ENVIRONMENTAL MONITORING REPORT FOR CALENDAR YEAR 1986

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ABSTRACT

The results of the 1986 environmental monitoring program for the Princeton Plasma Physics Laboratory (PPPL) are presented and discussed. Two of three large tokamak machines, the Princeton Large Torus (PLT) and the Tokamak Fusion Test Reactor (TFTR) were in operation during the year. The Princeton Beta Experiment (PBX) was shut down in December 1985 to undergo major modifications, and will recommence operations in 1987. PLT was shut down in December 1986. In addition, the S-1 Spheromak and the Radio-Frequency Test Facility (RFTF) were operated on a limited basis in 1986.

The Environmental Committee became a standing committee of the Executive Safety Board (ESB) and continued to review items of environmental importance. During CY86 no adverse effects to the environment or public resulted from any operational program activities at PPPL, and the Laboratory was in compliance with all applicable Federal, State, and local environmental regulations.

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TABLE OF CONTENTS

	<u>Page</u>
Abstract	i
Table of Contents	ii
List of Tables and Figures	iv
1.0 Introduction	1
1.1 General	1
1.2 Description of the Site	4
2.0 Summary	6
3.0 Monitoring, Environmental Program Information, Data Collection, Analyses, and Evaluation	7
3.1 Radioactivity	8
3.1.1 Penetrating Radiation	8
3.1.2 Special Surveys	9
3.1.3 Airborne Radioactivity	10
3.1.4 Waterborne Radioactivity	11
3.1.5 Foodstuffs	12
3.1.6 Soil, Grass, Vegetation	12
3.2 Nonradioactive Pollutants	12
3.2.1 Airborne Effluents	12
3.2.2 Water Utilization	13
3.2.3 Spills	15
3.2.4 Herbicides, Fertilizer, and Pesticides	15
3.2.5 Polychlorinated Biphenyls	15
3.2.6 Hazardous Waste	16
3.3 Environmental Impact	16
3.3.1 Assessment of Radiation Dose to the Public	16
3.3.2 Assessment of Nonradioactive Pollutants	17
4.0 Quality Assurance for Laboratory Analyses	17

	<u>Page</u>
5.0 Future Program Expansion	18
5.1 Meteorological	18
5.2 Water Quality	18
5.3 Radioactive Effluents	19
5.4 Nonradioactive Effluents	19
6.0 Regulations and Safety Criteria	20
7.0 Acknowledgments	20
8.0 References	21

LIST OF TABLES

		<u>Page</u>
Table 1	TFTR Radiation Exposure Criteria	24
Table 2	Critical Pathways	25
Table 3	Monitoring Program Covering Critical Pathways .	26
Table 4-13A	Demographics	27
Table 14-26	Water Quality Monitoring Data (Nonradioactive)..	38
Table 27	Nonradioactive QA Results	61
Table 28	QA/QC Tritium Cross Check Data	62
Table 29	Fertilizer, Pesticide, Herbicide Application	63

LIST OF FIGURES

Figure 1	The Spheromak S-1	64
Figure 2	The Radio-Frequency Test Facility	65
Figure 3	The Princeton Large Torus	66
Figure 4	The Princeton Beta Experiment	67
Figure 5	The Tokamak Fusion Test Reactor	68
Figure 6	Wind Rose Data 1984-86 (30 m)	69
Figure 7	Wind Rose Data 1984-86 (60m)	70
Figure 8	80-km (50 mile) Radius Of Site	71
Figure 9	5-Mile Radius Of Site	72
Figure 10	PPPL Site	73
Figure 11	1974 10-Mile Population Estimates	74
Figure 12	1985 10-Mile Population Estimates	75
Figure 13	C & D Site Monitoring Stations	76
Figure 14	Off-Site Surface Water Monitoring Stations	77
Figure 15	Off-Site Soil, Planned Air Monitoring Locations....	78

1.0 INTRODUCTION

1.1 General

This report gives the results of the environmental monitoring program at the Princeton Plasma Physics Laboratory (PPPL) for Calendar Year 1986 (CY86). The report is prepared to provide the U.S. Department of Energy (DOE) and the public with information on the level of radioactive and nonradioactive pollutants, if any, added to the environment as a result of PPPL operations. The objective of the environmental monitoring report is to document evidence that DOE facility environmental protection programs adequately protect the environment and the public health.

PPPL has engaged in fusion energy research since 1951 and in CY86 had two of its three large tokamak devices in operation; namely, the Princeton Large Torus (PLT) and the Tokamak Fusion Test Reactor (TFTR). The Princeton Beta Experiment (PBX) was shut down at the end of 1985 to undergo a major modification (PBX-M), and should be back in operation in June 1987. In addition, the S-1 Spheromak, which began operation in CY83, after upgrades to the flux core liner, has continued on a program of plasma research operation. The goal of the Magnetic Fusion Energy Research Program is to develop and demonstrate the practical application of fusion power as an alternate energy source.

The Spheromak is a compact toroidal concept. The S-1 (Fig. 1) achieved an initial goal of producing hot (100 eV) plasmas with a lifetime of 1 msec or more in 1985. With the achievement of toroidal currents of over 300 kA, electron densities in the mid-to-upper 10^{13} cm^{-3} range, operating currents over 500 kA, and with the new flux core liner installed, the future looks good for producing electron temperatures in the 200-300 eV range. A new current transformer, if the budget allows, will be installed to increase the plasma current into the 1 MA range. Operation and maintenance of the S-1 has no expected potential for impact

on the environment, a conclusion that is documented in the project's Safety Assessment Document (EI84).

Another small device, the Radio-Frequency Test Facility (RFTF) began operation in CY84 (Fig. 2). RF wave launcher testing for both PLT and TFTR operations were undertaken in 1985 and continued in 1986. In addition, feasibility studies were done on the use of plasma arcs to disassociate chemical compounds. The conclusion of the RFTF Safety Assessment Document was that the device will have no effect on the environment (Na84). This has proven to be the case in operations to date. If funding is obtained to increase the research on spin-off technologies, such as disassociating hazardous compounds, a new assessment will be initiated.

The PLT (Fig. 3) had another successful year of research in RF heating techniques. After 12 years of operation the PLT was shut down in December 1986, and for the immediate future will remain mothballed. The PLT had no effect on the environment.

The PBX (Fig. 4), after achieving a $>5\%$ beta (ratio of plasma pressure/magnetic pressure) in CY84 experiments, was shut down at the end of 1985 to undergo modifications to further examine theoretical predictions on plasma shaping. The addition of new coils within the vessel, new power supplies, and a new control system began in 1986. The modified device (PBX-M) is expected to be back in operation in June 1987. A Safety Assessment Document (SAD) was published for the PBX in 1984 (FI84) which indicated that the PBX did not pose any potential environmental concerns. A new SAD will be published for the PBX-M and initial indications are that the device should not pose any environmental concerns.

The TFTR (Fig. 5) which had its first full year of operation in CY83, increased the total neutron production in CY86 to 2.4×10^{18} . The increased neutron production increased the activation level of the machine to the point where health physics surveys were required in the test cell following a machine run before

entry was allowed for inspection, routine maintenance, or installation work. The TFTR is a toroidal device in which a deuterium-tritium (D-T) plasma will be magnetically confined and heated to extremely high temperatures by neutral beam injectors. D-T operations are presently scheduled for 1990. Ion Cyclotron Radio-Frequency (ICRF) heating is expected to be operational in 1988. A major achievement in 1986 was an increase in neutron production and power by operating in what is now called the "supershot" pulse mode. Using this technique a new record temperature of >200 million degrees Celsius was achieved. The potential hazards of this program are addressed in Safety Analysis Reports for the Project (PSAR78 and FSAR82). The FSAR is being updated to reflect tritium operation.

The PPPL site is, in general, open to the public. This free access has necessitated a thorough evaluation of the on-site discharges as well as the potential for off-site releases of radioactive and toxic nonradioactive effluents. An extensive monitoring program tailored to these needs has been instituted and expanded over recent years. The PPPL radiological environmental monitoring program generally follows the guidance given in two DOE reports, namely A Guide for: Environmental Radiological Surveillance at U.S. Department of Energy Installations (Co81) and Environmental Dose Assessment Methods for Normal Operations at DOE Nuclear Sites (PNL-4410) (St82). This includes adherence to the standards given in DOE Orders, in particular, DOE Order 5480.1A, Chapter XI (DOE81), which pertains to permissible doses and concentration guides, and gives guidance on maintaining exposures "to as low as reasonably achievable" (ALARA). Additional interim criteria were forwarded by memo (Mi85) and are expected to become an official part of the Order in the future. Specific criteria for implementing these standards on TFTR are contained in a TFTR Operational Safety Requirement (OSR/TFTR/O-2F-C) (see Table 1). This table was updated in 1986 to include the EPA airborne emission requirements.

The emphasis of the monitoring program has been placed on

exposure pathways appropriate to fusion energy projects. These pathways include external exposure from direct penetrating radiation and eventually from airborne radionuclides, such as ^{41}Ar , ^{13}N , ^{16}N , and internal exposure from radionuclides, such as ^3H in air and water. Seven major critical pathways were considered (see Table 2). Prompt radiation was also considered and is being measured. The monitoring program as envisioned by the TFTR Final Safety Analysis Report (FSAR82) has been updated to reflect the current environment around TFTR (see Table 2). At present, the radioactive pollutant potential to the environment by any pathway is essentially nonexistent. Small amounts of tritium produced from D-D reactions (approximately 100 mCi total in 1986 if all neutrons were D-D produced) are not measurable outside the TFTR facility. Low levels of tritium (exempt quantities) are now detectable in pump oils.

Preliminary meteorological considerations and associated methodology, which were established at the time of the installation of PPPL's first meteorological tower, were reported in Section 2 of the TFTR FSAR. Subsequently, improved methodologies were implemented and a new meteorological tower was erected and began operation in November 1983 (Mc83). The improved measurements and methodologies will be included in the updated FSAR being prepared for tritium operations. Data have been collected for three years using the monitors on the new tower. Wind rose plots from the data for these three years (1984-86) are shown in Figs. 6 and 7.

1.2 Description of the Site

PPPL is located at the James Forrestal Research Campus of Princeton University. As shown in Fig. 8, the location is in central New Jersey within Middlesex County. The site has undisturbed areas with virgin forest, open grass areas, an airplane runway, and a small brook (Bee Brook) running through its eastern boundary. The closest urban centers are New Brunswick, 14 miles to the northeast and Trenton, 12 miles to the southwest. Major metropolitan areas including New York

City, Philadelphia, and Newark are within 50 miles of the site. As shown in Fig. 9, the municipalities of Princeton, Plainsboro, Kingston, Penns Neck, Princeton Junction, and Cranbury, among others, are in the immediate vicinity of the site. Also, the main campus of Princeton University, located primarily within the borough of Princeton is approximately three miles to the west of the site. The general layout of the facilities at the Forrestal Campus is indicated in Fig. 10, where the specific location of TFTR is denoted as D-site.

Figure 11 and Table 4 indicate the 1974 population estimates in sectors within ten miles of PPPL. Table 5 and Fig. 12 show the projected population for 1985. This was derived by the New Jersey State Office of Business Economics in the Department of Labor and Industry which calculated the percentage increase projected for municipalities in the zero-to-ten-mile region. The resident population within 10 to 50 miles of PPPL, based on the 1970 census, is shown in Table 6. The site is in the center of a highly urbanized region extending from Boston, Massachusetts to Washington, D.C. The 1985 population projections for the States of New Jersey, New York, and Pennsylvania indicate a substantial population increase within 50 miles of the PPPL site. The actual change from 1970 to 1980, as indicated by the census in these two years, was not as large as expected. In fact, the population in New York City and Philadelphia decreased. The Princeton area continues to experience a substantial increase in new business moving into the Route 1 corridor near the site. The increase, however, has not been as great as the projections had indicated. Because of delays in the tritium program, a new demographic study was delayed. The Compact Ignition Tokamak (CIT) has a new demographic study underway and these data will be utilized in the CY87 report. An internal study on population distribution was done in 1985 (St85), but was not expanded to cover the detail of annular regions and sectors (see Tables 7-13). A sectorized population data summary was prepared in 1986 for use with several standard codes used for the determination of off-site dose due to the release of airborne activated nuclides and tritium (Ko86b). Table 13A shows data

supplied by the Princeton Forrestal Center on the number of workers within one mile of the TFTR site. This number was divided by 4 to obtain an equivalent exposure for habitation (Ko86b).

