamed arm of Cottonwood Wash) carry water only on an intermittent basis — primarily in the spring during increased rainfall and snowmelt runoff, in the autumn, and also briefly during local but intense electrical storms. There is a small perennial section of Westwater Creek (updrainage from the OBS) apparently receiving groundwater seepage from the underlying aquifer and some recharge from a nearby irrigation canal. The aquatic biota in this stretch of Westwater was not sampled by the applicant.

Again, because of the temporary nature of the streams downdrainage from the OBS, their contribution to the aquatic habitat of the region appears limited in providing a drinking water source for wildlife and a temporary habitat for insect and amphibian species.

The temporary watercourses in the vicinity of the OBS were not sampled for biota by the applicant during periods of waterfill. It is therefore possible that these streams (when active) support fish populations, with individuals migrating upstream or downstream from areas of more permanent water supply.

Five species of fish designated or proposed as endangered or threatened by the Federal government occur in Utah. These five species are listed in Table 2.17 along with their habitat requirements. Two of the species protected by the Federal government occurring in Utah, the Humpback Chub (*Gila cypha*) and the Woundfin (*Plegopterus argentissimus*), do not occur in southeastern Utah where the OBS is located. The Colorado Squawfish (*Ptyhocheilus lucius*), however, is listed as inhabiting large rivers in the Colorado River Drainage. The Bonytail Chub (*Gilea elegans*), classified as threatened by the State and proposed as endangered by Federal authorities [*Fed. Regist.* 43(79)], is also limited in its distribution to main channels of large rivers. In this section of Utah, the Humpback Sucker [Razorback Sucker (*Xyrauchen texanus*)], protected by the State as a threatened species [proposed as threatened by Federal authorities; *Fed. Regist.* 43(79)] is found inhabiting pools and quiet water areas of larger rivers. It is improbable, based on habitat preference and personal communication with the regional Utah Wildlife Conservation Officer in Blanding, that the Colorado River Squawfish, the Bonytail Chub, and the Humpback Sucker occur in the vicinity of the proposed mill site. The closest probable habitat is the San Juan River, 34 km (18 miles) to the south. OBS construction and/or operation should have no effect on this aquatic habitat.

2.10 NATURAL RADIATION ENVIRONMENT

Radiation exposure in the natural environment is due to cosmic and terrestrial radiation and to the inhalation of radon and its daughters. Doses attributable to background environmental radioactivity were determined by the applicant, using total lethal doses (TLDs) at five sampling sites.[23] Excluding one site where the measurements were influenced by an abandoned uranium mine, the average total-body dose was 188 millirems per year, of which 100 millirems were due to terrestrial and 88 from cosmic radiation. The cosmogenic radiation dose is about 1 millirem per year.[24] Terrestrial radiation originates from the radionuclude potassium-40, rubidium-87, and daughter isotopes from the decay series for uranium-238, thorium-232, and, to a lesser extent, uranium-235. The dose from ingested radionuclides is estimated to result in a dose of 18 millirems per year to the total body.[24] The dose to the total body from all sources of environmental radioactivity is about 207 millirems per year in the project site area.

Table 2.17. Threatened and endangered fish species occurring in Utah

Species	Habitat	Listing	Occurrence in southeastern Utah
Woundfin *(Plagopterus argentissimus)*	Silty streams, muddy-swift current areas. Virgin River Critical Habitat[d]	Federal[b] State[c]	No
Humpback chub *(Gila cypha)*	Large river systems, eddies, and backwater	Federal[a] State	No
Colorado River squawfish *(Ptychocheilus lucius)*	Main channels of large river systems in Colorado Drainage	Federal[a] State	Yes
Bonytail chub *(Gila elegans)*	Main channels of large river systems in Colorado Drainage	Federal[d] State	Yes
Razorback (Humpback) sucker, *(Xyrauchen texanus)*	Backwater pools and quiet water area of main rivers	Federal[c] State[b]	Yes

[a] *Fed. Regist.* 42(211).

[b] Species is endangered.

[c] Species is threatened.

[d] Species is proposed endangered by *Fed. Regist.* 43(79).

The concentration of radon in the area is in the range of 500 to 1000 pCi/m^3, based on the concentration of radium-226 in the local soil.[24,25] Exposure to this concentration on a continuous basis would result in a dose of up to 625 millirems per year[26] to the bronchial epithelium. In unventilated enclosures, the comparable dose could reach 1200 millirems per year.

The medical total-body dose for Utah is about 75 millirems per year per person.[27] The total dose in the area of the OBS from both natural background and medical exposure is estimated to be 236 millirems per year.

REFERENCES FOR SECTION 2

1. The Bureau of Economic and Business Research, *Community Economic Facts: Blanding, Utah — 1975*, prepared for Utah Industrial Development Information Service, Salt Lake City, Utah.
2. The Bureau of Economic and Business Research, *Community Economic Facts: Blanding, Utah — 1977*, prepared for Utah Industrial Development Information Service, Salt Lake City, Utah.
3. The Bureau of Economic and Business Research, *Community Economic Facts: Monticello, Utah — 1975*, prepared for Utah Industrial Development Information Service, Salt Lake City, Utah.
4. The Bureau of Economic and Business Research, *Community Economic Facts: Monticello, Utah — 1977*, prepared for Utah Industrial Development Information Service, Salt Lake City, Utah.
5. Utah Industrial Development Information Service, *County Economic Facts: San Juan County — 1977*.
6. Utah Department of Transportation, *State of Utah, Major Highways Map*, Salt Lake City, Utah, 1976.
7. U.S. Geological Survey, *The National Atlas of the United States of America*, U.S. Department of the Interior, Washington, D.C., 1970.
8. E. M. Shoemaker, "Structural features of southeastern Utah and adjacent parts of Colorado, New Mexico and Arizona," pp. 48-69 in Utah Geological Society's *Guidebook to the geology of Utah*, No. 9, 1954.
9. H. S. Johnson, Jr. and W. Thordarson, *Uranium deposits of the Moab, Monticello, White Canyon, and Monument Valley Districts, Utah and Arizona*, Bulletin 1222-H, U.S. Geological Survey, 1966.
10. L. C. Huff and F. G. Lesure, *Geology and uranium deposits of Montezuma Canyon area, San Juan County, Utah*, Bulletin 1190, U.S. Geological Survey, 1965.
11. I. J. Witkind, *Geology of the Abajo Mountains area, San Juan County, Utah*, Professional Paper 453, U.S. Geological Survey, 1964.
12. S. T. Algermissen and D. M. Perkins, *A probabilistic estimate of maximum acceleration in rock in the contiguous United States*, Open File Report 76-416, U.S. Geological Survey, 1976.
13. Soil Conservation Service, *Soil Survey San Juan, Utah*, U.S. Department of Agriculture in cooperation with Utah Agricultural Experiment Station, Series 1945, U.S. Government Printing Office, Washington, D.C., 1962.
14. L. Wilson, M. E. Olsen, T. B. Hutchings, A. R. Southard, and A. J. Erickson, *Soils of Utah*, Bulletin 492, Utah Agricultural Experiment Station, 1975.
15. A. W. Kuchler, *Potential Natural Vegetation of the Conterminous United States*, Special Publication 36, American Geographical Society, New York, 1964.
16. Division of Wildlife Resources, *Utah Big Game Range Inventory*, Publication No. 70-1, Utah Department of Natural Resources, Salt Lake City, Utah, 1969.
17. "Endangered and Threatened Species, Plants," *Fed. Regist.* 41(117): 24524-24572 (1976).
18. S. L. Welsh, and K. H. Thorne, *Illustrated Manual of Proposed Endangered and Threatened Plants of Utah*, U.S. Fish and Wildlife Service, Denver, Colo., 1979.
19. L. B. Dalton, C. B. Farnsworth, R. B. Smith, R. C. Wallace, R. B. Wilson, and S. C. Winegardner, *Species List of Vertebrate Wildlife that Inhabit Southeastern Utah*, Publication No. 78-16, Utah State Division of Wildlife Resources, Salt Lake City, Utah, 1978.

20. U.S. Nuclear Regulatory Commission, *Final Environmental Statement related to operation of White Mesa Uranium Project*, Docket No. 40-8681, May 1979.

21. "Endangered and Threatened Wildlife and Plants," *Fed. Regist.* 44(12): 3636-3654 (1979).

22. C. Snow, *Habitat Management Series for Endangered Species Rep. No. 1, American Peregrine Falcon* Falco peregrinus anatum *and Arctic Peregrine Falcon* Falco peregrinus tundrius, U.S. Bureau of Land Management Technical Note, Denver, Colo., 1972.

23. Plateau Resources, Limited, *Application for Source Material License for the Blanding Ore Buying Station*, Docket No. 8674, issued April 1978.

24. National Council on Radiation Protection and Measurements, *Natural Background Radiation in the United States*, Report No. 45, 1975.

25. K. J. Schaiger, "Analysis of Radiation Exposure On or Near Uranium Mill Tailings Piles," *Rad. Data Rep.* 14: 41 (1974).

26. National Academy of Sciences-National Research Council, *The Effects on Population of Exposure to Low Levels of Ionizing Radiation, Report of the Advisory Committee on the Biological Effects of Ionizing Radiation (BEIR)*, U.S. Government Printing Office, Washington, D.C., 1972.

27. U.S. Department of Health, Education, and Welfare, *Population Exposure to X-rays, U.S. 1970*, Report DHEW-73-8047, November 1973.

928 134

3. OPERATIONS

3.1 SCOPE

The Plateau Resources, Ltd., Ore Buying Station (OBS) buys and stores uranium ore produced by independent mines. By April 1978 the applicant had established purchase agreements with 12 mine operators. The purchased ore is primarily quartzose sandstone containing between 0.05% and 1.0% uranium [0.45 to 9.1 kg (1.0 to 20.0 lb) uranium per ton of ore as U_3O_8].

Construction of the OBS began in March 1977, and operations began in August 1977. Ore purchases have averaged approximately 2000 tons per month with an average uranium content of 0.11%. The applicant expects to stockpile ore until about October 1980 when transfer of ore to the proposed Shootering Canyon uranium processing facility will commence (Fig. 1.1). At that time about 71,000 tons of ore will be stored at the OBS.

It is expected that a maximum of 4830 tons of ore per month would be transferred to the proposed uranium processing facility, and the staff assumes that 2000 tons per month would continue to be purchased. In that case the OBS stockpile would be depleted by July 1982; the OBS itself would either become a purchase and transfer facility (2000 tons per month) with a minimum ore stockpile or be closed and the site reclaimed.

3.2 THE ORE BUYING STATION

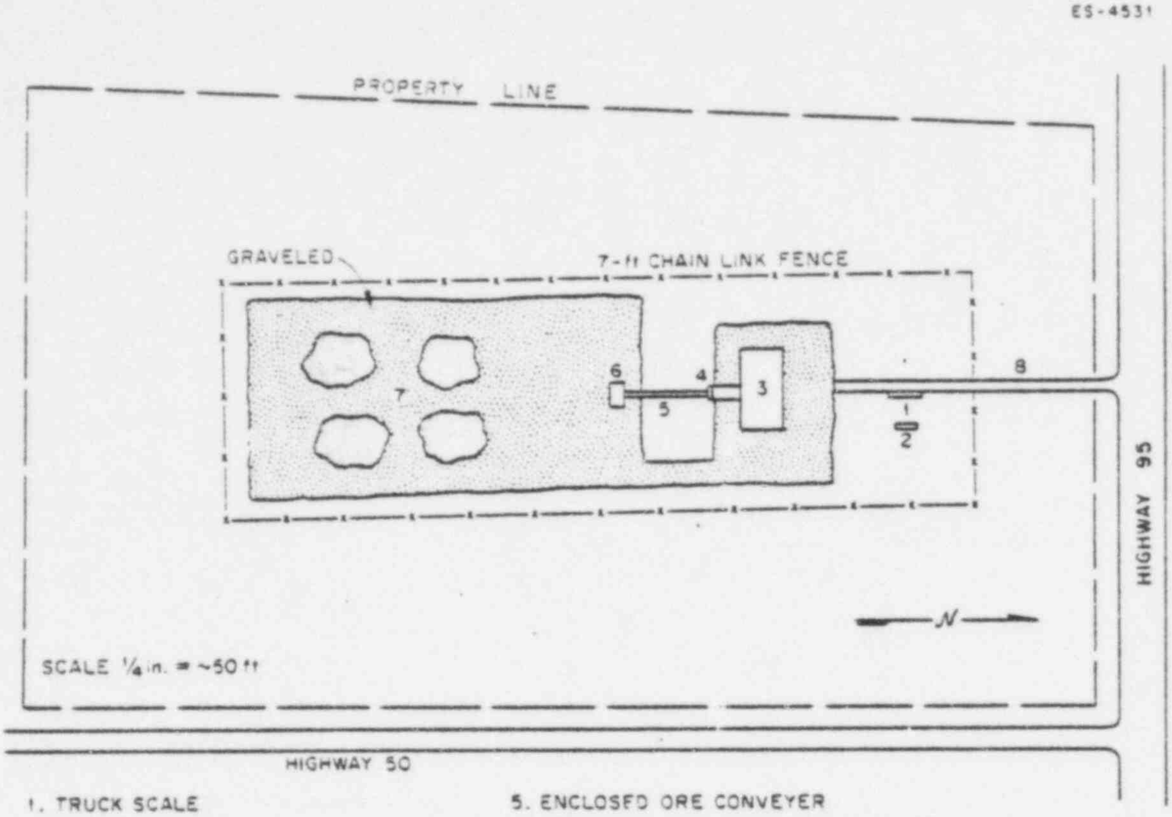
3.2.1 General

The location of the OBS with respect to other nearby facilities is shown in Fig. 2.1. The general layout of the OBS is shown in Fig. 3.1. The OBS occupies approximately 5.7 ha (14 acres) centrally located within the 26-ha (63-acre) site owned by the applicant. The nearest resident lives about 1 km (0.6 mile) east of the site. The OBS is surrounded by a 2-m (7-ft) chain link fence with one 7.3-m (24-ft) double gate that is locked when the OBS is unattended. The OBS is posted with "Restricted Area" signs in accordance with 10 CFR Part 20.203. The OBS operates one 8-hr shift per day, 5 days per week, 52 weeks per year.

