EEG-26

PROPOSED PREOPERATIONAL ENVIRONMENTAL MONITORING PROGRAM FOR WIPP

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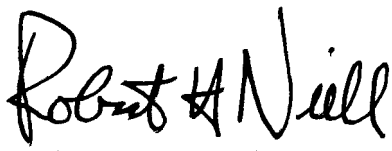
FOREWORD

The purpose of the Environmental Evaluation Group (EEG) is to conduct an independent technical evaluation of the potential radiation exposure to people from the proposed Federal radioactive Waste Isolation Pilot Plant (WIPP) near Carlsbad, in order to protect the public health and safety and ensure that there is minimal environmental degradation. The EEG is part of the Environmental Improvement Division, a component of the New Mexico Health and Environment Department -- the agency charged with the primary responsibility for protecting the health of the citizens of New Mexico.

The Group is neither a proponent nor an opponent of WIPP.

Analyses are conducted of available data concerning the proposed site, the design of the repository, its planned operation, and its long-term stability. These analyses include assessments of reports issued by the U.S. Department of Energy (DOE) and its contractors, other Federal agencies and organizations, as they relate to the potential health, safety and environmental impacts from WIPP.

The project is funded entirely by the U.S. Department of Energy through Contract DE-AC04-79AL10752 with the New Mexico Health and Environment Department.



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(1984)

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ACRONYMS

CH-TRU	Contact-handled transuranic waste
DOE	Department of Energy
DOP	Diocryl phthalate
EPA	Environmental Protection Agency
FEIS	Final Environmental Impact Statement
HEPA	High efficiency particulate air
HLW	High-level waste
HTO	Tritiated water
INEL	Idaho National Engineering Laboratory
MCL	Maximum contaminant level
NRC	Nuclear Regulatory Commission
NBS	National Bureau of Standards
NM-EID	New Mexico Environmental Improvement Division
RCG	Radioactive concentration guides
RH-TRU	Remote-handled transuranic waste
RPS	Radiation protection standard
TBD	To be determined
TLD	Thermoluminescent dosimeter
TRU	Transuranic wastes
USGS	United States Geological Survey
WIPP	Waste Isolation Pilot Plant

1. Introduction

The purpose of this report is to describe the recommended environmental surveillance program of the State of New Mexico for the Waste Isolation Pilot Plant (WIPP) and to provide a framework for discussion prior to establishing a cooperative monitoring program between the State and the U.S. Department of Energy. The WIPP project, a deep geological nuclear waste repository has the following two objectives: 1) To provide a full-scale facility which will demonstrate the technical and operational methods for the permanent isolation of Department of Energy (DOE) contact-handled (CH) and remote-handled (RH) transuranic (TRU) defense waste; 2) To provide a facility in which experiments can be conducted to extend the understanding of the behavior of high level waste (HLW) in salt. The mission calls for the disposal of up to 6.3 million cubic feet of defense TRU waste. About 40 to 60 canisters of HLW are expected to be used in the experiments and are to be removed from WIPP at the conclusion of the experiments.

Under the authorizing legislation, PL 96-164,the facility is exempted from regulation by the Nuclear Regulatory Commission (NRC). Therefore, to achieve public confidence and acceptance, the State of New Mexico will monitor independently the environment around the facility. The DOE has agreed to fund such a role for the State of New Mexico. The agreement is contained in the Supplemental Stipulated Agreement between the State of New Mexico and the U.S. Department of Energy which also contains an outline of the State's environmental radiation surveillance plan (United States District Court, Civil Action No. 81-0363 JB, Filed Dec. 28, 1982.) The outline describes a joint effort between the DOE and the State with the State independently evaluating the accuracy and precision of the results determined by the DOE's program. The outline specifies the following objectives: 1) the taking of split samples by a procedure approved by the State and the DOE; 2) expansion or alteration of the sample schedule and location in accordance with any reasonable request of the State; 3) analysis of the State's samples by laboratories not affiliated with nor under contract with the DOE; and 4) an independent State quality control program. In lieu of split samples, the State's representative may elect to monitor the sampling and analytic processes of DOE. If necessary, the State of New Mexico will conduct additional monitoring and surveillance in addition to the combined program.

The sections of the Supplemental Stipulated Agreement that pertain to the environmental surveillance program are reproduced in Appendix A. The surveillance plan described in this report is based on environmental surveillance carried out at other nuclear installations (refs. 1, 2, 3, 4).

2. General Description of WIPP

WIPP is located in Eddy County in southeastern New Mexico, 42 km (26 miles) east of Carlsbad (see Fig.1). The facility covers an area of 42 km^2 (10,240 acres) and it is located on a flat plain at an elevation of about 1040 m (3410 ft). The facility consists of three concentric zones: Zone I, which contains all the surface facilities, is fenced in and has restricted access; Zone II overlies the maximum extent of the underground excavation in which the TRU waste will be emplaced; Zone III is a one mile buffer zone.

The WIPP site is located in an area of low population density. The nearest residents live at the Mills Ranch which is about 6 km (3.5 miles) from the center of the site. There are three cities with populations greater than 10,000 people within an 80 km (50 miles) radius from the site. The population distribution surrounding WIPP is shown in Figure 2 (based on data in ref. 5).

The area surrounding the WIPP site is used primarily for livestock grazing. It also has numerous oil and gas wells. There are potash mines to the north, northwest and southwest. Livestock grazing is permitted in Zone III but potash mining and oil and gas exploration are not allowed. There are two paved roads that lead to the site; one from the north and the other from the southwest. Both roads will be used by trucks carrying waste to be disposed at WIPP. A railroad line from the west is under construction.