2.0 SUMMARY

During CY86 there were no accidents, incidents, or occurrences that had an impact on PPPL facilities, program operations, or the environment. A spill from a barrel of Freon-113 required the disposal of 13 cubic yards of dirt in the cleanup process (St86). Written procedures were initiated and implemented by the Environmental Committee to assign organizational responsibilities during a spill. Weed control and grass fertilization were applied under the direction of the Princeton University Buildings and Grounds Department. The work was done by University personnel or certified contractors in accordance with EPA regulations. Transformers and capacitors containing PCB oils are being removed from service and disposed of in accordance with prepared schedules and EPA regulations. The Laboratory has a program to monitor, inventory, and dispose of PCB and other potentially toxic materials.

Surface water analyses for both radioactive and nonradioactive pollutants have not shown anything above normally expected background values. The initial phase of a program for ground water analysis was initiated in 1985. The US Geological Service (USGS) finished their drilling programs in 1986, but continue to monitor a tracer test initiated in the fall of 1986. Tritium levels slightly less than 100 pCi/l (3.7 Bq/l) have been detected. These data are in agreement with the old on-site drinking water wells and surface water measurements. Soil and vegetation samples were collected and analyzed as part of the baseline studies.

Radiation exposure via airborne effluents into the environment is still at a concentration that is too low to be measurable under present operations. Prompt radiation is detectable at extremely

low levels during high power pulses from TFTR. The integrated level at the Exclusion Zone Boundary (EZB) around TFTR, from TFTR operations, was less than 1 mrem (0.01 mSv) for CY86 (Gi87).

Off-site surface water, soils, and biota were analyzed for radioactive baselines in CY86. In addition, negotiations were initiated for the placement of air, particulate, and passive tritium air monitors. These monitors were tested in 1986 and are expected to be placed in the field in the summer of 1987.

3.0 MONITORING, ENVIRONMENTAL PROGRAM INFORMATION, DATA COLLECTION, ANALYSES, AND EVALUATION

The monitoring program implementation has followed a phased approach commensurate with the potential hazards and the needs of an expanding program. Nonradioactive water pollutant monitoring has been conducted for many years. A more extensive program, which began in 1979, presently includes eight surface water sampling points (four on-site and four off-site), four ground water sites (two old drinking water wells and two new wells near the TFTR liquid effluent tanks), and the potable water supply source. Monitoring for sources of potential radiological exposures is quite extensive. Real-time prompt gamma/neutron environmental monitoring began on the TFTR site in 1981 to establish baselines prior to machine operation. The original station (RMS-B), located on the TFTR site, was discontinued in 1986 but data from the many other stations had been seen to correlate well. The area was vacated for TFTR ICRF needs and future CIT facilities. Four monitoring stations are located at the TFTR EZB. Neutron monitors were added at these locations at the end of CY84. Passive tritium monitors will be added in CY87. Radiological water samples are being collected at the same locations as the nonradioactive sample points (see Figs. 13 and 14). Soil and biota samples are also being analyzed for tritium baselines. Iodine, cesium, and ruthenium from the

Soviet reactor accident in Chernobyl were easily detected during May 1986; however, levels were low and no significant impact on the environment on or around the PPPL site resulted from this accident.

3.1 Radioactivity

3.1.1 Penetrating Radiation

Operation of the Princeton Large Torus (PLT) and the Princeton Beta Experiment (PBX) results in the production of some penetrating radiation (primarily bremsstrahlung X rays and neutrons). Because neither the PLT or PBX have a roof shield, skyshine radiation (primarily neutron) is seen at the TFTR EZB site monitoring stations. The shielding installed for the PLT/PBX machines has kept the total exposure dose equivalents in occupied areas below occupational exposure guidelines. Skyshine radiation from the neutron production by PLT added less than 1 mrem to the D-site environs. PBX was not operating in 1986, but the overall site boundary radiation from all devices was less than 1 mrem (0.01 mSv) (Gi87).

The stated Laboratory Policy is that when occupational exposures have the potential to exceed 1000 mrem/yr (10 mSv/yr), the appropriate project manager must petition the PPPL Executive Safety Board (ESB) for an exemption. In addition, the Laboratory applies the DOE ALARA policy to all its operations. This philosophy for occupational exposure means that environmental radiation levels, as a result of experimental device operation, are also very low, and acceptable.

The design objective for TFTR is to stay below 10 mrem/yr (0.1 mSv/yr) above natural background from all sources of radiation at 125 meters from the machine, i.e., the EZB. The TFTR, like other tokamaks, produces bremsstrahlung radiation from the electrons striking internal hardware at the end of a pulse. These X rays, in the range of 0 to 20 MeV, also produce photoneutrons. Injection of deuterium neutral beams began at the end of CY84.

With these D-D runs the neutron fluxes have increased each year as the neutral beam heating power increased. In CY85 the neutron production was on the order of 5×10^{16} for the entire year. This number increased to 2.4×10^{18} in CY86. Additional shielding was added to the TFTR test cell walls in the middle of CY85. This added shielding prevented any significant penetrating radiation from being added to the environs due to TFTR operations in 1986. Radiation levels (μR) were recorded for some pulses outside the test cell, with the total exposure dose equivalent at the TFTR EZB being less than 1 mrem (0.01 mSv) for CY86 (Gi87).

The TFTR real-time site boundary monitors are Reuter-Stokes Senti 1011 pressurized ionization chambers and He-3-moderated neutron detectors. The electronics in the ionization chambers were modified to allow the integration of any prompt radiation resulting from a TFTR machine pulse that may be above natural background. These data are stored and processed as part of the Central Instrumentation Control and Data Acquisition (CICADA) computer system. Four of these monitoring stations are placed at the EZB (125 meters from the TFTR) (see Fig. 13). Another eight ionization chambers of lower sensitivity and neutron monitors are located nearer the TFTR device (four outside the test cell wall, three in the basement, and one on the roof). These eight detector locations are for personnel safety and are not considered environmental detectors per se. However, data collected from these monitors are used to help correlate environmental measurements. Besides the moderated He-3 neutron detectors, Bonner-type-moderated Li(I) detectors were used for monitoring at various locations throughout the TFTR facility.

3.1.2 Special Surveys (St81)

In August 1980, EG&G, Inc., under DOE contract conducted an aerial radiological survey of PPPL and surrounding areas. The detection system consisted of 20 sodium iodide detectors, a multichannel analyzer, and a magnetic tape recording system.

The nominal exposure rate range observed was 8 to 10 $\mu\text{R}/\text{h}$. Detected radioisotopes were consistent with normal background emitters. Since conditions have not changed since 1980, there is no need at this time to repeat the survey.

3.1.3 Airborne Radioactivity

Radioactivation of air and tritium in measurable concentrations is not expected until TFTR D-T operations. A silica gel environmental tritium monitor (Gr86) was tested in 1986, and will be placed in the field by the summer of 1987. Based on D-D neutron production during CY86, it is estimated that approximately 100 mCi (3.7 GBq) of tritium could have been added to the environs outside the TFTR facility. This is essentially nonmeasurable because it is not produced and released all at once. In comparison, a fission pressurized water reactor releases about 3600 Ci/yr during normal operation (Nu79). Iodine-131 concentrations due to the Soviet reactor accident at Chernobyl went from background detection limits ($\sim 10^{-14}$ $\mu\text{Ci}/\text{cm}^3$) on May 8, 1986, to 2.5×10^{-12} $\mu\text{Ci}/\text{cm}^3$ on May 19, 1986, and back to background levels around May 28, 1986.

In November 1983, a three-level, 60 meter tower was installed for gathering meteorological data. Three years worth of data have now been collected. The wind rose data for the first three years of operation are shown in Figs. 6 and 7. Analysis indicates that the site is dominated by neutral to moderate stable conditions with moderately unstable to extremely unstable conditions occurring less than a few percent of the time. Average surface winds are about 2.1 m/s and rise to about 4.1 m/s at 60 m (Ko86a). Based on data from this tower, X/Q values will be recalculated for the updated FSAR before tritium operation. The data are also being checked for consistency by the Idaho National Engineering Laboratory (INEL) in their preparation of an Environmental Assessment (EA) for the CIT project.

3.1.4 Waterborne Radioactivity

3.1.4.1 Surface Water

Surface water samples at eight locations (four on-site and four off-site) have been analyzed for tritium and photon emitters. Five of these locations have been monitored since CY82. Downstream sampling occurs after mixing of effluent and ambient water is complete. Locations are indicated on Figs. 13 and 14.

Sample analysis has shown no unusual background radionuclides. Tritium analysis by liquid scintillation methods has shown tritium values to be less than 100 pCi/l (3.7 Bq/l) on all samples analyzed to date. Tritium enrichment procedures are used on some samples to see lower levels. Rain water samples collected and analyzed ranged from 40 to 140 pCi/l, which was similar to the 1985 range of 45 to 160 pCi/l.

3.1.4.2 Ground Water

Two existing on-site wells (W4 and W5 on C-site) were sampled (see Fig. 13). As a part of continuing efforts to characterize the site, a more comprehensive ground water program was initiated in June 1985 through the U.S. Geological Survey. This program entailed the drilling of several monitoring wells on the TFTR site in order to help profile the ground water system. The final survey report will be available in June 1987. The samples collected from two of the wells (W1 and W10 at D-site) were analyzed for tritium by PPPL and the University of Miami under a USGS sampling program. The split sample results were consistent and indicated tritium levels of slightly less than 100 pCi/l (3.7 Bq/l). These values are consistent with the results from wells W4 and W5 noted above, as well as the surface water measurements.

3.1.4.3 Drinking Water

Potable water is supplied by the public utility, Elizabethtown Water Co. In April 1984 a sample point at the input to PPPL was established (E1 location, Fig. 13) to provide baseline data for water coming onto the site. Radioactive analysis has included gamma spectroscopy and tritium.

3.1.5 Foodstuffs

Because there are so few dairy farms in this area, milk is not a viable analysis medium around the site. Also the fish population is very scarce or nonexistent in Ditch 5 and Bee Brook, which carry the runoff from the site. DOE has agreed that a substitute of vegetables and other biota from the surrounding area can be used. Sampling in 1986 indicated tritium levels below 100 pCi/l (3.7 Bq/l) (Gi87).

3.1.6 Soil, Grass, Vegetation

Off-site sample locations were established in late 1985 (see Fig. 15). Soil and grass samples collected on-site and off-site in 1986 indicated tritium levels below 100 pCi/l (3.7 Bq/l). Laboratory techniques for doing these analyses were perfected in CY84 (Gr85) and the techniques are documented in the Radiological Environmental Monitoring Laboratory Handbook (REML86). These baselines are being established since surface soils and vegetation are among the best indicators of tritium after a release (Jo74), (Mu77), (Mu82).

3.2 Nonradioactive Pollutants

3.2.1 Airborne Effluents (Ki87)

PPPL has a New Jersey Department of Environmental Protection (NJDEP) Permit for its C-site boilers and fuel tank vents. The seven permit certificates numbered 061294 through 061300,

were due to expire in March 1987. Application for new permits was initiated in October 1986.

Measurements of actual emissions are not required. Emissions are calculated using formulae supplied by the NJDEP.

3.2.2 Water Utilization (K187)

3.2.2.1 Drinking Water

Potable water is supplied by the public utility, Elizabethtown Water Co. PPPL used approximately 35 million gallons in CY86. Water quality analysis at the input to PPPL was initiated in CY84 for both radioactive and nonradioactive pollutants (Table 19, E-1 location).

3.2.2.2 Process (nonpotable) Water

Nonpotable water is pumped by PPPL from the Delaware & Raritan Canal as authorized by a permit agreement with the New Jersey Water Supply Authority. This agreement gives PPPL the right to draw up to one million gallons of water per day for process and fire fighting purposes for the period beginning July, 1984 and ending on September 30, 1991. Treatment consists of filtration to remove suspended solids. In 1986 a multimedia sand filter was installed to allow the source of the D-site cooling tower make-up water to be changed from potable water to process water supply. The sampling point (C-1) was established to provide baseline data for process water coming on-site. Table 16 indicates results of water quality analysis at the canal.

