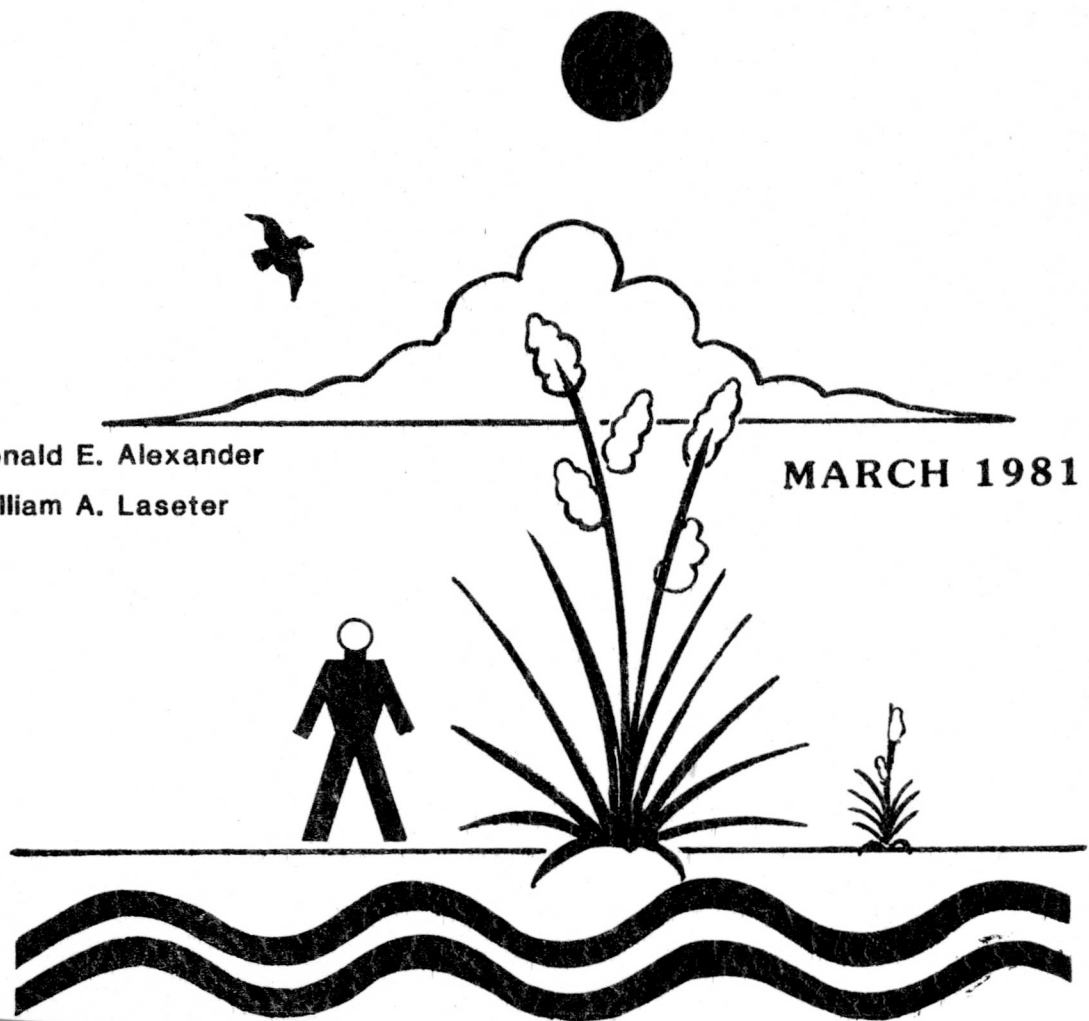


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# ENVIRONMENTAL MONITORING REPORT FOR **MASTER** PANTEX PLANT COVERING 1980



Ronald E. Alexander  
William A. Laseter

MARCH 1981



*Mason & Hanger - Silas Mason Co., Inc.*  
*Pantex Plant*

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# Environmental Monitoring Report for Pantex Plant Covering 1980

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## **ABSTRACT**

This report summarizes the environmental monitoring program at Pantex Plant for 1980. It has been prepared in accordance with the United States Department of Energy Manual Chapter 0513. This report presents monitoring data for both radioactive and non-radioactive species in the local environment.

Although plant activities involve the handling of significant quantities of

uranium, plutonium, and tritium, only small releases of uranium (depleted in the isotope  $^{235}\text{U}$ ) and tritium occurred which could have affected the local environment. Monitoring data indicate that concentrations of these nuclides in the environment are below established criteria for air and water and therefore do not present a health hazard either to employees or to the public.

## INTRODUCTION

Pantex Plant is a government owned, contractor-operated facility owned by the United States Department of Energy and administrated through the Albuquerque Operations Office. Mason and Hanger-Silas Mason Co., Inc., is the prime operating contractor.

Pantex plant is located in the Panhandle of Texas in Carson County. The facility is approximately 27 kilometers (17 miles) northeast of downtown Amarillo, and 16 kilometers (10 miles) west of downtown Panhandle, at 101° 32' 51" longitude and 35° 20' 34" latitude (Fig. 2). The plant site consists of 4,130 hectares (10,200 acres) which is a portion of the former 6,478 hectare (16,000 acre) Pantex Army Ordnance Plant which was constructed in 1942 for World War II conventional shell and bomb loading.

Operations of Pantex Plant take place in several widely separated zones (Fig. 3). With the exception of the operating zones, and the land around them required for safety buffer or security zones, the remaining land is in native grasses and farmland. Approximately 65% of the Plant's total area is utilized for agricultural research purposes through an agreement between Texas Tech University and the USDOE.

The principal purpose of Pantex Plant is the assembly of nuclear weapons. The overall plant mission involves the fabrication of chemical high explosive (HE) components for nuclear weapons, nuclear weapons assembly and disassembly, nuclear weapons modification and repair, and surveillance testing and disposal of chemical HE and nonradioactive components. Weapons assembly and stockpile surveillance activities involve handling significant quantities of uranium, plutonium, and tritium, as well as a variety of nonradioactive toxic chemicals.

Nuclear components are received at Pantex from other DOE plants. These radioactive nuclear materials are not processed further at Pantex before being assembled into weapons, thus avoiding the possibility of releasing materials during normal operating conditions. Radioactive materials released at the Pantex site are limited to certain infrequent high explosive test fires which disperse small quantities of depleted uranium (essentially Uranium-238) and other operations within the plant which involve the release of small amounts of tritium ( $^3\text{H}$ ). Although not treated, airborne emissions of radioactive material (Ref. Table I) are well below prescribed standards. Likewise nonradioactive emissions (Ref. Table II) from the on-site steam generating plant are untreated but below prescribed standards.

A trickling filter sewage treatment plant for the processing of both sanitary and industrial wastes created by the operation of the plant is located in the far northeast corner of Pantex Plant. The treatment consists of primary settling, sludge digestion, trickling filter oxidation, secondary settling, and chlorination. After processing, the effluent is used by Texas Tech University for irrigation either by pumping directly from the sewage plant location or it is sent to the retention playa where it may be pumped out at a later time.

All scrap paper and food discards from the cafeteria, office areas, and manufacturing areas are plastic bagged and buried at the sanitary landfill site which includes 3 hectares (8 acres) surrounded by a cyclone fence. No explosives, explosive-contaminated materials, or radioactive materials are included in the landfill waste materials. All waste dumped at the landfill is covered with dirt on a daily

basis. No contamination of the aquifer water below the landfill area is anticipated because of the impervious topsoil and caliche layers and due to the nature of the buried materials.

Waste and excess explosives are presently destroyed by burning on open pads in accordance with approved DOE and Department of Defense (DOD) methods of disposal of explosives(1). The explosives material, with a small amount of kerosene added to assist in ignition, is placed on an impermeable liner on the burn pad. An explosive squib is connected from a wiring post to the waste material and the material is then squib-ignited remotely from the control bunker after personnel have cleared the area. HE contaminated solvents are allowed to evaporate in an open tank and the residue burned. The burning of HE at Pantex Plant is done by the authority granted by the State of Texas Air Control Board(2).

Radioactive waste and waste contaminated with radioactive materials are stored in concrete cylinders and in trenches within the plant perimeter. This waste consists primarily of depleted uranium, with smaller quantities of plutonium-239, uranium-235, tritium (<sup>3</sup>H) and very small quantities of other isotopes. All radioactive waste is weapons related and includes no high level reactor waste. All radioactive waste is stored retrievably inside sealed containers. No liquid radiological wastes are generated or processed at Pantex.

Hazardous chemical disposal is based on the nature of the chemical itself. Non-volatile, nonreactive chemicals are buried in the sanitary landfill. Prior to burial it is determined that the chemical will not degrade the environment and there is no possibility of contaminating the Ogallala aquifer. Records are kept on the location of burial of the chemicals. Chemicals considered too hazardous to bury or

burn are shipped to an EPA-approved outside disposal agency according to current EPA regulations.

## ENVIRONMENTAL SETTING

Pantex Plant is located between the North Central Plains and the Llano Estacado (Staked Plains) which forms part of the Great Plains (Fig. 1). The Administration Building is at an altitude of 1,078 meters (3,538 feet). The area is characterized by rolling grassy plains and numerous natural playas. These playas are fed only by rainwater and melted snow and are therefore frequently dry. The total precipitation in 1980 in water equivalent is 34.01 cm (13.39 inches) as reported by the Amarillo Office of the National Weather Service. The annual evaporation rate is approximately 70 inches per year.

Local winds are from the south and southwest directions approximately 44% of the time with an average annual wind velocity of 4.3 meters per second (9.5 mph) (Fig. 4). Pantex Plant is located in one of the more severe tornado areas of the United States. Based on a statistical study of tornadoes by Thom, the probability of Pantex Plant being hit by a tornado per year is approximately three in one thousand(3).

The Pantex location and surrounding area is relatively free of earthquakes with only two being recorded since seismic observation of this region commenced; one on July 30, 1925, and the other on June 19, 1936. Both registered five on the Mercalli Intensity Scale with the epicenters located approximately 26 kilometers (16 miles) east and 64 kilometers (40 miles) northeast of Pantex Plant, respectively(4). The Uniform Building Code places the Pantex area in Zone 1, which rates second lowest in earthquake occurrence on a scale from Zone 0 to Zone 3(5).

Underlying the Texas Panhandle is the Ogallala aquifer which serves as the primary source of water for Pantex Plant and 30% of the water for Amarillo. The saturated Ogallala aquifer is from 61 to 122 meters (200 to 400 feet) thick and at a depth below the surface of approximately 244 meters (800 feet). A surface layer of clay 18 to 24 meters (60 to 80 feet) deep forms a barrier to surface moisture and prevents deep penetration of surface contaminants (5, 6, 7). This clay layer is usually underlaid with caliche and dry Ogallala sands which cover the saturated aquifer. Aquifer water which is removed is only partially replaced through natural recharging processes.

The Panhandle area is not densely populated having approximately 236,000 persons residing within an 80 kilometer (50 mile) radius of the Pantex Plant (8). Amarillo, Texas, located southwest of the plant site, is the largest single populated center with about 135,000 residents. Pampa, Texas, located about 64 kilometers (40 miles) northeast of the plant, is second in population density with about 21,000 residents. The remaining population is distributed throughout smaller communities, farms, and ranches. Although there is a variety of industries in the area, the local economy is influenced most significantly by agriculture and related industries.

## SUMMARY

During 1980 Pantex Plant released quantities of radioactive and non-radioactive pollutants as presented in Tables I and II.

An environmental monitoring program was carried out to determine whether any Pantex effluents were having a measurable or significant effect on

the environment. Calculations were performed to determine radiation dose to individuals and the public within an 80 kilometer (50 mile) radius. Results of these calculations show that whole body radiation dose to the public from Pantex operations was about  $1 \times 10^{-5}$ % of that due to naturally occurring external radiation.

## ENVIRONMENTAL MONITORING

During 1980 Pantex Plant continued its environmental monitoring program which evaluated the collection and analyses of air, water, soil, vegetation and specific biota samples. Analyses of area samples were specific for plutonium-239, uranium, and tritium as these are the isotopes of concern in the assembly of atomic weapons. Analyses were also performed for radium-226 and radium-228 which occur naturally in the environment.

Isotopes common to nuclear reactor sites were not monitored at Pantex because there are no nuclear reactors or high level radioactive waste from nuclear reactors at Pantex Plant.

There were nine off-site air sampling locations where continuously operating air samplers collect particulate and water vapor samples for radiometric analysis (Ref. Fig. 5). Air samples collected in 1980 were analyzed for total uranium, plutonium-239 and tritium. In no case were any of the results in excess of the established radioactivity concentration guides (RCG's).

Water sampling was performed for ground water from Pantex wells, an off-site playa located north of the facility and for the on-site retention playa which collects all industrial and treated sanitary effluents prior to use in crop irrigation.

The data on radioactivity in water do not indicate the presence of radioactivity discernible above natural levels.

Soil samples were collected and subjected to analysis for total uranium and plutonium-239 content at locations indicated on Fig. 6.

There are no official RCG's for radionuclides in soil. The concentrations resulting from analyses of the local soil for plutonium-239 show that local levels are indistinguishable from world-wide fallout. Total uranium analyses are also consistent with what is considered natural activity.

Analysis of vegetation to determine total uranium and tritium concentrations was performed to determine whether unusual uptake of uranium or

tritium from the soil or air had occurred. As with soil there are no established RCG's for uranium or tritium in vegetation although RCG's for water are sometimes used for purposes of comparison.

The data in Tables XVII and XVIII are consistent with past data on vegetation and do not indicate any upward trend. Local vegetation naturally contains uranium in concentrations comparable with those in Table XIX.

Since 1974 the jackrabbit (*Lepus Californicus* Gray) has been used for analysis in the environmental monitoring program. The jackrabbit was chosen as the subject because of its abundance, its prolific nature, and its habit of maintaining a limited range as long as food is available.

Three types of analyses were performed on jackrabbits as presented in Tables XIX, XX and XXI.

The individual organ weight is provided in Table XXII to assist in the evaluation of organ doses if desired.

On the basis of the estimated quantities of uranium-238 and tritium released during 1980 (Ref. Table I) the associated average concentrations and dose equivalents were calculated for persons residing within an 80 kilometer (50 mile) radius of Pantex Plant. Dose calculations for the site boundary and nearest inhabitants include kidney dose as well as total body dose equivalent since the kidney is the critical organ for uranium-238 exposure. The total body dose for all persons residing within an 80 kilometer (50 mile) radius of the Pantex Plant is expressed in person-rem.

Meteorological observations from the National Weather Service Office at the Amarillo Air Terminal were utilized in construction of a wind rose for the Pantex vicinity. This, together with associated climatological data, is utilized as input to a computer model for calculation of uranium and tritium concentrations within the 80 kilometer (50 miles) radius.

The computer model utilized for calculation of contaminant contributions is the Climatological Dispersion Model (CDM) written by the National Environmental Research Center of the U. S. Environmental Protection Agency(10).

The uranium and tritium concentrations in Table I were used in calculating the dose values in Table V. For the uranium calculations, separate RCG's and associated doses were used for the total body and kidney determinations since the limiting dose equivalent is different in each case.