The major hydrologic surface feature is the Pecos river to the west of the site which runs north-south through the city of Carlsbad. The subsurface geology includes successive sedimentary layers that were deposited over 200 million years ago. The repository is located in the Salado Formation, a thick bedded salt unit, at a depth of 660 m (2160 ft) below land surface. Stratigraphically above the Salado Formation are alternating anhydrite and dolomite units which comprise the Rustler Formation. There are two significant water bearing units,

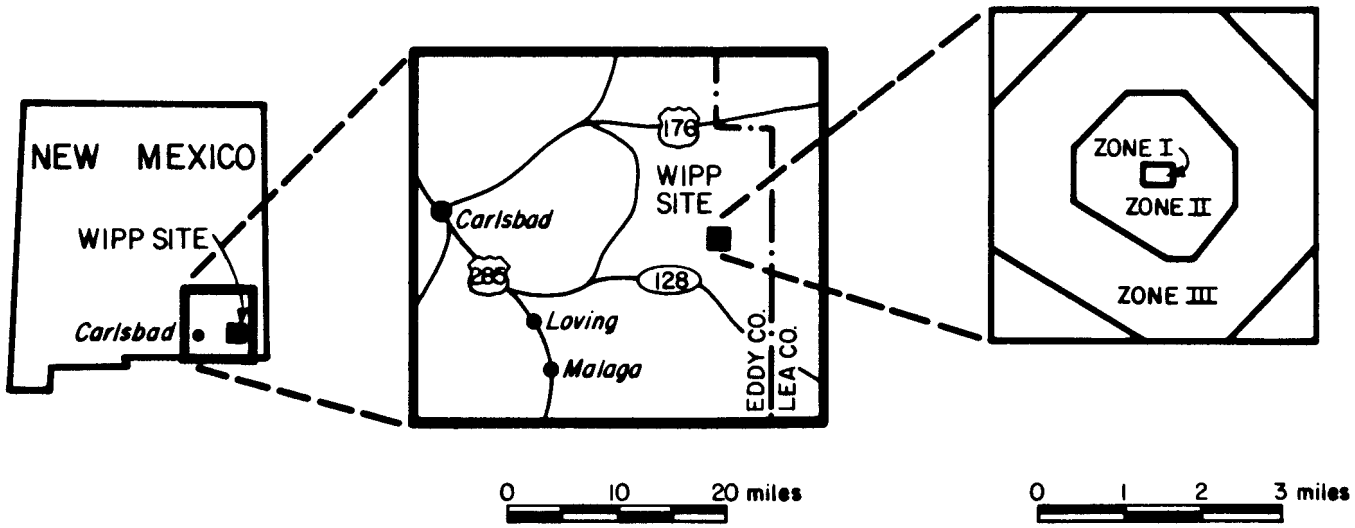

Figure 1. Location and layout of WIPP site.

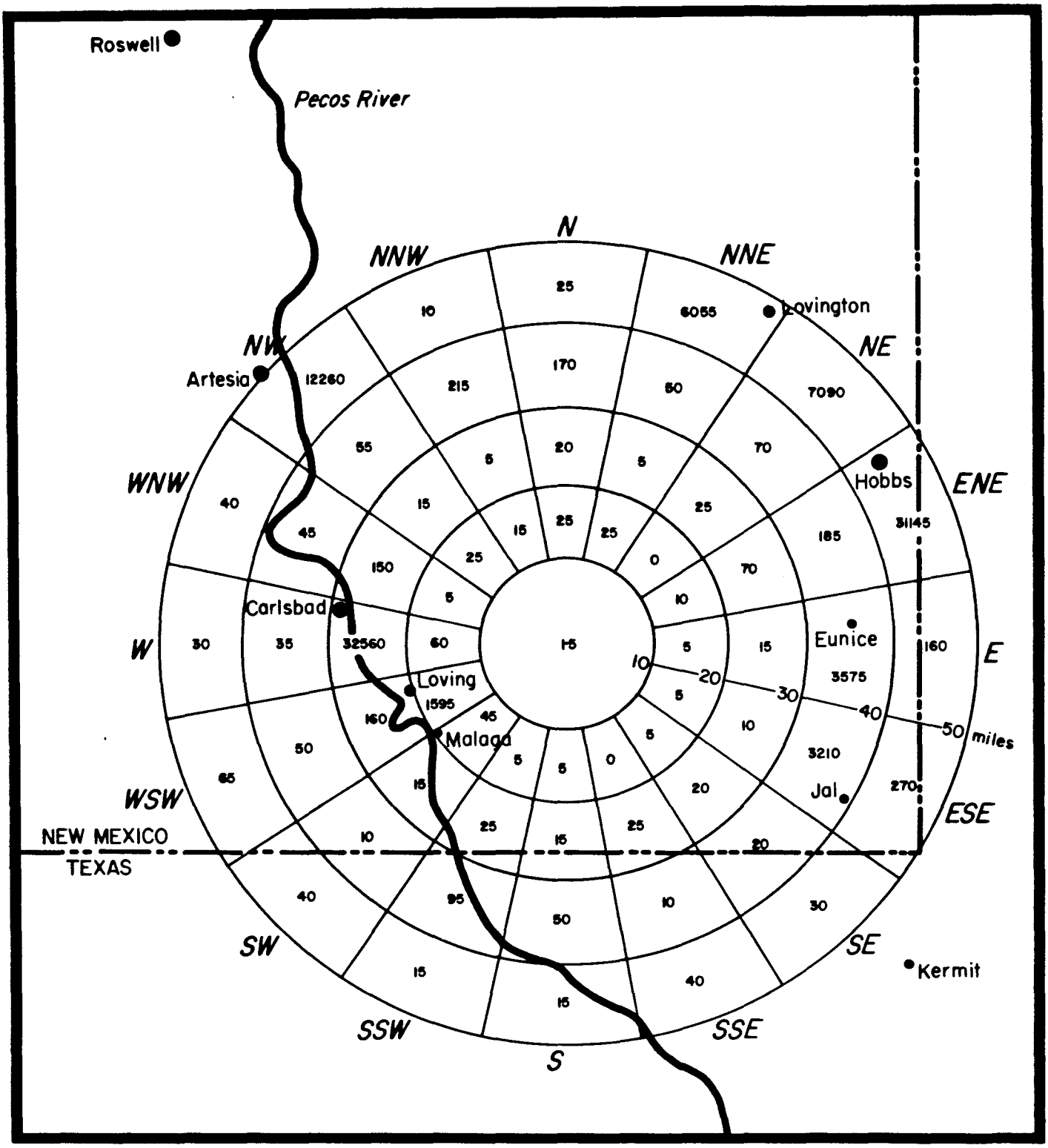

Figure 2. 1980 population within 50 miles of the WIPP (see Ref. 5).

the Magenta and Culebra Dolomites in the Rustler Formation at depths of 170 m (560 ft) and 205 m (672 ft) below land surface. Although the water in these units is briny at the site, these units are important in assessing the long term containment and transport of radionuclides from the repository. A minor water bearing unit occurs at the Rustler/Salado contact, about 250 m (830 ft) below land surface.