3.2.2.3 Storm Sewage

Storm sewage that includes cooling tower and boiler blowdown is discharged into surface waters and is governed at C- and D-sites by NPDES Permit No. NJ0023922 (effective date November 1, 1984 - expiration date October 31, 1989). All process water and most runoff water from C- and D-sites now passes through a

retention basin. Upgrades to the retention basin, including an oil spill detection and alarm system were completed in 1986. Quarterly water chemistry reports compiled from the data of Table 18, were submitted to the State of New Jersey in 1986 in accordance with NJDEP requirements. PPPL was within the allowable limits for all testing parameters during CY86.

Cooling water treatment was changed from a chromate-based corrosion inhibitor to a nonchromate inhibitor in June 1983. Water analyses downstream and ground water tests (see Tables 14-26) have not indicated concentrations of any environmental pollutants above applicable codes, regulations, or standards. As a result of the improvements made to the retention basin in 1986, the NJDEP is now requiring an application for discharge to ground water. This permit was applied for in 1986. An updated Spill Prevention Control and Countermeasures (SPCC) Plan was received in January 1985. All major action items of the plan have been addressed. These actions included modifications to the retention basin, an oil spill detection and alarm system at the C-site MG basement sump, an oil detection and alarm system at the retention basin, and spill containment dikes around three transformers. The SPCC response team meets quarterly for training sessions to improve their response efficiency in case a spill were to be detected. In addition, the Environmental Committee wrote a procedure, which was approved by Laboratory management, addressing responsibilities in case of a spill. One requirement, the writing of a spill report, is handled by the Environmental Coordinator.

3.2.2.4 Sanitary Sewage

Sanitary sewage is discharged to the publicly owned treatment works operated by South Brunswick Township at Stony Brook. Flow rates are measured by the PPPL sanitary sewage metering station and average approximately 57,000 gallons per day (21 million gallons in 1986). Sampling of PPPL discharges, performed by the publicly owned treatment works, has determined that pretreatment is unnecessary. Therefore, PPPL

is in compliance with the EPA Pretreatment Standard, 40 CFR Part 403.

3.2.3 Spills

A Freon-113 spill onto the asphalt next to the CAS building required a cleanup which included removal of 13 cubic yards of asphalt, dirt, and debris. The cleanup prevented any impact to the local environment. A report was issued on the cause and close out of this effort (St86).

3.2.4 Herbicides, Fertilizer, and Pesticides (CI87)

The use of herbicides, pesticides, and fertilizers is not controlled by PPPL but by Princeton University buildings and grounds maintenance personnel. These materials are applied in accordance with State and Federal regulations. Herbicides are applied by a certified applicator. Table 29 lists the quantities applied during CY86.

3.2.5 Polychlorinated Biphenyls (PCBs)

Beginning in CY82 PPPL started a program to dispose of PCB containing capacitors, transformers, and other contaminated items. During the early phases of the program all stored items in a GSA Warehouse in Belle Mead, NJ were discarded through approved disposal contractors. Remaining PCB items were labeled, as required by EPA regulations, and an inventory, inspection, and status report program was initiated. A Hazardous Material Coordinator was appointed to ensure that any newly identified leaking capacitors or transformers would be dispositioned promptly and properly. At the beginning of CY84 PPPL still had 15 PCB transformers and 6005 large capacitors containing PCBs. In CY84 375 large and 54 small PCB capacitors were disposed of as well as the oil and containers of two transformers (Ho85). In 1985, an additional 1330 large capacitors and 22 small capacitors were properly removed from the site. In 1986 a few small capacitors but no transformers

were discarded. Other PCB capacitors are being disposed of as they are taken out of service. Transformer replacement has been initiated and is scheduled to meet the EPA requirements.

3.2.6 Hazardous Wastes

Responsibility for this program rests with the PPPL Hazardous Material Coordinator under the Materiel Control Office. A facility was set up in CY82 for temporary storage of hazardous materials. A new area was built in 1986. This facility has concrete floors with containment walls, fire and security alarms, fire extinguishers, an eye wash station, an emergency shower, and telephones.

The hazardous waste generator annual report (EPA ID number NJ1960011152) has been submitted for 1986 in accordance with EPA requirements (St87). During 1986, 35,431 pounds of materials were sent to a waste contractor. This included 10,653 pounds of PCBs (oil plus containers). Also 4025 gallons of liquid and 18 cubic yards of asphalt/soil from a Freon-113 spill were disposed of. Testing of soil from the vacated hazardous material storage area (Annex) indicated PCB levels which were less than 50 ppm (Mi87).

3.3 Environmental Impact

3.3.1 Assessment of Radiation Dose to the Public

PPPL is located in one of the less densely populated, but also one of the fastest growth areas in the metropolitan region between New York City and Philadelphia. Previous census data indicate that approximately 16 million people live within 80 km (50 miles) of the site and approximately 225,000 within 16 km (10 miles) of PPPL. The detailed distribution of population as a function of distance is given in Tables 4-13A. Because of ever-increasing commercial growth in this area, a demographic update had been planned for TFTR prior to tritium operations. A demographic study is presently underway for the CIT

Environmental Assessment and will be available for next year's report.

The overall integrated exposure dose equivalent from all sources (excluding natural background) to a hypothetical individual residing at the PPPL site boundary 24 h/day, 365 d/y was estimated to be less than 1 mrem (0.01 mSv) for CY86 (Gi87). Detailed person-rem calculations for the surrounding population were not performed, because the value would be insignificant in comparison to the approximately 100 mrem (1 mSv) each individual receives from the natural background in New Jersey.

3.3.2 Assessment of Nonradioactive Pollutants

There were no activities during CY86 that created problems with respect to nonradioactive pollutants. The Freon-113 spill was detected and cleaned up with no significant environmental impact.

Polychlorinated biphenyls (PCB's) and other toxic materials continue to be disposed of in accordance with EPA requirements. Herbicides, pesticides, and fertilizers were used in very limited quantities and are not expected to have any noticeable negative impact on the environment.

4.0 QUALITY ASSURANCE FOR LABORATORY ANALYSIS

Analysis of water samples for radioactivity was accomplished in-house. In general, in-house procedures follow the HASL-300 Manual (Vo82). In-house procedures follow accepted techniques and are documented in the REML manual (REML86). PPPL participates in the EPA (Las Vegas) program as well as a program provided by the DOE Environmental Measurement Laboratory (EML) in New York City. These programs provide blind samples for analysis and subsequent comparison to values obtained by other participants, as well as to known values. Tritium results are shown in Table 28.

In CY84 PPPL initiated a program to have its radiation counting laboratory certified by the State of New Jersey through the EPA QA program. In March 1986 the laboratory and its procedures were reviewed and inspected by EPA/Las Vegas and the NJDEP. The laboratory was certified for tritium analysis in urine and water. The goal in the coming year is to extend this certification to gamma spectroscopy and all other procedures and techniques.

The vendor used for nonradioactive water quality analysis participates in a State of New Jersey QA program and has a quality assurance plan (A185). Blind split samples were also submitted for analysis in 1986 (Table 27).

5.0 FUTURE PROGRAM EXPANSION

5.1 Meteorological

A meteorological tower was installed in November 1983. Data from this system will be used in updating dose calculations for the planned updated version of the TFTR FSAR. Data will also be evaluated by the CIT project in relation to siting the CIT at PPPL. Several dose assessment codes are being used by PPPL with respect to using the data from this tower. These codes include the required DOE standard AIRDOS-EPA, as well as PANVAN, XOQDOQ, and an Ontario Hydro version of TRITMOD. Future plans include considerations of hooking up a real-time output of the meteorological data.

5.2 Water Quality

The initial phases of a ground water monitoring program began in CY85. Analysis of water samples from two D-site wells was added to the monitoring program in CY86. CIT evaluations will determine whether or not this program has to be expanded.

5.3 Radioactive Effluents

5.3.1.1 Air Gaseous and Particulate

Based on collected data, a decision was made in CY84 to limit the specific air and particulate real-time monitors at the EZB to a beta detector only. One system was calibrated in CY86 and is presently being installed. Three other systems will be procured for on-site stations. Environmental tritium monitors tested in CY86 will be deployed in CY87.

5.3.2.2 Off-Site Radiological Monitoring

An off-site grab sample water analysis program is well established. Whether or not more sampling points will be added in the future depends on reevaluation of the program, which is done annually. Locations for off-site tritium and particulate monitoring stations were negotiated in CY86. Placement of hardware at these sites is expected to be finished in CY87. Soil and vegetation sampling is underway and will continue.

5.4 Nonradioactive Effluents

Air effluent standards will continue to be met by following the guidelines of the NJDEP. Any potential toxic materials will be monitored and disposed of in accordance with applicable regulations and accepted guidelines. With respect to the retention basin, application has been made for a ground water discharge permit. Also, because of the addition of an oil separator on the retention basin, the NJDEP had requested that we apply for a treatment works permit. A permit application was made and a subsequent waiver was granted (Ku86).

6.0 REGULATIONS AND SAFETY CRITERIA

The appropriate Radiation Protection Standard for penetrating radiation was taken from DOE Order 5480.1A, Chapter XI. Specific criteria for implementing these standards on TFTR are contained in TFTR Operational Safety Requirements, in particular OSR/TFTR/0-2F-C. The Concentration Guides used in the analyses of surface water samples for radioactivity were taken from DOE Order 5480.1A, Chapter XI, Table II, Column 2 (Water in Uncontrolled Areas). The concentration guides for airborne activity are taken from the same DOE Order, Table I, Column 1 (Concentration in Air in Uncontrolled Areas). Tritium, for example, is listed as 2×10^{-7} uCi/ml. The Laboratory was also in compliance with the new DOE draft Order 5480.11, of which some interim requirements on dose to the public were established by a DOE letter (Mi85).

Air and Water Pollutions Standards for nonradioactive pollutants were taken from the New Jersey Administrative Code (NJAC), Department of Environmental Protection 7:9-4, et seq. The appropriate regulations for hazardous waste are found in the U.S. Code of Federal Regulations, 40 CFR 761 and 40 CFR 260-265, respectively.

7.0 ACKNOWLEDGEMENTS

E. Mitman, III and J. Gilbert compiled the data for radiation analysis, O. Griesbach performed in-house radiation analyses, and J. Fennimore and K. Chase worked on instrument installation and calibration. These individuals are staff members of the PPPL Project and Operational Safety Office, Health Physics Branch. R. Mitchell and J. Tobin, MD, of the Occupational Medicine and Safety Office reviewed nonradioactive pollutant analysis data. C. Kircher is responsible for all water utilization information and forwarding of relevant data to DOE for environmental protection permits. S. Holcombe and S. Larson are responsible for toxic waste disposal. Various other PPPL individuals reviewed the manuscript.

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TABLE I

TFTR RADIATION EXPOSURE CRITERIA

The research facility radiation exposure criteria itemized in this table shall be invoked for the TFTR only and shall not be construed as being applicable to subsequent fusion test facilities, research facilities, or reactor projects. The values quoted are for whole body exposures, however, the DOE manual requirements for other organs (hands, arms, bones, etc.) and other time periods (quarterly) are also applicable to TFTR and reductions between limits and design objectives shall be consistent with those of the table.

Condition	Off-Site ≥125 m		On-Site <125 m	
	Limit	Design Objective	Limit	Design Objective
Routine Operation mrem/yr [footnotes (a), (b) & (e)]	500 to an individual (e)	≤100 to an individual (b)	500 in an uncontrolled area	≤100 in an uncontrolled area
	170 average population member (e)	≤35 average population member	5000 in a controlled area	≤1000 in a controlled area
Accident rem [footnotes (c) and (d)]	25	≤5 (d)	25	25

- (a) Routine operation consists of:
- 1) Normal component operation including shutdown, repair, maintenance, checkout, adjustment, etc.
 - 2) Operational occurrences such as leaks, loss of power, and component malfunctions that are likely to occur once or more during the life of the facility.
- (b) For normal operation, defined in (a) 1) above, the off-site design objective shall be 10 mrem/yr.
- (c) Accident conditions consist of:
- 1) Very low probability events such as "most intense predicted" natural phenomena.
 - 2) Low probability events such as "most probable" natural phenomena and other component failure events that are not likely to occur during the life of the facility.
- (d) For those accident conditions defined by (c) 1) above, the off-site design objective shall be 5 rem and that for (c) 2) above, 1 rem.
- (e) For emission of airborne radionuclides, the off-site limit on dose equivalent is 25 mrem/yr to the whole body and 75 mrem/yr to the critical organ.