Ore is hauled to the OBS from independent mines by truck. Thirty tons of ore per truck is typical, but smaller deliveries are accepted. An average of three to four truckloads per operating day is expected. When shipment to the uranium processing facility commences, a total between 11 and 12 truck trips per day can be expected.

Incoming ore trucks are weighed on a 3.0- x 21-m (10- x 70-ft) scale, unloaded onto the 30- x 46-m (100- x 150-ft) concrete ore receiving pad, and then reweighed to determine the quantity of ore delivered. A sample of ore is also taken for moisture determination because payment is based on assay per ton of dry ore. The ore receiving pad is partitioned with concrete walls so that ore from different mines can be segregated.

The ore is then processed (partially crushed) as described in the next section so that a small homogeneous sample can be obtained for uranium analysis. The ore is then truck-transported to the ore storage area where it is added to the appropriate storage pile.



1. TRUCK SCALE
2. OFFICE TRAILER
3. CONCRETE ORE-RECEIVING PAD
4. PRIMARY CRUSHER AND BAGHOUSE
5. ENCLOSED ORE CONVEYER
6. SAMPLING BUILDING AND BAGHOUSE
7. ORE STORAGE
8. DRIVEWAY

Fig. 3.1. Plateau Resources Ore Buying Station: Blanding, Utah.

3.2.2 Ore crushing, sampling, and storage

All mechanical equipment associated with crushing and sampling is enclosed or double enclosed except for the top of the ore-receiving bin. The loadout bin is only operated when loading the truck that is transporting the ore to the storage pile(s). A 1.2-m-long (4-ft) neoprene boot extends into the truck bed below the bin gate, minimizing potential dusting at this point. A side view of the crushing and sampling system is shown in Fig. 3.2, and a schematic showing the general operation of the system is shown in Fig. 3.3. Figure 3.1 shows the relationship of the crushing and sampling system to the overall OBS. The figures mentioned above exemplify in detail the operational steps discussed below.

A front-end loader moves ore from the concrete receiving pad and dumps it through a 30-cm x 30-cm (12-in. x 12-in.) grizzly (essentially a massive screen) into the 40-ton receiving bin. Oversize material [i.e., larger than 30 cm (12 in.)] must be manually broken, but this material is rarely found. A 91-cm-wide (36-in.) x 3.7-m-long (12-ft) apron feeder transports material passing this screen to a 6.4-cm x 6.4-cm (2.5-in x 2.5-in.) grizzly where the undersize [smaller than 6.4 cm (2.5 in.)] falls to an enclosed belt conveyer 46 cm (18 in.) wide by 54 m (178 ft) long. Oversize material enters the primary crusher, is crushed, and then falls to the belt conveyer. Air is exhausted from this area and sent to a baghouse for dust removal, as discussed in Sect. 3.5.1. The belt conveyer transports the ore to the primary sampler where 20% of the ore is diverted to a secondary crusher and the remaining 80% is gravity-fed to the loadout bin. The secondary crusher reduces the 20% sample to a maximum size of 1.8 cm (3/4 in.). A belt feeder transports this ore to a second sample where 10% (2% of the original ore) is diverted to a third small crusher and the remaining 90% (18% of the original ore) is gravity-fed to a bucket elevator that transports this ore to the loadout bin. The third, and last,

928 136

928 136

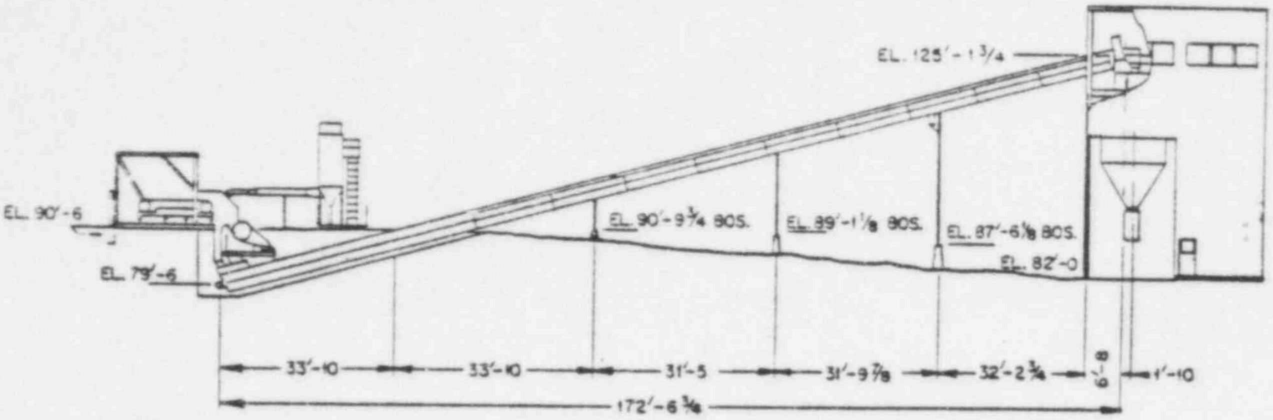


Fig. 3.2. General arrangement and equipment list for the OBS. Source: Plateau Resources, Limited, *Application for Source Material License*, Docket No. 40-8674, Apr. 3, 1978.

crusher reduces the ore sample to a maximum size of 0.4 cm (3/16 in.). A final sampler then diverts 5% (0.1% of the original ore) to a sample container and the remainder (1.9% of the original ore) is gravity-fed to the bucket elevator and transported to the 70-ton loadout bin. The design processing rate is 50 tons/hr. In summarizing the above discussion, one must keep in mind that

80% is crushed to smaller than 6.4 cm (2.5 in.),
18% is crushed to smaller than 1.8 cm (3/4 in.),
2% is crushed to smaller than 0.4 cm (3/16 in.),

and a 0.1% sample of the fine fraction is retained for analysis and the remaining ore transferred to the loadout bin.

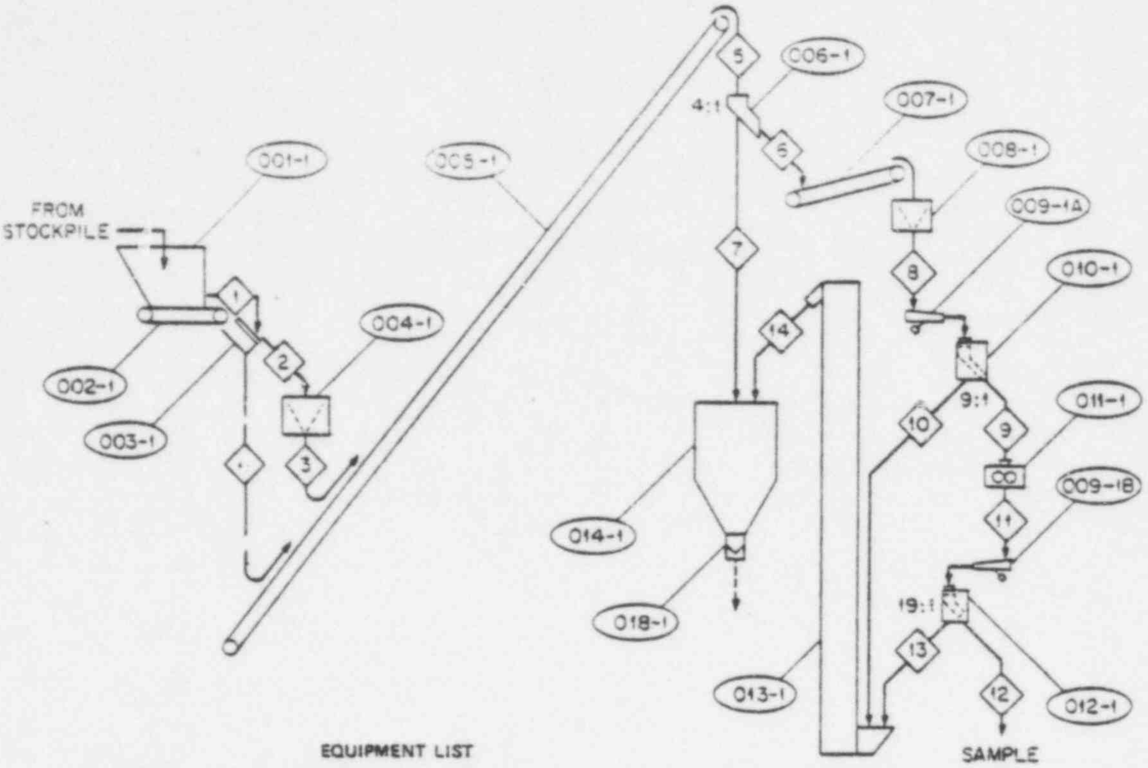
The ore sample is taken to a preparation area located at ground level adjacent to the sampling plant and prepared for analysis. The analysis is performed in a 3.7- x 15-m (12- x 50-ft) trailer adjacent to the ore receiving pad. A small insulated steel building is used for ore moisture determination.

After the ore sampling has been completed, the ore is discharged from the loadout bin into trucks and hauled to the 259- x 128-m (850- x 420-ft), gravel-surfaced, ore storage area. The ore is segregated by uranium content into stockpiles containing less than 0.1%, 0.1-0.2%, 0.21 to 0.40%, and greater than 0.40% uranium as U_3O_8.

Eventually the ore will be sent to a uranium processing facility for uranium extraction. At that time it will be loaded into trucks by a front-end loader, covered with canvas to prevent ore losses, and transported to the processing mill.

Unlike the tailings from a uranium milling operation, the crushed ore from the OBS is of relatively coarse rock size (Table 3.1) and low moisture content when compared with tailings. Because the slope of the stockpile faces is formed by the natural angle of repose, the pile(s) are very stable. Seepage is not considered to be a problem because of the absence of free water in the stockpiles. Water resulting from rain and snowfall onto the stockpiles is largely absorbed and, rather than being objectionable, is actually beneficial for the suppression of blowing particulate matter.

ES-4529



EQUIPMENT LIST

ITEM	DESCRIPTION	SIZE	HP
001-1	BIN WITH GRIZZLY (12 OPENINGS)	40 ton	–
002-1	APRON FEEDER	36 X 12 in.	7-1/2
003-1	GRIZZLY (2-1/2 OPENINGS) CHUTE		–
004-1	PRIMARY CRUSHER DENVER JAW	15 X 24 in.	50
005-1	BELT CONVEYOR	18 X 178 ft 6 in.	7-1/2
006-1	PRIMARY SAMPLE DEN. AUTO.	40 in. X HH	1-1/2
007-1	BELT FEEDER	18 in.	1
008-1	SECONDARY CRUSHER DEN. JAW	10 X 20 in.	25
009-1	A & B SEC. AND TERT. SAMPLER FEEDER	8 X 38 in.	
010-1	SECONDARY SAMPLER DEN VEZIN	28 in.	1/2
011-1	TERTIARY CRUSHER DEN CENTEROL	8 X 8 in.	5
012-1	TERTIARY SAMPLE DEN VEZIN	20 in.	1/3
013-1	REJECTS ELEVATOR – CONTINUOUS		2
014-1	LOADOUT BIN (BY CUSTOMER)	70 ton	
015-1	CHUTE WORK		
016-1	ENGINEERING		
017-1	MOTOR CONTROL CENTER CONTROL PANEL		
018-1	BIN GATE – ELECTRIC	24 X 24 in.	1/2
	DUST COLLECTION		
019-1	FAN		10
020-1	COMPRESSOR		7-1/2
021-1	AIR LOCK VALVE		1
022-1	AFTER COOLER (COMPRESSOR)		1/4

Fig. 3.3. Flow diagram for crushing and sampling system. Source: Plateau Resources, Limited, *Application for Source Material License*, Docket No. 40-8674, Apr. 3, 1978.

928 138

Table 3.1. A typical screen analysis of the crushed ore in the stockpile

Screen size	Ore size (mm)	Ore retained (%)	Ore passed (%)
Inches			
2	50.8	2.6	97.4
1	25.4	40.3	59.7
½	12.70	61.7	38.3
¼	6.35	70.9	29.1
Mesh[a]			
4	4.669	72.4	27.6
6	3.327	74.2	26.0
8	2.632	75.1	24.9
10	1.651	76.2	23.8
14	1.168	77.2	22.8
20	0.833	78.5	21.5
28	0.589	79.9	20.1
35	0.417	81.4	18.6
48	0.295	83.3	16.7
65	0.208	85.7	14.3
100	0.147	88.5	11.3
150	0.104	91.0	9.0
200	0.074	92.3	7.7
270	0.053	93.1	6.9
325	0.043	93.7	6.3
400	0.038	93.9	6.1

[a] Mesh sizes are derived from the Tyler Standard Sieve Scale.