The climate in the area is semi-arid with an average annual precipitation of 28 to 33 cm (11 to 13 in.). The precipitation is unevenly distributed throughout the area with much of it coming down in the form of cloud bursts. Winds are predominantly from the south with an annual average wind speed measured between May 1977 and June 1979 of 3.7 m/sec. Figure 3 shows the wind rose compiled for the same period and Table 1 presents the average wind speed and percent frequency for each of the 16 wind directions.

The surface and underground facilities are currently under construction and scheduled to be completed by December 1986. The initial waste shipments are scheduled to arrive from the Idaho National Engineering Laboratory (INEL) and the Rocky Flats facilities by October 1988. Twenty percent of the waste shipments will be arriving by truck and 80% by rail.

The design capacity of WIPP is 1.4×10^4 m^3 (5×10^5 ft^3) of CH-TRU waste per year based on a one-shift-per-day 5 days-per-week operation for the handling of waste (ref. 6). Forty thousand m^3 (1.41×10^6 ft^3) of CH-TRU waste are expected to be in storage at the end of the 5 year retrieval decision period. The total design capacity is 1.8×10^5 m^3 (6.33×10^6 ft^3). Schedules for the shipment of waste to WIPP have been published in reports of DOE (ref.7). They suggest that about 1.13×10^5 m^3 (4×10^6 ft^3) of waste will have been emplaced by the year 2006.

Upon arrival at WIPP, the waste will be transferred for inspection to the Waste Handling Building, the largest surface facility. It will then be transferred to the Underground Storage Area by an elevator in the Waste Handling Shaft. Air effluents from the Waste Handling Building will be filtered at all times through two banks of HEPA filters in series, each bank having a collection efficiency of 99.95% for 0.3 micron diocryl phthalate (DOP) particles. Air effluents from the underground facilities will be exhausted to the environment

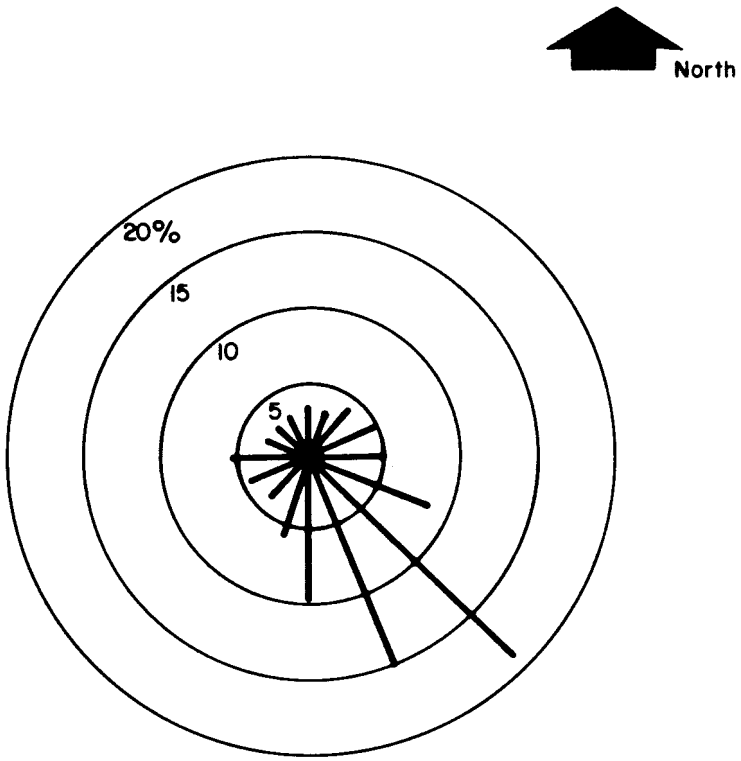

Figure 3. The relative frequency of winds from different directions for the WIPP (Based on data from meteorological Table 32 or ref. 5).

Table 1. Average annual percent frequency of wind direction and average wind speed (m/sec) June 1977 - May 1979[a]

Direction	Percent	Average Speed (m/sec)
N	3.4	3.7
NNE	3.3	3.5
NE	4.3	3.6
ENE	4.9	4.4
E	5.2	4.4
ESE	8.5	3.0
SE	18.8	3.6
SSE	15.0	4.1
S	9.1	3.4
SSW	5.2	3.1
SW	3.8	3.4
WSW	4.1	4.2
W	5.0	5.1
WNW	3.1	4.0
NW	2.9	3.3
NNW	3.1	3.6
CALM	0.4	---
Total	100.0	3.7

[a]Based on data from meteorological Table 32 of Ref. 5.