## AIR

### Radioactive

Environmental air sampling is accomplished through the use of nine continuously operating air samplers, which are located around an approximate 8 kilometer (5-mile) radius of Pantex Plant (Ref. Fig. 5).

These samplers are equipped with air pumps that operate continuously at a collection rate of approximately 56 l/min. Particulates are collected on a 47 millimeter diameter membrane filter which is collected nominally on a weekly basis. Although severe weather and other factors influence collection frequency, a typical weekly air sample will represent about 600 cubic meters of air.

A silica gel column is included in the sampling line for collection of environmental tritium oxide. The silica gel, acting as a desiccant, removes water vapor from the air stream following removal of the particulates. Any tritium oxide present will be captured with the water vapor and may be recovered for analysis at some later date. Silica gel columns are exchanged on the same frequency as the air filters.

Each weekly air sample filter is composited on a monthly basis with other filters from the same air sampling station. These samples are then sent to an outside laboratory for total uranium, plutonium-239, radium-226, and radium-228 analysis. Silica gel samples are also analyzed by an outside laboratory to determine tritium oxide content, but are not composited as were the air filters.

A summary of the results for uranium, plutonium-239, and tritium oxide in air is presented in Tables VII through IX. Deviations above background are attributed to natural meteorological distribution of worldwide fallout.

#### Non-Radioactive

Pantex Plant does not have any industrial processes which serve as significant sources of particulate matter, carbon monoxide, photochemical oxidants, hydrocarbons, oxides of nitrogen, or oxides of sulfur. Steam is generated by natural gas-fired boilers which are low in sulfur dioxide emissions (see Appendix). Other sources of pollutants are generally absent since most of the work performed is mechanical rather than chemical. Estimated emissions from Pantex Plant steam generation operations during 1980 are presented in Table II.

Some emissions occur from test fires of chemical high explosives, burning of waste high explosives, and "flashing" of high explosives contaminated scrap metal. These operations occur so infrequently, however, (a few hours per week) that off-site environmental sampling for related non-radioactive contaminants is not performed. During 1980 an estimated 69,000 kg of waste chemical high explosives were burned and approximately 40,000 litres of toluene were disposed of by evaporation.

#### WATER

##### Radioactive

Local geologic characteristics of the Pantex vicinity are such that there are no streams or rivers which flow through or near the plant site. Plant effluents flow into an on-site playa (designated WS-8 on Fig. 6) prior to use for irrigation. A second on-site retention playa (WS-27) is not currently used for either collection of plant effluents or irrigation.

These on-site retention playas, a nearby natural playa (WS-1), and groundwater from plant wells are the only available locations for collecting environmental water samples. Plant wells include deep water wells from the Ogallala aquifer and two special shallow test wells designated WS-19 and WS-20. WS-19 is so located to indicate whether contamination from the radioactive waste storage area or the retention playa is leaching into the groundwater. Playa water is not considered potable as it is high in natural dissolved alkali salts. The nearby natural playa was dry during most of 1980, which accounts for the small number of samples taken at that sampling site.

From the sources available, two-gallon water samples are collected monthly and sent to an outside laboratory for analysis of total uranium, plutonium-239, radium-226, radium-228, and tritium oxide content. A summary of these data for 1980 is presented in Tables X through XIV.

#### Non-Radioactive

Analyses of environmental water samples are also accomplished for nonradioactive species. The number of samples varies due to evaporation of the playas. Most of the actual analytical work is performed by an outside laboratory and comparisons are made with Environmental Protection Agency.

A summary of analyses for nonradioactive species for 1980 is presented in Table XXIII.

#### SOIL

##### Radioactive

Thirty-one environmental soil samples are collected monthly, weather permitting, at the locations indicated in Figure 5 according to standard soil sampling protocol. Each sample consists of two plugs from a "cookie cutter" which is 8.9 centimeters in diameter and 5.1 centimeters in depth. A sample may also contain a small amount of roots/vegetation.

After collection, the samples are sent to an outside laboratory where any uranium, or plutonium, is chemically extracted according to standard methods and then analyzed to determine the amount of each isotope of interest.

A summary of soil sampling results is presented in Tables XV and XVI for uranium and plutonium-239, respectively.

#### VEGETATION

##### Radioactive

Environmental vegetation samples are collected from 16 locations (Ref. Fig. 6) each month, weather permitting, for analysis of total uranium and tritium oxide content. These samples consist primarily of native and domestic grasses although it is not uncommon for a small percentage of other vascular plants to be present in some samples.

Following collection and labeling the samples are sent to an outside laboratory for the actual analysis. The analytical procedures used are essentially the same as for analysis of nuclides in soil and a summary of the results is presented in Tables XVII and XVIII.

#### BIOTA

##### Radioactive

During 1980, 10 jackrabbits (*Lepus Californicus* Gray) were collected from within the plant perimeter and analyzed for the presence of uranium, plutonium-239, and tritium oxide. The locations where the specimens were collected were chosen carefully to help determine whether other than natural levels of uranium, plutonium-239, or tritium oxide were present in the biological cycle.

Following collection the specimens were frozen and sent to an independent laboratory where dissection and analyses of lung, liver, kidney, bone, and muscle tissue were performed to determine the quantity of uranium, plutonium-239, and tritium oxide present in each organ.

These data are presented in their entirety in Tables XIX, XX and XXI.

# CALCULATION OF POTENTIAL RADIATION DOSE TO THE PUBLIC FROM PANTEX ACTIVITIES FOR 1980

Radiation exposure to the public from Pantex activities is minimal. An estimation of the overall impact to the public from routine activities was made by application of atmospheric diffusion calculations to estimated average annual radioactivity release rates using local meteorological data.

Table I provides estimated curies of depleted uranium and tritium released during 1980. These releases are considered ground level releases since the uranium and tritium were released from structures or facilities not having stacks. Average wind speed and directional frequency (Ref. Figure 4) were determined for each of the sixteen compass points using official climatological data for Amarillo, Texas, for 1980(11).

Population estimates were based on figures presented in the Texas Almanac for each city, town, and county within an 80 kilometer (50 miles) radius of Pantex Plant(9,12).

The computer model utilized in describing local atmospheric dispersion utilizes six atmospheric stability classes and six wind speed classes to describe the atmospheric characteristics of the sixteen wind sectors contained within the 80 kilometer (50 mile) radius. Meteorological parameters were chosen from data obtained at the Amarillo Office of the National Weather Service and utilized as input parameters for the Climatological Dispersion Model (CDM). Following input of approximate parameters, source data, and receptor points, the CDM calculates average annual concentration of contaminants at each receptor point.

Estimated dose equivalents from the inhalation of depleted uranium and tritium were evaluated according to equation (1) which uses a simple ratio of the calculated concentration to the appropriate RCG as the basis for dose determination:

$$D_{\chi} = \frac{\chi \cdot D}{RCG} \quad (1)$$

Where

$D_{\chi}$  = dose to critical organ in rem

$\chi$  = concentration of nuclide (Ref. Table IV)

RCG = RCG for uncontrolled area expressed in curies/cubic meter(13)

D = dose to critical organ associated with the appropriate RCG(13)

For Pantex operations, three groups of receptors were chosen in performing dose calculations: (a) hypothetical site boundary receptors, (b) nearest inhabitants to the plant reservation, and (c) cities, towns, and communities within an 80 kilometer (50 mile) radius of Pantex Plant. Dose estimates are expressed in rem or person-rem where the term person-rem refers to the product of dose times population for the various receptor groups.

The 80 kilometer (50 mile) person-rem is determined according to contaminant concentration and population in sixteen sectors (Ref. Figure 7) as described by equation (2):

$$D_{80} = \sum_{n=1}^K \frac{\chi_n D_{wb} P_n}{RCG_{wb}} \quad (2)$$

where

$D_{80}$  = 80-kilometer total body dose in person-rem

$\chi_n$  = average concentration for each receptor location (Ref. Table IV)

$RCG_{wb}$  = radioactivity concentration guide associated with the whole body as the critical organ

$D_{wb}$  = dose to whole body associated with the appropriate RCG

$P_n$  = population for receptor location considered (Ref. Table III)