3.3 NONRADIOACTIVE OBS WASTES AND EFFLUENTS

3.3.1 Sanitary and laboratory wastes

Liquid effluents from the sanitary system and the analytical laboratory are discharged to a 6.27-m^3 (1650-gal) septic tank and then to a leach field located adjacent to the office trailer. The analytical laboratory fume hood discharges directly to the atmosphere.

3.3.2 Toxic wastes from ore leaching

There are small quantities of potentially toxic wastes in the stored ore. A typical analysis of uranium ore of the type expected is given in Table 3.2. Some of these toxic wastes may be dissolved by rainfall entering the ore piles and then transported into the surface soil or water by mechanisms discussed in Sect. 3.5.3.1.

The staff believes that the only likely method of transport would be in the form of sediment carried by runoff water from a major rainfall event because all of the constituents of the ore were stable in a natural groundwater environment before mining and because the pH of rainfall in Utah is close enough to neutral that chemical changes will probably not occur. Potential exceptions to toxic waste releases are selenium, arsenic, and uranium, which may oxidize slowly in air in the presence of liquid water to more soluble forms than those found in situ.

Arsenic and selenium may occur up to 100 ppm in the ore, but it is unlikely that natural oxidation to arsenates or selenates will occur at a rate that would cause their concentrations in surface water offsite to exceed applicable limits, especially in view of the small amount of expected rainfall percolation and runoff in the region. The recommendation that the applicant provide a berm around the ore storage pad (Sect. 3.5.3.3) should preclude ore fines sediment transport to surface water with subsequent oxidation, solution, and pollution. The Mancos shale underlying the site effectively precludes the possibility of groundwater contamination.

Table 3.2. Typical analysis of expected type of purchased ore

(Values are percentages)

Element	Emission[a]	X-ray fluorescence[b]	Element	Emission[a]	X-ray fluorescence[b]
Si	Major		V	0.5	0.3
Al	8		Sr	0.003	0.02
Fe	3	1	Ba	0.003	0.08
Ca	1		Co		0.001
Mg	0.1		Zn		0.01
Na	1		As		0.01
Ti	0.2	0.1	Se		0.01
Mn	0.1	0.04	Rb		0.01
Cr	0.005		Zr		0.02
Cu	0.001	0.006	Mo		0.01
Ni	0.003	0.002	U		0.087
Pb		0.02	Y		0.005

[a] Emission by Spectran Laboratory, Denver, Colo.

[b] X-ray fluorescence by Fluo-X-Spec Laboratory, Denver, Colo.

3.4 RADIOACTIVE OBS EFFLUENTS

The only radioactive effluents from the OBS are those associated with handling and storage of uranium ore.

Airborne effluents are ore dust and radon. No radioactive liquid effluents are released from the crushing, sampling, or ore storage. There is a small potential for rainfall to leach the stored ore and to infiltrate the soil of the ore storage area (Sect. 3.5.3.1).

3.5 CONTROL OF OBS RADIOACTIVE EFFLUENTS

3.5.1 Ore dust control and release

3.5.1.1 Dust control during crushing and sampling

Dust control at the primary crusher is accomplished by an 11 m^3/min (400-cfm) suction air system exhausting through a 71-m^2 (763-ft^2) baghouse filter. The staff estimates a suction air velocity at the 30-cm x 30-cm (12-in. x 12-in.) grizzly in excess of 7.6 m/min (25 fpm), which should prevent nearly all of the dust formed as the gross ore is dumped into the receiving bin from reaching the external environment. The staff expects little potential for dust formation at this point because of natural moisture in the ore and the large size of the particulate. As a license condition, the applicant shall water spray delivered ore that may exhibit dust formation when dumped on the concrete ore receiving pad. At the primary crusher, suction air velocities in excess of 122 m/min (400 fpm) ensure dust control at this point. The entire crushing and sampling system is contained within the structure from this point.

All other crushing and sampling is conducted in the sampling tower. Dust suction lines are installed

1. above the first sampler,
2. above the secondary crusher,
3. above the tertiary crusher, and
4. at the entrance to the bucket elevator.

These suction lines transport any formed dust at 42 m^3/min (1500 cfm) to a second baghouse with 22 m^2 (236 ft^2) of filter area.

In addition to the baghouse filters, dusting is also minimize within the operating area by spraying the ore with detergent foam at several locations in the process line. The applicant (ER, p. 6-64) estimates that average daily dust emissions from the dust collector stacks and ore receiving pad will be 0.039 lb/hr (0.005 g/sec) during operating days and that annual average emissions will be 0.028 lb/hr (0.004 g/sec).

The staff, using the assumptions in ORNL/TM-4903, calculates a dust loss from the crushing and sampling operations as 0.0029 kg/day (0.0065 lb/day) and estimates another 0.29 kg/day (0.64 lb/day) released at the receiving pad during operating days. This value of 0.01 kg/hr (0.027 lb/hr) is comparable to the values estimated by the applicant. For impact assessment, the staff has used 0.45 kg (1 lb) of ore dust release per operating day, containing 2.4 times the gross ore activity or 746 pCi/g of uranium-238 and each of its daughters, with all of the dust in the respirable size range.

3.5.1.2 Dust control or the storage pads

Ore discharged from the loadout bin is trucked to the 3.3-ha (8.2-acre) graveled storage area where it is dumped into one of four storage stockpiles — depending on ore grade. The staff estimates that at maximum stockpile (71,000 tons) the ore pile will cover 1.4 ha (3.5 acres). The applicant proposes to control excess dust by water spraying or by the use of chemical binders. The staff agrees that both suggested methods are satisfactory if properly utilized. As a license condition, the applicant will be required to apply dust control measures whenever dust blowing from ore piles is apparent and at any time gusty winds above 40 km/hr (25 mph) are forecast.

The staff expects that the inactive portions of the ore piles will not be sources of fugitive dust under usual weather conditions because soil particles with a diameter less than 0.05 mm (0.002 in.) and sands larger than 1.0 mm (0.04 in.) in diameter hardly erode at all. About 78% of the stored ore is of a diameter greater than 1.0 mm (0.04 in.), and about 7% is smaller than 0.05 mm (0.002 in.). Soil erosion occurs most readily between 0.1 and 0.14 mm (0.004 and 0.006 in.) in diameter, and about 1.3% of the ore is in this size range. Surface erosion and transport of soil particles in this size range start with wind speeds of 26 to 31 km/hr (16 to 19 mph). Even a small amount of moisture (>2%) could raise the required wind velocities for transport to greater than 39 km/hr (24 mph). Using wind data from Farmington, New Mexico, the staff estimates that wind velocities at the site will exceed this magnitude less than 35 hr/year.

As the ore piles are sprinkled or sustain natural precipitation, the fines are transported into the pile matrix formed by the larger agglomerate, and only small amounts of the sizes that can be transported by wind will be available at the pile surface. Further minimization of potential dust formation occurs because of surface crusting of the ore. These natural phenomena together with proposed mitigating measures should adequately prevent wind-formed dust from inactive sections of the ore storage piles.

For dust release from the active sections of the ore storage piles, the staff has assumed 0.4 ha (1 acre) involved at any one time. Operations continue for 5 days per week, 8 hr/day, 52 weeks per year (2080 hr/year) and include time for pile-shaping operations. At 4.5 kg/hr·ha (4 lb/hr·acre) of fugitive dust,[1] 0.12 g/sec will enter the external environment on an annual average basis.

The applicant estimated total releases for pile loading, vehicular traffic, wind erosion, and pile loadout as 10,471 kg/year (23,084 lb/year) or 0.33 g/sec on an annual basis (ER, pp. 6-106 and 6-107). The applicant estimated average ore dust emissions as 3248 kg/year (7160 lb/year) between 1977 and 1980 compared to the staff estimate of 3774 kg/year (8320 lb/year).

For impact assessment, the staff has chosen to use 0.12 g/sec of ore dust released together with an additional 0.24 g/sec of uncontaminated natural soil material from truck traffic over the graveled roads and areas on the site.

/745?

3.5.1.3 Dust release summary

The uranium ore dust released to the environment stems from two sources: (1) the ore-receiving pad and crushing and sampling operations, 118 kg/year (260 lb/year), and (2) the ore stockpile area, including loading, unloading, and pile-shaping, 3774 kg/year (8320 lb/year).

A total release of 3892 kg/year (8580 lb/year) at an annual average rate of 0.123 g/sec with the ore containing 746 pCi/g of uranium-238 (2.9×10^{-3} Ci/year) in secular equilibrium with all of its daughters. For radiological calculation all of this ore was assumed in the respirable size range and insoluble.

For particulate calculations concerning air quality the total dust released was estimated to be as high as 9.1 kg/hr (20 lb/hr) at times (2.5 g/sec) with an annual average of 0.36 g/sec.

3.5.2 Radon emissions

No control measures are available to prevent radon release.

3.5.2.1 Radon release from the ore piles

The major source of radon is from the radioactive decay of radium-226 produced in the stored ore. The radon then diffuses from its point of origin into the capillary network formed by the ore particles and diffuses through this network into the atmosphere.

Only a fraction of the formed radon-222 escapes from the particles in which it is formed. Experimental evidence[2-4] suggests an average value for this "emanation factor" of 20 to 25%. Molecular diffusion causes the movement from the higher concentration in the ore pile to the lower concentrations in the atmosphere. The instantaneous flux across a unit area of the ore pile is influenced by such factors as atmospheric pressure, temperature differentials, wind speeds, atmospheric stability, and the presence or absence of either moisture or freezing conditions.

The applicant estimates that 269 Ci/year will be released from the ore storage area. The staff, using data from old tailings piles[5] at Mexican Flat, Utah, Salt Lake City, Utah, and Tuba City, Arizona, calculates an expected release of $3.81 \pm 1.2 \times 10^{-3}$ Ci/year per ton of ore. When the applicant has 71,000 tons of ore in storage, 217 ± 88 Ci/year of release could be expected. The applicant will average less than this level of storage. The staff has selected 217 Ci/year of radon-222 release as a conservative value suitable for assessment purposes.

3.5.2.2 Radon release from crushing and sampling

At secular equilibrium the average ton of crushed ore contains 2.8×10^{-4} Ci of radon-222. The applicant expects to crush and sample 24,000 tons of ore per year, containing not more than 6.8 Ci of radon. The staff's opinion is that incoming ore will not be an equilibrium and that all of the contained radon will not be released; however, for assessment purposes the staff has chosen 7 Ci/year of radon from the crushing and sampling operation.

3.5.2.3 Summary of radon releases

The total radon released used in the staff's environmental assessment is 224 Ci/year. The uncertainty of this numerical value is high, but because the applicant had only 17,000 tons of ore in storage in April 1978 and expects to add only 2000 tons per month until a peak storage of 71,000 tons is reached (after which the ore stockpile will reduce in size by at least 2500 tons per month), the staff considers the value chosen conservative.

3.5.3 Radioactivity transport by precipitation

3.5.3.1 Transport mechanisms

The only way ore, or its constituents, can be moved from the ore piles except as dust is by the action of flowing water. The source of this water is natural precipitation. Over a

30-year period (1931 to 1960), the largest observed one-day precipitation was 5.0 cm (1.98 in.). Such a rainfall would not be expected to do more than transport some of the ore fines at the pile edges into the matrix of the gravel base underlying the stored ore.

The main ore pile structure would merely absorb the rain, which should not penetrate more than 0.3 m (1 ft) into the pile per inch of rain (assuming that field capacity is about 15% moisture and initial moisture is about 7%).

From 1951 through 1974 the maximum monthly precipitation at Blanding was 16.8 cm (6.61 in.) in October, with the next greatest monthly value being 12.6 cm (4.96 in.) in August. Evaporation during August should exceed the rainfall value so that saturation of the ore piles would not occur. In October evaporation is much smaller, and it is likely that ore pile sections less than 1.8 m (6 ft) in depth could become saturated with the resulting "mud" slurrying and spreading over and into the underlying gravel. The staff considers is unlikely that any substantial transport of ore from the gravel ore storage pad would occur via this mechanism. Some ore fines, however, would be carried into the dirt below the gravel and would eventually have to be disposed of (Sect. 3.6.1).

3.5.3.2 Potential groundwater contamination

The drillers' log for a water well on the site showed about 1.8 m (6 ft) of quaternary alluvium as surface soil underlain by 10.4 m (34 ft) of Mancos shale. This nearly impervious shale provides a barrier between the stored ore and the Dakota sandstone, the most shallow groundwater source in the vicinity of the OBS. No significant potential for groundwater contamination by rainfall leaching of ore exists.

3.5.3.3 Potential surface-water contamination

Flooding is the only potential cause of offsite surface-water contamination and then only if gross transport of ore fines as sediment in the runoff occurs. The staff believes that this possibility is very remote for the following reasons:

1. The total drainage area above the OBS bounded by the Corral Creek drainage divide and Highways 95 and 163 is about 1.6 sq km (0.6 sq mile).
2. The probable maximum precipitation (6-hr duration) is 27.9 cm (11 in.) (ER, p. 2-31) or an average of 1.3×10^{-5} m/sec (4.2×10^{-5} fps).
3. If one assumes 100% runoff, 20 m^3/sec (710 cfs) would be produced from this drainage, and most of this drainage would flow east into Corral Creek through culverts under Highway 163.
4. The ditches on each side of Highway 95, north of the OBS, could drain 370 cfs without flooding. Therefore, only the catchment area south of Highway 95 intercepting the ore storage pad will provide floodwater for ore fines transport. The staff estimates the area to be about 7.4×10^4 m^2 (8×10^5 ft^2) which (using previous assumptions) would provide 33.6 cfs of flood flow from about 7.3 ha (18 acres).