TABLE 2*CRITICAL PATHWAYS

<u>Path I.D.</u>	<u>Discharge Pathway</u>
A1	Atmospheric --> Whole Body Exposure
A2	Atmospheric --> Inhalation Exposure
A3	Atmospheric --> Deposition on Soil & Vegetation, Ingestion, Whole Body Exposure
L1	Liquid Water Way --> Drinking Water Supply ----> Man
L2	Liquid Water Way --> External Exposure
L3	Liquid Water Way --> Sediments --> External Exposure
L4	Liquid Water Way --> Fish --> Man

*TAKEN FROM TFTR FSAR TABLE 8.5-1

TABLE 3*

MONITORING PROGRAM COVERING CRITICAL PATHWAYS

TYPE OF SAMPLE	CRITICAL PATH I.D.	SAMPLE POINT DESCRIPTION	SAMPLING FREQUENCY	ANALYSIS
Surface	L1,L2,L4	1)Cooling Water Discharge Drainage 2)See Brook Upstream & Downstream 3)D&R Canal	Monthly Composite of Weekly Samples	Gross γ Gross β Isotopic if Necessary
Sediment	L3	Delaware - Raritan Canal	Biennially	Gross γ Gross β
Surface Water	L1,L2	Waste Collection Tanks	As Required By Filling	Gross γ Gross β Rate
Air	A1-A3	Test Cell	Continuous	Gross γ Gross β ^3H (Gas & Water Vapor)
Air	A1-A3	Vault	Continuous	^3H (Gas & Water Vapor)
Air	A1-A3	HVAC Discharge	Continuous	Gross γ Gross β ^3H , particu- lates
Direct Radiation		4 Locations at Site Perimeter	Continuous	$\gamma, n, ^3\text{H}$, HTO/ ^3H , particu- lates

*TAKEN FROM TFTR FSAR TABLE 8.5-2

TABLE 4*

1974 POPULATION ESTIMATES WITHIN ANNULAR SECTORS, 0-10 MILES

<u>Sector</u>	<u>TOTAL</u>							<u>Sector</u>
	<u>0-1 Mile</u>	<u>1-2 Miles</u>	<u>2-3 Miles</u>	<u>3-4 Miles</u>	<u>4-5 Miles</u>	<u>5-10 Miles</u>	<u>0-10 Miles</u>	
N	7	430	289	182	164	7,869	8,941	N
NNE	0	22	144	137	3,284	10,353	13,940	NNE
NE	7	58	202	690	274	14,029	15,260	NE
ENE	11	6	0	123	271	9,561	9,972	ENE
E	0	0	55	25	43	11,796	11,819	E
ESE	6	32	63	68	123	3,705	3,997	ESE
SE	3	23	356	29	94	13,511	14,016	SE
SSE	6	2,859	49	27	71	13,837	15,849	SSE
S	0	293	400	570	198	2,839	4,300	S
SSW	0	95	688	1,221	530	26,112	28,646	SSW
SW	0	6	679	43	899	20,690	22,317	SW
WSW	0	394	71	873	253	9,850	11,441	WSW
W	3	835	5,712	5,832	695	7,586	20,663	W
WNW	0	437	2,889	1,455	294	6,788	11,863	WNW
NW	3	198	786	688	221	3,183	5,079	NW
NNW	3	415	259	144	698	2,854	4,373	NNW
TOTAL	49	6,103	12,642	12,107	8,112	163,563	202,576	TOTAL

*TAKEN FROM TFTR FSAR, TABLE 2.1.2-1

TABLE 5*1985 POPULATION PROJECTIONS WITHIN ANNULAR SECTORS, 0-10 MILES

<u>Sector</u>	<u>TOTAL</u>						<u>0-10 Miles</u>	<u>Sector</u>
	<u>0-1 Mile</u>	<u>1-2 Miles</u>	<u>2-3 Miles</u>	<u>3-4 Miles</u>	<u>4-5 Miles</u>	<u>5-10 Miles</u>		
N	9	529	355	229	205	9,850	11,177	N
NNE	0	27	177	169	4,041	13,008	17,422	NNE
NE	9	71	248	849	337	7,769	9,283	NE
ENE	16	8	0	151	333	12,406	12,914	ENE
E	1,217	0	74	31	53	13,956	15,331	E
ESE	9	46	1,600	78	144	4,157	6,034	ESE
SE	4	33	4,356	33	108	16,373	20,907	SE
SSE	9	4,117	71	35	82	16,018	20,332	SSE
S	0	548	456	650	226	3,788	5,668	S
SSW	0	137	784	1,392	604	30,893	33,810	SSW
SW	0	9	774	49	1,025	24,987	26,844	SW
WSW	0	552	81	1,126	326	12,765	14,850	WSW
W	683	3,793	6,683	6,823	897	10,252	29,131	W
WNW	0	564	3,611	1,877	379	8,815	15,246	WNW
NW	4	255	1,014	860	263	3,815	6,211	NW
NNW	4	511	326	186	893	3,433	5,353	NNW
TOTAL	1,964	11,200	20,610	14,538	9,916	192,285	250,513	TOTAL

*TAKEN FROM TFTR FSAR TABLE 2.1.2-3

TABLE 6*1970 RESIDENT POPULATION WITHIN ANNULAR SECTORS BETWEEN
10-50 MILES

<u>Sector</u>	<u>10-20 Miles</u>	<u>20-30 Miles</u>	<u>30-40 Miles</u>	<u>40-50 Miles</u>	<u>Total</u>	<u>Sector</u>
N	69,330	35,961	143,546	60,073	308,910	N
NNE	133,838	237,191	354,551	544,621	1,270,201	NNE
NE	185,569	437,917	1,483,657	3,893,770	6,000,913	NE
ENE	119,874	166,477	1,134,648	1,629,062	3,050,061	ENE
E	33,077	112,389	69,706	0	215,172	E
ESE	29,247	35,408	111,280	0	175,935	ESE
SE	6,928	52,737	108,930	2,033	170,628	SE
SSE	5,004	4,984	7,887	11,023	28,898	SSE
S	5,933	61,238	7,349	3,935	78,455	S
SSW	52,983	55,122	56,229	114,782	279,116	SSW
SW	247,409	324,276	1,368,041	1,220,152	3,159,878	SW
WSW	35,985	117,952	310,930	289,105	753,972	WSW
W	12,576	20,180	69,806	56,145	158,707	W
WNW	6,054	10,112	15,399	254,563	286,128	WNW
NW	12,819	12,698	66,455	85,836	177,808	NW
NNW	14,429	14,462	34,875	14,937	78,703	NNW
TOTAL	971,055	1,699,104	5,343,289	8,180,037	16,193,485	TOTAL

*Taken from TFTR FSAR, Table 2.1.2-4

TABLE 7. POPULATION OF SMSA's WITHIN 50 MILES OF THE TFTR SITE
(St85)

<u>SMSA's*</u>	<u>FSAR (1983) Census of April 1970</u>	<u>Estimate For July 1974</u>	<u>Census¹ of April 1980</u>
Allentown-Bethlehem Easton, PA (N.J. portion)	73,960	79,200	84,829
Jersey City, NJ	607,839	584,900	556,972
Long Branch Asbury Park, NJ	461,849	486,100	503,173
New Brunswick Perth Amboy Sayreville, NJ	583,813	549,900	595,893
New York, NY (NJ portion)	9,973,716	9,634,400	9,120,346
Newark, NJ	2,057,468	2,014,500	1,965,969
Paterson-Clifton- Passaic, NJ	460,782	456,700	447,585
Philadelphia, PA (NJ portion)	952,104	1,000,400	1,034,109
Trenton, NJ	<u>304,116</u>	<u>319,800</u>	<u>307,863</u>
TOTAL	15,475,647	15,125,900	14,616,739

*Standard Metropolitan Statistical Area

1

Source: 1980 Census of Population and Housing ODEA

Table 8. Census and Population Projections for Counties
in New Jersey Within 10-50 Miles of TFTR Site
(St85)

County	FSAR (1983)		Census ¹ of April 1980	Projections for July 1 ¹			
	Census of April 1970	Projection for 1985		1985	1990	1995	2000
Atlantic	175,770	202,760	194,119	206,700	220,000	233,400	245,800
Bergen	897,148	1,089,140	845,385	802,600	767,100	736,200	707,800
Burlington	323,132	413,600	362,542	391,200	422,300	454,800	487,000
Camden	456,291	553,030	471,650	482,900	497,400	512,700	526,400
Essex	932,326	985,530	851,304	813,700	785,400	761,600	739,900
Gloucester	172,681	217,980	199,917	216,400	233,600	250,600	265,700
Hudson	607,839	618,400	556,972	538,200	524,400	513,800	506,000
Hunterdon	69,718	94,220	87,361	94,600	101,300	107,700	113,200
Morris	383,454	449,110	407,630	412,800	418,200	422,700	423,900
Ocean	208,470	289,860	346,038	407,800	470,200	536,700	605,700
Passaic	460,782	545,980	447,585	440,500	434,800	428,700	421,200
Sussex	77,528	100,270	116,119	136,200	156,700	177,800	198,200
Union	543,116	642,210	504,094	482,400	467,800	458,800	454,200
Warren	73,960	83,590	84,429	90,300	96,300	102,200	107,400
Subtotal	5,382,215	6,285,680	5,475,145	5,516,300	5,595,500	5,697,700	5,802,400

(See Table 10 for Mercer, Middlesex, Somerset and Monmouth Counties.)

1. New Jersey Factbook, November 1984

State Data Center, New Jersey Department of Labor
Div. of Planning & Research, Office of Demographics & Analysis
CN, Trenton, New Jersey 08625-0388

Reference from: Princeton University Computer Center
(which is part of the network for the State Data Center)

TABLE 9. POPULATION OF COUNTIES IN NEW YORK AND PENNSYLVANIA
WITHIN 10-50 MILES OF THE TFTR SITE. (St85)

NEW YORK¹

<u>County</u>	<u>*Census of April 1970</u>	<u>*Projection for 1985</u>	<u>Census of April 1980</u>	<u>Projection for 1990</u>
Kings	2,602,000	2,287,000	2,231,028	2,225,192
New York	1,539,000	1,309,000	1,428,285	1,452,080
Queens	1,987,000	1,909,000	1,881,325	1,914,038
Richmond	295,000	396,000	352,029	394,783
SUBTOTAL	6,423,000	5,901,000	5,892,667	5,986,093

PENNSYLVANIA²

<u>County</u>	<u>*Census of April 1970</u>	<u>*Projection for 1985</u>	<u>Census of April 1980</u>	<u>Projection for 1990</u>
Bucks	417,981	511,609	479,211	514,387
Chester	278,362	366,823	316,660	379,431
Delaware	602,741	645,373	555,007	506,311
Lehigh	255,679	293,715	272,349	271,602
Monroe	45,470	55,483	69,409	87,146
Montgomery	624,304	759,207	643,621	656,551
Northhampton	214,807	229,767	225,418	223,826
Philadelphia	1,927,673	1,952,912	1,688,210	1,595,393
SUBTOTAL	4,367,617	4,814,889	4,249,885	4,234,647
TOTAL	10,790,617	10,715,889	10,142,552	10,220,740

1. New York Department of Commerce April 1985

2. Pennsylvania State Data Center April 1984

Table 10. Population Projections for Counties in New Jersey: 1985-2000
Within 0-10 Miles of TFTR Site. (St85)