$K$  = number of receptor locations



***FIGURES***

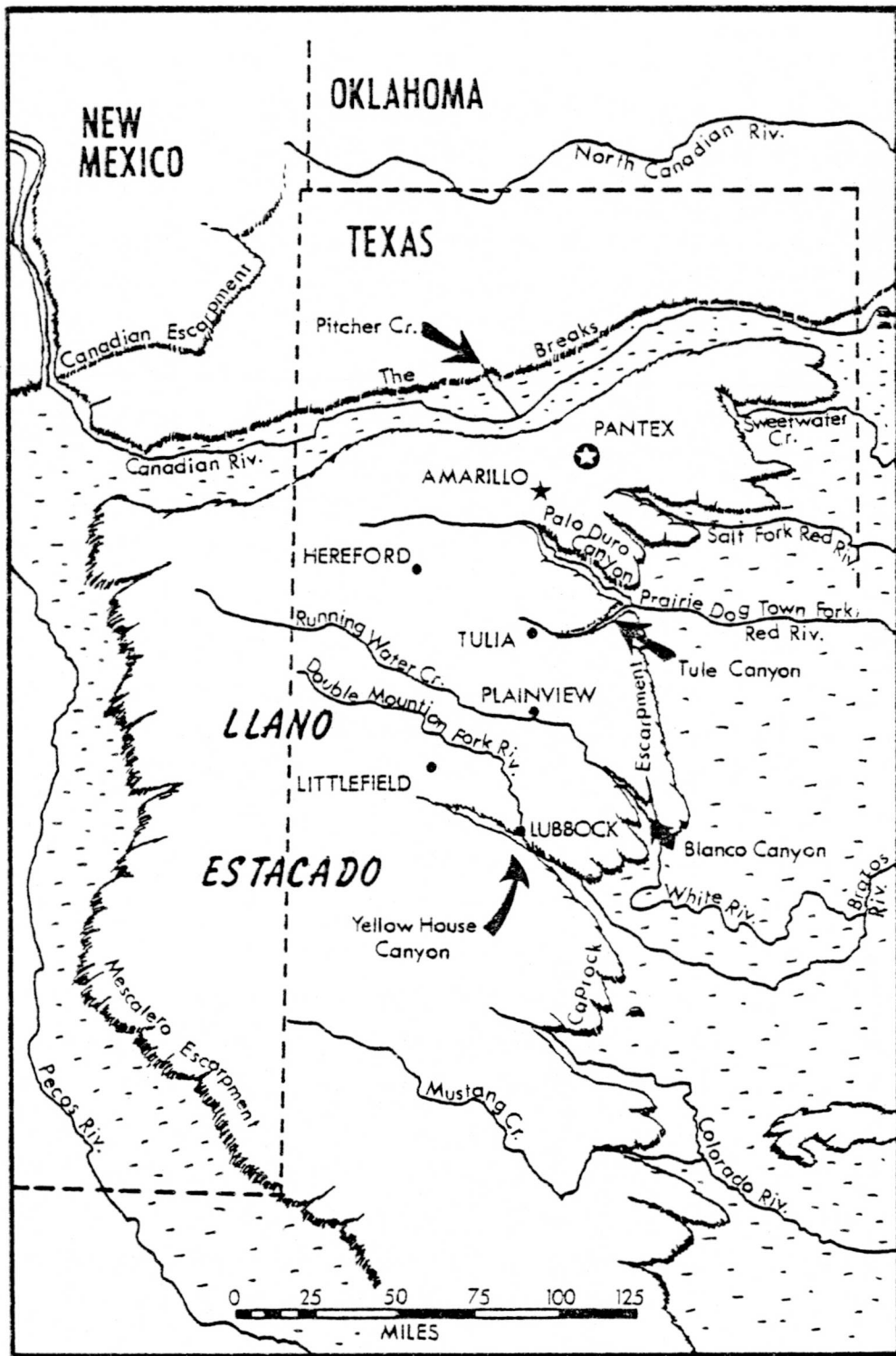


Figure 1. Physical Features of The Texas High Plains

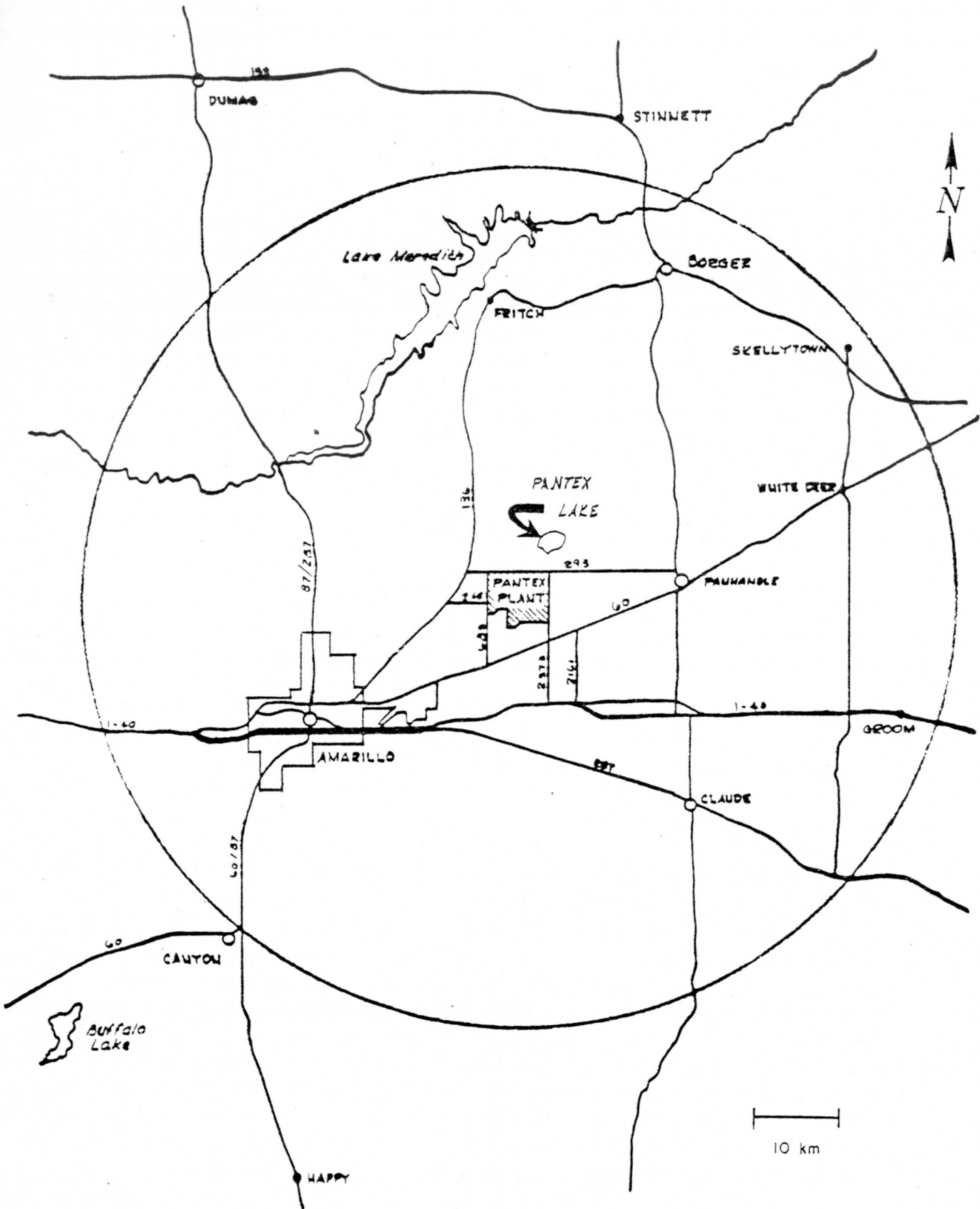
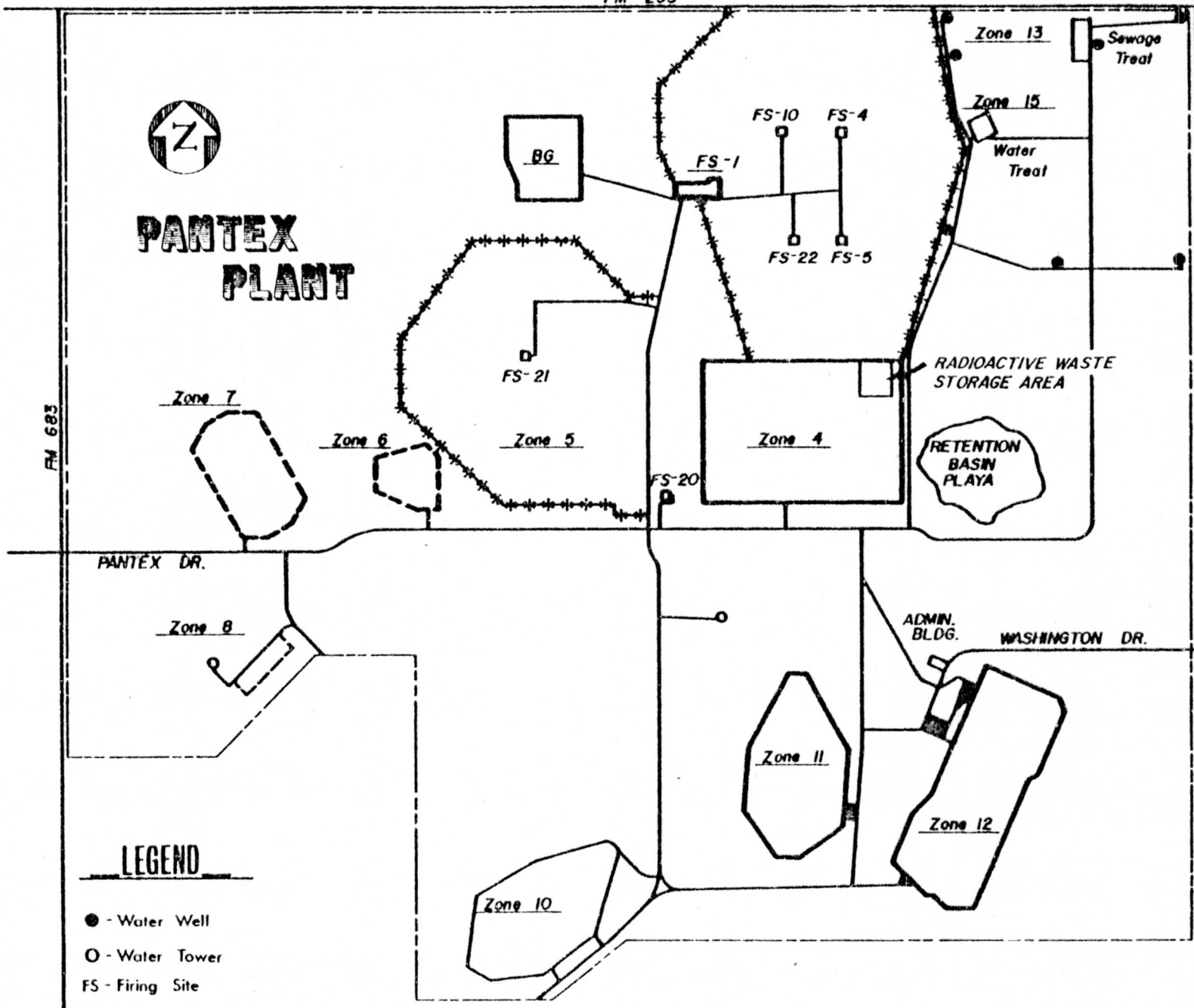


Figure 2. Pantex Plant 48 Kilometer (30 Mile) Vicinity Map



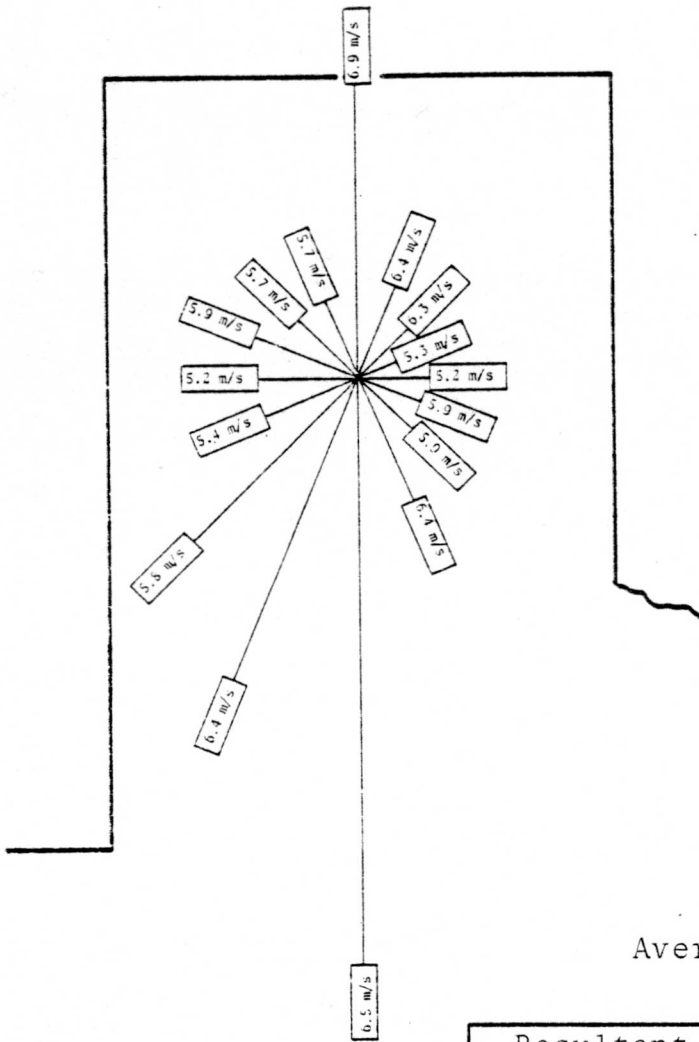
**LEGEND**

- - Water Well
- - Water Tower
- FS - Firing Site
- BG - Burning Ground
- \*\*\* - Fence (Barbed Wire)
- - Road

Scale

1 km

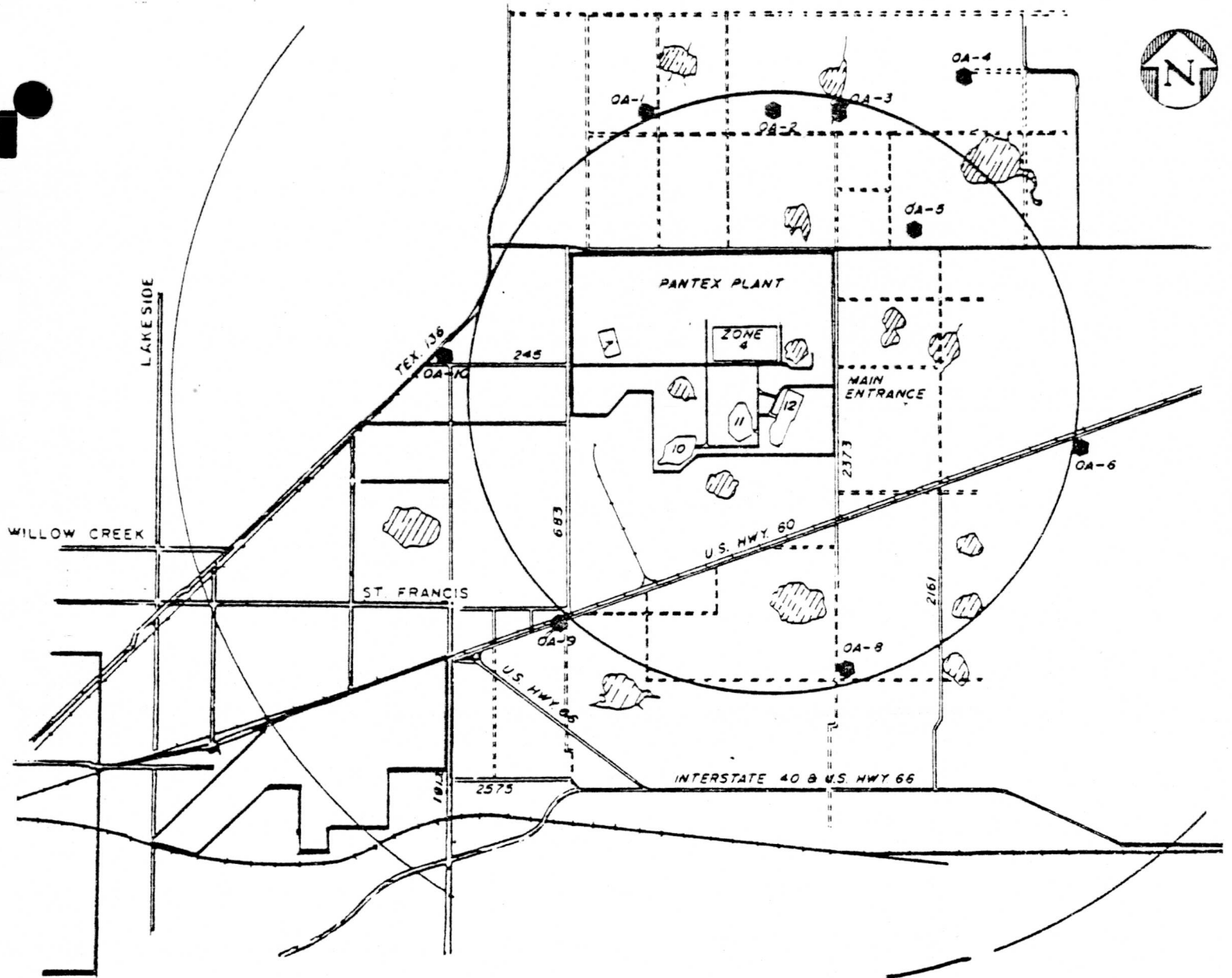
Figure 3. Pantex Plant Facility Site



Average Winds for Amarillo, Texas  
for 1980

Resultant Dir. From	Average Speed (m/s)	Percent Occurrence
N	6.9	10.7
NNE	6.4	4.1
NE	6.3	2.7
ENE	5.3	1.9
E	5.2	3.3
ESE	5.9	2.7
SE	5.9	3.0
SSE	6.4	5.2
S	6.5	22.4
SSW	6.4	12.6
SW	5.8	9.8
WSW	5.4	4.9
W	5.2	4.9
WNW	5.9	4.6
NW	5.7	3.6
NNW	5.7	3.6

FIGURE 4. AVERAGE WINDS FOR AMARILLO, TEXAS FOR 1980



LEGEND

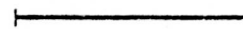
==== SOIL SURFACE ROAD

==== PAVED ROAD

 PLAYA

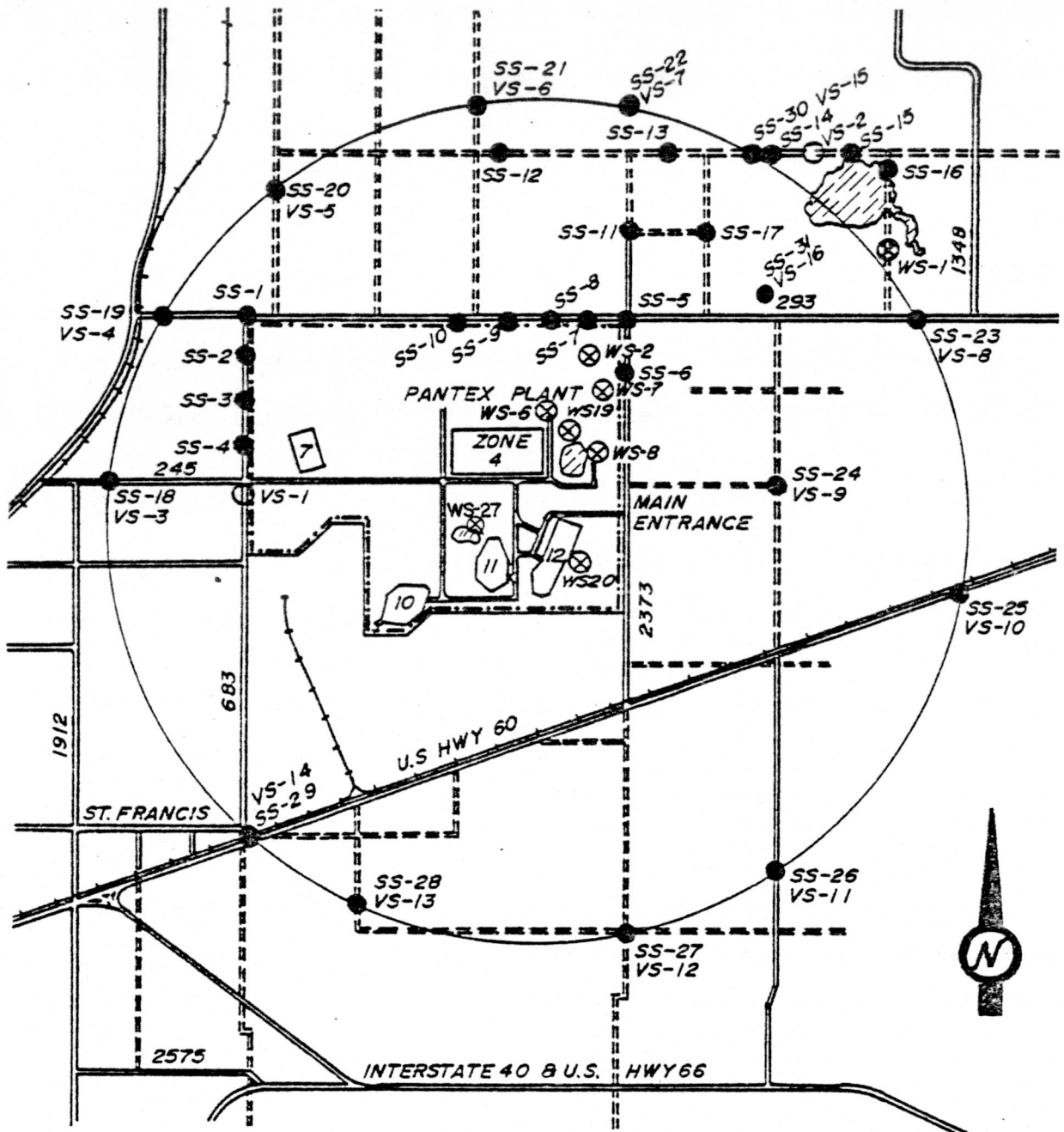
— BOUNDARY LINE

 OFF SITE AIR SAMPLER OA



5 km

Fig. 5. Pantex Environmental Air Sampling Network Around an 8 Kilometer (5 Mile) Radius