The applicant has estimated that at least a dilution factor of 10 would be achieved by the time the runoff enters Corral Creek and that a further dilution factor of 165 would be realized at Corral Creek. More dilution would occur as the runoff progressed further downstream.

The staff concurs with this analysis with one exception; some minor contamination could occur in the drainage ditches along Highway 163 by sediment precipitation. The low specific activity of the ore would preclude any significant risk to public health and safety even if this event were to occur, but present guidelines could be exceeded.

The staff considers that the above scenario is extremely unlikely but requires that the applicant provide an earthen berm around the ore storage pad so that even such an unlikely event is precluded completely. This precaution will require less than 770 m^3 (1000 yd^3) of earth and will represent a minimal expense to the applicant.

Executive Order 11918 requires that installations such as this one not be located on existing floodplains. The nearest floodplain is about 0.5 mile from the site and is at least 100 ft lower than the site.

3.6 OBS DECOMMISSIONING

3.6.1 Decommissioning

At the end of the useful life of the OBS, the site will be decontaminated to a level that will permit its unrestricted use.

The physical equipment used at the site (such as trailers, crushers, trucks, scales, loaders, etc.) will be decontaminated and transferred for use elsewhere or buried in a licensed burial area. The staff expects no difficulty in cleaning such equipment to meet applicable standards for unrestricted use by the general public.

Concrete used for roads, ore storage pads, and foundations (if contaminated) can be cleaned to levels suitable for possible use, after crushing, as aggregate in other concrete structures. Much of the gravel on which the ore was stored will contain enough uranium ore fines that it can be transported and used as low-grade blendings ore at the applicant's uranium mill either at a profit or no net loss.

Cleanup of soils, contaminated buildings, and structures will be done in accordance with NRC regulatory guidance and requirements in force at the time of decommissioning such as those contained in the Staff Technical Position, Fuel Processing and Fabrication Branch, "Interim Land Cleanup Criteria for Decommissioning Uranium Mill Sites," May 1978.

If the applicant disposes of this estimated quantity of contaminated soil in his Shootering Canyon tailings disposal facility, the staff approximates the cost to be

5600 yd of excavation at $1.00 yd	$ 5,600
7500 tons trucked 130 miles at $0.085 per mile	82,875
Site borrow, fill and grade, 5600 yd at $1.00 yd	5,600
	$94,075

The final license will contain a condition which requires removal of any contaminated soil to a licensed burial area.

3.6.2 Reclamation

The applicant has proposed to place 10 to 15 cm (4 to 6 in.) of topsoil over all areas where the soil was removed during construction of the OBS or stripped because of radioactive contamination and then tie this topsoil to the subsoil by ripping. This soil will be fertilized if required and mulched with straw at a rate of 2 tons per acre.

Bluebunch wheatgrass and Indian ricegrass will then be drill-seeded at 7 and 2 kg/ha (6 and 2 lb/acre) respectively. Seeding will take place in midsummer before the rainy season. The fence surrounding the OBS will remain for at least two growing seasons to protect the area until the new vegetation is established. If necessary, reseeding will be done. The staff estimates revegetation costs to be $5925 and total reclamation costs to be $100,000.

If the applicant continues to operate the OBS for the proposed mill operating period of 15 years and if the buying station continues to purchase 2000 tons per month of ore, the decommissioning and reclamation costs will be less than 30¢ per ton of ore.

As a license condition, the applicant will be required to file a performance bond with the State of Utah to ensure that the above reclamation is performed regardless of the eventual method of contaminated soil disposal. When reclamation is completed, the site will be available for unrestricted use by the general public for any suitable activity.

REFERENCES FOR SECTION 3

1. U.S. Environmental Protection Agency, *Investigation of Fugitive Dust — Sources, Emissions, and Controls*, Publication AP TD1582, Research Triangle Park, N.C., 1973.

2. M. J. J. Culot, H. G. Olson, and K. J. Schiager, *Radon Progeny Control in Buildings, Final Report*, U.S. Atomic Energy Commission Report COO-2273-1, Colorado State University, Fort Collins, May 1973.

3. T. I. Sisigina, "Assessment of Radon Emanation from the Surface of Extensive Territories," pp. 239-244 in *Nuclear Meteorology*, K. P. Makhon'ko and S. G. Malakhow, Eds., Report TT-74-50011, Gidrometioiz, Moscow, 1972.

4. K. Megumi and T. Mamuro, "Emanation and Exhalation of Radon and Thoron Gases from Soil Particles," *J. Geophys. Res.*, 79: 3357-3360 (1974).

5. W. A. Goldsmith, " Radiological Aspects of Uranium-Milling Sites: An Overview," *Nucl. Saf.* 17(6): 722-732 (1976).

928 145

4. ENVIRONMENTAL IMPACTS

4.1 AIR QUALITY

The principal nonradiological air pollutants associated with the completed construction of the Plateau Resources Ore Buying Station (OBS) were fugitive dust emissions and minor amounts of gaseous emissions from internal combustion engines. Construction took approximately five months and included disturbance of only about 6 ha (14 acres) of land. Construction included installation of a prefabricated office and laboratory, the truck scale, and the ore receiving pad and erection of the crushing and sampling facilities. Although the air pollutants associated with construction activities were not monitored, the relatively small area of land and short duration of construction probably precluded a significant impact to local air quality.

The most significant nonradiological emission associated with operation of the OBS is dust generated by vehicular traffic and ore stockpiling operations. Fugitive dust is expected to be the highest during late 1979 when stockpiles are at their maximum size (71,000 tons) and when ore is being removed for processing (Application for Source Material Licence ER, Sect. 6.2.3). If a maximum of 4830 tons of ore is removed from the OBS per month, dust emissions during the year are estimated by the applicant to be 10,470 kg (23,084 lb), with an average emission rate of about 0.33 gps (2.6 lb/hr). Lesser amounts are anticipated during operations before removal of the ore. The average ore-dust emissions between 1977 and 1980 are estimated by the applicant to be 0.10 gps, or 7160 lb/year (Application for Source Material License ER, Appendix B, p. 6-107). The staff has estimated the maximum annual average emission rate of particulates to be 0.36 gps (2.9 lb/hr) during ore removal. Average ore-dust emissions between 1977 and 1980 are estimated by the staff to be 0.12 gps (0.95 lb/hr) (Sect. 3.5.1). Using dispersion coefficients based on modified meteorological data from Farmington, New Mexico (Application for Source Material License ER, Sect. 2.2, and Appendix B), the applicant estimates that the maximum annual average concentration of particulates at the south property boundary will be about 27 $\mu g/m^3$. Under worst-case meteorological conditions [6 hr of persistent wind direction with F stability and a wind speed of 2.5 m/sec (0.2 fps)], the applicant calculated an expected 24-hr average suspended particulate concentration to be about 82 $\mu g/m^3$ at the western boundary of the OBS property.

Approximately 30 tons of ore at one time are hauled to the OBS by truck (Application for Source Material License ER, Sect. 6.2.2). The applicant is required to spray water on delivered ore that exhibits dust formation when dumped onto the pad (Sect. 3.5.1.1). The ore is hauled by trucks to the ore storage area, which is surfaced with gravel. The applicant employs several dust control measures during the crushing and sampling operation (Sects. 3.2.2 and 3.5.1.1). Dust control at the ore storage pads is discussed in Sect. 3.5.1.2. The applicant proposes to control dust from the stockpiles by the use of either water sprays or chemical binders. The staff finds these methods acceptable and, for reasons discussed in Sect. 3.5.1.2, requires the applicant to apply dust control measures whenever blowing dust from ore piles is apparent and at times when winds with gusts above 40 km/hr (25 mph) are forecast. Ore transported to the processing mill will be covered with canvas.

The trucks and front-end loader used to move the ore will emit minor amounts of oxides of nitrogen, carbon monoxide, unburned hydrocarbons, and sulfur dioxide. The total quantity of these combustion products released to the atmosphere is dependent on (1) the number and types of equipment in use and (2) their frequency and duration of operation. At present, three to four trucks arrive at the OBS per operating day; when shipment of the ore to the processing mill begins, the number of trucks may increase to 12 per day (Sect. 3.2.1). This relatively small number of trucks is not expected to affect significantly the air quality of the region.

Fumes from the analytical laboratory are collected in a hood and discharged to the atmosphere. Based on the small size of the laboratory and the analyses performed, it is the staff's opinion that such fumes should not significantly affect the air quality of the area.

4.2 LAND USE

4.2.1 Land resources

The OBS occupies approximately 6 ha (14 acres) of land located centrally within the 25-ha (63-acre) site owned by the applicant. Because the OBS is located on an abandoned agricultural field and because of the large amount of agricultural land in the region (Sect. 2.5.1.3 and Fig. 2.5), construction of the facility did not result in any significant land use impacts. Also, continued operation of the facility is not expected to produce any adverse land use impacts. Although the station site itself was fallow field that supported weeds and other invader species prior to construction, the applicant plans to restore the disturbed lands to a productive condition for livestock upon termination of the project (Application for Source Material License ER, Sect. 6.2.7).

4.2.2 Historical and archaeological resources

Operation of the OBS does not affect local historical or archaeological resources.

4.3 WATER

4.3.1 Surface water

The construction and operation of the OBS have had minimal impact on the surface waters of the project site or vicinity. During construction, the ground surface was disturbed by grading, soil and topsoil storage, and other construction-related activities. The soils of the project site are normally subject to extensive erosion due to lack of consolidation and poor vegetative cover (Sects. 2.8 and 2.9.1). In the arid climate experienced at the project site, such construction activities could have slightly increased sediment runoff, but only during periods of heavy, erosion-producing rainfall.

An analysis of the potential toxic products produced by the weathering of stored uranium (Table 3.2) indicates the possible oxidation of arsenic and selenium in the ore to water soluble forms. Therefore, a possible source of aquatic impact as a result of OBS operation would be the rainfall runoff transfer of these and other potentially toxic substances in particulate or soluable form to Corral Creek [about 1.6 km (1 mile) to the south-southeast of the OBS]. The introduction of such material into Corral Creek could permit further transport of these substances southward to Recapture Creek and the San Juan River under extreme rainfall conditions. However, the relatively flat topography, the arid climate, and the distance of the OBS from Corral Creek indicate that this possibility is remote. The staff is requiring the applicant to construct a runoff diversion/retention barrier around the ore stockpile to reduce further the possibility of ore material transfer to adjacent watercourses under adverse meteorological conditions (carried either by runoff originating upslope from the OBS and impinging on the stockpiles or by direct precipitation on the ore stockpiles and subsequent runoff). See also Sect. 3.5.3.3.

4.3.2 Groundwater

Plateau Resources received a permit to appropriate groundwater from the Utah Department of Natural Resources in 1977. A well (OBS Well No. 1) was drilled to the Dakota Sandstone aquifer; however, the quality of the water was too poor for domestic use at the station. Another well (OBS Well No. 2) was drilled adjacent to Well No. 1 into the lower Salt Wash Member of the Morrison Formation. Water from this well is being used at the OBS. Well No. 1 was not capped so that a water quality sampling source could be provided.

No noticeable effect on groundwater resources is expected from OBS operations. The staff estimates use of less than 100 acre-ft/year from an aquifer containing several thousand acre-feet per square mile.

4.4 MINERAL RESOURCES

OBS operation does not affect mineral resources.

4.5 SOILS

Construction and operation of the OBS have disturbed about 6 ha (14 acres) of soil. Stripping and stockpiling of topsoil material disrupted existing physical, chemical, and biotic soil processes. Although the topsoil will be replaced upon termination of the project, the natural soil productivity may be somewhat reduced, and removal of vegetative cover on the site may have accelerated wind and water erosion. However, this impact lasted only a few months during construction. Soil over much of the site is now stabilized by gravel and established structures. Soil compaction resulting from grading and operation of heavy equipment also increases the potential for runoff, erosion, and sedimentation. However, because of the relatively flat terrain of the mesa, low precipitation, and sparse vegetation on the site before construction, the OBS activities should not create a significant increase in soil erosion on the site. To prevent runoff from the ore stockpile area, the staff has also required the applicant to construct a runoff diversion/ rention barrier around the stockpiles (Sect. 3.5.3.3).

The length of time required to restore the soil to nearly its original condition is not known. The applicant plans to restore the disturbed lands to a productive condition for livestock (Application for Source Material License ER, Sect. 6.2.7). Reclamation plans are discussed in Sect. 6.2. The staff recommends that reclamation efforts begin as soon as practical following decommissioning of the facility. If the reclamation effort is successful, long-term impacts to the soil are not expected to be significant.[1]

4.6 BIOTA

4.6.1 Terrestrial

Old-field vegetation was removed from approximately 6 ha (14 acres) during OBS construction. This loss represents less than 0.2% of the agricultural land within a 4.8-km (3-mile) radius of the site (Fig. 2.5) and is, therefore, not considered to be a significant impact to the community. Animals that occupied the site prior to construction were displaced or destroyed when the facility was built. Many of the individuals that were displaced may have been lost because of either predation or increased competition for food, territory, and other habitat requirements. Destruction of these species is not considered to be a significant impact because these individuals comprise a very small percentage of the total regional populations. Habitat disturbed as a result of construction and operation of the OBS represents less than 0.007% of similar habitat in the county.

Human activity, traffic, and noise associated with construction and operation of the OBS are expected to have a negligible impact on the wildlife in the vicinity. Noise will initially cause migration by some wildlife away from the immediate site vicinity, but those that remain or return will generally become accustomed to the noise and activity.[2] Although the increase in animal mortality because of highway collisions cannot be predicted, such an impact is expected to be negligible.