County	Census Counts ¹		Projections for July 1 ¹			
	April 1970	April 1980	1985	1990	1995	2000
Mercer	304,116	307,863	307,100	306,300	304,700	301,900
Middlesex	583,813	595,893	598,400	601,200	603,000	603,300
Somerset	198,372	203,129	202,000	201,700	201,400	199,600
Monmouth	<u>461,849</u>	<u>503,173</u>	<u>525,100</u>	<u>546,400</u>	<u>566,000</u>	<u>580,800</u>
Subtotal	1,548,150	1,610,058	1,632,600	1,655,600	1,675,100	1,685,600

1. New Jersey Factbook, November 1984
State Data Center
New Jersey Department of Labor
Division of Planning & Research
Office of Demographics and Analysis
CN, Trenton, New Jersey 08625-0388

Note: These counties were not listed in FSAR

Table 11. Population of Municipalities Within 0-10 Miles of TFTR Site. (St85)
(Mercer County)

Municipality	FSAR (1973)		Census ¹ of 1980	Projections ¹	
	Census of 1970	Projec- tion for 1985		1990	2000
MERCER COUNTY (TOTAL)	304,116	365,220	338,863	340,000	359,400
East Windsor Twp.	11,736	24,507	21,041	23,500	26,000
Hightstown (Boro)	5,431	6,624	4,581	5,000	5,100
Hamilton Twp.	79,609	97,024	81,801	87,700	90,000
Hopewell Twp.	10,030	16,008	10,893	11,025	13,650
Hopewell (Boro)	2,271	2,666	2,001	2,050	2,100
Pennington (Boro)	2,151	2,993	2,109	2,300	2,300
Lawrence Twp.	19,567	25,011	19,724	28,300	33,900
Princeton Twp.	13,651	18,009	13,683	14,400	14,700
Princeton (Boro)	12,311	14,000	12,035	12,600	12,700
Washington Twp.	3,311	5,003	3,487	8,500	8,800
West Windsor Twp.	<u>6,431</u>	<u>8,573</u>	<u>8,542</u>	<u>15,600</u>	<u>17,500</u>
Subtotal	166,499	220,518	179,897	210,975	226,750

1. "Mercer County Growth Management Plan,"
Mercer County Planning Board, 1985.

Table 12. Population of Municipalities Within 0-10 Miles of TFTR Site (St85)
(Middlesex County)

Municipality	FSAR (1983)		*Census of 1980	Projections	
	Census Of	Projec- tion		1990	2000
	1970	for 1985			
MIDDLESEX COUNTY (TOTAL)	583,813	730,160	595,893	*690,400	*757,100
Cranbury (Twp.)	2,253	2,629	1,927	**3,417	**4,632
East Brunswick (Twp.)	34,166	48,119	37,711	**52,960	**59,324
Helmetta (Boro)	955	1,222	955	**1,002	**1,031
Monroe (Twp.)	9,138	11,464	15,858	**16,413	**18,015
Jamesburg (Boro)	4,584	5,476	4,114	**5,298	**5,470
North Brunswick (Twp.)	16,691	22,040	41,442	**30,847	**30,647
Plainsboro (Twp.)	1,648	15,075	5,605	**14,046	**17,026
South Brunswick (Twp.)	<u>14,058</u>	<u>18,546</u>	<u>17,127</u>	<u>**31,001</u>	<u>**43,004</u>
Subtotal	83,493	124,571	124,739	154,984	179,349

*New Jersey Revised Total Age and Sex Population Projections, 1983

New Jersey Department of Labor
Office of Demographics and Economic Analysis
Division of Planning and Research
CN 388
Trenton, NJ 08625-0388
(Total Projections for Middlesex County Only)

**Municipal Forecasts by Middlesex County
Planning Board, August 1979

Table 13. Population of Municipalities Within 0-10 Miles of TFTR Site. (St85)
(Somerset County)

Municipality	FSAR (1983)		Census of 1980	Projections	
	Census of 1970	Projec- tion for 1985		1990	2000
SOMERSET COUNTY (TOTAL)	198,372	252,130	203,129	*246,800	*284,000
Franklin (Twp.)	30,389	40,270	31,358	**45,724	**52,651
Hillsborough (Twp.)	11,061	15,225	19,061	**26,665	**30,725
Montgomery (Twp.)	6,353	7,640	7,360	**11,099	**15,299
Rocky Hill (Boro)	<u>917</u>	<u>1,184</u>	<u>717</u>	<u>**717</u>	<u>**1,017</u>
Subtotal	48,720	64,319	58,496	84,205	99,692

*New Jersey Revised Total Age and Sex Population Projections, 1983

N.J. Department of Labor, Office of Demographics and Economic Analysis,
Division of Planning and Research
CN 388, Trenton, NJ 08625-0388

(Total projections for Somerset County Only)

**Municipal Projections by Somerset County Planning Board, 1984

TABLE 13A (Ku86)

SECTORIZED POPULATION DATA TO 1 MILE

		radial distances (m)*				
		<u>50</u>	<u>125</u>	<u>375</u>	<u>1105</u>	<u>2416</u>
S	n	0	0	0	377	486
	nnw	0	0	63	0	469
	nw	0	0	0	20	416
E	wnw	0	0	0	800	830
	w	0	0	103	0	1587
C	wsW	0	0	116	192	749
	sw	0	0	116	317	12
T	ssw	0	0	0	950	247
	s	0	0	317	317	820
O	sse	0	0	0	0	3848
	se	0	0	18	0	64
R	ese	0	0	73	0	60
	e	0	0	73	0	30
	ene	0	0	18	34	17
	ne	0	0	0	250	66
	nne	0	0	0	186	25

* The radii shown are midpoints of the sector radial boundaries.

TABLE 14

WATER QUALITY MONITORING DATA
FORRESTAL CAMPUS, PRINCETON UNIVERSITY

Station: 51

Monitoring Station Location: Bee Brook

PARAMETER	1-22-86 4:20 PM	2-24-86 4:50 PM	3-18-86 3:20 PM	4-28-86 11:20 AM	5-27-86 5:00 PM	6-19-86 12:30 PM
Alkalinity, mg/l CaCO_3 eq.	4	8	8	12	14	66
BOD ₅ mg/l O_2	< 1	< 1	< 1	< 1	1.5	2
Calcium Hardness, mg/l CaCO_3 eq.	12	16	24	8	8	60
Chromium - Total, mg/l Cr	< .02	< .02	< .02	< .02	< .02	< .02
Chromium - Hexavalent, mg/l Cr	< .02	< .02	< .02	< .02	< .02	< .02
COD, mg/l O_2	< 2	< 2	11	8	9.0	30
Copper, mg/l Cu	< .02	< .02	< .02	.02	< .02	< .02
Dissolved Oxygen, mg/l O_2	12.9	8.6	7.8	10.6	8.4	9.1
EDTA, mg/l Cu eq.	.06	.07	.06	.08	.048	.062
Total Coliform Count, MPN/100 ml	93	49	26	350	1100	540
Flow, ft ³ /sec	.13	.19	.16	.24	.11	.07
Iron, mg/l Fe	.25	.25	.27	.35	< .02	.27
Nitrogen, Total Kjeldahl, mg/l N	1.7	.4	.9	.35	< .2	.6
Nitrogen, Nitrate, mg/l N	.71	< .1	.29	.41	.73	.66
Oil & Grease, mg/l	< .5	< .5	< .5	< .5	< .5	< .5
pH	6.65	6.50	6.80	6.90	7.25	7.30
Phosphate, Total mg/l P	< .2	< .2	< .2	< .2	< .2	< .2
Phosphate, Ortho mg/l P	< .2	< .2	< .2	< .2	< .2	< .2
Solids - Dissolved, mg/l	121	129	88	75	114	186
Solids - Suspended, mg/l	< 1	1	6	< 1	24	1
Sulfate, mg/l SO_4	22	19	18	19	18	29
Temperature, °C	5.5	5	10	15.8	20.0	16.5
Turbidity, NTU	7.8	3.6	2.8	3.6	3.6	8.9
Zinc, mg/l Zn	.02	.03	.02	.02	< .01	.01
Clarity	Sl. Cloudy	Clear	Clear	Sl. Cloudy	Sl. Cloudy	Clear

TABLE 14 (cont'd)

WATER QUALITY MONITORING DATA
FORRESTAL CAMPUS, PRINCETON UNIVERSITY

Station: B 1

Monitoring Station Location: Bee Brook

PARAMETER	7-22-86 12:45 PM	8-20-86 2:00 PM	9-22-86 1:45 PM	10-20-86 1:20 PM	11-18-86 12:35 PM	12-23-86 12:50 PM
Alkalinity, mg/l CaCO ₃ eq.	30	50	48	60	22	10
BOD ₅ mg/l O ₂	1.2	1.3	1.4	<1	2.2	1.2
Calcium Hardness, mg/l CaCO ₃ eq.	32	44	40	36	40	32
Chromium - Total, mg/l Cr	<.02	<.02	<.02	<.02	<.02	<.02
Chromium - Hexavalent, mg/l Cr	<.02	<.02	<.02	<.02	<.02	<.02
COD, mg/l O ₂	19	23	5.0	12.5	22	17
Copper, mg/l Cu	<.02	<.02	<.02	<.02	<.02	.03
Dissolved Oxygen, mg/l O ₂	6.2	7.8	6.8	8.5	8.8	14.0
EDTA, mg/l Cu eq.	.05	.06	.04	.046	.06	.07
Total Coliform Count, MPN/100 ml	460	1600	≥ 2,400	540	170	180
Flow, ft ³ /sec	.067	.055	.065	.05	.07	.16
Iron, mg/l Fe	.17	.44	.61	.14	.77	.24
Nitrogen, Total Kjeldahl, mg/l N	.4	.9	1.0	.5	.6	<.1
Nitrogen, Nitrate, mg/l N	.24	.103	.38	1.06	<.1	8.8
Oil & Grease, mg/l	<.5	<.5	<.5	<.5	<.5	<.5
pH	6.65	7.65	6.55	7.25	6.50	6.75
Phosphate, Total mg/l P	<.2	<.2	<.2	.5	<.2	<.2
Phosphate, Ortho mg/l P	<.2	<.2	<.2	.4	<.2	<.2
Solids - Dissolved, mg/l	151	175	113	168	96	73
Solids - Suspended, mg/l	1	1	4	2	<1	32
Sulfate, mg/l SO ₄	21	17.2	24	30	34	21
Temperature, °C	22.3°C	21.0	16.0°C	10.5	8.0	3.0
Turbidity, NTU	3.4	2.3	2.3	1.6	2.2	2.4
Zinc, mg/l Zn	.03	.02	.02	.03	.025	.10
Clarity	Sl. Cloudy	Clear	Clear	Clear	Sl. Cloudy	Clear

TABLE 15

WATER QUALITY MONITORING DATA
FORRESTAL CAMPUS, PRINCETON UNIVERSITY

Station: B 2
Monitoring Station Location: Bee Brook

PARAMETER	1-22-86 3:40 PM	2-24-86 5:15 PM	3-18-86 2:25 PM	4-28-86 10:50 AM	5-27-86 4:25 PM	6-19-86 11:50 AM
Alkalinity, mg/l CaCO_3 eq.	12	48	44	50	52	66
BOD ₅ mg/l O ₂	< 1	< 1	< 1	< 1	1.1	3.2
Calcium Hardness, mg/l CaCO_3 eq.	72	52	64	72	36	52
Chromium, Total, mg/l Cr	< .02	< .02	< .02	< .02	< .02	< .02
Chromium, Hexavalent, mg/l Cr	< .02	< .02	< .02	< .02	< .02	< .02
COD, mg/l O ₂	< 2	< 2	7.5	7	13.0	15
Copper, mg/l Cu	.07	< .02	< .02	.02	< .02	< .02
Dissolved Oxygen, mg/l O ₂	11.4	7.90	7.85	10.4	8.6	8.9
EDTA, mg/l Cu eq.	.05	.07	.06	.08	.05	.059
Total Coliform Count, MPN/100 ml	240	280	49	350	460	130
Flow, ft ³ /sec	.30	.17	.38	.58	.31	.28
Iron, mg/l Fe	.04	.26	.44	.90	.13	.15
Nitrogen, Total Kjeldahl, mg/l N	.7	.6	.1	.2	< .2	.4
Nitrate, mg/l N	.95	< .1	.48	.56	.89	.80
Oil & Grease, mg/l	< .5	< .5	< .5	< .5	< .5	< .5
pH	7.45	7.30	7.55	7.45	7.25	7.10
Phosphate, Total, mg/l P	.3	< .2	.25	.3	.3	.5
Phosphate, Ortho, mg/l P	< .2	< .2	< .2	< .2	.2	.4
Solids, Dissolved, mg/l	177	168	141	147	143	178
Solids, Suspended, mg/l	10	1	2	22	20	< 1
Sulfate, mg/l SO_4	27	20	19	23	19	25
Temperature, °C	10.0	7.5	13.0	16.2	20.9	21.0
Turbidity, NTU	9.9	4.1	5.6	11	3.4	3.6
Zinc, mg/l Zn	.02	.02	.02	.02	.01	.02
Clarity	Clear	Clear	Clear	Sl. Cloudy	Sl. Cloudy	Sl. Cloudy