**LEGEND**

===== SOIL SURFACED ROAD

————— PAVED ROAD

 PLAYA

-----•----- BOUNDARY LINE

● SOIL SAMPLE - SS

○ VEGETATION SAMPLE - VS

⊗ WATER SAMPLE - WS

**SCALE**

—————  
5 km

Fig. 6. Environmental Soil, Water and Vegetation Sampling Locations for Pantex Plant [12 Kilometer (7.5 Mile) Radius]

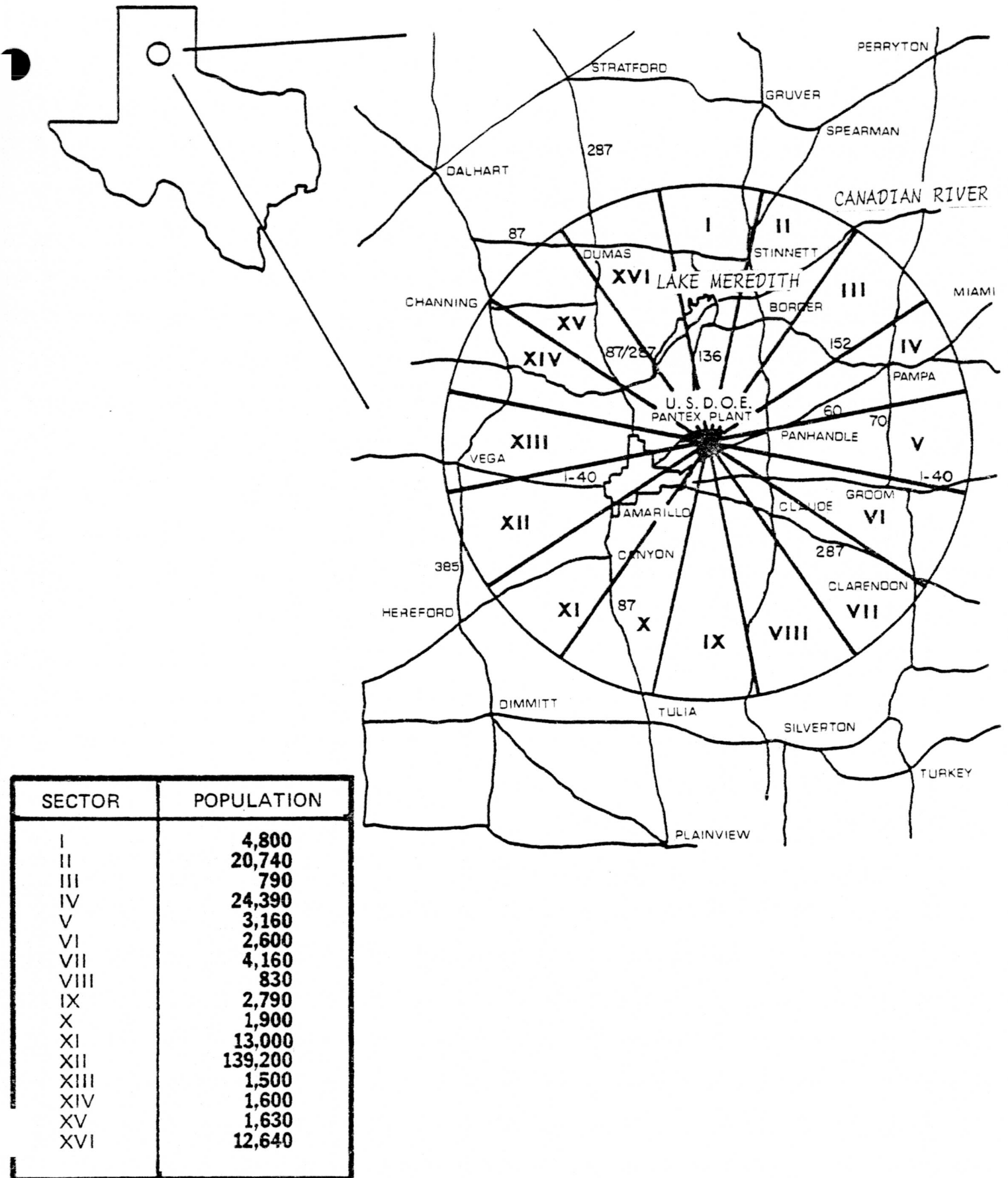


Figure 7. Population Within an 80 Kilometer (50 Mile) Radius of Pantex Plant



***TABLES***

Table I. Estimated Atmospheric Releases of Radioactive Material from Pantex Plant for 1980

<u>Nuclide</u>	<u>Curies</u>	<u>Average Source Emission (Curies/Second)*</u>
Depleted Uranium ( $^{238}\text{U}$ )	$5.0 \times 10^{-5}$	$1.6 \times 10^{-12}$
Plutonium	0	0
Tritium ( $^3\text{H}$ )	$10.2 \times 10^{-2}$	$3.2 \times 10^{-9}$

*\*Based on  $3.16 \times 10^7$  seconds/year*

Table II. Estimated Steam Generating Plant Emissions for 1980\*

<u>Contaminant</u>	<u>Release (lb/10<sup>6</sup> BTU)</u>	<u>% of Standard</u>
Carbon Monoxide	0.019	N/A
Oxides of Nitrogen	0.085	42.50

*\* $4.4 \times 10^{11}$  BTU's of gas fuel were used in 1980  
Standard = 0.2 pounds nitrogen/10<sup>6</sup> BTU's of gas fuel*

Table III. Population of Area Receptors Used in 1980 Uranium and Tritium Calculations

<u>Receptor</u>	<u>Sector</u>	<u>Population</u>	<u>Receptor</u>	<u>Sector</u>	<u>Population</u>
Fritch	I	1,795	Rural/Suburban	VIII	1,477
Sanford	I	185			
Stinnett	I	2,025	Wayside	IX	40
Rural/Suburban	I	795	Rural/Suburban	IX	2,774
Buena Vista	II	1,410	Washburn	X	70
Borger	II	14,560	Happy	X	680
Phillips	II	2,540	Rural/Suburban	X	1,127
Rural/Suburban	II	2,234			
Skellytown	III	701	Canyon	XI	8,758
Rural/Suburban	III	91	Umbarger	XI	327
			Dawn	XI	94
			Rural/Suburban	XI	3,816
Pampa	IV	20,979			
White Deer	IV	1,102	Amarillo	XII	134,576
Kings Mill	IV	65	Bushland	XII	130
Rural/Suburban	IV	2,240	Wildorado	XII	180
			Rural/Suburban	XII	4,328
Panhandle	V	2,190			
Lefors	V	816	Vega	XIII	839
Alanreed	V	60	Rural/Suburban	XIII	668
Rural/Suburban	V	92			
Groom	VI	808	Channing	XIV	352
Jerico	VI	100	Boys Ranch	XIV	410
Lark	VI	26	Rural/Suburban	XIV	841
Rural/Suburban	VI	1,669			
Conway	VII	50	Masterson	XV	85
Asholta	VII	20	Rural/Suburban	XV	1,541
Clarendon	VII	2,400			
Claude	VII	1,017	Dumas	XVI	9,850
Goodnight	VII	25	Rural/Suburban	XVI	2,791
Rural/Suburban	VII	620			

Table IV. Calculated Uranium-in-Air and Tritium-in-Air Contributions from Pantex Plant for 1980

Receptor	Calculated Tritium Contribution ( $\mu\text{Ci}/\text{m}^3 \times 10^{-13}$ )	% RCG*	Calculated Uranium Contribution ( $\mu\text{Ci}/\text{m}^3 \times 10^{-21}$ )	% RCG
Fritch	29	$29 \times 10^{-9}$	17	$17 \times 10^{-7}$
Sanford	22	$22 \times 10^{-9}$	13	$13 \times 10^{-7}$
Stinnett	14	$14 \times 10^{-9}$	8	$8 \times 10^{-7}$
Rural/Suburban Sector I	24	$24 \times 10^{-9}$	14	$14 \times 10^{-7}$
Buena Vista	28	$28 \times 10^{-9}$	6	$6 \times 10^{-7}$
Borger	9	$9 \times 10^{-9}$	5	$5 \times 10^{-7}$
Phillips	3	$3 \times 10^{-9}$	5	$5 \times 10^{-7}$
Rural/Suburban Sector II	9	$9 \times 10^{-9}$	5	$5 \times 10^{-7}$
Skellytown	3	$3 \times 10^{-9}$	3	$3 \times 10^{-7}$
Rural/Suburban Sector III	6	$6 \times 10^{-9}$	3	$3 \times 10^{-7}$
Pampa	4	$4 \times 10^{-9}$	2	$2 \times 10^{-7}$
White Deer	3	$3 \times 10^{-9}$	4	$4 \times 10^{-7}$
Kings Mill	5	$5 \times 10^{-9}$	3	$3 \times 10^{-7}$
Rural/Suburban Sector IV	7	$7 \times 10^{-9}$	4	$4 \times 10^{-7}$
Panhandle	33	$33 \times 10^{-9}$	28	$28 \times 10^{-7}$
Lefors	5	$5 \times 10^{-9}$	2	$2 \times 10^{-7}$
Alanreed	5	$5 \times 10^{-9}$	1	$1 \times 10^{-7}$
Rural/Suburban Sector V	12	$12 \times 10^{-9}$	6	$6 \times 10^{-7}$
Groom	6	$6 \times 10^{-9}$	3	$3 \times 10^{-7}$
Jerico	4	$4 \times 10^{-9}$	2	$2 \times 10^{-7}$
Lark	10	$10 \times 10^{-9}$	4	$4 \times 10^{-7}$
Rural/Suburban Sector VI	7	$7 \times 10^{-9}$	3	$3 \times 10^{-7}$
Conway	25	$25 \times 10^{-9}$	10	$10 \times 10^{-7}$
Ashtola	5	$5 \times 10^{-9}$	2	$2 \times 10^{-7}$
Clarendon	3	$3 \times 10^{-9}$	1	$1 \times 10^{-7}$
Goodnight	6	$6 \times 10^{-9}$	3	$3 \times 10^{-7}$
Claude	14	$14 \times 10^{-9}$	10	$10 \times 10^{-7}$
Rural/Suburban Sector VII	7	$7 \times 10^{-9}$	3	$3 \times 10^{-7}$
Rural/Suburban Sector VIII	13	$13 \times 10^{-9}$	6	$7 \times 10^{-7}$
Wayside	32	$32 \times 10^{-9}$	14	$14 \times 10^{-7}$
Rural/Suburban Sector IX	56	$56 \times 10^{-9}$	24	$24 \times 10^{-7}$
Washburn	210	$210 \times 10^{-9}$	76	$76 \times 10^{-7}$
Happy	12	$12 \times 10^{-9}$	6	$6 \times 10^{-7}$
Rural/Suburban Sector X	31	$31 \times 10^{-9}$	14	$14 \times 10^{-7}$
Canyon	17	$17 \times 10^{-9}$	8	$8 \times 10^{-7}$
Umberger	11	$11 \times 10^{-9}$	5	$5 \times 10^{-7}$
Dawn	9	$9 \times 10^{-9}$	4	$4 \times 10^{-7}$
Rural/Suburban Sector XI	24	$24 \times 10^{-9}$	11	$11 \times 10^{-7}$
Amarillo	31	$31 \times 10^{-9}$	15	$15 \times 10^{-7}$
Bushland	13	$13 \times 10^{-9}$	6	$6 \times 10^{-7}$
Wildorado	10	$10 \times 10^{-9}$	5	$5 \times 10^{-7}$
Rural/Suburban Sector XII	18	$18 \times 10^{-9}$	8	$8 \times 10^{-7}$
Vega	6	$6 \times 10^{-9}$	3	$3 \times 10^{-7}$
Rural/Suburban Sector XIII	18	$18 \times 10^{-9}$	9	$9 \times 10^{-7}$
Channing	4	$4 \times 10^{-9}$	2	$2 \times 10^{-7}$
Boys Ranch	5	$5 \times 10^{-9}$	2	$2 \times 10^{-7}$
Rural/Suburban Sector XIV	11	$11 \times 10^{-9}$	6	$6 \times 10^{-7}$
Masterson	3	$3 \times 10^{-9}$	4	$4 \times 10^{-7}$
Rural/Suburban Sector XV	13	$13 \times 10^{-9}$	7	$7 \times 10^{-7}$
Dumas	5	$5 \times 10^{-9}$	3	$3 \times 10^{-7}$
Rural/Suburban Sector XVI	12	$12 \times 10^{-9}$	7	$7 \times 10^{-7}$
Nearest Inhabitant	560	$560 \times 10^{-9}$	290	$290 \times 10^{-7}$
Site Boundary	36,000	$36,000 \times 10^{-9}$	750	$750 \times 10^{-7}$

\*Radioactivity Concentration Guide =  $1 = 10^{-12}$   $\mu\text{Ci}/\text{m}^3$  for  $^{238}\text{U}$  and  
 $1 = 10^{-7}$   $\mu\text{Ci}/\text{m}^3$  for  $^3\text{H}$

Table V. Vicinity Dose Calculations from Pantex Plant Contributions for 1980

<u>Reference Point</u>	<u>Tritium (<sup>3</sup>H)</u>	<u>Uranium (<sup>238</sup>U)</u>
Nearest Individual		
Total Body	4 x 10 <sup>-10</sup> Rem	3 x 10 <sup>-9</sup> Rem
Kidney	N/A	2 x 10 <sup>-7</sup> Rem
Lung	N/A	9 x 10 <sup>-8</sup> Rem
Site Boundary		
Total Body	3 x 10 <sup>-8</sup> Rem	6 x 10 <sup>-9</sup> Rem
Kidney	N/A	4 x 10 <sup>-7</sup> Rem
Lung	N/A	2 x 10 <sup>-7</sup> Rem
80 Kilometer		
Total Body	4 x 10 <sup>-6</sup> Person-Rem	2 x 10 <sup>-3</sup> Person-Rem

*\*For Uranium-238, the kidney is the critical organ, the total body is the critical organ for Tritium exposures. Total body RCG's were used in total body and person-rem determinations.*

Table VI. Pantex Vicinity Population Dose Due to Naturally Occurring Penetrating Radiation\*

<u>Reference Point</u>	<u>Dose</u>
80 Kilometer	
Total Body	2 x 10 <sup>4</sup> Person-Rem
Typical Individual	8 x 10 <sup>-2</sup> Rem

*\*Based on an exposure rate of 9.5 x 10<sup>-6</sup> R/hr due to naturally occurring sources of penetrating radiation*