Loss of soil particles as a result of construction and operation of the OBS is discussed in Sects. 4.1 and 4.5. Wind erosion is minimized using a variety of methods (Sect. 3.5.1.2), and water erosion is not expected to be a significant problem because of the relativity flat terrain, sandy soil, and low precipitation. However, particles from the ore stockpiles could be loosened by precipitation and carried off the applicant's property. The resultant ore-fines sediment could contain toxic compounds of selenium and arsenic, which could have a deleterious effect on the surrounding vegetation and, indirectly, on the wildlife. To minimize the probability of this type of event, the staff has required the applicant to construct a runoff diversion/retention barrier around the ore stockpiles (Sect. 3.5.3.3).

Vegetation adjacent to the OBS will be affected by settling dust and other air pollutants associated with OBS construction and operation (Sect. 4.1). Although the reduction in photosynthetic activity and vigor of the vegetation cannot be determined, such an impact is expected to be negligible.

Because of the site was an old agricultural field prior to construction, none of the proposed endangered plant species[3] that have documented distributions in San Juan County[4] are expected to occur on the facility site or immediate vicinity. Although the range of the endangered species[5] American peregrine falcon (*Falco peregrinus anatum*) and bald eagle (*Haliaeetus Leucocephalus*) includes the vicinity of the OBS, lack of suitable habitat makes it unlikely that these species will utilize the project site for feeding or nesting. Therefore, construction and operation of the OBS should have no significant impact on endangered species.

4.6.2 Aquatic biota

The operation of the uranium OBS does not involve direct discharge into any surface waters. It is possible that runoff carrying toxic substances (e.g. arsenic and selenium) from the ore stockpiles might reach Corral Creek and subsequently enter Recapture Creek and the San Juan River. However, the relatively flat topography, arid climate, and distance of the OBS from the potential receiving water bodies preclude this possibility. The staff also requires that the applicant construct a runoff diversion/retention barrier around the stockpiles to further reduce the possibility of ore material transfer to Corral Creek.

4.7 RADIOLOGICAL IMPACTS

The sources of radiological impact to the environmental area of the OBS are the natural radiation background and the contribution of the plant's effluents. The exposed population is comprised of the workers at the site and the public within a radius of 80 km (50 miles) of the plant.

4.7.1 Preoperational radiation environment

The preoperational radiation environment at the OBS site represented a combination of the natural radiation environment and radiation resulting from prior mining operations. The natural radiation environment is a result of cosmic radiation, cosmogenic radioactivity, and terrestrial radioactivity (Sect. 2.10). Radiation background at the site is not presently affected by other facilities; however, a uranium ore milling operation proposed for a site approximately 4.8 km (3 miles) south of the plant will possibly have some slight effect on the background levels. The dose to the total body from all sources of natural background radiation, estimated by actual site measurements and from literature data, is about 207 millirems per year for the plant site area.

4.7.2 Radiological impacts from routine operations

Radiation doses were estimated for both individuals and the general population living near the OBS site. The estimates were calculated on the basis of recommendations of the International Commission on Radiological Protection (ICRP-II)[6] and the report of the Task Group on Lung Dynamics for Committee II of ICRP.[7] The following information was used in the dose calculations: (1) estimates of predicted radioactive releases presented in Sect. 3.2.4 and Appendix A, (2) site meteorological and hydrological considerations discussed in Sect. 2.1 and 2.6 and Appendix A, and (3) land use information discussed in Sect. 2.5.

AIRDOS-II, a FORTRAN computer code,[8] was used to estimate individual and population dose resulting from continuous atmospheric releases of airborne radioactive materials from the storage and crushing of ore-bearing materials. Where possible, site-specific environmental parameters were used in dose determinations. Where the information was not available, conservative parameters were used; that is, values were chosen to maximize intake by man. Reducing factors, such as shielding provided by dwellings and time spend away from home, were not considered. Also, because the nearest residents have vegetable gardens, it was assumed that all the produce and meat consumed was raised at the residence. A more detailed discussion of methods used in estimating radiation dose is provided in Appendix A of this report and in ORNL-4992.[9]

4.7.3 Exposure pathways

The potential environmental exposure pathways for radiation exposure to man are presented shematically in Fig. 4.1. The estimates of dose commitments to man were made for radioactive effluent discharges to the environment using actual locations and characteristics of the plant site environs and the actual pathways by which members of the public can be exposed to the discharges. Included in the analysis are dose-commitment evaluations of three effluent categories: (1) pathways associated with particulate releases to the atmosphere, (2) pathways associated with gaseous releases to the atmosphere, and (3) pathways associated with seepage to surface water and groundwater. For the OBS operation, the pathways of importance for producing the most significant dose commitment to individuals and population are (1) inhalation of radon and its daughters, (2) inhalation of radioactive dust particles, and (3) ingestion of radionuclides in beef and vegetables. All other exposure pathways are estimated to contribute less significant dose commitments.

4.7.4 Radiation dose commitments to individuals

A summary of the dose commitments to individuals at selected offsite locations where doses are calculated to be the largest are listed in Table 4.1. Estimates are presented for the significant exposure pathways discussed in Sect. 4.8.3. The highest doses received by individuals living in the vicinity of the OBS occur at the nearest residence, approximately 2.6 km (1.6 miles) northeast of the plant effluents. The highest annual dose commitments were 0.40 millirem to the total body, 1.9 millirems to the bone, and 0.63 millirem to the lungs.

An evaluation of the potential land used near the OBS was carried out to identify locations where individuals might live permanently during station operations. This investigation revealed that the nearest potential homesite would be 0.97 km (0.6 mile) northeast of the plant effluents. The dose commitments for this site are also shown in Table 4.1. The highest annual dose commitments are 2.5 millirems to the total body, 12.1 millirems to the bone, and 2.7 millirems to the lungs.

In the case of the dose commitment estimated for the nearest resident, the major contributing radionuclides to the total-body dose were radium-226 (74%), lead-210 (13%), and thorium-230 (8%). Similarly, for the bone dose, radium-226 (42%), lead-210 (37%), and thorium-230 (19%) were the major contributors. The dose to the lungs, however, was due primarily to radon-222 (5%) and its short-lived daughters, polonium-218 (29%) and lead-214 (42%).

At locations further from the station operations (Table 4.2), individuals will receive lower doses than those estimated for the two locations shown in Table 4.1. A brief discussion of various pathways for radiation exposure to individuals living near the station site is presented in the following sections.

4.7.4.1 Internal exposures

Air pathways

The average rate of release of airborne radioactivity during the ore grinding and storage operations is given in Table A.3 (Appendix A) and discussed in Sect. 3.5.

The exposure pathways for air are by inhalation of airborne radioactive particles (soluble and insoluble). The fraction of the radioactivity deposited in the nasopharynx, trachea, and the bronchial tree and pulmonary region is dependent upon the particulate aerodynamic-size distribution, the physiological state of the body (i.e., active versus basal or sedentary state affecting the total lung volume and respiratory frequency), and the solubility in the lung fluid. The 50-year dose commitments for continuous inhalation were calculated on the basis of the recommendations of the International Commission on Radiological Protection (ICRP), Committee II Report[6] and the Task Group on Lung Dynamics for Committee II of ICRP.[7] The dose conversion factors for inhaled radionuclides[10] based on the Task Group lung model are listed in Appendix A, Tables A.5 and A.6. Other pertinent dose conversion factors are from ORNL-4992.[9] The doses by pathway for the nearest resident and the nearest potential resident are shown in Table 4.1. Essentially all of the lung dose (85%) resulted from the innalation pathway while only 11% of the total-body dose and 20% of the bone were due to this pathway. The dispersion factors (χ/Q values) for the OBS are presented in Appendix A as a function of the

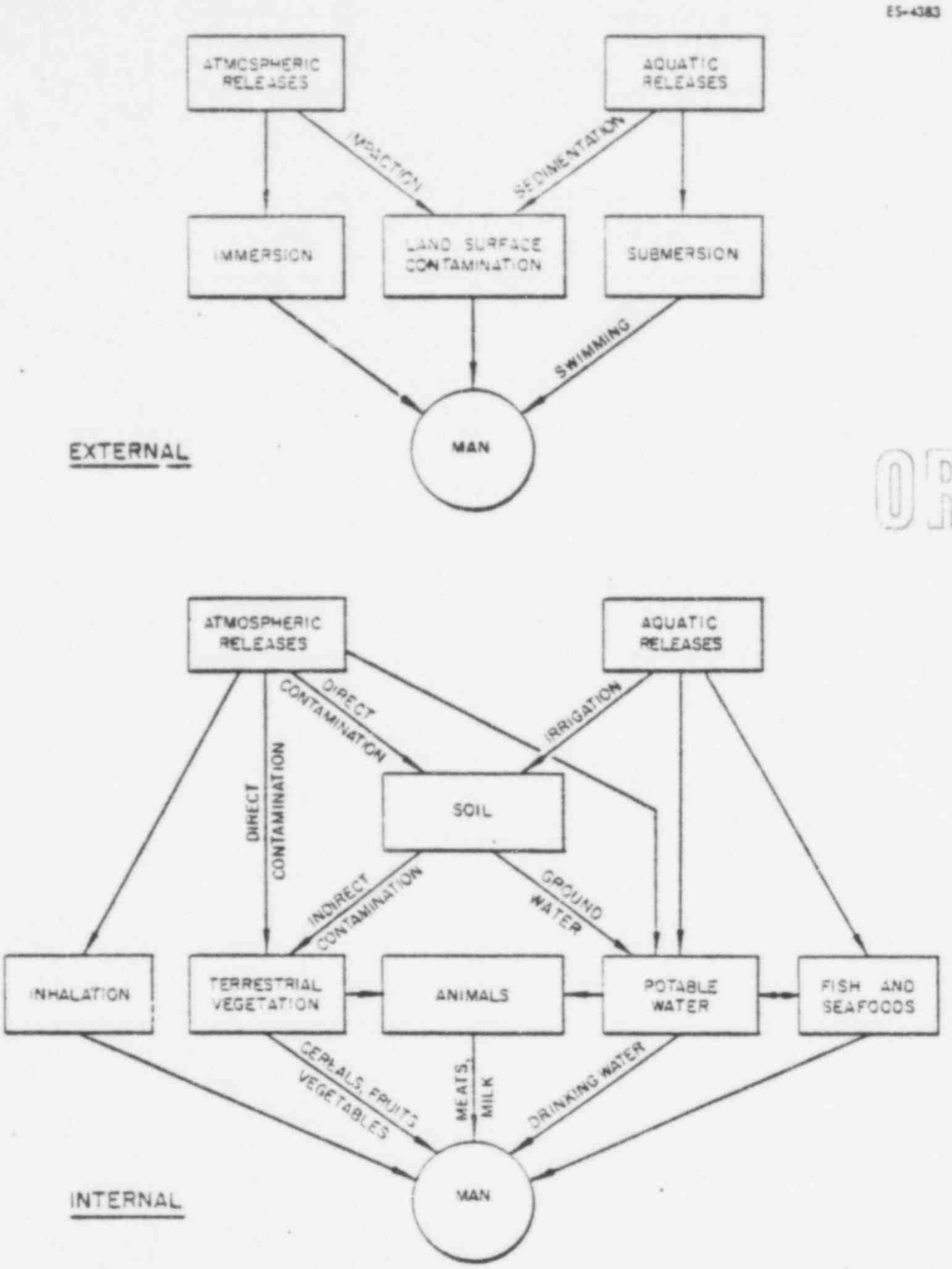


Fig. 4.1. Pathways for external and internal exposure in man.

distance from the site. The airborne release rates of radionuclides for the various sources are given in Table A.3 of Appendix A.

Water pathways

The OBS ore grinding operation will not release radioactive waste directly into surface waters. However, the potential of the contamination of groundwater by seepage of leached radionuclides from the ore storage pile does exist. Routine sampling of nearby wells and springs originating from the groundwater will be performed to monitor the potential seepage. It is likely that all the moisture produced in this arid area will be absorbed by the ore piles and will not result in leaching to the groundwater or surface water. Therefore, no significant contribution to dose is expected from the storage of ore via the groundwater pathway.

928 151

Table 4.1. Annual dose commitments[a] to individuals from radioactive releases from the Plateau Resources Ore Buying Station

Location	Exposure pathway	Dose (millirems per year)				
		Total body	Bone	Kidney	Lung	Bronchial epithelium
Nearest permanent residence, 2.6 km (1.6 miles) NE of the plant	Inhalation[b]	0.033	0.234	0.107	1.37	3.43
	Ingestion	0.249	2.640	0.411	0.249	
	External	0.018	0.026	0.014	0.015	
Total		0.300	2.900	0.532	1.64	3.43
Nearest site of potential permanent residence, 0.97 km (0.6 mile) NE of the plant	Inhalation[b]	0.217	1.530	0.700	8.98	17.1
	Ingestion	1.570	16.650	2.590	1.570	
	External	0.110	0.157	0.862	0.098	
Total		1.897	18.337	4.152	10.65	17.1

[a] Doses integrated over a 50-year period from one year of inhalation or ingestion.

[b] Doses to total body, bone, kidney, and lungs are those resulting from inhalation of particulates of U-234, U-238, Th-230, Ra-226, Pb-210, and Po-210. The doses to the bronchial epithelium are those from inhalation of radon daughters.