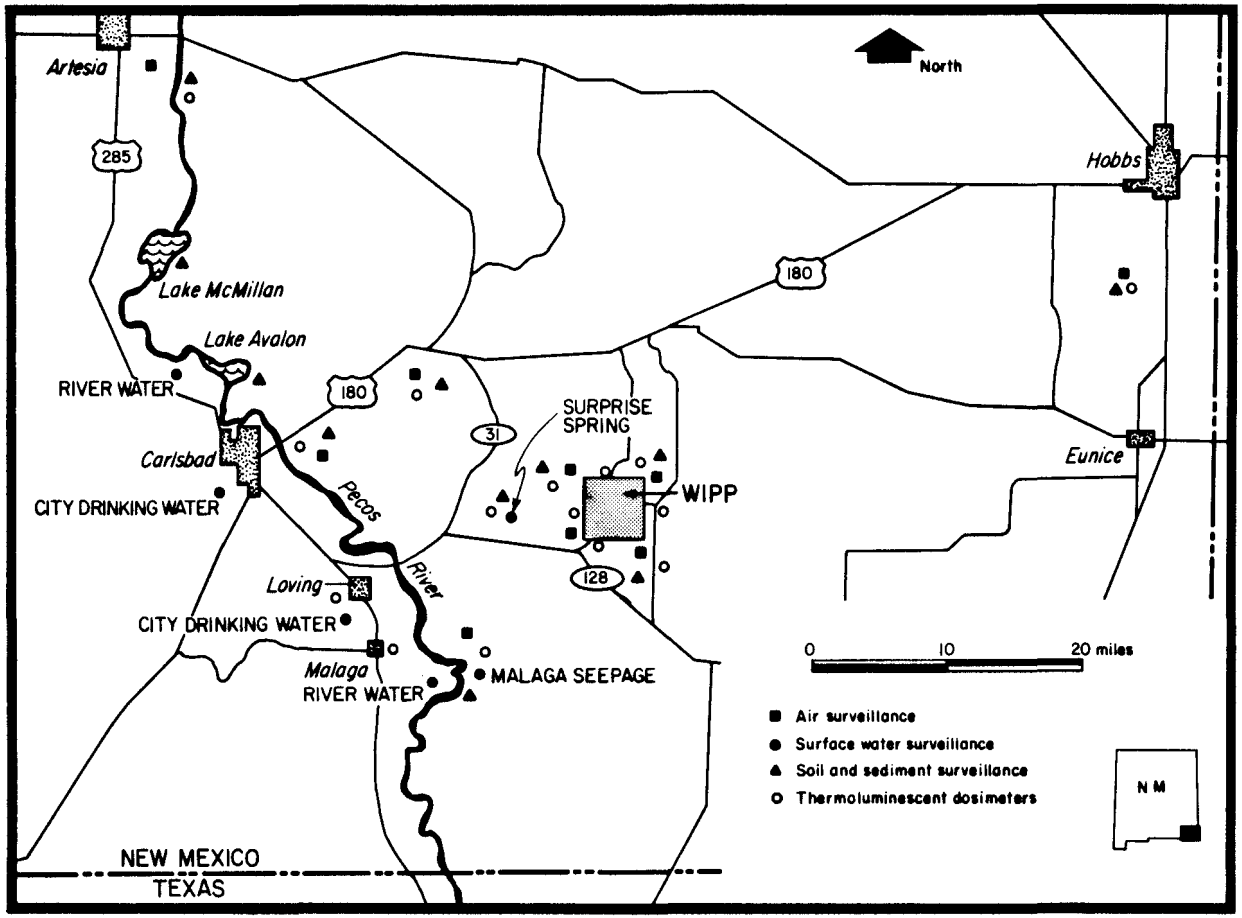

Figure 4. Location of stations for the preoperational surveillance program

Table 2 - Preoperational Environmental Surveillance Program Proposed for WIPP

Air Surveillance	Sampling & Analysis Frequency	Parameter Measured
Offsite		
9 locations	Weekly	gross α and β. Pu-238, Pu-239, Pu-240, Am-241, Cs-137, Sr-90, U-series, non-radioactive air particulate
Onsite [a]		
TBD locations	Daily	gross α and β. Pu-238, Pu-239, Pu-240, Am-241, Cs-137, Sr-90, U-series
Stack Emission [a]		
2 locations	Daily	gross α and β. Pu-238, Pu-239, Pu-240, Am-241, Cs-137, Sr-90, U-series
Water Surveillance - Offsite		
Pecos River		
2 locations	Monthly/ Quarterly	gross α and β. HTO, Pu-238, Pu-239, Pu-240 U-series
Spring		
2 locations	Monthly	gross α and β. HTO, Pu-238, Pu-239, Pu-240 U-series
Municipal Drinking Water		
2 locations	Quarterly	gross α and β. HTO, Pu-238, Pu-239, Pu-240 U-series.
Well Water		
TBD locations	Monthly/ Quarterly	gross α and β. HTO, Pu-238, Pu-239, Pu-240 U-series.
Water Surveillance - Onsite		
Effluent Water		
1 location	Daily	HTO, Pu-238, Pu-239, Pu-240 Non-radioactive pollutants.
Silt Surveillance - Offsite		
River		
4 locations	Quarterly/ Biannually	gross α and β. Cs-137, Sr-90, Pu-238, Pu-239, Pu-240
Pond		
1 location	Quarterly	gross α and β. Cs-137, Sr-90, Pu-238, Pu-239, Pu-240
Biota and Foodstuff Surveillance		
Biota		
3 locations	Annually	Pu-238, Pu-239, Pu-240, HTO
Farm products		
3 locations	Annually	Pu-238, Pu-239, Pu-240, HTO
Environmental Level Surveillance - Offsite		
15 locations	Quarterly	Penetrating gamma radiation

[a] Sampling to be performed by DOE.

without filtration. If radiation monitors located in the underground areas and in the exhaust stack detect airborne radioactivity, then the underground airflow will be routed at reduced flow through two banks of HEPA filters located in the Exhaust Ventillation Building.

Site generated radioactive waste will be packaged in the Waste Solidification area of the Waste Handling Building and disposed at the underground waste horizon.

Non-radioactive liquid waste will be disposed at a sewage treatment plant 1000 m (3400 ft) south of the Waste Handling building.