Table VII. Summary of Plutonium 239 in Air for 1980

Sample Station	Number Samples	Average $\mu\text{Ci}/\text{m}\ell$ ( $10^{-17}$ )	Maximum $\mu\text{Ci}/\text{m}\ell$ ( $10^{-17}$ )	Minimum $\mu\text{Ci}/\text{m}\ell$ ( $10^{-17}$ )	% RCG (Average)
QA-1	12	0.58 $\pm$ 1.62	6.96 $\pm$ 4.71	0.0 $\pm$ 0.81	0.03
QA-2	12	0.96 $\pm$ 1.81	6.00 $\pm$ 3.63	0.0 $\pm$ 0.81	0.05
QA-3	12	0.59 $\pm$ 1.40	5.94 $\pm$ 3.68	0.0 $\pm$ 0.79	0.03
QA-4	12	0.19 $\pm$ 1.01	2.28 $\pm$ 1.63	0.0 $\pm$ 0.79	0.01
QA-5	12	0.31 $\pm$ 1.04	3.74 $\pm$ 1.46	0.0 $\pm$ 0.79	0.02
QA-6	12	0.21 $\pm$ 1.02	2.53 $\pm$ 1.58	0.0 $\pm$ 0.81	0.02
QA-8	12	0.68 $\pm$ 1.22	4.74 $\pm$ 2.53	0.0 $\pm$ 0.81	0.03
QA-9	12	0.34 $\pm$ 1.35	4.09 $\pm$ 3.48	0.0 $\pm$ 0.81	0.02
QA-10	12	1.22 $\pm$ 1.53	8.69 $\pm$ 3.47	0.0 $\pm$ 0.81	0.07
QA-11	8	0.0 $\pm$ 1.05	0.0 $\pm$ 0.99	0.0 $\pm$ 0.99	0.05
QA-12	4	0.0 $\pm$ 1.01	0.0 $\pm$ 0.95	0.0 $\pm$ 0.95	0.05

Minimum Detectable Limit =  $1 \times 10^{-17}$   $\mu\text{Ci}/\text{m}\ell$

Radioactivity Concentration Guide =  $2 \times 10^{-14}$   $\mu\text{Ci}/\text{m}\ell$

Reported errors are counting errors at the 95% confidence level

Table VIII. Summary of Tritium Oxide in Air for 1980

Sample Station	Number Samples	Average $\mu\text{Ci}/\text{m}\ell$ ( $10^{-12}$ )	Maximum $\mu\text{Ci}/\text{m}\ell$ ( $10^{-12}$ )	Minimum $\mu\text{Ci}/\text{m}\ell$ ( $10^{-12}$ )	% RCG (Average)
QA-1	48	0.37 $\pm$ 0.83	5.27 $\pm$ 2.98	0.0 $\pm$ 0.33	$3.7 \times 10^{-4}$
QA-2	48	0.72 $\pm$ 2.29	18.51 $\pm$ 14.63	0.0 $\pm$ 0.33	$7.2 \times 10^{-4}$
QA-3	48	0.28 $\pm$ 0.86	5.50 $\pm$ 3.21	0.0 $\pm$ 0.33	$2.8 \times 10^{-4}$
QA-4	48	0.24 $\pm$ 0.72	3.87 $\pm$ 1.11	0.0 $\pm$ 0.33	$2.4 \times 10^{-4}$
QA-5	47	0.67 $\pm$ 2.35	17.86 $\pm$ 15.28	0.0 $\pm$ 0.33	$6.7 \times 10^{-4}$
QA-6	48	0.86 $\pm$ 3.92	27.76 $\pm$ 26.68	0.0 $\pm$ 0.33	$8.6 \times 10^{-4}$
QA-8	48	0.20 $\pm$ 0.74	3.32 $\pm$ 1.11	0.0 $\pm$ 0.33	$2.0 \times 10^{-4}$
QA-9	48	0.65 $\pm$ 2.15	17.65 $\pm$ 13.99	0.0 $\pm$ 0.33	$6.5 \times 10^{-4}$
QA-10	48	0.87 $\pm$ 3.91	31.20 $\pm$ 26.68	0.0 $\pm$ 0.33	$8.7 \times 10^{-4}$
QA-11	34	0.73 $\pm$ 1.63	5.55 $\pm$ 4.99	0.0 $\pm$ 0.82	$7.3 \times 10^{-4}$
QA-12	18	1.78 $\pm$ 4.70	27.11 $\pm$ 19.58	0.0 $\pm$ 1.11	$17.8 \times 10^{-4}$

Minimum Detectable Limit =  $1 \times 10^{-12}$   $\mu\text{Ci}/\text{m}\ell$

Radioactivity Concentration Guide =  $1 \times 10^{-7}$   $\mu\text{Ci}/\text{m}\ell$

Reported errors are counting errors at the 95% confidence level

Table IX. Summary of Uranium in Air for 1980

Sample Station	Number Samples	Average $\mu\text{Ci}/\text{ml}$ ( $10^{-16}$ )	Maximum $\mu\text{Ci}/\text{ml}$ ( $10^{-16}$ )	Minimum $\mu\text{Ci}/\text{ml}$ ( $10^{-16}$ )	% RCG (Average)
QA-1	12	$3.05 \pm 1.24$	$10.54 \pm 1.19$	$0.0 \pm 0.10$	$3.1 \times 10^{-2}$
QA-2	12	$4.73 \pm 1.46$	$15.25 \pm 1.41$	$0.0 \pm 0.08$	$4.7 \times 10^{-2}$
QA-3	12	$2.19 \pm 0.89$	$6.60 \pm 0.90$	$0.0 \pm 0.10$	$2.2 \times 10^{-2}$
QA-4	12	$3.88 \pm 1.21$	$14.26 \pm 1.25$	$0.0 \pm 0.10$	$3.9 \times 10^{-2}$
QA-5	12	$3.31 \pm 1.54$	$11.38 \pm 4.26$	$0.0 \pm 0.10$	$3.3 \times 10^{-2}$
QA-6	12	$2.75 \pm 1.25$	$8.27 \pm 1.06$	$0.0 \pm 0.10$	$2.8 \times 10^{-2}$
QA-8	12	$2.87 \pm 1.17$	$12.82 \pm 1.31$	$0.0 \pm 0.10$	$2.9 \times 10^{-2}$
QA-9	12	$4.65 \pm 1.71$	$13.53 \pm 1.33$	$0.0 \pm 0.10$	$4.7 \times 10^{-2}$
QA-10	12	$3.79 \pm 1.88$	$16.41 \pm 4.60$	$0.0 \pm 0.10$	$3.8 \times 10^{-2}$
QA-11	9	$1.09 \pm 1.24$	$3.32 \pm 1.19$	$0.0 \pm 1.34$	$1.1 \times 10^{-2}$
QA-12	4	$0.26 \pm 0.45$	$1.06 \pm 0.88$	$0.0 \pm 0.08$	$0.3 \times 10^{-2}$

Minimum Detectable Limit =  $2 \times 10^{-16}$   $\mu\text{Ci}/\text{ml}$

Radioactivity Concentration Guide =  $1 \times 10^{-12}$   $\mu\text{Ci}/\text{ml}$

Reported errors are counting errors at the 95% confidence level

Table X. Summary of Tritium Oxide in Water for 1980

Sample Station	Number Samples	Average $\mu\text{Ci}/\text{ml}$ ( $10^{-6}$ )	Maximum $\mu\text{Ci}/\text{ml}$ ( $10^{-6}$ )	Minimum $\mu\text{Ci}/\text{ml}$ ( $10^{-6}$ )	% RCG (Average)
WS-1	2	$0.00 \pm 0.50$	$0.00 \pm 0.50$	$0.00 \pm 0.50$	0.05
WS-6	2	$0.00 \pm 0.50$	$0.00 \pm 0.50$	$0.00 \pm 0.50$	0.05
WS-8	8	$0.19 \pm 0.50$	$1.00 \pm 0.60$	$0.00 \pm 0.50$	0.02
WS-20	7	$0.10 \pm 0.52$	$0.70 \pm 0.60$	$0.00 \pm 0.50$	0.01
WS-27	5	$0.32 \pm 0.52$	$1.60 \pm 0.60$	$0.00 \pm 0.50$	0.03

Minimum Detectable Limit =  $5 \times 10^{-7}$   $\mu\text{Ci}/\text{ml}$

Radioactivity Concentration Guide  $1 \times 10^{-3}$   $\mu\text{Ci}/\text{ml}$

Reported errors are counting errors at the 95% confidence level

Table XI. Summary of Plutonium 239 in Water for 1980

Sample Station	Number Samples	Average $\mu\text{Ci}/\text{m}\ell$ ( $10^{-10}$ )	Maximum $\mu\text{Ci}/\text{m}\ell$ ( $10^{-10}$ )	Minimum $\mu\text{Ci}/\text{m}\ell$ ( $10^{-10}$ )	% RCG (Average)
WS-1	2	$0.00 \pm 0.20$	$0.00 \pm 0.20$	$0.00 \pm 0.20$	$<1.0 \times 10^{-3}$
WS-6	2	$0.00 \pm 0.20$	$0.00 \pm 0.20$	$0.00 \pm 0.20$	$<1.0 \times 10^{-3}$
WS-8	8	$0.07 \pm 0.19$	$0.40 \pm 0.20$	$0.00 \pm 0.20$	$3.5 \times 10^{-4}$
WS-20	7	$0.00 \pm 0.20$	$0.00 \pm 0.20$	$0.00 \pm 0.20$	$<1.0 \times 10^{-3}$
WS-27	5	$0.14 \pm 0.22$	$0.40 \pm 0.30$	$0.00 \pm 0.20$	$7.0 \times 10^{-4}$

Minimum Detectable Limit =  $2 \times 10^{-11} \mu\text{Ci}/\text{m}\ell$

Radioactivity Concentration Guide =  $2 \times 10^{-6} \mu\text{Ci}/\text{m}\ell$

Reported errors are counting errors at the 95% confidence level

Table XII. Summary of Radium 226 in Water for 1980

Sample Station	Number Samples	Average $\mu\text{Ci}/\text{m}\ell$ ( $10^{-9}$ )	Maximum $\mu\text{Ci}/\text{m}\ell$ ( $10^{-9}$ )	Minimum $\mu\text{Ci}/\text{m}\ell$ ( $10^{-9}$ )	% RCG (Average)
WS-1	2	$0.00 \pm 0.60$	$0.00 \pm 0.60$	$0.00 \pm 0.60$	<6.0
WS-6	2	$1.55 \pm 0.47$	$2.00 \pm 0.60$	$1.10 \pm 0.30$	15.5
WS-8	8	$0.67 \pm 0.59$	$4.30 \pm 0.70$	$0.00 \pm 0.60$	6.7
WS-20	7	$2.63 \pm 0.73$	$8.50 \pm 0.90$	$0.00 \pm 0.60$	26.3
WS-27	5	$1.14 \pm 0.64$	$5.70 \pm 0.80$	$0.00 \pm 0.60$	11.4

Minimum Detectable Limit =  $6 \times 10^{-11} \mu\text{Ci}/\text{m}\ell$

Radioactivity Concentration Guide =  $1 \times 10^{-8} \mu\text{Ci}/\text{m}\ell$

Reported errors are counting errors at the 95% confidence level

Table XIII. Summary of Radium 228 in Water for 1980

<u>Sample Station</u>	<u>Number Samples</u>	<u>Average <math>\mu\text{Ci}/\text{ml}</math> (<math>10^{-9}</math>)</u>	<u>Maximum <math>\mu\text{Ci}/\text{ml}</math> (<math>10^{-9}</math>)</u>	<u>Minimum <math>\mu\text{Ci}/\text{ml}</math> (<math>10^{-9}</math>)</u>	<u>% RCG (Average)</u>
WS-1	2	1.50 $\pm$ 0.75	1.70 $\pm$ 0.80	1.30 $\pm$ 0.70	15.0
WS-6	2	0.00 $\pm$ 1.00	0.00 $\pm$ 1.00	0.00 $\pm$ 1.00	<10.0
WS-8	8	0.13 $\pm$ 0.96	1.00 $\pm$ 0.60	0.00 $\pm$ 1.00	1.3
WS-20	7	0.37 $\pm$ 0.89	1.50 $\pm$ 0.60	0.00 $\pm$ 1.00	3.7
WS-27	5	1.02 $\pm$ 0.98	2.00 $\pm$ 0.70	0.00 $\pm$ 1.00	10.2

*Minimum Detectable Limit =  $1 \times 10^{-9}$   $\mu\text{Ci}/\text{ml}$*

*Radioactivity Concentration Guide =  $1 \times 10^{-8}$   $\mu\text{Ci}/\text{ml}$*

*Reported errors are counting errors at the 95% confidence level*

Table XIV. Summary of Total Uranium in Water for 1980

<u>Sample Station</u>	<u>Number Samples</u>	<u>Average <math>\mu\text{Ci}/\text{ml}</math> (<math>10^{-9}</math>)</u>	<u>Maximum <math>\mu\text{Ci}/\text{ml}</math> (<math>10^{-9}</math>)</u>	<u>Minimum <math>\mu\text{Ci}/\text{ml}</math> (<math>10^{-9}</math>)</u>	<u>% RCG (Average)</u>
WS-1	2	6.00 $\pm$ 4.95	12.00 $\pm$ 7.00	0.00 $\pm$ 0.30	0.06
WS-6	2	4.50 $\pm$ 2.55	9.00 $\pm$ 3.60	0.00 $\pm$ 0.30	0.05
WS-8	8	14.21 $\pm$ 2.87	34.90 $\pm$ 5.90	0.00 $\pm$ 0.30	0.14
WS-20	7	4.61 $\pm$ 2.15	11.40 $\pm$ 1.70	0.00 $\pm$ 0.30	0.05
WS-27	5	5.10 $\pm$ 1.38	19.10 $\pm$ 2.50	0.00 $\pm$ 0.30	0.05

*Minimum Detectable Limit =  $1 \times 10^{-9}$   $\mu\text{Ci}/\text{ml}$*

*Radioactivity Concentration Guide =  $1 \times 10^{-5}$   $\mu\text{Ci}/\text{ml}$*