Table 4.2. Annual population dose commitments to the 1970 population[a] within an 80-km (50-mile) radius of the plant site

Receptor organ	Dose (man-rems)	
	Plant effluents	Natural background
Total body[b]	0.033	3,664
Lung[c]	2.436	17,045
Bone	0.322	4,407

[a] Based on a population of 1.77×10^4 persons.

[b] Total body dose from background based on actual measurements and literature data is 207 millirems per year (Sect. 2.10).

[c] Dose to the lung includes dose to the bronchial epithelium from Rn-222 daughters. With normal background conditions, continuous exposure to the mean concentration (500 to 1000 pCi/m^3) of Rn-222 in the air would deliver a dose of 500 to 1000 millirems per year to the bronchial epithelium [National Academy of Science—National Research Council, *The Effects on Populations of Exposures to Low Levels of Ionizing Radiation, Report of the Advisory Committee on the Biological Effects of Ionizing Radiation*, (BEIR), U.S. Government Printing Office, Washington, D.C., 1972].

Food pathways

A survey of residents living near the site indicated that some cultivate vegetable gardens. For this assessment, it was assumed that all food consumed by the individual was produced at the residence. This assumption is conservative; thus, the individual dose estimates will be higher than actually expected. It was assumed that the individual consumed 0.25 kg (0.55 lb) of vegetables, 0.30 kg (0.66 lb) of beef, and 1 liter (0.2 gal) of milk daily, which would result in the maximum annual dose commitments shown in Table 4.1. Approximately 85% of the total-body dose and bone dose was via the ingestion pathway.

4.7.4.2 External exposure

The concentration of radioactivity deposited on the ground was based on a 20-year lifetime for the station operation. The methodology of air dispersion and deposition has been discussed in detail.[3] External exposures from immersion in contaminated air and from contaminated surfaces were considered. As shown in Table 4.1, external gamma radiation exposures to individuals living in the area are quite low.

4.7.5 Radiation dose commitments to populations

The population dose commitments based on the 1970 population within an 80-km (50 mile) radius of the station are shown in Table 4.2. Similar natural background doses are also presented for comparison. Dose commitments resulting from normal operations of the station represent only a very small increase in the population radiation dose rates from natural background sources.

4.7.6 Evaluation of radiological impacts on the public

The predicted annual individual commitments (Table 4.1) resulting from the normal operations of the station are only a small fraction of the present NRC dose limits for members of the public outside of restricted areas as specified in 10 CFR Part 20, Standards for Protection Against Radiation. The predicted dose commitments are also well below the EPA Radiation Protection Standards for Normal Operations of the Uranium Fuel Cycle (40 CFR Part 190), which is to become effective for uranium ore buying stations by December 1980. Table 4.3 presents a comparison of the predicted maximum annual dose commitments to individuals living at the nearest residence to the OBS with radiation standards for individual members of the public.

Table 4.3. Comparison of annual dose commitments to individuals[a] with radiation protection standards

Receptor organs	Estimated annual dose commitments	Radiation protection standards	Fraction of standards
	Present NRC regulation (10 CFR Part 20)		
Total body	0.30 millirems per year	500 millirems per year	0.0006
Lung	1.674 millirems per year	1500 millirems per year	0.0011
Kidney	0.532 millirems per year	1500 millirems per year	0.00035
Bone	2.900 millirems per year	3000 millirems per year	0.0001
Bronchial epithelium	0.000017 WL[b]	0.033 WL[b]	0.00052
	Future EPA standards (40 CFR Part 190)		
Total body	0.30 millirems per year	25 millirems per year	0.012
Lung	1.68 millirems per year	25 millirems per year	0.067
Kidney	0.53 millirems per year	25 millirems per year	0.021
Bone	2.90 millirems per year	25 millirems per year	0.116
Bronchial epithelium	0.000017 WL[b]	NA[c]	

[a] Maximum dose at 2.6 km (1.6 miles) from plant effluents.

[b] Radiation standards for exposures to Rn-222 and daughters are expressed in working levels (WL), that is, the amount of any combination of short-lived radioactive decay products of Rn-222 in 1 liter of air that will release 1.3 X 10^5 MeV of alpha particle energy during their decay to Pb-210 (radium D).

[c] Not applicable: 40 CFR Part 90 does not include doses from Rn-222 daughters.

928 153

The population dose commitments (Table 4.2) resulting from OBS operation are only a small fraction of the similar doses received from natural background radiation.

4.7.7 Occupational dose

Any worker likely to receive a dose in any calendar quarter in excess of 25% of the applicable value specified in 10 CFR Part 20 limits will be required by the applicant to wear a thermoluminescent dosimeter (TLD) which is monitored on a quarterly basis. Air sampling data will be taken in all occupational areas on a monthly basis for uranium, radon-222 daughters, and radium-226.

On the basis of data available for uranium ore milling operations with similar ore crushing and storage facilities, it is estimated that occupational dose from OBS operations will not exceed 25% of the recommended limit.[11,12] There are presently no comparable exposure data accumulated for ore buying stations.

4.7.8 Radiological impact on biota other than man

Although no guidelines concerning acceptable limits of radiation exposures have been established for the protection of species other than man, it is generally agreed that the limits for humans are also conservative for those species.[13-20] Doses to terrestrial biota, such as birds and mammals, are quite similar to those calculated for man because of gaseous effluents and arise from the same dispersion pathways and considerations. Because the effluents of the OBS will be monitored and maintained within safer radiological protection limits for man, no adverse radiological impact is expected for resident animals.

4.8 SOCIOECONOMIC IMPACT

4.8.1 Demography

Because the OBS is already operating, it is unlikely to have any effect on local demography other than that which has already occurred — the employment of approximately eight people, some of which are native to the area. Eventually, from eight to ten truck drivers will be required to haul ore from the OBS to the proposed mill. The staff assumes that these drivers will be acquired from the local labor pool and that they will not cause a need for additional public services.

4.8.2 Social organization

Because most employees at the OBS will be from the area, no effects on social organization are expected.

4.8.3 Economic organization

The OBS provides a sales point for ore from local mines; thus, it affects the local economy to a degree far greater than the impact from OBS direct employment.

4.8.4 Conclusion

The OBS operation has little direct impact on the community. Secondary impacts on local mining operations should enable mining expansion at a slower pace than if the mines were expected to lupply an instant ore supply for the proposed mill.

928 154

REFERENCES FOR SECTION 4

1. Office of Water Planning and Standards, *Methods of Quickly Vegetating Soils of Low Productivity, Construction Activities*, Report No. 440/9-75-006, U.S. Environmental Protection Agency, Washington, D.C., 1975.

2. Office of Noise Abatement and Control, *Effects of Noise on Wildlife and Other Animals*, Report No. NTID300, U.S. Environmental Protection Agency, Washington D.C., 1971.

3. "Endangered and Threatened Species, Plants," *Fed. Regist.* 41(117): 24524-24572 (1976).

4. S. L. Welsh and K. H. Thorne, *Illustrated Manual of Proposed Endangered and Threatened Plants of Utah*, U.S. Fish and Wildlife Service, Denver, Colo., 1979.

5. "Endangered and Threatened Wildlife and Plants," *Fed. Regist.* 44(12): 3636-3654 (1979).

6. International Commission on Radiological Protection, "Recommendations of the International Commission on Radiological Protection, Report of Committee II on Permissible Dose for Internal Radiation," *Health Phys.* 3: 1-380 (1960).

7. ICRP Task Group on Lung Dynamics, "Deposition and Retention Models for Internal Dosimetry of the Human Respiratory Tract," *Health Phys.* 12: 181 (1966).

8. R. E. Moore, *The AIRDOS-II Computer Code for Estimating Radiation Dose to Man for Airborne Radionuclides in Areas Surrounding Nuclear Facilities*, Report ORNL-5245, Oak Ridge National Laboratory, Oak Ridge, Tenn., 1977.

9. G. G. Killough and L. R. McKay, Eds., *A Methodology for Calculating Radiation Doses from Radioactivity Released to the Environment*, Report ORNL-4992, Oak Ridge National Laboratory, Oak Ridge, Tenn., 1976.

10. J. R. Houston, B. L. Strengh, and E. C. Watson, *DACRIN — A Computer Program for Calculating Organ Dose from Acute or Chronic Radionuclide Inhalation*, Report BNWL-B-389, Battelle Pacific Northwest Laboratories, Richland, Wash., 1975.

11. B. R. Metzzer, "Nuclear Regulatory Commission Occupational Exposure Experience at Uranium Plants," *Conference on Occupational Health Experience with Uranium*, Report ERDA-93, Washington, D.C., 1975.

12. International Atomic Energy Agency, *Safety Series No. 43, Manual on Radiation Safety in Uranium and Thorium Mines and Mills*, IAEA, Vienna, 1976.

13. S. I. Auerbach, "Ecological Considerations in Siting Nuclear Plants. The Long-Term Biota Effects Problem," *Nucl. Saf.* 12: 25-35 (1971).

14. *Proceedings of the Environmental Plutonium Symposium*, Report LA-4756, Los Alamos Scientific Laboratory, Los Alamos, N. Mex., 1971, and *A Proposed Interim Standard for Plutonium*, Report LA-5483-MS, Los Alamos Scientific Laboratory, Los Alamos, N. Mex., 1974.

15. *Enewetak Radiological Survey*, U.S. Atomic Energy Commission Report NVO-140, Nevada Operations Office, Las Vegas, Nev., 1973.

16. N. A. Frigerio, K. F. Eckerman, and R. S. Stowe, "Background Radiation as a Carcinogenic Hazard," *Radia. Res.* 62: 599 (1975).

17. A. H. Sparrow et al., "Chromosomes and Cellular Radiosensitivity," *Radiat. Res.* 32: 915 (1967).

18. *Radioactivity in the Marine Environment*, Report of the Committee on Oceanography, National Academy of Sciences—National Research Council, Washington, D.C., 1971.

19. R. J. Garner, "Transfer of Radioactive Materials from the Terrestrial Environment to Animals and Man," CRC Critical Reviews in *Environ. Control Saf. Manage.* 2: 337-385 (1971).

20. S. E. Thompson, *Concentration Factors of Chemical Elements in Edible Aquatic Organisms*, U.S. Atomic Energy Commission Report UCRL-50564, rev. 1, October 1972.

5. ENVIRONMENTAL EFFECTS OF ACCIDENTS

5.1 OBS ACCIDENTS

The possibility of any accident on the OBS site severely affecting the offsite environment is negligible.

The quantities of chemicals used for ore analysis are too small to create a serious explosion hazard. If a fire occurs, it would not disperse the low-specific-activity ore.

A tornado striking the site could disperse large quantities of the stored ore. The probability of such a tornado striking a 1° square at the OBS location is about 8×10^{-5} per year (ref. 1) or once in 12,500 years. The OBS buildings would be destroyed, but dispersal of any ore offsite would not result in any measurable hazard to public health and safety.

5.2 TRANSPORTATION ACCIDENTS

The most significant potential impact of transporting ore to and from the OBS is spillage of radioactive material as the result of transportation accidents. The probability of a truck accident is about 1.6×10^{-6} to 2.6×10^{-6} per mile. It is estimated that eight to ten trucks will transport ore 5 days per week, 52 weeks per year. The maximum cumulative distance driven by all trucks with a load of ore on board is approximately 260,000 to 325,000 miles per year. Consequently, there is a potential for the loaded ore trucks to have 0.4 to 0.8 accident per year.

The statistics used in this analysis include all types of accidents, and an accident involving a uranium ore truck would not necessarily result in the spillage of any ore. However, if a spill did occur, it is unlikely that significant amounts of radionuclides would be released to the environment.

The trucks used to haul ore to the OBS commonly carry a maximum of 30 tons of material. Assuming an average ore grade of 0.1% uranium oxide (approximate average grade of the ore received to date), a delivery truck would carry a maximum of about 30 kg (66 lb) of uranium oxide. Even if the entire load were spilled, it would be difficult for significant amounts of this radioactive material to enter the environment because it is relatively insoluble and is not likely to be easily dispersed by wind. In addition, the ore would be both valuable and easy to clean up.

REFERENCE FOR SECTION 5

1. H. C. S. Thom, "Tornado Probabilities," *Mon. Weather Rev.* 91: 730-737 (1963).

6. MONITORING PROGRAMS

Construction of the Plateau Resources OBS began in March 1977 and was completed approximately five months later. By late February 1978, the applicant had stockpiled approximately 17,000 tons of ore at the station. The need for a Source Material License for the OBS construction and operation was not established until February 1978 (Application for Source Material License ER, Sect. 6.5.1). Consequently, preoperational monitoring was not conducted at the site. For the current license application, the applicant relied primarily on information from published reports and limited monitoring of air quality following construction of the facility (Application for Source Material License ER, Sect. 6.1).

6.1 AIR QUALITY

Suspended particulate matter, the major nonradiological pollutant emitted from the OBS, was monitored at the station by the applicant from July 22 through December 19, 1977. The monitor was located approximately 3 m (10 ft) aboveground to the east of the OBS, near the property fence. Twenty-four-hour samples were collected on glass fiber filters, using a standard Environmental Protection Agency (EPA), high-volume, particulate sampler fitted with a constant-flow controller. In addition, the Utah Bureau of Air Quality operates a monitoring station for suspended particulates and sulfur dioxide approximately 109 km (68 miles) to the west-southwest at Bullfrog Basin Marina.