TABLE 15 (cont'd)

WATER QUALITY MONITORING DATA
FORRESTAL CAMPUS, PRINCETON UNIVERSITY

Station: B 2

Monitoring Station Location: Bee Brook

PARAMETER	7-22-86 12:00 PM	8-20-86 1:25 PM	9-22-86 1:20 PM	10-20-86 12:30 PM	11-18-86 11:50 AM	12-22-86 12:30
Alkalinity, mg/l CaCO ₃ eq.	60	60	100	76	48	44
BOD ₅ mg/l O ₂	< 1	1.7	< 1	< 1	1.4	1.6
Calcium Hardness, mg/l CaCO ₃ eq.	56	96	50	48	80	88
Chromium, Total, mg/l Cr	<.02	<.02	<.02	<.02	<.02	<.02
Chromium, Hexavalent, mg/l Cr	<.02	<.02	<.02	<.02	<.02	<.02
COD, mg/l O ₂	10	13	15	12.5	6.5	17
Copper, mg/l Cu	<.02	.02	<.02	<.02	<.02	.02
Dissolved Oxygen, mg/l O ₂	8.1	8.4	8.8	9.6	11.3	12.6
EDTA, mg/l Cu eq.	.05	.07	.04	.049	.05	.07
Total Coliform Count, MPN/100 ml	≥2400	920	≥ 2,400	1600	23	49
Flow, ft ³ /sec	.423	.204	.358	.23	.33	.35
Iron, mg/l Fe	.17	.29	2.28	.17	.27	.406
Nitrogen, Total Kjeldahl, mg/l N	.2	.5	.6	.3	.6	<.1
Nitrate, mg/l N	.16	.25	.79	1.1	.15	1.3
Oil & Grease, mg/l	<.5	<.5	<.5	<.5	<.5	<.5
pH	7.65	7.75	6.95	7.4	7.65	7.45
Phosphate, Total, mg/l P	.5	.7	.9	.4	.5	<.2
Phosphate, Ortho, mg/l P	.4	.6	.45	.4	.3	<.2
Solids, Dissolved, mg/l	165	254	155	149	122	128
Solids, Suspended, mg/l	2	< 1	2	1	1	16
Sulfate, mg/l SO ₄	22	69	36	30	29	23
Temperature, °C	24.0°C	23.0	20.0	17.0	12.0	8.0
Turbidity, NTU	3.2	1.9	29	3.0	4.5	12
Zinc, mg/l Zn	.02	.02	.04	.02	.021	.05
Clarity	Clear	Clear	Mod. Cloudy	Clear	SL. Cloudy	SL. Cloudy

TABLE 16

WATER QUALITY MONITORING DATA
FORRESTAL CAMPUS, PRINCETON UNIVERSITY

Station: C 1
Monitoring Station Location: Delaware Raritan Center

PARAMETER	1-22-86 4:45 PM	2-24-86 4:10 PM	3-18-86 2:05 PM	4-28-86 10:35 AM	5-27-86 4:40 PM	6-19-86 3:40 PM
Alkalinity, mg/l CaCO_3 eq.	10	18	22	22	22	36
Calcium Hardness, mg/l CaCO_3 eq.	68	28	40	44	24	40
Chromium, Total, mg/l Cr	< .02	< .02	< .02	< .02	< .02	< .02
Chromium, Hexavalent, mg/l Cr	< .02	< .02	< .02	< .02	< .02	< .02
Copper, mg/l Cu	< .02	< .02	< .02	< .02	< .02	< .02
EDTA mg/l Cu eq.	.07	.07	.05	.08	.051	.056
Iron, mg/l Fe	.40	.36	1.66	.99	.34	.26
Nitrate, mg/l N	.78	.57	.40	.66	.98	.85
Oil and Grease, mg/l	< .5	< .5	< .5	< .5	< .5	.7
pH	6.90	6.70	6.30	6.80	6.85	7.75
Phosphate, Total, mg/l P	< .2	< .2	< .2	< .2	.2	< .2
Phosphate, Ortho, mg/l P	< .2	< .2	< .2	< .2	< .2	< .2
Solids, Dissolved, mg/l	161	157	173	89	117	149
Solids, Suspended, mg/l	1	< 1	25	9	29	7
Sulfate, mg/l SO_4	27	19	28	23	18	20
Turbidity, NTU	7.8	10.5	22	12	6.7	8.7
Zinc, mg/l Zn	.05	.02	.04	.03	.02	.02
Clarity	Sl. Cloudy	Sl. Cloudy	Sl. Cloudy	Sl. Cloudy	Sl. Cloudy	Sl. Cloudy

TABLE 16 (cont'd)

WATER QUALITY MONITORING DATA
FORRESTAL CAMPUS, PRINCETON UNIVERSITY

Station: C 1
 Monitoring Station Location: Delaware Raritan Center

PARAMETER	7-22-86 12:00 PM	8-20-86 2:15 PM	9-22-86 2:30 PM	10-20-86 10:05 AM	11-18-86 10:26 AM	12-22-86 12:50 PM
Alkalinity, mg/l CaCO_3 eq.	38	40	36	38	32	30
Calcium Hardness, mg/l CaCO_3 eq.	32	40	48	48	56	76
Chromium, Total, mg/l Cr	<.02	<.02	<.02	<.02	<.02	<.02
Chromium, Hexavalent, mg/l Cr	<.02	<.02	<.02	<.02	<.02	<.02
Copper, mg/l Cu	<.02	<.02	<.02	<.02	<.02	.13
EDTA mg/l Cu eq.	.03	.06	.03	.041	.05	.09
Iron, mg/l Fe	1.04	3.18	1.13	.36	.24	.53
Nitrate, mg/l N	.18	.103	2.03	1.06	.10	1.5
Oil and Grease, mg/l	<.5	<.5	<.5	<.5	<.5	<.5
pH	7.55	7.25	7.05	7.25	7.35	7.25
Phosphate, Total, mg/l P	<.2	<.2	<.2	<.2	<.2	<.2
Phosphate, Ortho, mg/l P	<.2	<.2	<.2	<.2	<.2	<.2
Solids, Dissolved, mg/l	137	106	135	115	90	125
Solids, Suspended, mg/l	1	1	1	2	3	16
Sulfate, mg/l SO_4	20	16.2	26	27	23	29
Turbidity, NTU	18	2.0	17	5.9	3.7	12
Zinc, mg/l Zn	.02	.02	<.01	.02	.019	.20
Clarity	Mod. Cloudy	Sl. Cloudy	Sl. Cloudy	S. Cloudy	Sl. Cloudy	Sl. Cloudy

TABLE 17

WATER QUALITY MONITORING DATA
FORRESTAL CAMPUS, PRINCETON UNIVERSITY

Station: D1
 Monitoring Station Location: Drainage Ditch

PARAMETER	1-22-86 11:30 AM	2-24-86 1:40 PM	3-18-86 1:50 PM	4-28-86 10:25 AM	5-27-86 3:45 PM	6-19-86 12:30 PM
Alkalinity, mg/l CaCO_3 eq.	10	22	24	22	28	38
BOD ₅ , mg/l O_2	< 1	< 1	< 1	< 1	1.7	2.6
Calcium Hardness, mg/l CaCO_3 eq.	60	40	48	32	28	44
Chromium, Total, mg/l Cr	< .02	< .02	< .03	< .02	< .02	< .02
Chromium, Hexavalent, mg/l Cr	< .02	< .02	< .02	< .02	< .02	< .02
COD, mg/l O_2	< 2	< 2	11	< 2	15	23
Copper, mg/l Cu	.02	< .02	< .02	.03	< .02	< .02
Dissolved Oxygen, mg/l O_2	11.2	7.30	6.55	9.60	7.8	7.8
EDTA, mg/l Cu eq	.05	.06	.04	.09	.051	.034
Total Coliform Count, MPN/100 ml	< 3	< 2	4	21	43	350
Flow, ft ³ /sec	.05	.09	.05	.07	.07	.06
Iron, mg/l Fe	.18	.25	1.62	.83	.15	.13
Nitrogen:						
Total Kjeldahl, mg/l N	3	.3	1	.4	1.3	.8
Nitrate, mg/l N	1.2	< .1	.59	.82	1.1	.86
Oil & Grease, mg/l	< .5	< .5	< .5	< .5	< .5	< .5
pH	7.15	7.35	6.85	6.75	7.15	7.10
Phosphate, Total, mg/l P	.8	< .2	.6	.9	.6	.6
Phosphate, Ortho, mg/l P	.4	.2	.3	.3	.4	.4
Solids, Dissolved, mg/l	178	171	160	136	152	154
Solids, Suspended, mg/l	23	3	25	8	31	< 1
Sulfate, mg/l SO_4	21	20	22	23	21	21
Temperature, °C	11.0	10.5	11.5	15.3	18.5	22.5
Turbidity, NTU	25	8.3	20	11	4.3	4.0
Zinc, mg/l Zn	.04	.05	.05	.03	.02	.01
Clarity	Mod. Cloudy	Sl. Cloudy	Sl. Cloudy	Sl. Cloudy	Mod. Cloudy	Sl. Cloudy

TABLE 17 (cont'd)

WATER QUALITY MONITORING DATA
FORRESTAL CAMPUS, PRINCETON UNIVERSITY

Station: D1

Monitoring Station Location: Drainage Ditch

PARAMETER	7-22-86 2:00 PM	8-20-86 12:00 PM	9-22-86 12:50 PM	10-20-86 11:35 AM	11-18-86 10:35 AM	12-22-86 11:50 AM
Alkalinity, mg/l CaCO ₃ eq.	38	38	38	40	34	30
BOD ₅ , mg/l O ₂	2.8	5.9	< 1	< 1	1	1.0
Calcium Hardness, mg/l CaCO ₃ eq.	32	40	52	40	58	68
Chromium, Total, mg/l Cr	<.02	<.02	<.02	<.02	<.02	<.02
Chromium, Hexavalent, mg/l Cr	<.02	<.02	<.02	<.02	<.02	<.02
COD, mg/l O ₂	10	40	9.0	12.5	6.5	9.0
Copper, mg/l Cu	<.02	<.02	<.02	<.02	<.02	.09
Dissolved Oxygen, mg/l O ₂	6.8	7.1	8.8	9.5	10.8	11.8
EDTA, mg/l Cu eq	.04	.06	.05	.04	.04	.09
Total Coliform Count, NPN/100 ml	460	540	20	< 2	< 2	< 2
Flow, ft ³ /sec	.051	.055	.095	.06	.11	.12
Iron, mg/l Fe	.26	.43	1.44	.27	1.2	.47
Nitrogen:						
Total Kjeldahl, mg/l N	<.2	.5	.8	.6	.25	.9
Nitrate, mg/l N	.17	<.1	.55	2.0	.28	1.7
Oil & Grease, mg/l	<.5	<.5	<.5	<.5	<.5	<.5
pH	7.25	7.45	6.85	7.4	7.35	7.15
Phosphate, Total, mg/l P	.6	.5	.8	.5	.65	.2
Phosphate, Ortho, mg/l P	.4	.3	.4	.5	.35	<.2
Solids, Dissolved, mg/l	151	105	132	112	98	111
Solids, Suspended, mg/l	1	1	5	1	2	22
Sulfate, mg/l SO ₄	21	16.2	24	28	27	8.4
Temperature, °C	25°C	25.0	21.0	18.0	11.5	9.0
Turbidity, NTU	5.4	5.5	14	6.4	5.0	15
Zinc, mg/l Zn	.02	.02	<.01	.04	.22	.29
Clarity	St. Cloudy	St. Cloudy	Mod. Cloudy	St. Cloudy	Clear	Clear