3. Proposed EEG Environmental Surveillance Program

3.1 Summary of Surveillance Program

The proposed preoperational environmental surveillance program of the New Mexico Environmental Evaluation Group is summarized in Table 2. Similar to various nuclear facilities, the monitoring and sampling locations for various types of measurements are organized into three main groups. On-site stations of the DOE will be located within Zones I, II and III. Perimeter stations will be located around Zone III. Regional stations will be located at distances up to 80 km (50 mi) and in communities in the area. The program is comprehensive and calls for the monitoring of air, water, soil, biota, and external radiation levels. WIPP is a defense TRU waste repository which primarily requires the monitoring of transuranic radionuclides of plutonium and americium. However, the monitoring of other radionuclides such as H-3, Sr-90, Cs-137, and the uranium series will be included to provide data on the trends and origin of radiation levels in the area. Once these trends have been established prior to the shipment of wastes to WIPP, it should be possible to reduce the frequency of samples and the number of sampling locations. Further reviews and changes should be contemplated periodically after the start of operation, the start of the DHLW experiments, and the accumulation of working experience with TRU waste.

3.2 Air Surveillance

The radioactive waste destined for WIPP will contain large quantities of alpha emitting radionuclides, the major hazard of which is inhalation. Furthermore, radioactivity may be released from the WIPP during the operational life of the facility in the event of an accident or malfunctioning of the ventilation system. Therefore, air surveillance will be the most important task of the environmental monitoring plan. The proposed program calls for a total of nine perimeter and regional continuous air sampling stations. The locations of the stations are shown in Figure 4. The parameters to be measured are listed in Table 2. Four stations surround the outer perimeter of the site while the remaining five sample air near the population centers. As a result of the layout, three stations are essentially in line with the predominant wind direction. There will be at least (TBD) onsite continuous air monitors. The emissions from the Waste Handling Building as well as the emissions from the Exhaust Ventillation Shaft will be monitored continuously through isokinetic probes near the outlets to the environment. In the design of the underground facilities, there are (TBD) continuous air monitors.

The primary sources of non-radioactive airborne emissions will be from vehicular traffic at the surface and in the underground area. The air emitted by the Exhaust Ventillation Shaft is expected to contain salt dust and diesel emissions.

The Air Quality Bureau of the State of New Mexico Environmental Improvement Division presently monitors the air for nitrous oxides and particulate concentrations. Samplers are located on top of structures in Artesia, Carlsbad, Hobbs, and Lovington. The samplers operate for 24 hours every other day. The data are published in the Air Quality Bureau's annual report. Because of the potential particulate emissions expected from WIPP, air particulate concentrations should be measured at the site during the pre-operational environmental monitoring phase and compared with the air particulate concentrations in the surrounding communities.

For the operational phase, the air surveillance program could be simplified to that of the State of Colorado for the Rocky Flats Plant. In that program, seven air monitors are continuously operated within or bordering the fence of the facility. The filters are changed every second day at which time

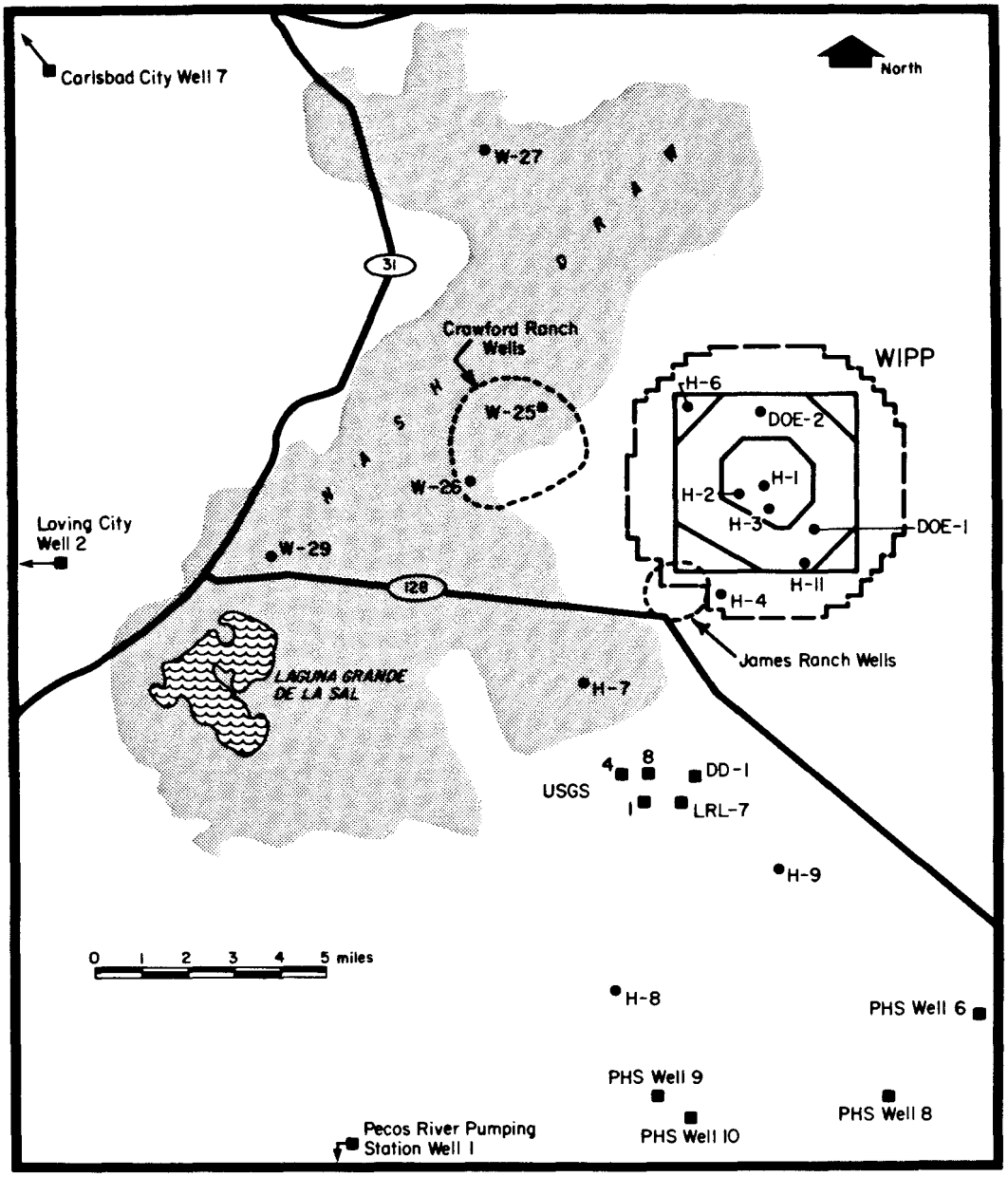

Figure 5. Wells available for groundwater surveillance near the WIPP site. The large squares represent wells monitored by the EPA.