The applicant has not presented plans for futher monitoring of suspended particulate matter at the site. Because only a few tons of ore had been stockpiled at the station when initial monitoring of suspended particulates was conducted and because as much as 57,000 tons of ore will be stored at the site (Application for Source Material License ER, Sect. 1.0), the staff requires that total suspended particulate matter be measured at least four times a year near the property fence downwind from the station. Samples should be collected according to EPA and/or Utah Division of Health acceptable procedures so that 24-hr and annual average concentrations can be calculated. After one year of sampling, the data should be analyzed, and a report should be prepared and submitted to the Utah Division of Health and to the NRC for their evaluation and recommendations.

6.2 LAND USE AND RECLAMATION

The applicant acquired land use data from published reports; discussions with personnel of various Federal, State, and local offices; and onsite visits. No other special methodology was required.

Decommissioning of the buying station is discussed in Sect. 3.6.1. The applicant proposes to restore all lands disturbed by the OBS to a productive condition consistent with past and present uses of the area (Application for Source Material License ER, Sect. 6.2.7). Land in the vicinity of the OBS is used for agricultural crops (primarily pinto beans) and for pasture. Prior to construction, the station site itself was fallow field supporting weeds and other invader species (Sect. 2.9.1). Lands disturbed by the OBS will be reclaimed to a productive condition for livestock.

Upon termination of the project, all structures and footings will be removed from the site. Gravel, rock, and concrete used for roads, ore pads, and foundations will be removed and disposed of in an appropriate manner (Sect. 3.6.1 and Application for Source Material License ER, Sect. 4.3). The contour and elevation of the land will be restored to be consistent with the land adjacent to the site. Radioactively contaminated soils will be excavated and disposed of in an appropriate manner (Sect. 3.6.1).

About 10 to 15 cm (4 to 6 in.) of topsoil will be placed over all areas where soil was removed during OBS construction or stripped because of radioactive contamination. After this soil is tied to the subsoil by ripping, it will be analyzed to determine if the application of fertilizer is necessary. The soil will be fertilized, if necessary, and mulched with straw at the rate of 4500 kg/ha (2 tons per acre). Bluebunch wheatgrass (*Agropyron spicatum*) and Indian rice grass (*Oryzopsis hymenoides*) will be drill-seeded at a rate of 6.7 and 2.2 kg/ha (6 and 2 lb/acre) respectively. These two species are palatable to livestock and are native to the area. Seeding will take place in midsummer before the rainy season. To protect the area until the new vegetation becomes established, the fence surrounding the OBS will remain for at least two complete growing seasons (Application for Source Material License ER, Sect. 6.2.7).

The possible removal of noxious weeds was not discussed by the applicant. If herbicides are applied to control weeds, the staff requires that all herbicides and their use comply with all appropriate Federal, State, and local regulations.

The applicant did not present a plan to monitor the reclamation efforts. The staff requires the applicant to monitor and maintain the reclaimed areas until stand establishment and self-perpetuation are assured. In accordance with the State of Utah Division of Oil, Gas, and Mining, Reclamation Regulation, Rule M-10,[1] the revegetation will be accomplished and successful when the species (1) have achieved a surface cover of at least 70% of the representative communities surrounding the operation; vegetative cover levels shall be determined by the operator, using professionally accepted inventory methods approved by the division; (2) have survived for at least three growing seasons; (3) are evenly distributed; and (4) are not supported by irrigation or continuing soil amendments.

The applicant's reclamation plan, along with the staff's requirements, should be adequate to ensure successful reclamation of the site. In addition, the staff requires that the applicant maintain sufficient records to furnish evidence of compliance with all monitoring and mitigative measures. To ensure that the above reclamation is performed, the staff requires that the applicant file a performance bond with the State of Utah (Sect. 3.6.2). The operator will be required to take samples of soil following final cleanup to confirm or show that applicable soil contamination standards have been met.

6.3 WATER

6.3.1 Surface water

No adverse impacts on local or regional surface waters or aquatic biota as a result of OBS operation are predicted because of the required runoff diversion/retention barrier around the ore stockpiles and the lack of direct or indirect discharge into local surface waters. Therefore, the staff is not requiring an operational surface-water-quality monitoring program.

6.3.2 Groundwater

No monitoring of groundwater other than that discussed in Sect. 6.6.2 will be required.

6.4 SOILS

Information on soils in the OBS area was obtained from U.S. Soil Conservation Service publications describing soil taxonomy and from a soil survey of the San Juan area. Additional information regarding potential erosion hazards was supplied by the Utah Agricultural Experiment Station (Application for Source Material License ER, Sects. 2.4 and 6.9).

6.5 BIOTA

6.5.1 Terrestrial

The applicant acquired information on the terrestrial biota in the OBS vicinity from published reports and discussions with personnel of the Moab district office of the Bureau of Land Management (Application for Source Material License ER, Sects. 6.1.3 and 6.9).

928 159

6.5.2 Aquatic biota

An aquatic biota monitoring program is not being required by the staff because of (1) the lack of aquatic habitat in the OBS vicinity, (2) the lack of any direct or indirect discharge into local surface waters, and (3) the staff requirement of a runoff diversion/retention barrier around the ore stockpiles.

6.6 RADIOLOGICAL

6.6.1 Preapplication environmental monitoring program

At the time of OBS construction, there was no license requirement for operation; consequently, no preoperational monitoring was conducted on the site. However, offsite natural radiation environmental measurements have been conducted 10 to 13 km (6 to 8 miles) west-southwest of the station using thermoluminescent dosimeter (TLD) packets. The geometric mean for the sites, excluding one location in the vicinity of an abandoned uranium mine, was 1.92 millirems per week. The results of the sampling are shown in Table 6.1. Studies were also conducted to determine the radon-222 concentration in the air near the OBS. The geometric mean for all samples was 1.93 pCi/liter.

Table 6.1. Terrestrial and cosmic background radiation measured in the vicinity of the OBS

All values are measured in millirems per week

Sample sites	TLD[a]	Cosmic flux	K-40[b]
1	1.75	1.75	0.0054
3	1.70	1.70	0.0054
7	2.17	1.65	0.0054
8	6.79[c]	1.62	0.0054
14	2.12	1.71	0.0054

[a] Thermoluminescent dosimeter.

[b] Potassium-40 content was assumed to be the same for all locations.

[c] Measured in the vicinity of an abandoned uranium mine; this measurement excluded from area natural background calculations.

Particulates were collected with a high-volume sampler at the OBS during July and August of 1977. The August sample, however, was collected after one shipment of ore had been received at the station. These results are shown in Table 6.2.

Table 6.2. Radioactive particulates

Sample date	Total air sample (m^3)	Radioactivity concentration (pCi/m^3)			
		Total U	Th-230	Ra-226	Pb-210
July 22, 1977	1711	7.9×10^{-5}	4.0×10^{-4}	1.4×10^{-4}	7.0×10^{-3}
Aug. 3, 1977[a]	1713	7.9×10^{-5}	4.7×10^{-4}	8.9×10^{-4}	3.3×10^{-2}

[a] Samples taken after one shipment of ore had been made to the OBS.

Results of water samples taken in the OBS area show that the uranium-238 content of the water was generally relatively low, ranging from 0.11 to 32.7 ppb (Table 6.3). The high value for uranium was obtained from a spring near the abandoned mine west of Blanding. Radium-226 was also low, ranging from 0.04 to 0.97 pCi/liter. With two minor exceptions, no thorium-232 or radium-228 was detected in the water (Table 6.3). Both thorium-230 and radon-226 were in considerable disequilibrium with uranium in the water samples, which was believed to occur because of the oxidizing environment and high bicarbonate concentrations of the waters.

Gross alpha values for the water samples were generally low, ranging from insignificant to a high of 17 pCi/liter in the spring near the abandoned mines (Table 6.3).

6.6.2 Proposed operational environmental monitoring program

Radiological environmental impacts could result from dust blowing from the OBS, from radon-222 emanating from the ore from runoff and seepage from the ore stockpiles, and from direct gamma radiation from the ore.

Dust will be monitored at the OBS by high-volume sampling. The sample locations are shown in Fig. 6.1, and the monitoring program is described in Table 6.4. These samples will be analyzed for uranium, radium-226, and thorium-230. At the same sampling locations, the air will be monitored for radon-222 each quarter.

The potential seepage of radioactivity will be monitored routinely at OBS Well No. 1, drilled into the Dakota Sandstone aquifer near the southeast corner of the station site. In addition, two springs that derive water from this aquifer located about 1.6 km (1 mile) south-southeast of the station will be monitored. Surface-water contamination from runoff will be monitored by sampling a small impoundment located in the southeast corner of the station site. Additionally, surface water in the ditch bordering U.S. Highway 163 southeast of the OBS will be sampled. The water monitoring program is described in Table 6.4.

A total of 13 TLDs will be placed around the OBS to monitor radiation levels in the environment (Fig. 6.1). Three TLDs will be used as controls — one in Blanding, one in the foothills of the Abajo Mountains, and one at an analytical laboratory in Santa Fe, New Mexico. The direct radiation monitoring program is shown in Table 6.4.

REFERENCE FOR SECTION 6

1. State of Utah Division of Oil, Gas, and Mining, *Changes and Additions to the General Rules and Regulations*, adopted by the Board of Oil, Gas, and Mining on Mar. 22, 1978 (effective June 1, 1978).

928 161

Table 6.3. Radioactive materials in water samples from the OBS area

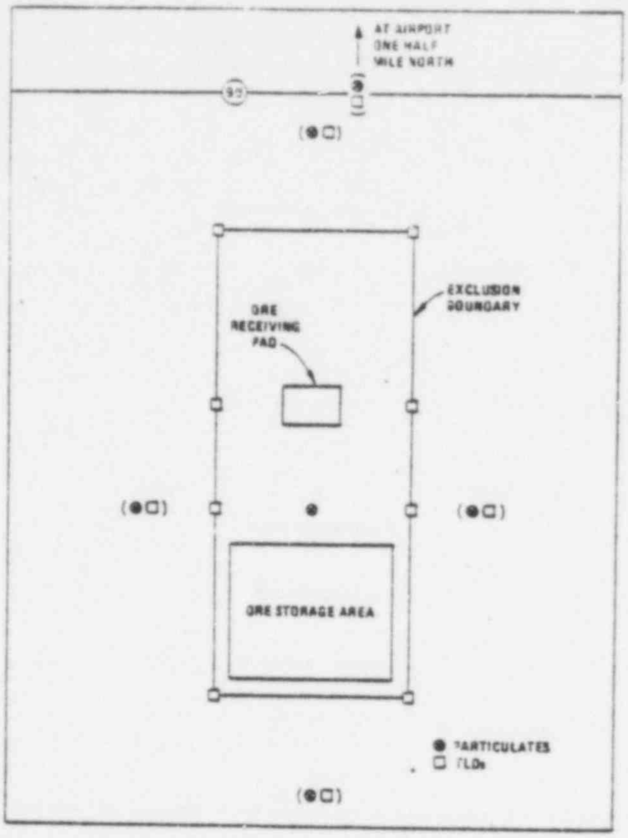
All units in pCi/liter unless otherwise noted

	Sample site*											Water quality criteria			
Mass spectrometry	C	D	E	F	B	A	A′	OBS Well #1	OBS Well #2	Lake Powell (8 19 77)	San Juan River mean (1968 1976)	Utah Class C	EPA livestock	EPA water supply intake	Federal interim drinking
Total U	<5	<6	<5	28 ± 6	11 ± 6	7 ± 6	<5			6					
U 238, ppb	0.11	2.58	1.06	32.7	7.6	9.4	1.79			6.39					
U 235, ppb	0.00077	0.0184	0.0076	0.237	0.0548	0.067	0.0128			0.0395					
U 234, ppb	Not detected	17E−5	6E−5	170E−5	49E−5	76E−5	14E−5			0.00046					
Th 230	0 ± 0.1	0 ± 0.1	1.5 ± 0.1	0.3 ± 0.1	0.7 ± 0.1	2.1 ± 0.1	0.7 ± 0.1			0 ± 0.06					
Ra 226	0 ± 0.04	0.22 ± 0.04	0.08 ± 0.04	0.97 ± 0.04	0 ± 0.06	0.5 ± 0.2	0 ± 0.04		0.2 ± 0.5	0.08 ± 0.04		3		5	5
Rn 222	0 ± 2	0 ± 2	6 ± 2	520 ± 30	8 ± 1	24 ± 2	8 ± 2			0 ± 2				comb	comb
Th 232	0 ± 0.1	0 ± 0.1	0 ± 0.1	0 ± 0.1	0.2 ± 0.1	0 ± 0.1	0.4 ± 0.1			0 ± 0.05					
Ra 228	0 ± 1	0 ± 2	0 ± 1	0 ± 1	0 ± 1	0 ± 1	0 ± 1			0 ± 1					
Gross alpha	(−)1 ± 2	4 ± 1	2 ± 2	17 ± 2	(−)12 ± 4	1 ± 4	2 ± 2		11 ± 3	0 ± 3					15 (excluding Rn [illegible] U)
Gross beta	20 ± 2	25 ± 3	24 ± ?	16 ± 2	28 ± 3	62 ± 5	22 ± 3		0 ± 13	13 ± 2		1000			

*Site designations include C (Comb Ridge pool), D (Buck Brush reservoir), E (Buck Brush pond), F (Buck Brush spring, B (Cottonwood Creek), A (Brushy Basin spring, and A′ (Brushy Basin pool)

Source: Plateau Resources, Limited, *Application for Source Material License*, Table 6.1-16, p. 6-19, Apr. 3, 1978.