*Reported errors are counting errors at 95% confidence level*

Table XV. Summary of Plutonium 239 in Soil for 1980

Sample Station	Number Samples	Average $\mu\text{Ci/g}$ ( $10^{-6}$ )	Maximum $\mu\text{Ci/g}$ ( $10^{-6}$ )	Minimum $\mu\text{Ci/g}$ ( $10^{-6}$ )
SS-1	11	0.00 $\pm$ 0.02	0.00 $\pm$ 0.02	0.0 $\pm$ 0.02
SS-2	11	0.00 $\pm$ 0.02	0.03 $\pm$ 0.02	0.0 $\pm$ 0.02
SS-3	11	0.00 $\pm$ 0.02	0.00 $\pm$ 0.02	0.0 $\pm$ 0.02
SS-4	11	0.01 $\pm$ 0.02	0.07 $\pm$ 0.01	0.0 $\pm$ 0.02
SS-5	11	0.00 $\pm$ 0.02	0.00 $\pm$ 0.02	0.0 $\pm$ 0.02
SS-6	11	0.00 $\pm$ 0.02	0.03 $\pm$ 0.02	0.0 $\pm$ 0.02
SS-7	11	0.01 $\pm$ 0.02	0.04 $\pm$ 0.01	0.0 $\pm$ 0.02
SS-8	11	0.00 $\pm$ 0.02	0.00 $\pm$ 0.02	0.0 $\pm$ 0.02
SS-9	11	0.00 $\pm$ 0.02	0.05 $\pm$ 0.03	0.0 $\pm$ 0.02
SS-10	11	0.00 $\pm$ 0.02	0.03 $\pm$ 0.01	0.0 $\pm$ 0.02
SS-11	11	0.00 $\pm$ 0.02	0.00 $\pm$ 0.02	0.0 $\pm$ 0.02
SS-12	11	0.00 $\pm$ 0.02	0.00 $\pm$ 0.02	0.0 $\pm$ 0.02
SS-13	11	0.00 $\pm$ 0.02	0.03 $\pm$ 0.01	0.0 $\pm$ 0.02
SS-14	11	0.00 $\pm$ 0.02	0.02 $\pm$ 0.02	0.0 $\pm$ 0.02
SS-15	11	0.00 $\pm$ 0.02	0.03 $\pm$ 0.02	0.0 $\pm$ 0.02
SS-16	11	0.01 $\pm$ 0.02	0.05 $\pm$ 0.02	0.0 $\pm$ 0.02
SS-17	11	0.00 $\pm$ 0.02	0.00 $\pm$ 0.02	0.0 $\pm$ 0.02
SS-18	11	0.00 $\pm$ 0.02	0.04 $\pm$ 0.01	0.0 $\pm$ 0.02
SS-19	11	0.00 $\pm$ 0.02	0.03 $\pm$ 0.01	0.0 $\pm$ 0.02
SS-20	11	0.01 $\pm$ 0.02	0.03 $\pm$ 0.02	0.0 $\pm$ 0.02
SS-21	11	0.00 $\pm$ 0.02	0.00 $\pm$ 0.02	0.0 $\pm$ 0.02
SS-22	10	0.00 $\pm$ 0.02	0.00 $\pm$ 0.02	0.0 $\pm$ 0.02
SS-23	10	0.00 $\pm$ 0.02	0.00 $\pm$ 0.02	0.0 $\pm$ 0.02
SS-24	11	0.00 $\pm$ 0.02	0.00 $\pm$ 0.02	0.0 $\pm$ 0.02
SS-25	10	0.00 $\pm$ 0.02	0.00 $\pm$ 0.02	0.0 $\pm$ 0.02
SS-26	11	0.00 $\pm$ 0.02	0.00 $\pm$ 0.02	0.0 $\pm$ 0.02
SS-27	10	0.00 $\pm$ 0.02	0.00 $\pm$ 0.02	0.0 $\pm$ 0.02
SS-28	11	0.00 $\pm$ 0.02	0.04 $\pm$ 0.01	0.0 $\pm$ 0.02
SS-29	11	0.02 $\pm$ 0.02	0.18 $\pm$ 0.02	0.0 $\pm$ 0.02
SS-30	10	0.00 $\pm$ 0.02	0.03 $\pm$ 0.01	0.0 $\pm$ 0.02
SS-31	9	0.00 $\pm$ 0.02	0.00 $\pm$ 0.02	0.0 $\pm$ 0.02

Minimum Detectable Limit =  $2 \times 10^{-8}$   $\mu\text{Ci/g}$

Reported errors are counting errors at 95% confidence level

Activity is per gram of dry soil

Table XVI. Summary of Total Uranium in Soil for 1980

Sample Station	Number Samples	Average $\mu\text{Ci/g}$ ( $10^{-7}$ )	Maximum $\mu\text{Ci/g}$ ( $10^{-7}$ )	Minimum $\mu\text{Ci/g}$ ( $10^{-7}$ )
SS-1	11	5.22 $\pm$ 0.69	11.10 $\pm$ 0.60	1.40 $\pm$ 0.10
SS-2	11	5.24 $\pm$ 0.90	13.20 $\pm$ 0.70	1.00 $\pm$ 1.20
SS-3	11	4.58 $\pm$ 0.82	10.00 $\pm$ 1.00	0.00 $\pm$ 0.50
SS-4	11	5.00 $\pm$ 0.83	8.60 $\pm$ 1.50	1.50 $\pm$ 0.10
SS-5	11	4.56 $\pm$ 0.87	10.20 $\pm$ 1.80	1.30 $\pm$ 0.50
SS-6	11	5.72 $\pm$ 0.81	11.70 $\pm$ 0.60	1.10 $\pm$ 0.50
SS-7	11	4.17 $\pm$ 0.73	7.70 $\pm$ 1.40	1.00 $\pm$ 0.10
SS-8	11	5.82 $\pm$ 0.73	14.30 $\pm$ 1.00	0.00 $\pm$ 0.50
SS-9	11	4.50 $\pm$ 0.76	7.20 $\pm$ 0.50	0.90 $\pm$ 0.10
SS-10	11	6.02 $\pm$ 0.88	15.80 $\pm$ 1.80	1.70 $\pm$ 0.10
SS-11	11	4.84 $\pm$ 0.91	13.00 $\pm$ 1.60	0.00 $\pm$ 0.50
SS-12	11	5.03 $\pm$ 0.79	9.40 $\pm$ 1.50	1.30 $\pm$ 0.10
SS-13	11	5.19 $\pm$ 0.80	14.00 $\pm$ 0.60	0.00 $\pm$ 0.50
SS-14	11	3.87 $\pm$ 0.78	8.90 $\pm$ 0.60	0.70 $\pm$ 0.10
SS-15	10	4.89 $\pm$ 0.82	9.90 $\pm$ 1.60	1.50 $\pm$ 0.10
SS-16	11	4.82 $\pm$ 0.84	10.30 $\pm$ 1.20	1.20 $\pm$ 0.10
SS-17	11	5.63 $\pm$ 0.83	11.90 $\pm$ 1.20	1.50 $\pm$ 0.10
SS-18	11	6.35 $\pm$ 0.92	22.70 $\pm$ 2.10	1.30 $\pm$ 0.10
SS-19	11	4.70 $\pm$ 0.76	12.50 $\pm$ 1.30	0.60 $\pm$ 0.10
SS-20	11	10.29 $\pm$ 1.07	30.20 $\pm$ 2.30	1.70 $\pm$ 0.10
SS-21	11	4.65 $\pm$ 0.85	11.00 $\pm$ 1.00	0.00 $\pm$ 0.50
SS-22	10	5.67 $\pm$ 0.83	9.40 $\pm$ 1.50	0.60 $\pm$ 0.10
SS-23	10	3.88 $\pm$ 0.75	7.30 $\pm$ 0.50	0.40 $\pm$ 1.00
SS-24	11	4.23 $\pm$ 0.75	10.10 $\pm$ 1.60	0.90 $\pm$ 0.40
SS-25	10	4.68 $\pm$ 0.74	7.00 $\pm$ 1.00	1.80 $\pm$ 0.20
SS-26	11	3.84 $\pm$ 0.70	14.10 $\pm$ 1.30	0.50 $\pm$ 0.40
SS-27	10	3.44 $\pm$ 0.70	6.40 $\pm$ 1.10	0.00 $\pm$ 0.50
SS-28	11	3.63 $\pm$ 0.71	8.70 $\pm$ 1.30	0.00 $\pm$ 0.50
SS-29	11	6.35 $\pm$ 0.83	27.50 $\pm$ 2.00	0.80 $\pm$ 0.40
SS-30	11	4.42 $\pm$ 0.71	9.60 $\pm$ 0.60	1.40 $\pm$ 0.40
SS-31	9	5.20 $\pm$ 0.75	10.40 $\pm$ 1.30	1.00 $\pm$ 0.10

Minimum Detectable limit =  $1 \times 10^{-8}$   $\mu\text{Ci/g}$   
 Reported errors are at the 95% confidence level  
 Activity is per gram of dry soil

Table XVII. Summary of Tritium Oxide in Vegetation for 1980

Sample Station	Number Samples	Average % Moisture	Average $\mu\text{Ci/g}$ Moisture ( $10^{-6}$ )	Maximum $\mu\text{Ci/g}$ Moisture ( $10^{-6}$ )	Minimum $\mu\text{Ci/g}$ Moisture ( $10^{-6}$ )
VS-1	10	46.6	$0.41 \pm 0.31$	$1.30 \pm 0.20$	$0.00 \pm 0.40$
VS-2	11	38.9	$0.12 \pm 0.33$	$0.70 \pm 0.40$	$0.00 \pm 0.40$
VS-3	11	41.7	$0.28 \pm 0.36$	$1.79 \pm 0.35$	$0.00 \pm 0.40$
VS-4	11	40.1	$0.10 \pm 0.35$	$0.50 \pm 0.30$	$0.00 \pm 0.40$
VS-5	11	41.0	$0.18 \pm 0.33$	$0.80 \pm 0.50$	$0.00 \pm 0.40$
VS-6	11	37.1	$0.14 \pm 0.35$	$1.20 \pm 0.40$	$0.00 \pm 0.40$
VS-7	11	42.8	$0.13 \pm 0.33$	$0.80 \pm 0.40$	$0.00 \pm 0.40$
VS-8	9	47.4	$0.37 \pm 0.33$	$0.90 \pm 0.40$	$0.00 \pm 0.40$
VS-9	9	40.0	$0.27 \pm 0.30$	$0.90 \pm 0.40$	$0.00 \pm 0.40$
VS-10	11	35.4	$0.15 \pm 0.31$	$0.60 \pm 0.10$	$0.00 \pm 0.40$
VS-11	10	38.0	$0.31 \pm 0.34$	$0.80 \pm 0.40$	$0.00 \pm 0.40$
VS-12	9	32.1	$0.18 \pm 0.38$	$0.90 \pm 0.40$	$0.00 \pm 0.40$
VS-13	11	35.8	$0.09 \pm 0.35$	$0.60 \pm 0.40$	$0.00 \pm 0.40$
VS-14	10	46.1	$0.25 \pm 0.32$	$0.90 \pm 0.40$	$0.00 \pm 0.40$
VS-15	10	39.1	$0.24 \pm 0.34$	$1.00 \pm 0.40$	$0.00 \pm 0.40$
VS-16	8	41.6	$0.11 \pm 0.35$	$0.90 \pm 0.40$	$0.00 \pm 0.40$

Minimum Detectable Limit =  $4 \times 10^{-7}$   $\mu\text{Ci/g}$  moisture  
 Reported errors are counting errors at 95% confidence level

Table XVIII. Summary of Total Uranium in Vegetation for 1980

Sample Station	Number Samples	Average $\mu\text{Ci/g}$ ( $10^{-7}$ )	Maximum $\mu\text{Ci/g}$ ( $10^{-7}$ )	Minimum $\mu\text{Ci/g}$ ( $10^{-7}$ )
VS-1	11	$1.32 \pm 0.50$	$5.00 \pm 0.50$	$0.00 \pm 0.40$
VS-2	11	$1.77 \pm 0.51$	$8.30 \pm 0.70$	$0.00 \pm 0.40$
VS-3	11	$0.91 \pm 0.39$	$4.60 \pm 0.50$	$0.00 \pm 0.40$
VS-4	11	$0.81 \pm 0.45$	$4.00 \pm 0.50$	$0.00 \pm 0.40$
VS-5	11	$1.06 \pm 0.47$	$5.00 \pm 0.50$	$0.00 \pm 0.40$
VS-6	11	$1.05 \pm 0.49$	$3.80 \pm 0.50$	$0.00 \pm 0.40$
VS-7	11	$1.23 \pm 0.46$	$3.80 \pm 0.50$	$0.00 \pm 0.40$
VS-8	8	$0.81 \pm 0.41$	$3.40 \pm 0.50$	$0.00 \pm 0.40$
VS-9	9	$0.88 \pm 0.41$	$3.90 \pm 0.50$	$0.00 \pm 0.40$
VS-10	10	$1.15 \pm 0.53$	$5.00 \pm 0.50$	$0.00 \pm 0.40$
VS-11	10	$1.26 \pm 0.54$	$4.00 \pm 0.50$	$0.00 \pm 0.40$
VS-12	9	$1.12 \pm 0.55$	$4.70 \pm 0.50$	$0.00 \pm 0.40$
VS-13	11	$1.30 \pm 0.52$	$4.90 \pm 0.90$	$0.00 \pm 0.40$
VS-14	11	$0.80 \pm 0.38$	$4.60 \pm 0.50$	$0.00 \pm 0.40$
VS-15	11	$0.94 \pm 0.60$	$3.60 \pm 0.50$	$0.00 \pm 0.40$
VS-16	9	$1.21 \pm 0.53$	$5.70 \pm 0.60$	$0.00 \pm 0.40$

Minimum Detectable Limit =  $2 \times 10^{-8}$   $\mu\text{Ci/g}$   
 Reported errors are counting errors at 95% confidence level  
 Results are per gram dry vegetation

Table XIX. Tritium Oxide in Jackrabbit for 1980

Specimen Identification	Kidney		Liver		Lung		(Flesh) Muscle	
	( $10^{-6}$ $\mu\text{Ci/g}$ moisture)	Moisture (%)	( $10^{-6}$ $\mu\text{Ci/g}$ moisture)	Moisture (%)	( $10^{-6}$ $\mu\text{Ci/g}$ moisture)	Moisture (%)	( $10^{-6}$ $\mu\text{Ci/g}$ moisture)	Moisture (%)
Zone 12 (1)	$0.0 \pm 0.2$	53.3	$0.0 \pm 0.2$	54.2	$0.0 \pm 0.2$	71.0	$0.0 \pm 0.2$	50.0
(2)	$0.0 \pm 0.2$	53.3	$1.9 \pm 1.6$	59.5	$0.0 \pm 0.2$	59.1	$0.0 \pm 0.2$	55.8
Firing Site (1)	$0.0 \pm 0.2$	57.1	$0.0 \pm 0.2$	52.4	$1.9 \pm 1.5$	61.4	$0.0 \pm 0.2$	60.4
(2)	$0.0 \pm 0.2$	53.8	$0.0 \pm 0.2$	63.8	$0.0 \pm 0.2$	70.0	$0.0 \pm 0.2$	62.5
Radioactive Waste (1)	$0.0 \pm 0.2$	57.1	$0.0 \pm 0.2$	56.0	$1.7 \pm 1.3$	66.7	$0.0 \pm 0.2$	58.1
Storage Area (2)	$0.0 \pm 0.2$	52.8	$0.0 \pm 0.2$	60.9	$0.0 \pm 0.2$	59.4	$2.7 \pm 1.8$	50.0
Sewage Treatment (1)	$0.0 \pm 0.2$	62.5	$0.0 \pm 0.2$	65.8	$0.0 \pm 0.2$	70.2	$0.0 \pm 0.2$	60.4
Plant (2)	$0.0 \pm 0.2$	64.3	$0.0 \pm 0.2$	57.8	$0.0 \pm 0.2$	60.5	$0.0 \pm 0.2$	41.3
Retention Basin (1)	$0.0 \pm 0.2$	55.9	$0.0 \pm 0.2$	66.0	$0.0 \pm 0.2$	64.3	$0.0 \pm 0.2$	57.4
(2)	$0.0 \pm 0.2$	63.9	$0.0 \pm 0.2$	63.2	$0.0 \pm 0.2$	65.2	$0.0 \pm 0.2$	50.0