3000 m^3 of air has been filtered. The filters are then counted for gross alpha and beta and for Pu-239 and Pu-240. The Colorado Department of Health also monitors for radioactivity the filters of all air quality monitoring stations from the Denver area as well as the air filters from four distant communities. The data are released in monthly information exchange meetings.

The air surveillance measurements will be performed in conformance with the standards proposed by the American National Standards Institute (Ref. 8).

3.3 Water Surveillance

Surface water will be monitored in at least four regional stations. Groundwater will be monitored onsite and at the perimeter using wells that were drilled to characterize the hydrology of the Rustler and Dewey Lake water bearing units. The purpose of the water surveillance program is to provide baseline levels of radioactivity as well as data on the dispersion of radionuclides which could be released in the aquifers. The proposed surface water monitoring stations are shown in Figure 4 while the wells available for groundwater monitoring are shown in Figure 5. The locations of additional monitoring wells south and/or east of the site will be determined after additional information is available on all wells near the WIPP site. The parameters to be measured are listed in Table 2.

The Environmental Protection Agency (EPA) has a long-term hydrological monitoring program for the Gnome site, a location 16 km (10 miles) south of the WIPP site where a nuclear device was detonated in the Salado Formation at a depth of 360 m (1200 ft) on December 10, 1961. The long-term hydrological monitoring program is detailed in Reference 9, and it is performed by the Environmental Monitoring System Laboratory of Las Vegas (EMSL-LV). The waters from ten wells as well as waters from municipal supplies of Carlsbad, Loving, and Malaga are analyzed annually for gamma emitters, tritium, as well as selected alpha emitters. The data is reported annually in reports of the EMSL-LV. The locations of the wells monitored by the EPA are shown on Figure 5 (Ref. 1).

Under the provisions of the Safe Drinking Water Act, samples of the communities' water supply system must also be analyzed every four years for

radionuclides. The analysis must be performed by a laboratory certified by the State of New Mexico and by the EPA. Records of the analyses are kept by the individual water supply systems as well as by the regional offices of the Water Supply Section of EID. These data are not considered useful in the hydrological monitoring of the WIPP site.

On-site produced liquid radioactive waste will not present an environmental monitoring problem since it will be solidified inside the Waste Handling Building and then transferred to the Underground Storage Area, and since it will contain the same radionuclides as the waste being shipped to WIPP.

The sanitary sewage treatment system will include a buried sanitary collection system, a sewage treatment plant, and an effluent pond. The sewage treatment plant and the effluent pond will be located about 1040 m (3400 ft) to the south of the Waste Handling Building. Although radioactive and chemical wastes are excluded from the sewage system, surveillance to verify this will be necessary.

The water surveillance sampling procedures may be performed in conformance with those recommended by the Federal Health and Safety Laboratory of New York (Ref. 10).

3.4 Biota and Foodstuff

Measurements will determine whether there is any uptake or concentration of radionuclides by plant or animal life in the area around WIPP as described in Section 5 of Appendix A of the Supplemental Stipulated Agreement.

The area surrounding the WIPP is used primarily for livestock grazing with about 8 cattle per square mile. Fruit and vegetables are produced along the Pecos River, about 32 km (20 miles) to the west. Therefore, two types of annual monitoring are considered: 1) monitoring of farm products from three locations, and 2) monitoring of local vegetation and local wild life. The sampling frequency for farm products will be coordinated with the local harvests. A biannual frequency will be considered for crops grown more than once annually.

The biota and foodstuff sampling procedures may be performed in conformance with those procedures recommended by the Federal Health and Safety Laboratory of New York (Ref. 10).

3.5 Sediment and Soil

The location of sediment and soil sampling stations is shown in Figure 4. The parameters to be measured are listed in Table 2. Soil sampling stations will be located near every continuous air monitoring station. Sediment sampling stations will be located along the river and near surface water sampling stations.

The soil and sediment sampling procedures will be performed in conformance with those described in NRC regulatory guide 4.5 (Ref. 11).

3.6 External Penetrating Radiation

The RH-TRU waste and the HLW used in the experimental program contain large quantities of fission products. Therefore it is necessary to monitor the exposure from external beta and gamma ray sources. External gamma and beta exposure will be monitored off-site by a network of thermoluminescent dosimeters (TLD) at 15 locations surrounding the site. Proposed locations for off-site TLDs are shown in Figure 4. In general, it is planned to place a TLD package near every air and water sampling station. There will be a large number of TLD packages at the onsite locations. The purpose of this program will be to assess increases in external radiation that could be attributed to WIPP operations and to determine variation in background radiation attributable to differences in the natural radioactivity content of geologic formations. The TLD measurements will be performed in conformance with the standards proposed by the American National Standards Institute and the NRC (Refs. 12 and 13).

3.7 Offsite Human Surveillance Program

An offsite human surveillance program is currently under consideration. Such a program is presently carried out at the Nevada Test Site (Ref. 1) and it involves the biannual monitoring of a few families residing in communities and

ranches surrounding the site. The following tests are performed on each participant: physical examination, short medical history, whole body count, urinalysis, thyroid profile, and complete blood count.

4. Quality Assurance

The quality assurance program will be designed to provide adequate confidence in the following activities: 1) handling of samples; 2) measurement of radioactivity; and 3) data analyses and reporting of the monitoring results.

The quality assurance program will be documented and publilshed prior to the start of operations.