TABLE 18

WATER QUALITY MONITORING DATA
FORRESTAL CAMPUS, PRINCETON UNIVERSITY

Station: D 2

Monitoring Station Location: Drainage Ditch

PARAMETER	1-22-86 4:40 PM	2-24-86 2:05 PM	3-18-86 12:50 PM	4-28-86 11:35 AM	5-27-86 5:15 PM	6-19-86 12:50 PM
Alkalinity, mg/l CaCO_3 eq	18	66	66	64	60	64
BOD ₅ , mg/l O_2	< 1	< 1	< 1	< 1	2	2.6
Calcium Hardness, mg/l CaCO_3 eq	92	44	88	68	44	64
Chromium, Total, mg/l Cr	< .02	< .02	.05	< .02	< .02	< .02
Chromium, Hexavalent, mg/l Cr	< .02	< .02	< .02	< .02	< .02	< .02
COD, mg/l O_2	< 2	< 2	9.3	< 2	17	21
Copper, mg/l Cu	< .02	< .02	< .02	.03	< .02	< .02
Dissolved Oxygen, mg/l O_2	10.7	7.15	7.25	9.60	8.8	9.7
EDTA, mg/l Cu eq	.04	.06	.05	.09	.054	.065
Total Coliform Count, MPN/100 ml	240	240	350	170	93	280
Flow, ft ³ /sec	.18	.21	.31	.23	.15	.14
Iron, mg/l Fe	.42	.21	1.6	1.3	.18	.16
Nitrogen:						
Total Kjeldahl, mg/l N	.3	.3	1.6	.7	.4	.5
Nitrate, mg/l N	.6	.54	.51	.86	.77	.58
Oil & Grease, mg/l	< .5	< .5	< .5	< .5	< .5	< .5
pH	7.50	7.35	7.45	7.35	6.90	7.85
Phosphate, Total, mg/l P	.4	< .2	.3	.5	.4	.4
Phosphate, Ortho, mg/l P	.2	< .2	< .2	.2	.3	.3
Solids, Dissolved, mg/l	195	210	189	163	166	179
Solids, Suspended, mg/l	4	1	< 1	11	22	< 1
Sulfate, mg/l SO_4	21	22	20	24	22	20
Temperature, °C	11.7	11.3	14.0	17.0	20.7	22.0
Turbidity, NTU	11	5.2	8.1	20	3.3	3.6
Zinc, mg/l Zn	.03	.04	.04	.02	.04	.02
Clarity	Sl. Cloudy	Clear	Sl. Cloudy	Sl. Cloudy	Sl. Cloudy	Sl. Cloudy

TABLE 18 (cont'd)

WATER QUALITY MONITORING DATA
FORRESTAL CAMPUS, PRINCETON UNIVERSITY

Station: D 2

Monitoring Station Location: Drainage Ditch

PARAMETER	7-22-86 1:05 PM	8-20-86 2:30 PM	9-22-86 11:50 PM	10-20-86 10:30 AM	11-18-86 12:55 AM	12-22-86 1:15 PM
Alkalinity, mg/l CaCO_3 eq	46	58	48	52	48	56
BOD ₅ mg/l o_2	< 1	3.3	< 1	< 1	< 1	< 1
Calcium Hardness, mg/l CaCO_3 eq	44	56	56	40	76	76
Chromium, Total, mg/l Cr	<.02	<.02	<.02	<.02	<.02	<.02
Chromium, Hexavalent, mg/l Cr	<.02	<.02	<.02	<.02	<.02	<.02
COD, mg/l o_2	10	45	< 2.0	5.0	3.5	12
Copper, mg/l Cu	<.02	<.02	<.02	<.02	<.02	.03
Dissolved Oxygen, mg/l o_2	7.4	9.0	9.4	10.0	10.6	10.4
EDTA, mg/l Cu eq	.04	.07	.06	.041	.05	.05
Total Coliform Count, MPN/100 ml	≥ 2400	240	150	350	350	13
Flow, ft ³ /sec	.164	.131	.307	.18	.24	.28
Iron, mg/l Fe	.30	.31	.88	.50	.84	.54
Nitrogen:						
Total kjedahl, mg/l N	<.2	.5	.4	.6	.2	<.1
Nitrate, mg/l N	.19	<.1	.58	1.7	.20	1.3
Oil & Grease, mg/l	<.5	<.5	<.5	<.5	<.5	<.5
pH	7.25	7.55	7.50	7.4	7.65	7.45
Phosphate, Total, mg/l P	.3	.3	.7	.4	.5	.2
Phosphate, Ortho, mg/l P	.3	.2	.3	.4	.3	<.2
Solids, Dissolved, mg/l	151	149	151	142	124	143
Solids, Suspended, mg/l	2	1	1	3	<1	19
Sulfate, mg/l SO_4	22	16.7	29	29	27	30
Temperature, °C	24.5°C	24.5°C	21.0	16.75	12.0	10.0
Turbidity, NTU	5.2	1.8	10	13	3.9	13
Zinc, mg/l Zn	.03	.03	.01	.04	.20	.04
Clarity	Sl. Cloudy	Clear	Sl. Cloudy	Sl. Cloudy	Sl. Cloudy	Sl. Cloudy

TABLE 19

WATER QUALITY MONITORING DATA
FORRESTAL CAMPUS, PRINCETON UNIVERSITY

Station: E 1

Monitoring Station Location: Elizabethtown Water

PARAMETER	1-22-86 11:15 AM	2-24-86 1:30 PM	3-18-86 1:30 PM	4-28-86 10:00 AM	5-27-86 3:35 PM	6-19-86 10:15 AM
Alkalinity, mg/l CaCO ₃ eq.	12	122	90	100	90	88
Calcium Hardness, mg/l CaCO ₃ eq.	56	128	128	120	76	108
Copper, mg/l Cu	< .02	< .02	.03	< .02	< .02	< .02
Total Coliform Count, MPN/100 ml.	< 3	< 2	2	< 2	< 3	< 2
Iron, mg/l Fe	.15	< .02	.09	.08	.12	.14
Nitrogen, Total mg/l N	.5	< .2	1.1	.3	.3	< .2
Nitrate, mg/l NO ₃	2.2	.6	.49	2	2.0	1.2
pH	6.90	7.35	7.15	7.05	6.95	7.20
Phosphate, Total, mg/l P	< .2	< .2	< .2	< .2	< .2	< .2
Phosphate, Ortho, mg/l P	< .2	< .2	< .2	< .2	< .2	< .2
Manganese, mg/l Mn	172	.02	.01	.01	< .01	.02
Chloride, mg/l Cl	.02	21	24	23	24	25
Solids, Dissolved, mg/l	19	234	217	216	232	246
Sulfate, mg/l SO ₄	29	30	25	27	31	19
Temperature, °C	8.0	9.0	11.0	13.0	15.0	19.5
Turbidity, NTU	.57	.68	.25	.46	.35	.6

TABLE 19 (cont'd)

WATER QUALITY MONITORING DATA
FORRESTAL CAMPUS, PRINCETON UNIVERSITY

Station: E 1

Monitoring Station Location: Elizabethtown Water

PARAMETER	7-22-86 1:45 PM	8-20-86 11:25 AM	9-22-86 12:30 PM	10-20-86 11:15 AM	11-18-86 12:55 AM	12-22-86 11:15 PM
Alkalinity, mg/l CaCO_3 eq.	18	82	84	84	120	34
Calcium Hardness, mg/l CaCO_3 eq.	96	88	44	36	140	100
Copper, mg/l Cu	<.02	<.02	<.02	.04	<.02	.03
Total Coliform Count, MPN/100 ml.	< 3	< 2	< 3	< 2	< 2	< 2
Iron, mg/l Fe	.07	.09	.07	.11	.12	.15
Nitrogen, Total mg/l N	<.2	.8	.4	.3	.5	1.0
Nitrate, mg/l NO_3	.28	.13	.31	1.4	2.7	2.7
pH	7.05	7.20	6.65	7.4	7.40	7.25
Phosphate, Total, mg/l P	<.2	<.2	<.2	<.2	<.2	<.2
Phosphate, Ortho, mg/l P	<.2	<.2	<.2	<.2	<.2	<.2
Solids, Dissolved, mg/l	295	199	159	202	218	132
Manganese, mg/l Mn	.01	<.01	.01	<.01	<.01	.016
Chloride, mg/l Cl	24	20	17	22	22	21
Sulfate, mg/l SO_4	71	28.3	39	59	54	46
Temperature, $^{\circ}\text{C}$	20.0 $^{\circ}\text{C}$	19.5 $^{\circ}\text{C}$	17.5 $^{\circ}\text{C}$	15.0	12.0	9.5
Turbidity, NTU	1.4	.30	56	.36	.54	1

TABLE 20

WATER QUALITY MONITORING DATA
FORRESTAL CAMPUS, PRINCETON UNIVERSITY

Station: P 1

Monitoring Station Location: Off-Site Location

PARAMETER	1-22-86 3:50 PM	2-24-86 3:15 PM	3-18-86 1:25 PM	4-28-86 10:00 AM	5-27-86 4:00 PM	6-19-86 3:00 PM
Alkalinity, mg/l CaCO_3 eq.	2	6	12	8	26	34
Calcium Hardness, mg/l CaCO_3	56	20	96	20	20	40
Chromium, Total, mg/l Cr	< .02	< .02	< .02	< .02	< .02	< .02
Chromium, Hexavalent, mg/l Cr	< .02	< .02	< .02	< .02	< .02	< .02
Copper, mg/l Cu	< .02	< .02	< .02	.02	.02	< .02
EDTA, mg/l Cu eq.	.08	.06	.06	.07	.067	.052
Iron, mg/l Fe	.32	.75	1.18	1.64	.44	.53
Nitrate, mg/l N	1.9	.58	1.1	.65	1.3	.58
Oil and Grease, mg/l	< .5	< .5	< .5	< .5	< .5	< .5
pH	6.25	6.00	6.40	6.45	6.95	6.8
Phosphate, Total, mg/l P	< .2	< .2	< .2	< .2	< .2	< .2
Phosphate, Ortho, mg/l P	< .2	< .2	< .2	< .2	< .2	< .2
Solids, Dissolved	141	130	103	78	80	134
Solids, Suspended, mg/l	1	21	7	1	26	2
Sulfate, mg/l SO_4	27	17	19	23	16	15
Turbidity, NTU	7.8	17	8.6	16	7.9	5.8
Zinc	.05	.03	.02	.02	.02	.02
Clarity	Sl. Cloudy	Mod. Cloudy	Clear	Mod. Cloudy	Clear	Sl. Cloudy

TABLE 20 (cont'd)

WATER QUALITY MONITORING DATA
FORRESTAL CAMPUS, PRINCETON UNIVERSITY

Station: P 1

Monitoring Station Location: Off-Site Location

PARAMETER	7-22-86 11:20 AM	8-20-86 1:15 PM	9-22-86 1:50 PM	10-20-86 9:15 AM	11-18-86 9:35 AM	12-22-86 12:10 PM
Alkalinity, mg/l CaCO_3 eq.	30	16	16	20	14	8
Calcium Hardness, mg/l CaCO_3	24	20	32	56	44	36
Chromium, Total, mg/l Cr	<.02	<.02	<.02	<.02	<.02	<.02
Chromium, Hexavalent, mg/l Cr	<.02	<.02	<.02	<.02	<.02	<.02
Copper, mg/l Cu	<.02	<.02	<.02	.02	<.02	<.02
EDTA, mg/l Cu eq.	.04	.04	.04	.068	.05	.05
Iron, mg/l Fe	1.05	2.29	1.42	.85	.67	1.07
Nitrate, mg/l N	.26	<.1	1.8	.63	.95	1.3
Oil and Grease, mg/l	<.5	<.5	<.5	<.5	<.5	<.5
pH	7.10	6.65	6.65	6.8	6.70	6.50
Phosphate, Total, mg/l P	<.2	<.2	<.2	<.2	<.2	<.2
Phosphate, Ortho, mg/l P	<.2	<.2	<.2	<.2	<.2	<.2
Solids, Dissolved	138	92	81	94	97	81
Solids, Suspended, mg/l	< 1	1	6	3	2	36
Sulfate, mg/l SO_4	11	12.5	11	23	12	23
Turbidity, NTU	5.8	3.7	4.9	4.3	5.6	27
Zinc	.02	.01	<.01	.01	.02	.02
Clarity	Sl. Cloudy	Sl. Cloudy	Sl. Cloudy	Sl. Cloudy	Sl. Cloudy	Moderately Cloudy