Minimum Detectable Limit =  $0.2 \pm 10^{-6}$   $\mu\text{Ci/g}$  moisture

Table XX. Plutonium-239 in Jackrabbit for 1980

Specimen Identification	Kidney	Liver	Lung	(Flesh) Muscle	Bone
	( $10^{-6}$ $\mu\text{Ci/g}$ )	( $10^{-6}$ $\mu\text{Ci/g}$ )	( $10^{-6}$ $\mu\text{Ci/g}$ )	( $10^{-6}$ $\mu\text{Ci/g}$ )	( $10^{-6}$ $\mu\text{Ci/g}$ )
Zone 12 (1)	$0.00 \pm 0.02$	$0.00 \pm 0.02$	$0.00 \pm 0.02$	$0.00 \pm 0.02$	$0.00 \pm 0.02$
(2)	$0.00 \pm 0.02$	$0.00 \pm 0.02$	$0.00 \pm 0.02$	$0.00 \pm 0.02$	$0.00 \pm 0.02$
Firing Site (1)	$0.00 \pm 0.02$	$0.00 \pm 0.02$	$0.00 \pm 0.02$	$0.00 \pm 0.02$	$0.00 \pm 0.02$
(2)	$0.00 \pm 0.02$	$0.00 \pm 0.02$	$0.00 \pm 0.02$	$0.00 \pm 0.02$	$0.00 \pm 0.02$
Radioactive Waste (1)	$0.00 \pm 0.02$	$0.00 \pm 0.02$	$0.00 \pm 0.02$	$0.00 \pm 0.02$	$0.00 \pm 0.02$
Storage Area (2)	$0.00 \pm 0.02$	$0.00 \pm 0.02$	$0.00 \pm 0.02$	$0.00 \pm 0.02$	$0.00 \pm 0.02$
Sewage Treatment (1)	$0.00 \pm 0.02$	$0.00 \pm 0.02$	$0.00 \pm 0.02$	$0.00 \pm 0.02$	$0.00 \pm 0.02$
Plant (2)	$0.00 \pm 0.02$	$0.00 \pm 0.02$	$0.00 \pm 0.02$	$0.00 \pm 0.02$	$0.00 \pm 0.02$
Retention Basin (1)	$0.00 \pm 0.02$	$0.00 \pm 0.02$	$0.00 \pm 0.02$	$0.00 \pm 0.02$	$0.00 \pm 0.02$
(2)	$0.00 \pm 0.02$	$0.00 \pm 0.02$	$0.00 \pm 0.02$	$0.00 \pm 0.02$	$0.00 \pm 0.02$

Minimum Detectable Limit =  $0.02 \pm 10^{-6}$   $\mu\text{Ci/g}$  Ash

Table XXI. Total Uranium in Jackrabbit for 1980

Specimen Identification	(µg U/g ash)				
	Kidney	Liver	Lung	Muscle (Flesh)	Bone
Zone 12 (1)	0.40 ± 0.38	0.36 ± 0.25	0.00 ± 0.05	0.00 ± 0.05	0.00 ± 0.05
(2)	0.00 ± 0.05	0.00 ± 0.05	0.00 ± 0.05	0.21 ± 0.20	0.58 ± 0.41
Firing Site (1)	0.00 ± 0.05	0.00 ± 0.05	0.00 ± 0.05	0.00 ± 0.05	0.00 ± 0.05
(2)	0.98 ± 0.48	0.00 ± 0.05	0.00 ± 0.05	0.40 ± 0.26	0.00 ± 0.05
Radioactive Waste (1)	0.00 ± 0.05	0.00 ± 0.05	0.00 ± 0.05	0.34 ± 0.22	1.32 ± 0.42
Storage Area (2)	0.00 ± 0.05	0.29 ± 0.26	0.00 ± 0.05	0.00 ± 0.05	0.00 ± 0.05
Sewage Treatment (1)	0.00 ± 0.05	0.00 ± 0.05	0.00 ± 0.05	0.21 ± 0.19	0.00 ± 0.05
Plant (2)	0.00 ± 0.05	0.00 ± 0.05	0.00 ± 0.05	0.00 ± 0.05	0.00 ± 0.05
Retention Basin (1)	0.00 ± 0.05	0.00 ± 0.05	0.38 ± 0.05	0.42 ± 0.27	0.00 ± 0.05
(2)	0.00 ± 0.05	0.00 ± 0.05	0.00 ± 0.05	0.35 ± 0.25	0.00 ± 0.05

Minimum Detectable Limit = 0.05 µg U/g Ash

Table XXII. Organ Weights of Jackrabbit for 1980

Specimen Identification	Kidney (g)	Liver (g)	Lung (g)
Zone 12 (1)	15.0	58.9	19.0
(2)	15.0	43.5	22.0
Firing Site (1)	14.0	42.2	22.0
(2)	13.0	63.1	20.0
Radioactive Waste (1)	14.0	37.4	24.0
Storage Area (2)	18.0	65.3	18.5
Sewage Treatment (1)	12.0	29.3	23.5
Plant (2)	14.0	49.2	21.5
Retention Basin (1)	17.0	35.1	21.0
(2)	18.0	31.7	23.0

Table XXIII. Summary of Chemical Analyses for Water Pollutants for 1980

Analysis	Sample Identification	Number Samples	(mg/l)			Minimum Criteria (mg/l)	Detectable Limit (mg/l)
			Average	Maximum	Minimum		
Ag (silver)	PL	1	< 0.01	-	-	-	0.01
	RP	5	< 0.01	-	-	-	-
	GW	9	< 0.01	-	-	0.05	-
	TW	3	< 0.01	-	-	-	-
	SLP	4	< 0.02	0.03	< 0.01	-	-
As (arsenic)	PL	1	0.02	-	-	-	0.01
	RP	5	< 0.01	0.01	< 0.01	0.1	-
	GW	11	< 0.01	-	-	0.05	-
	TW	6	< 0.01	-	-	-	-
	SLP	4	< 0.02	0.02	< 0.01	0.1	-
Ba (barium)	PL	1	0.2	-	-	-	0.1
	RP	5	0.2	0.4	0.1	-	-
	GW	9	0.2	0.3	0.1	1.0	-
	TW	3	0.2	0.3	0.1	-	-
	SLP	4	0.02	0.03	0.01	-	-
Cd (cadmium)	PL	1	0.001	-	-	-	0.001
	RP	5	< 0.002	0.007	< 0.001	0.005	-
	GW	11	< 0.001	0.004	< 0.001	0.01	-
	TW	6	< 0.001	-	-	-	-
	SLP	4	< 0.002	0.007	< 0.001	0.005	-
Cr (total chromium)	PL	1	0.001	-	-	-	0.001
	RP	5	< 0.002	0.008	0.001	5.0	-
	GW	11	< 0.007	0.01	< 0.004	0.05	-
	TW	6	0.11	0.4	< 0.001	-	-
	SLP	4	< 0.008	0.01	0.001	5.0	-
Cr <sup>6+</sup> (hexavalent chromium)	PL	1	< 0.01	-	-	-	0.01
	RP	5	< 0.01	-	-	5.0	-
	GW	11	< 0.01	-	-	0.05	-
	TW	6	< 0.01	-	-	-	-
	SLP	4	0.01	-	-	5.0	-
Cu (copper)	PL	1	0.004	-	-	-	0.001
	RP	5	0.006	0.008	0.002	0.2	-
	GW	11	< 0.006	0.014	< 0.001	-	-
	TW	6	< 0.01	0.03	< 0.001	-	-
	SLP	4	< 0.012	0.03	< 0.001	0.2	-
Cn <sup>-1</sup> (cyanide)	PL	1	< 0.1	-	-	-	0.1
	RP	5	< 0.1	-	-	-	-
	GW	11	< 0.1	-	-	-	-
	TW	6	< 0.1	-	-	-	-
	SLP	4	< 0.1	0.1	0.1	-	-
F <sup>-1</sup> (fluoride)	PL	1	1.1	-	-	-	0.01
	RP	5	6.5	2.5	1.8	-	-
	GW	9	1.5	1.7	1.3	2.0	-
	TW	6	0.2	0.36	0.09	-	-
	SLP	4	0.2	0.36	0.09	-	-
Fe (iron)	PL	1	0.01	-	-	-	0.005
	RP	5	0.10	0.29	< 0.01	-	-
	GW	11	< 0.02	0.09	< 0.01	-	-
	TW	3	< 0.01	-	-	-	-
	SLP	4	0.03	0.04	0.02	-	-
Hg (mercury)	PL	1	< 0.0004	-	-	-	0.0004
	RP	5	< 0.0004	-	-	0.002	-
	GW	11	< 0.0004	-	-	0.002	-
	TW	6	< 0.0004	-	-	-	-
	SLP	4	< 0.0010	0.0033	< 0.0004	0.002	-
NO <sub>3</sub> <sup>-3</sup> (nitrate)	PL	1	1.3	-	-	-	0.1
	RP	5	3.8	6.8	2.3	-	-
	GW	11	1.2	1.6	1.0	10.0	-
	TW	3	7.8	8.5	6.8	-	-
	SLP	4	6.0	11.0	5.0	-	-
Pb (lead)	PL	1	< 0.001	-	-	-	0.001
	RP	5	< 0.002	0.004	< 0.001	5.0	-
	GW	11	< 0.001	0.004	< 0.001	0.05	-
	TW	6	< 0.67	2.7	< 0.001	-	-
	SLP	4	< 0.002	0.004	< 0.001	5.0	-
Phenol	PL	1	< 0.001	-	-	-	0.001
	RP	5	< 0.005	0.006	< 0.001	-	-
	GW	11	< 0.003	0.012	< 0.001	-	-
	TW	6	< 0.006	0.025	< 0.001	-	-
	SLP	4	< 0.007	0.03	< 0.001	-	-
PO <sub>4</sub> <sup>-3</sup> (phosphate)	PL	1	0.3	-	-	-	0.1
	RP	5	1.5	1.9	1.2	-	-
	GW	11	< 0.1	0.1	< 0.1	-	-
	TW	6	< 0.2	0.7	< 0.1	-	-
	SLP	4	1.4	1.8	1.0	-	-
Se (selenium)	PL	1	0.01	-	-	-	0.01
	RP	5	< 0.01	-	-	-	-
	GW	9	< 0.01	-	-	< 0.01	-
	TW	3	< 0.01	-	-	-	-
	SLP	4	< 0.01	-	-	-	-
SO <sub>4</sub> <sup>-2</sup> (sulfate)	PL	1	26.0	-	-	-	1.0
	RP	5	88.0	134.0	40.0	50.0	-
	GW	11	22.0	28.0	17.0	-	-
	TW	6	22.5	30.0	14.0	-	-
	SLP	4	87.6	149.0	60.0	50.0	-

PL = Pantes Lake  
 RP = Retention Playa  
 GW = Ground Water  
 TW = Test Wells  
 STD = Sewage Treatment Discharge  
 SLP = Sanitary Landfill Playa

Table XXIII. (Cont'd)

Analysis	Sample Identification	Number Samples	(mg/l)			Minimum Criteria (mg/l)	Detectable Limit (mg/l)
			Average	Maximum	Minimum		
Total Settleable Solids	PL	1	0.1	-	-	-	0.1
	RP	5	< 0.2	0.5	< 0.1	-	-
	GW	11	< 0.2	1.5	< 0.1	-	-
	TW	3	1.4	2.0	1.0	-	-
	STD	5	< 0.5	1.5	< 0.1	-	-
Total Dissolved Solids	SLP	4	12.0	30.0	0.5	-	-
	PL	1	334.0	-	-	-	1.0
	RP	5	597.0	718.0	421.0	-	-
	GW	11	278.0	296.0	246.0	-	-
	TW	3	229.0	236.0	210.0	-	-
Zn (zinc)	STD	5	541.0	639.0	458.0	-	-
	SLP	4	199.0	251.0	114.0	-	-
	PL	1	0.02	-	-	-	0.01
	RP	5	< 0.02	0.05	< 0.01	5.0	-
	GW	11	< 0.04	0.19	< 0.01	-	-
pH (pH units, not mg/l)	TW	4	< 0.02	0.07	< 0.01	-	-
	STD	5	0.02	0.04	0.01	5.0	-
	SLP	4	< 0.02	0.02	< 0.01	-	-
	PL	1	7.6	-	-	-	0.01
	RP	5	7.9	8.4	7.6	-	-
Oil/Grease	GW	11	7.3	8.3	7.4	-	-
	TW	4	7.7	8.5	7.4	-	-
	STD	5	7.7	7.8	7.5	> 6.0 &lt; 9.0	-
	SLP	4	7.2	7.5	6.9	-	-
	PL	1	2.4	-	-	-	1.0
Hardness	RP	5	3.1	48.0	1.6	-	-
	GW	11	3.1	8.8	1.1	-	-
	TW	3	5.4	10.0	2.0	-	-
	STD	5	< 2.1	2.8	< 1.0	-	-
	SLP	4	7.8	15.0	2.6	-	-
HMX	PL	1	210.0	-	-	-	1.0
	RP	5	265.0	290.0	230.0	-	-
	GW	11	211.0	229.0	190.0	-	-
	TW	3	200.0	210.0	180.0	-	-
	STD	5	245.0	267.0	220.0	-	-
RDX	SLP	4	170.0	206.0	150.0	-	-
	PL	1	< 0.5	-	-	-	0.5
	RP	5	< 0.5	-	-	-	-
	GW	11	< 0.5	-	-	-	-
	TW	3	< 0.5	-	-	-	-
PETN	STD	5	< 0.5	-	-	-	-
	SLP	4	< 0.5	-	-	-	-
	PL	1	< 0.001	-	-	-	0.001
	RP	5	< 0.001	-	-	-	-
	GW	11	< 0.001	-	-	-	-
Endrin	TW	3	< 0.001	-	-	-	-
	STD	5	< 0.001	-	-	-	-
	SLP	4	< 0.001	-	-	-	-
	PL	1	< 0.005	-	-	-	0.005
	RP	5	< 0.005	-	-	-	-
Lindane	GW	11	< 0.01	0.07	< 0.005	-	-
	TW	3	< 0.014	0.05	< 0.005	-	-
	STD	5	< 0.03	0.12	< 0.005	-	-
	SLP	4	< 0.02	0.07	< 0.005	-	-
	PL	1	< 0.0002	-	-	-	0.0002
Methoxy Chlor	RP	5	< 0.0002	-	-	-	-
	GW	11	< 0.0002	-	-	0.0002	-
	SLP	4	< 0.0002	-	-	-	-
	PL	1	< 0.004	-	-	-	0.04
	RP	5	< 0.004	-	-	-	-
Toxaphene	GW	11	< 0.004	-	-	0.004	-
	SLP	4	< 0.004	-	-	-	-
	PL	1	< 0.1	-	-	-	0.1
	RP	5	< 0.1	-	-	-	-
	GW	11	< 0.1	-	-	0.1	-
2, 4-D	SLP	4	< 0.1	-	-	-	-
	PL	1	0.005	-	-	-	0.005
	RP	5	< 0.005	-	-	-	-
	GW	11	< 0.005	-	-	0.005	-
	SLP	4	< 0.005	-	-	-	-
2, 4, 5-TP (silvex)	PL	1	< 0.1	-	-	-	0.1
	RP	5	< 0.1	-	-	-	-
	GW	11	< 0.1	-	-	0.1	-
	SLP	4	< 0.1	-	-	-	-
	PL	1	< 0.01	-	-	-	0.01
BOD	RP	5	< 0.01	-	-	-	-
	GW	11	< 0.01	-	-	0.01	-
	SLP	4	< 0.01	-	-	-	-
	RP	34	7.21	22.3	2.08	-	0.1
	STD	38	8.24	36.4	0.48	30.0	-
Fecal Coliform (colonies/100 ml)	GW	48	0.0	-	-	-	1.0
	RP	5	122.8	211.0	55.0	-	0.1
COD	SLP	16	36.9	280.0	12.0	-	-

PL = Portex Lake  
 RP = Retention Playa  
 GW = Ground Water  
 TW = Test Wells  
 STD = Sewage Treatment Discharge  
 SLP = Sanitary Landfill Playa

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***APPENDIX***

## **STANDARDS FOR RADIOACTIVITY IN AIR AND WATER**

Generally standards for radioactivity in air and water are derived from DOE Manual Chapter 0524 and its appendix(13). The Radioactivity Concentration Guides (RCG's) for uncontrolled areas are generally the concentrations at which an individual if continually exposed would receive about 0.500 rem total body dose equivalent per year. RCG's for the general population are approximately 1/3 of the RCG's for uncontrolled areas so that the general population will receive no more than 0.170 rem total dose equivalent per year or not

more than 0.500 rem to the lungs or kidney when these serve as the critical organ.