4.1 Handling of Samples

The State and DOE will follow written procedures of the DOE for the collection, transportation, and handling of samples. This is in part necessitated by the Supplemental Stipulated Agreement which calls for a joint effort between the State and the DOE in the environmental monitoring of the WIPP site. The State will provide input to these procedures by reviewing the draft documents covering these procedures. As indicated in the previous sections, the State will insist on sampling procedures that conform with standards described in references 8, 10, 11, 12, and 13.

4.2 Quality Assurance Procedures in the Analysis of Samples

At present, it is planned to have most of the State's samples analyzed by a third party which is either a certified EPA laboratory or one which can demonstrate that its quality assurance program meets the requirements of Appendix B of 10 CFR 50 of the NRC or the NRC guidelines (refs. 11, 13, 14, 15). In the analysis of water samples, the laboratory should also be certified by the State of New Mexico (or reciprocity states) under the Safe Drinking Water Act.

For the measurements to be performed by the State, quality control and quality assurance samples for radioactive constituents will be obtained from outside

agencies. Reference 2 reports that radioactive quality assurance samples for environmental monitoring can be obtained from the Quality Assurance Division of the Environmental Monitoring Systems Laboratory (EPA-Las Vegas) and that geological quality assurance samples can be obtained from the Canadian Geological Survey, the National Bureau of Standards (NBS), and the United States Geological Survey (USGS). Water quality assurance samples can be obtained from the Environmental Protection Agency.

Lower detection limits will be calculated from the variation of "blank values." A "blank value" is determined by carrying out the chemical analysis without a sample, but rather using deionized water, or an unused filter paper, or only the reagent used in the analysis. The analysis of blanks is also essential to verify the absence of laboratory contamination.

4.3 Data Analysis and Reporting

Procedures for analyzing and reporting the data will be established after the completion of detailed sampling and analysis procedures. The results will be published in an annual report available to the public that will also contain for comparative purpose a review of the independent measurements of the DOE, the measurements of the long-term hydrological monitoring program at the Gnome site, and the air particulate measurements by the Environmental Improvement Division in the Carlsbad area.

APPENDIX A

EXCERPTS FROM THE SUPPLEMENTAL STIPULATED AGREEMENT

The agreement for the joint environmental monitoring program between the State of New Mexico and the U.S. Department of Energy is contained in the December 28, 1982 Supplemental Stipulated Agreement. The following sections are taken from pages 1 through 9 of Appendix A of that document.

Appendix A of Supplemental Stipulated Agreement
The State of New Mexico's Environmental Monitoring Program For WIPP

The State of New Mexico's environmental radiation surveillance program for WIPP operations is designed to serve as an independent means to evaluate the accuracy and precision of the results as determined by the Department of Energy's program. Such a meaningful, independent State role is crucial for public confidence and acceptance given the fact that WIPP is exempted from NRC licensing and inspection requirements. In order to maintain this independence the State will require the following: (1) that split samples will be taken by a procedure approved by the State and DOE, and, if the parties so desire, under the observation of the designated representatives of both agencies on a routine collection schedule; that, where applicable, sample preparation will follow established quality assurance/quality control procedures to insure a homogenous mixture prior to taking aliquots; (2) that the sample schedule and location will be expanded or altered in accordance with any reasonable request by the representatives of the State of New Mexico; (3) that sample analyses will be performed by laboratories not affiliated with nor under contract with the Department of Energy to perform analysis of WIPP environmental monitoring samples; and (4) that a State quality control program will be established and maintained for routine calibration of air samples and thermoluminescent dosimeters in addition to the intercomparison of specific radionuclide analyses by a referee laboratory program, such as one certified by the National Bureau of Standards or the Environmental Protection Agency.

A. Pre-operational Phase (Begins Two Years Prior to Waste Emplacement)

1. External Gamma Exposure

Duplicate thermoluminescent dosimeters (TLD's) at all of the DOE's stations.

2. Soil

Random split sampling and specific isotopic analyses for up to 30% of the DOE's scheduled program.

3. Atmospheric Particulates

Duplicate high volume air particulate sampler(s) adjacent to the DOE's station in the area of maximum predicted downwind ground deposition. The State representative may elect to monitor the sampling, monitoring and analytic process rather than take duplicate samples.

4. Water and Sediments

Random split samples and specific isotopic analyses for up to 30% of the DOE's scheduled program.

5. Produce and Meat

Locally produced fruit, vegetables, meat and poultry random split samples and the same analyses for up to 30% of the DOE's scheduled program.

B. Operational Phase

The operational radiation surveillance program will be similar to the preoperational phase. The final design of the program, however, will be based on a review of the environmental data collected during the two years prior to waste emplacement operations. Two additional high volume air sampling stations are planned for (1) an area downwind determined to be the area of largest risk to population during the operational phase and, (2) a location remote and 180 degrees from the previous location and on the opposite side of the WIPP site.

C. Decommissioning and Decontamination Phase

The level of environmental radiological surveillance developed during the operational phase shall be continued during and for at least two years

following complete decommissioning and decontamination of the surface facilities. This is to include both the State and the Department of Energy's programs. In addition, increased surface soil and vegetation samples will be collected and analyzed to ensure decontamination standards in effect at the time are met.

D. Post-Operational Phase

The final environmental radiological surveillance phase will primarily serve to ensure the public that resuspension of contaminated ground surface particles, if any, is not creating a potential long-term inhalation problem. The program will also include continued analyses on an annual basis of some selected soil, and surface and ground water sampling locations as determined by a review of the data and/or the most critical pathways to man. The minimum program projected at this time and to be continued for a period of not less than five (5) years following termination of the decommissioning and decontamination phase is:

(1) Intermittent operation of the State-operated high volume air sampling stations.
(2) Four annual soil surface samples.
(3) Four annual water samples.
(4) Thermoluminescent dosimeters.