928 162



POOR
ORIGINAL

Fig. 6.1. Proposed radiological sampling sites. Source: Plateau Resources, Limited, *Application for Source Material License*, Docket No. 40-8674, Apr. 3, 1978.

Table 6.4. Future radiological monitoring program

Type of sample	Number	Sampling			Test frequency	Radiation or radionuclides
		Location[a]	Method	Frequency		
Ambient air (particulates)	6	Four locations along the principal wind vector (south to north) and two locations perpendicular to this vector	Continuous	Filters changed weekly or as required by dust loading	Monthly composite Quarterly composite	U_{nat} Ra-226, Th-230
Ambient air (radon gas)	6	Same locations as airborne particulates	One week, continuous per quarter	Quarterly	Quarterly	Rn-222
Direct radiation	13	Ten locations around or near the site boundary. Three locations – Blanding, foothills of Abajo Mts. and Sante Fe, N.Mex. – as controls	TLD	Quarterly	Quarterly	X-ray and gamma dose rate
Groundwater (well and springs)	3	Southeast corner of OBS site and 1.6 km (1 mile) south-southeast and OBS	Grab	Quarterly	Quarterly	Gross β and γ, U_{nat}, Ra-226, Th-230
Surface water (pond and ditch)	3	Southeast corner of OBS property and drainage ditch of U.S. Highway 163 southeast of OBS	Grab	Quarterly	Quarterly	Gross β and γ, U_{nat}, Ra-226, Th-230

[a] Refer to Fig. 6.1.

7. UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS

7.1 AIR QUALITY

An unavoidable impact of construction and operation of the Plateau Resources OBS is an increase in suspended particulate matter (fugitive dust) and gaseous emissions from internal combustion engines (Sect. 4.1). The concentrations of these pollutants are presently below the Federal and State air quality standards (Sect. 2.1). However, only a few tons of ore had been stockpiled at the station when initial monitoring of suspended particulates was conducted, and as much as 71,000 tons will be stored at the site. Consequently, the staff requires that total suspended particulate matter be measured at least four times a year near the property fence downwind from the station to determine whether the concentrations of these pollutants exceed Federal and State standards.

7.2 LAND USE

Construction and operation of the OBS resulted in an unavoidable temporary loss of 6 ha (14 acres) of potential agricultural land. Upon termination of the project the applicant plans to reclaim the disturbed lands to a productive condition for livestock (Application for Source Material License ER, Sect. 6.2.7).

7.3 WATER

7.3.1 Surface water

Unavoidable adverse impacts on the aquatic habitat and biota due to OBS operation are expected to be minimal or nonexistent. During construction, runoff from the site might have increased sediment transfer to adjacent streams under heavy rainfall conditions. Because runoff streamflow in this area is normally characterized by high sediment content, the effect of this small increase in sediment load would be expected to be inconsequential. The retention of sanitary wastes in the drainage field, the construction of the runoff diversion/retention barrier around the ore stockpiles, and the lack of any other direct or indirect discharge into adjacent aquatic habitats will protect the aquatic environment from any unavoidable adverse impacts.

7.3.2 Groundwater

No measurable impact on groundwater resources is expected since OBS water use is estimated to be less than 100 acre-ft/year from a formation containing several thousand acre-feet per square mile.

7.4 MINERAL RESOURCES

Operation of the OBS will not affect mineral resources.

7.5 SOILS

Construction of the OBS resulted in an unavoidable alteration of 6 ha (14 acres) of soil material (Sect. 4.5). It is expected that this disturbance altered the natural soil characteristics that have developed over long periods of geologic time. Although the length of time required to restore the soil to nearly its original condition is not known, a suitable reclamation effort (Sect. 6.2) following decommissioning should not result in any long-term impacts to the soil.

928 164

7.6 BIOTA

7.6.1 Terrestrial

An unavoidable impact of construction of the OBS was a loss of 6 ha (14 acres) of old-field vegetation. Destruction of this habitat has resulted in destruction or displacement of some wildlife. Unavoidable impacts due to OBS operation include disturbances to wildlife as a result of noise and human activities and a potential increase in road kill. Fugitive dust and gaseous emissions generated during construction and operation may affect the surrounding vegetation, but the extent of the impact cannot be quantified.

Although some vegetation and wildlife loss is unavoidable, the loss of individuals is not expected to result in the long-term elimination of any species in the vicinity of the OBS.

7.6.2 Aquatic

The impact on limited available aquatic habitat in this arid region due to OBS operation is projected as insignificant because of the lack of direct or indirect discharge into local surface waters (Sects. 4.6.2 and 7.3.1). The possibility of indirect influence on surface-water quality and biota by runoff transport of toxic uranium-ore material to Corral Creek is considerably reduced by the staff requirement of a runoff diversion/retention barrier around the ore stockpiles. Therefore, there are no foreseeable adverse impacts on local or regional aquatic biota during OBS operation.

7.7 RADIOLOGICAL IMPACT

Radon emission and ore dust transport will have a minimal effect on individuals and the public, as discussed in Sect. 4.7 (Tables 4.1 and 4.2).

7.8 SOCIOECONOMIC IMPACT

Operation of the OBS requires about eight employees, with another eight to ten truck drivers eventually employed to transfer ore to the milling facility. Because most of these employees will come from the local labor pool, the effects on the community are expected to be minor.

Indirectly, the mines and mill serviced by the OBS have a much greater potential for community impact.

Appendix A

DETAILED RADIOLOGICAL ASSESSMENT

POOR ORIGINAL

928 166

Appendix A

DETAILED RADIOLOGICAL ASSESSMENT

When evaluated in conjunction with Sects. 3.5 and 4.7, the following information permits a detailed analysis of the radiological impact of the Plateau Resources OBS (the Blanding site) and permits complete review and verification by qualified radiological scientists. Calculations of radiation doses have been made for radionuclides and receptors around the site.

A.1 MODELS AND ASSUMPTIONS

AIRDOS-II, a FORTRAN computer code,[1] was used to estimate individual and population doses resulting from the continuous atmospheric release of airborne radioactive materials from the normal project operations and from accidental releases. Pathways to man include (1) inhalation of radionuclides in air, (2) immersion in air containing radionuclides, (3) exposure to ground surfaces contaminated by deposited radionuclides, (4) ingestion of food produced in the area, and (5) immersion (swimming) in water subjected to surface deposition from plumes. Doses are estimated for the total body as well as for the following organs: gastrointestinal tract, bone, thyroid, lungs, muscles, kidneys, liver, spleen, testes, and ovaries. The dose to the bronchial epithelium from radon daughters is also estimated.

The area surrounding the project was divided into 16 sectors. Each sector is bounded by radial distances of 0.8, 1.6, 3.2, 4.8, 6.4, 8.0, 16, 32, 48, 64, and 80 km (0.5, 1.0, 2.0, 3.0, 4.0, 5.0, 10, 20, 30, 40, and 50 miles) from the point of release. Human population, numbers of beef and dairy cattle, and specifications determining whether or not each of the areas lying outside the plant boundary is used for producing vegetable crops or is a water area are required as input data.

The first part of AIRDOS-II is an atmospheric dispersion model (AIRMOD) that estimates concentrations of radionuclides in the air at ground level and their rates of deposition on ground surfaces as a function of distance and direction from the point of release. Annual average onsite meteorological data are supplied as input for AIRMOD.

AIRMOD is interfaced with environmental models within AIRDOS-II to estimate doses to man through the five pathways. One such model is a terrestrial model (TERMOD) developed by Booth, Kaye, and Rohwer[2] that estimates radionuclide intakes from ingestion of radionuclides deposited on crops, soil, and pastures. Such intakes result from drinking milk and eating beef and vegetable crops.

Population doses are summarized in the output tables of AIRDOS-II. Actual population distributions were summarized from 1970 Census Bureau tape records. The computer code PANS[3] provides sector summaries that correspond to the same sectors and annuli in the 16 compass directions for which χ/Q values are calculated. The population dose is calculated for each division and then summed over the entire 80-km (50-mile) radius.

The dose conversion factors for the radionuclides are based on two ICRP reports.[4,5] The method used in estimating radiation doses is given in a reference handbook.[6]

A.2 ATMOSPHERIC DISPERSION (METEOROLOGY)

The basic equation used to estimate atmospheric transport to the terrestrial environment is Pasquill's Equation[7] as modified by Gifford.[8] For particulate releases, the meteorological χ/Q values are used in conjunction with dry deposition velocities and scavenging coefficients to estimate air concentrations. Radioactive decay during plume travel is taken into account in AIRDOS-II.[1] Daughters produced during plume travel must be added to the AIRDOS-II source

928 167

The χ/Q values for receptor points at the nearest residence and for the potential future nearest residence are shown in Table A.3.

Table A.3. χ/Q values at receptor points for the Plateau Resources OBS[a]

Location and distance from effluents	χ/Q values (sec/m^3)	
	Particulates	Rn-222
Nearest permanent residence (2574 m)	2.86E−7[b]	4.83E−7
Nearest potential residence (965 m)	1.87E−6	2.41E−6

[a] A 6-m stack height with no plume rise is assumed.

[b] Read as 2.86×10^{-7}.

A.3 AMOUNT OF RADIONUCLIDES RELEASED (SOURCE TERMS)

The amounts of radionuclides released routinely (source terms) during a year's operation of the mill and mines on which annual dose calculations to the individual and the population are based are shown in Table A.4.

Table A.4. Radionuclide content (source term) of airborne releases from the OBS ore crushing and storage

Radionuclide	Release (Ci/year)
Pb-210	2.90E−3[a]
Po-210	2.90E−3
Rn-222[b]	2.24E2[c]
Ra-226	2.90E−3
Th-230	2.90E−3
U-234	2.90E−3
U-235	1.30E−4
U-238	2.90E−3

[a] Read as 2.90×10^{-3}.

[b] Radioactive decay during plume travel was taken into account. Daughters of Rn-222 produced during plume travel were calculated and added back to the source term.

[c] Read as 2.24×10^{2}.

Source: Based on information in ER. For details see section 3.5 of this report.

A.4 OTHER PARAMETERS USED IN RADIOLOGICAL ASSESSMENT

Dose conversion factors used in the radiological assessments for inhaled radionuclides are given in Tables A.5 and A.6. Dose conversion factors for ingestion and external dose calculations

Table A.5. Dose conversion factors used in radiological assessments of ore buying stations for exposure of specific organs to various radionuclides inhaled from the ore crushing and storage effluents[a]

Radionuclide	Dose conversion factor (rems/μCi)			
	Total body	Bone	Lungs	Kidney
Pb-210	1.4	42.0	6.0	35.0
Po-210	0.26	1.1	17.0	7.9
Ra-226	40.0	390.0	47.0	40.0
Th-230	16.0	520.0	200.0	160.0
U-234	0.15	2.4	210.0	0.57
U-235	0.14	2.3	200.0	0.54
U-238	0.13	2.2	180.0	0.50

[a] Other pertinent dose conversion factors for ingestion and external dose rates are listed in ref. 6 of Appendix A.

Table A.6. Dose conversion factor used in radiological assessment for exposure of bronchial epithelium to Rn-222 and daughters

Radionuclide	Dose conversion factor millirem/year per μCi/m³ of air
Rn-222 and daughters	1

are listed in ref. 6. Other principal parameters used in the radiological assessment of the Plateau Resources OBS are shown in Table A.7.

Table A.7. Some parameters and conditions used in the radiological assessments of the Plateau Resources OBS

Parameter	Ore crushing and storage operation
Ore quality	0.05–1,0% U_3O_8
Operating time	8 hr/day, 5 days per week, 52 weeks per year
Capacity for crushing and sampling	50 tons/hr (max) to date, averaging 2E3[a] tons per month
Ore stockpiling (max amount)	5.7E3 tons
Operating life of station	~20 years

[a] Read as 2×10^3.

928 169

REFERENCES FOR APPENDIX A

1. R. E. Moore, *The AIRDOS-II Computer Code for Estimating Radiation Dose to Man from Airborne Radionuclides in Areas Surrounding Nuclear Facilities*, Report ORNL-5245, Oak Ridge National Laboratory, Oak Ridge, Tenn., April 1977.

2. R. S. Booth, S. V. Kaye, and P. S. Rohwer, "A Systems Analysis Methodology for Predicting Dose to Man from a Radioactively Contaminated Terrestrial Environment," pp. 877-893 in *Proceedings of the Third National Symposium on Radioecology*, D. J. Nelson, Ed., Report CONF-710501, Oak Ridge National Laboratory, Oak Ridge, Tenn., May 1971.

3. P. R. Coleman and A. A. Brooks, *PANS: A Program to Tally Population by Annuli and Sectors*, Report ORNL/TM-3923, Oak Ridge National Laboratory, Oak Ridge, Tenn., October 1972.

4. International Commission on Radiological Protection, *Report of Committee II on Permissible Dose for Internal Radiation*, ICRP Publication 2, Pergamon Press, New York, 1959.

5. ICRP Task Group on Lung Dynamics, "Deposition and Retention Models for Internal Dosimetry of the Human Respiratory Tract," *Health Phys.* 12: 181 (1966).

6. G. G. Killough and L. R. McKay, Eds., *A Methodology for Calculating Radiation Doses from Radioactivity Releases to the Environment*, Report ORNL-4992, Oak Ridge National Laboratory, Oak Ridge, Tenn., March 1976.

7. F. Pasquill, *Meteorol. Mag.* 90: 1063 (1971).

8. F. A. Gifford, Jr., "Use of Routine Meteorological Observations for Estimating Atmospheric Dispersion," *Nucl. Saf.* 2(4): 47 (1961).