In the case of mixtures of specific nuclides, the resultant RCG is determined such that the sum of the ratios of the concentrations of each nuclide to its respective RCG does not exceed unity. Nuclide concentrations are not considered part of a mixture whenever the concentration to RCG ratio is less than or equal to 0.1 and the sum of the ratios for all nuclides is less than 0.25.

### **RADIOACTIVITY CONCENTRATION GUIDES FOR SOIL AND VEGETATION**

Presently there are no published generally accepted RCG's for radio-

nuclides in soil and vegetation.

### **NON-RADIOACTIVE WATER QUALITY STANDARDS**

Non-radioactive analyses are compared to applicable EPA Primary Drinking Water Standards 40 CFR 141 EPA

Secondary Treatment Regulations 40 CFR 133 and Texas Water Development Board Regulations, Chapter XIX (14,15,16).

### **STATISTICAL METHODS**

Non-radioactive measurements are based on analog representations of physical parameters and a lower limit exists as to the sensitivity of the techniques and instrumentation employed. When measurements of non-radioactive parameters were performed and no indication in excess of lower detection limit was observed, the result is presented as less than (<) the

minimum detectable limit. Average values were calculated by assuming the minimum detectable limit where positive indications were not obtained and portrayal of the final average as a less than value. The less than value for an average therefore indicates the assumption of the minimum detectable limit for one or more terms within the average.

Radioactive measurements however are subject to the statistical nature of radioactive decay and are presented in conjunction with an associated statistical error. All errors presented represent counting error only; no attempt has been made to quantify systematic errors. The minimum detectable limit of a radioactive parameter has been conservatively expressed as the standard deviation of the measurement at the point for which the technique is no longer sensitive

at the desired confidence level. This treatment is further conservative in that statistically significant negative numbers are assumed to be zero. Negative numbers can arise from statistical fluctuations in the radioactive decay of the sample, the blank, or in the background of the counting device. Averages are taken using zero for values which are less than the minimum detectable limit and by determining the associated error.

## **ANALYTICAL METHODS - RADIOACTIVE**

AIR

### Air Filters

Gross Alpha, Gross Beta

Filter paper samples are counted for gross alpha radioactivity on a low background internal flow proportional counter which simultaneously counts alpha and beta activity. Appropriate corrections are applied for absorption and counter efficiency.

Total Uranium

The sample is dissolved in 8N HNO<sub>3</sub>, taken to dryness, and oxidized to remove organics. Then the sample is dissolved in 2N Al(NO<sub>3</sub>)<sub>3</sub> and extracted into diethyl ether. The ether is dried and the sample transferred to a stainless steel planchet for counting in a proportional counter.

Plutonium-239

A Pu-236 tracer is added to the filter paper sample, totally dissolved and converted to the nitrate by additions of HNO<sub>3</sub>. The plutonium is separated using

an ion exchange resin, eluted off the column, and electroplated on a stainless steel disc. A solid state Alpha Spectrometer is utilized to count the disc, and chemical recovery is determined from the tracer peak.

### Silica Gel

Moisture is removed from the silica gel using a distillation apparatus. A portion of the distillate is mixed with a scintillation solution and counted in a liquid scintillation spectrometer. The atmospheric tritium concentration is related to the tritium concentration of the distillate through the average absolute humidity for the month during which the sample was collected.

### Water

Gross Alpha (Dissolved Solids)

After thorough agitation a suitable aliquot is taken for analysis. The aliquot is acidified and evaporated to dryness on a hot plate after which the residue is dissolved in 0.5N HNO<sub>3</sub> and transferred to a tared planchet. Gross alpha radioactivity

is then determined by counting the planchet in an internal flow proportional counter (Wide Beta II instrument).

The result is corrected for counter efficiency and self-absorption if an appreciable solid residue is obtained. For thickness greater than 1 mg/cm<sup>2</sup>, a correction must be applied.

#### Gross Beta (Dissolved Solids)

The same method is used as described under Gross Alpha (Dissolved Solids). A self-absorption correction factor is applied when the sample mass exceeds 1 mg/cm<sup>2</sup>.

#### Gross Alpha (Suspended Solids)

One litre of water is filtered through a millipore filter (0.45 μm), the filter is counted utilizing a Wide Beta II Instrument.

#### Gross Beta (Suspended Solids)

The same method is used as described under Gross Alpha (Suspended Solids).

#### Total Uranium

After evaporation of a suitable aliquot the sample is dissolved in 8N HNO<sub>3</sub>, taken to dryness and oxidized to remove organics. Then the sample is dissolved in 2N Al(NO<sub>3</sub>)<sub>3</sub> and extracted into diethyl ether. The ether is dried and the sample transferred to a stainless steel planchet for counting in a proportional counter.

#### Plutonium-239

The total water sample is acidified and aliquoted. A Pu-236 tracer is added to the aliquot and the plutonium is precipitated as an alkaline-earth phosphate. The precipitate is separated, ashed, and dissolved in nitric acid. Plutonium is separated using an ion exchange resin, eluted off the column, and electroplated on a stainless steel disc. A solid state Alpha Spectrometer is utilized to count the disc and chemical recovery is determined from the tracer peak.

#### Tritium

The water sample is distilled to remove quenching materials and nonvolatile radioactive materials. Distillation is carried to dryness to ensure complete transfer of the tritium to the distillate. A portion of the distillate is mixed with scintillation solution and counted in a liquid scintillation spectrometer. Standard tritium and background samples are prepared and counted alternately to nullify errors produced by aging of the scintillation medium or instrument drift. Each sample is counted for 500 minutes.

#### Soil

##### Total Uranium

The sample is dissolved in 8N HNO<sub>3</sub>, taken to dryness and oxidized to remove organics. Then the sample is dissolved in 2N Al(NO<sub>3</sub>)<sub>3</sub> and extracted into diethyl ether. The ether is dried and the sample

transferred to a stainless steel planchet for counting in a proportional counter.

#### Plutonium

The soil sample is totally dissolved using a 40% solution of HF and a Pu-236 tracer is added before dissolution. After fuming with HF the sample is converted to sulfate and brought up with HNO<sub>3</sub>. An ion exchange column is utilized to separate the plutonium which is subsequently eluted off the column and electroplated on a stainless steel counting disc. This disc is counted on a solid state alpha spectrometer and recovery is determined from the tracer peak.

#### Vegetation

##### Total Uranium

After ashing the sample is dissolved in 8N HNO<sub>3</sub>, taken to

dryness and oxidized to remove organics. Then the sample is dissolved in 2N Al(NO<sub>3</sub>)<sub>3</sub> and extracted into diethyl ether. The ether is dried and the sample transferred to a stainless steel planchet for counting in a proportional counter.

##### Tritium

The water is extracted from the vegetation sample by azeotropic distillation with benzene. The distillation is carried to dryness to ensure complete transfer of the tritium. A portion of the distillate is mixed with scintillation solution and counted utilizing a liquid scintillation spectrometer. Standard tritium and background samples are prepared and counted alternately to nullify errors produced by aging of the scintillation medium or instrument drift. Each sample is counted for 500 minutes.

## **ANALYTICAL METHODS - NON-RADIOACTIVE**

#### Water Quality

In general, non-radioactive analyses are performed in accordance with standard methods(17). Analysis for explosives and pesticides is accom-

plished using an electron capture vapor phase chromatography technique(18). Mercury analyses are performed in accordance with an Environmental Protection Agency Standard Method(19).

## QUALITY CONTROL

Except for the gross alpha and gross beta in air and BOD analyses, all analyses during 1980 were performed under contract by Controls for Environmental Pollution (CEP) Inc. of Santa Fe, New Mexico. The management of CEP administers the following three-phase quality control programs(18).

1. All reagents, including carriers and tracer radionuclides, which are critical to the procedures in question are standardized and checked periodically by two different chemists. When possible the reagents are standardized using two different chemical procedures, e.g., strontium carrier-gravimetrically and atomic absorption.
2. All personnel within the laboratory are required to run spiked samples to prove their proficiency in determining accurately the content of the spiked sample in question. Furthermore, to eliminate the possibility of preferential treatment of a spiked sample by an analyst, spiked samples are slipped into routinely analyzed samples without the knowledge of the analyst. Also, every set of samples has a spike and a blank run concurrently with it.
3. All instrumentation is maintained on monthly preventive maintenance programs by the manufacturer. Each instrument is calibrated weekly. If the calibration detects any anomaly from the routine performance of the instrument, no analysis is allowed to be performed by that instrument until it is functioning properly. All radioactive sources and solutions used for calibration are calibrated against National Bureau of Standards' standards where possible. Inter-laboratory comparisons are conducted with the U. S. Public Health Service, Environmental Protection Agency, United States Department of Energy, Department of the Navy, and the American Industrial Hygiene Association.
4. CEP also participates in the Environmental Protection Agency's quality assurance tests.
5. CEP works in conjunction with Pantex Plant in the USDOE's environmental intercomparison measurement study.

**RADIOACTIVITY CONCENTRATION GUIDES (RCG's)**

Uncontrolled Area

	Air ( $\mu\text{Ci}/\text{ml}$ )	Water ( $\mu\text{Ci}/\text{ml}$ )
Total Plutonium	$6 \times 10^{-14}$	$5 \times 10^{-6}$
Tritium	$2 \times 10^{-7}$	$3 \times 10^{-3}$
Uranium	$3 \times 10^{-12}$	$4 \times 10^{-5}$
Radium-226	$3 \times 10^{-12}$	$3 \times 10^{-8}$
Radium-228	$2 \times 10^{-12}$	$3 \times 10^{-8}$

General Population

Total Plutonium	$2 \times 10^{-14}$	$2 \times 10^{-6}$
Tritium	$1 \times 10^{-7}$	$1 \times 10^{-3}$
Uranium	$1 \times 10^{-12}$	$1 \times 10^{-5}$
Radium-226	$1 \times 10^{-12}$	$1 \times 10^{-8}$
Radium-228	$7 \times 10^{-13}$	$1 \times 10^{-8}$

**PERMISSIBLE ANNUAL POPULATION DOSES FOR KIDNEY  
AND WHOLE BODY EXPOSURES**

<u>Reference Point</u>	<u>Kidney (rem)</u>	<u>Lung (rem)</u>	<u>Total Body (rem)</u>
Site boundary and highest exposed individual or group	1.500	1.500	0.500
General Population	0.500	0.500	0.170

## WATER QUALITY CRITERIA

	EPA Drinking Water Regulations (mg/l)	Federal Water Pollution Control Administration Criteria for Trace Element Tolerances for Irrigation Waters (mg/l)	Texas Water Development Board Water Quality Levels - Inland Waters (mg/l)
Arsenic (As)	0.05	0.01	0.1
Barium (Ba)	1.0	0.5	1.0
Cadmium (Cd)	0.010	0.01	0.05
Chromium (Total)	0.05	-	0.5
Chromium (+6)	-	0.02	-
Copper	-	0.01	0.5
Cyanide	-	0.20	-
Fluoride	2.2*	-	-
Iron	-	0.05	-
Lead	0.05	0.01	0.5
Mercury	0.002	0.002	0.005
Nitrate	10	0.1	-
Phenol	-	-	-
Phosphate	-	0.1	-
Silver	0.05	0.05	0.05
Sulfate	-	50	-
Selenium	0.01	0.01	0.05
Total Dissolved Solids	-	-	-
Suspended Solids	-	0.05	-
Zinc	-	5.0	1.0
BOD (5 day)	-	-	-
Fecal Coliform	1 ct/100 ml	-	-
pH	-	-	-
<u>Pesticides:</u>			
Aldrin	-	-	-
Chlorodane	-	-	-
DDT	-	-	-
Dieldrin	-	-	-
Endrin	0.0002	-	-
Heptachlor	-	-	-
Heptachlor Epoxide	-	-	-
Lindane	0.004	-	-
Methoxychlor	0.1	-	-
Toxaphene	0.005	-	-
2,4-D	0.1	-	-
2,4,5-TP (Silvex)	0.01	-	-

\*This value for fluoride is based on an annual average maximum daily air temperature of 12.7 C.

PERFORMANCE STANDARDS FOR STATIONARY SOURCES

	<u>Reference</u>	<u>Standards</u>
Fossil Fueled Steam Generator	42 FR 37936 July 25, 1977	Particulate: 0.10 lb/10 <sup>6</sup> BTU
		Opacity: 20%
		SO <sub>2</sub> :
		0.80 lb/10 <sup>6</sup> BTU (liquid fuel)
		1.2 lb/10 <sup>6</sup> BTU (solid fuel)
		NO <sub>2</sub> :
		0.20 lb/10 <sup>6</sup> BTU (gas fuel)
0.30 lb/10 <sup>6</sup> BTU (liquid fuel)		
0.70 lb/10 <sup>6</sup> BTU (solid fuel)		

**WATER SAMPLE LOCATIONS**

<u>Sample No.</u>	<u>Description of Location</u>
WS-1	Pantex Lake
WS-2	Well #17
WS-6	Well #6
WS-8	Retention Playa
WS-16	Well #20
WS-17	Sewage Discharge
WS-19	Retention Playa Test Well #1
WS-20	Zone 12 Test Well #2
WS-22	Drinking Water from 12-36
WS-27	Sanitary Landfill Playa

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