APPENDIX B

B.1 Applicable Standards

The concentration of radioactive and chemical contaminants in air and water samples collected throughout the environment will be compared with pertinent standards contained in regulations of Federal and State agencies. In the case of radioactive materials in the environment, the standards are given as radioactivity concentration guides (RCG) in 10CFR20 and the radiation protection regulations of the State of New Mexico. Relevant RCG values for WIPP are presented in Table B-1. An RCG is the concentration of radioactivity in air breathed continuously or water constituting all that ingested during 50 years that will result in whole body or organ doses in the fiftieth year equal to the Radiation Protection Standards (RPS) for internal and external exposures. The radiation protection standards are presented in Table B-2. Uncontrolled area RCGs correspond to RPSs for the general public whereas controlled area RCGs correspond to RPSs for workers.

TABLE B-1
10CFR20 Radioactivity Concentration Guides (RCGs)

Concentration Guides for Uncontrolled Areas[a]			Concentration Guides for Controlled Areas[a]		
Nuclide	RCG for Air (μCi/mℓ)	RCG for Water (μCi/mℓ)	Nuclide	RCG for Air (μCi/mℓ)	RCG for Water (μCi/mℓ)
H-3	2×10^{-7}	3×10^{-3}	H-3	5×10^{-6}	1×10^{-1}
Sr-90	3×10^{-11}	3×10^{-7}	Sr-90	1×10^{-9}	1×10^{-5}
Cs-137	5×10^{-10}	2×10^{-5}	Cs-137	1×10^{-8}	4×10^{-4}
Pu-238	7×10^{-14}	5×10^{-6}	Pu-238	2×10^{-12}	1×10^{-4}
Pu-239	6×10^{-14}	5×10^{-6}	Pu-239	2×10^{-12}	1×10^{-4}
Am-241	2×10^{-13}	4×10^{-6}	Am-241	6×10^{-12}	1×10^{-4}
	(pg/m^3)[b]			(pg/m^3)[b]	
U, natural[c]	6×10^{6}	6×10^{-7}	U, natural[c]	1.8×10^{8}	2×10^{-5}

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[a] RCGs apply to radionuclide concentrations in excess of that occurring naturally or due to fallout.

[b] One curie of natural uranium is equivalent to 3000 kg of natural uranium. Hence, uranium masses may be converted to the DOE "uranium special curie" by using the factor 3.3×10^{-10} μCi/pg.

[c] The RCGs of Pu-239 and Sr-90 are the most appropriate to use for gross alpha and gross beta RCGs, respectively.

Table B-2
RADIATION PROTECTION STANDARDS FOR
EXTERNAL AND INTERNAL EXPOSURES

Individuals and Population Groups in Uncontrolled Areas

Type of Exposure	Annual Dose Equivalent or Dose Commitment (rem) Based on Dose to Individuals at Points of Maximum Probable Exposure	Based on an Average Dose to a Suitable Sample of the Exposed Popualtion
Whole body, gonads, or bone marrow	0.5	0.17
Other organs	1.5	0.5

Individuals in Controlled Areas

Type of Exposure	Exposure Period	Dose Equivalent Dose or Dose Commitment (rem)
Whole body, head and trunk, gonads, lens of the eyes, red bone marrow, active blood forming organs.	Year	5
	Calendar Quarter	3
Unlimited areas of the skin (except hands and forearms). Other organs, tissues, and organ systems (except bone).	Year	15
	Calendar Quarter	5
Bone	Year	30
	Calendar Quarter	10
Forearms	Year	30
	Calendar Quarter	10
Hands and feet	Year	75
	Calendar Quarter	25

Table B-3
MAXIMUM CONTAMINANT LEVEL (MCL) IN WATER SUPPLY FOR
INORGANIC CHEMICALS AND RADIOCHEMICALS[a]

Inorganic Chemical Contaminant	MCL (mg/ℓ)	Radiochemical Contaminant	MCL (μCi/mℓ)
	Primary Standard[a]		
Ag	0.05	Cs-137	200×10^{-9}
As	0.05	Gross alpha[d]	5×10^{-9}
Ba	1.0	H-3	20×10^{-6}
Cd	0.010	Pu-238	15×10^{-9}
Cr	0.05	Pu-239	15×10^{-9}
F[b]	2.0		
Hg	0.002		
NO_3	45		
Pb	0.05		
Se	0.01		
	Secondary Standards[c]		
Cℓ	250		
Cu	1.0		
Fe	0.3		
Mn	0.05		
SO_4	250		
Zn	5.0		
TDS	500		
pH	6.5 - 8.5		

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[a]Reference 16.
[b]Based on annual average of the maximum daily air temperature of 14.6 to 17.7°C.
[c]Reference 17.
[d]See text for discussion of application of gross alpha MCL.

For chemical pollutants in water supply, the controlling standards are those promulgated by either the Environmental Protection Agency (EPA) or the New Mexico Environmental Improvement Division (NM-EID). These standards are reproduced in Table B-3. The EPA's primary maximum contaminant level (MCL) is the maximum permissible level of a contaminant in water which is delivered to the free flowing outlet of the ultimate user of a public water system.

The EPA's secondary drinking water regulations control contaminants in drinking water that primarily affect aesthetic qualities relating to public acceptance of drinking water. At considerably higher concentrations of these contaminants, health implications may also exist as well as aesthetic degradations.

Radioactivity in public water supply is governed by EPA regulations contained in 40 CFR 141. For naturally occurrence radioactivity, these regulations provide that the combined Ra-226 and Ra-228 activity shall not exceed 5×10^{-9} µCi/mℓ (5 pCi/ℓ) and that gross alpha activity (including Ra-226, but excluding radon and uranium) shall not exceed 15×10^{-9} µCi/mℓ (15 pCi/ℓ). For man-made beta and photon emitting radionuclides, the EPA drinking water regulations specify that a concentration be limited to a level that would result in a dose of 4 mrem/yr calculated according to a specified procedure. The EPA calculated value for tritium (H-3) is 20×10^{-6} µCi/mℓ and for cesium (Cs-137) is 200×10^{-9} µCi/mℓ (Ref. 16).

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