TABLE 21

WATER QUALITY MONITORING DATA
FORRESTAL CAMPUS, PRINCETON UNIVERSITY

Station: P 2

Monitoring Station Location: Off-Site Location

PARAMETER	1-22-86 4:15 PM	2-24-86 3:40 PM	3-18-86 1:45 PM	4-28-86 10:20 AM	5-27-86 4:20 PM	6-19-86 3:20 PM
Alkalinity, mg/l CaCO_3 eq.	2	6	8	10	20	28
Calcium Hardness, mg/l CaCO_3 eq.	44	4	44	32	16	28
Chromium, Total, mg/l Cr	< .02	< .02	< .02	< .02	< .02	< .02
Chromium, Hexavalent, mg/l Cr	< .02	< .02	< .02	< .02	< .02	< .02
Copper, mg/l Cu	< .02	< .02	< .02	.02	.02	< .02
EDTA mg/l Cu eq.	.08	.06	.06	.05	.067	.058
Iron, mg/l Fe	.23	.24	.37	.48	.44	.14
Nitrate, mg/l N	1.3	.46	.6	.84	1.3	1.3
Oil and Grease, mg/l	< .5	< .5	< .5	< .5	.5	< .5
pH	6.40	6.25	6.55	6.65	6.95	6.70
Phosphate, Total, mg/l P	< .2	< .2	< .2	< .2	< .2	< .2
Phosphate, Ortho, mg/l P	< .2	< .2	< .2	< .2	< .2	< .2
Solids, Dissolved	109	79	72	64	73	172
Solids, Suspended, mg/l	< 1	1	5	4	27	1
Sulfate, mg/l SO_4	15	12	14	14	< 1.0	10
Turbidity, NTU	4.0	3.8	3.4	2.9	2.6	1.8
Zinc, mg/l Zn	.02	.03	.02	.01	.03	.02
Clarity	Clear	Clear	Clear	Sl. Cloudy	Sl. Cloudy	Clear

TABLE 21 (cont'd)

WATER QUALITY MONITORING DATA
FORRESTAL CAMPUS, PRINCETON UNIVERSITY

Station: P 2

Monitoring Station Location: Off-Site Location

PARAMETER	7-22-86 11:40 AM	8-20-86 1:35 PM	9-22-86 2:10 PM	10-20-86 9:35 AM	11-18-86 10:00 AM	12-22-86 12:30 PM
Alkalinity, mg/l CaCO_3 eq.	26	16	18	18	14	10
Calcium Hardness, mg/l CaCO_3 eq.	20	20	32	48	32	24
Chromium, Total, mg/l Cr	<.02	<.02	<.02	<.02	<.02	<.02
Chromium, Hexavalent, mg/l Cr	<.02	<.02	<.02	<.02	<.02	<.02
Copper, mg/l Cu	<.02	<.02	<.02	<.02	<.02	<.02
EDTA mg/l Cu eq.	.04	.04	.04	.052	.05	.06
Iron, mg/l Fe	.48	1.07	.20	.08	.39	.34
Nitrate, mg/l N	.42	.14	1.6	4.5	1.8	2.2
Oil and Grease, mg/l	<.5	<.5	<.5	<.5	<.5	<.5
pH	6.85	6.90	6.7	7.0	6.60	6.60
Phosphate, Total, mg/l P	<.2	<.2	<.2	<.2	<.2	<.2
Phosphate, Ortho. mg/l P	<.2	<.2	<.2	<.2	<.2	<.2
Solids, Dissolved	130	82	87	107	67	66
Solids, Suspended, mg/l	1	<1	3	6	3	4
Sulfate, mg/l SO_4	15	10.8	8.7	15	19	10.3
Turbidity, NTU	2.6	3.8	1.2	.72	1.9	6
Zinc, mg/l Zn	.01	.01	<.01	.02	.022	.02
Clarity	Clear	Clear	Clear	Clear	Clear	Clear

TABLE 22

WATER QUALITY MONITORING DATA
FORRESTAL CAMPUS, PRINCETON UNIVERSITY

Station: M 1
Monitoring Station Location: Millstone River

PARAMETER	1-22-86 5:10 PM	2-24-86 4:30 PM	3-18-86 3:20 PM	4-28-86 11:00 AM	5-27-86 5:00 PM	6-19-86 5:30 PM
Alkalinity, mg/l CaCO_3 eq.	2	10	10	14	22	28
Calcium Hardness, mg/l CaCO_3 eq.	56	20	64	28	24	32
Chromium, Total, mg/l Cr	< .02	< .02	< .02	< .02	< .02	< .02
Chromium, Hexavalent, mg/l Cr	< .02	< .02	< .02	< .02	< .02	< .02
Copper, mg/l Cu	< .02	.03	< .02	< .02	< .02	< .02
EDTA mg/l Cu eq.	.08	.08	.06	.05	.062	.056
Iron, mg/l Fe	.24	.95	.82	.92	.38	.36
Nitrate, mg/l N	3	1	.17	.65	.7	1.2
Oil and Grease, mg/l	< .5	< .5	< .5	< .5	< .5	< .5
pH	6.45	6.60	7.00	6.60	6.95	7.05
Phosphate, Total, mg/l P	.2	< .2	< .2	< .2	.2	< .2
Phosphate, Ortho, mg/l P	< .2	< .2	< .2	< .2	< .2	< .2
Solids, Dissolved	141	141	114	119	113	158
Solids, Suspended, mg/l	3	33	9	1	21	< 1
Sulfate, mg/l SO_4	26	17	22	22	18	19
Turbidity, NTU	6.9	13	8.7	6.3	4.2	3.9
Zinc	.03	.03	.02	.01	.03	.01
Clarity	Sl. Cloudy	Mod. Cloudy	Clear	Sl. Cloudy	Sl. Cloudy	Sl. Cloudy

TABLE 22 (cont'd)

WATER QUALITY MONITORING DATA
FORRESTAL CAMPUS, PRINCETON UNIVERSITY

Station: M 1
 Monitoring Station Location: Millstone River

PARAMETER	7-22-86 12:20 PM	8-20-86 1:55 PM	9-22-86 2:50 PM	10-20-86 10:20 AM	11-18-86 10:40 AM	12-22-86 1:10 PM
Alkalinity, mg/l CaCO_3 eq.	24	22	24	26	20	12
Calcium Hardness, mg/l CaCO_3 eq.	24	28	36	44	92	56
Chromium, Total, mg/l Cr	<.02	<.02	<.02	<.02	<.02	<.02
Chromium, Hexavalent, mg/l Cr	<.02	<.02	<.02	<.02	<.02	<.02
Copper, mg/l Cu	<.02	<.02	<.02	<.02	<.02	<.02
EDTA mg/l Cu eq.	.04	.04	.03	.061	.06	.05
Iron, mg/l Fe	.25	.65	.24	.13	.53	.84
Nitrate, mg/l N	.58	<.1	1.8	3.1	1.0	2.2
Oil and Grease, mg/l	<.5	<.5	<.5	<.5	<.5	<.5
pH	6.90	6.85	6.45	7.25	6.75	6.5
Phosphate, Total, mg/l P	<.2	.2	.2	<.2	.2	<.2
Phosphate, Ortho, mg/l P	<.2	<.2	<.2	<.2	<.2	<.2
Solids, Dissolved	159	92	129	104	103	87
Solids, Suspended, mg/l	<1	<1	4	4	4	10
Sulfate, mg/l SO_4	20	12.6	18	21	31	22
Turbidity, NTU	3.3	2.8	2.0	1.3	4.4	14
Zinc	.03	.02	<.01	.01	.022	.02
Clarity	Clear	Clear	Clear	Clear	Clear	SL. Cloudy

TABLE 23
WATER QUALITY MONITORING DATA
FORRESTAL CAMPUS, PRINCETON UNIVERSITY

Station: W 4 (C-site)

Monitoring Station Location: Underground Well

PARAMETER	3-18-86 12:25 PM	6-19-86 11:20 AM				
Alkalinity, mg/l CaCO_3 eq.	116	50				
Calcium Hardness, mg/l CaCO_3 eq.	108	36				
Copper, mg/l Cu	.05	< .02				
Total Coliform Count, MPN/100 ml	< 2	< 2				
Iron, mg/l Fe	.69	.40				
Nitrogen, Total mg/l N	.5	.4				
Nitrogen, Nitrate, mg/l NO_3	< .1	.34				
pH	7.40	6.30				
Phosphate, Total, mg/l P	< .2	< .2				
Phosphate, Ortho, mg/l P	< .2	< .2				
Manganese, mg/l Mn	.18	.08				
Chloride, mg/l Cl	8	5				
Solids, Dissolved, mg/l	169	113				
Sulfate, mg/l SO_4	14	13				
Temperature, $^{\circ}\text{C}$	13.0	12.5				
Turbidity, NTU	1.8	5.4				

TABLE 23 (cont'd)
WATER QUALITY MONITORING DATA
FORRESTAL CAMPUS, PRINCETON UNIVERSITY

Station: W 4 (C-site)

Monitoring Station Location: Underground Well

PARAMETER	8-20-86 12:50 PM	11-18-86 11:20 AM
Alkalinity, mg/l CaCO_3 eq.	108	100
Calcium Hardness, mg/l CaCO_3 eq.	60	84
Copper, mg/l Cu	.04	.03
Total Coliform Count, MPN/100 ml	< 2	< 2
Iron, mg/l Fe	1.84	1.0
Nitrogen, Total mg/l N	.5	.2
Nitrogen, Nitrate, mg/l NO_3	< .1	< .1
pH	7.70	7.40
Phosphate, Total, mg/l P	.3	< .2
Phosphate, Ortho, mg/l P	.2	< .2
Manganese, mg/l Mn	156	.093
Chloride, mg/l Cl	.16	8
Solids, Dissolved, mg/l	5	148
Sulfate, mg/l SO_4	10.0	18
Temperature, °C	14.5°C	13.0°
Turbidity, NTU	4.5	3.6

TABLE 24

WATER QUALITY MONITORING DATA
FORRESTAL CAMPUS, PRINCETON UNIVERSITY

Station: W 5 (C-site)

Monitoring Station Location: Underground Well

PARAMETER	5-27-86 12:10 PM	2-24-86 12:00 PM	9-22-86 11:20 AM			12-22-86 10:55 AM
Alkalinity, mg/l CaCO_3 eq.	114	7	72			50
Calcium Hardness, mg/l CaCO_3 eq.	52	48	64			68
Copper, mg/l Cu	.05	<.02	.02			<.02
Total Coliform Count, MPN/100 ml	2	< 2	< 3			< 2
Iron, mg/l Fe	1.05	.54	1.70			.47
Nitrogen, Total mg/l N	4.6	<.2	< .1			<.1
Nitrate Nitrogen, mg/l NO_3	.82	.44	.60			2.2
pH	7.0	6.25	6.55			6.95
Phosphate, Total, mg/l P	.4	<.2	< .2			< .2
Phosphate, Ortho, mg/l P	.2	<.2	< .2			.2
Manganese, mg/l Mn	.11	.02	.03			.042
Chloride, mg/l Cl	7	7	5			5
Solids, Dissolved, mg/l	173	133	119			102
Sulfate, mg/l SO_4	12	15	13			19
Temperature, $^{\circ}\text{C}$	14.5	11.0	12.0 $^{\circ}\text{C}$			11.6
Turbidity, NTU	4.9	9.9	3.1			4.8

Table 25

WATER QUALITY MONITORING DATA
FORRESTAL CAMPUS, PRINCETON UNIVERSITY

Test Well 1

<u>Parameter Name</u>	<u>4-24-86</u>	<u>7-24-86</u>	<u>10-29-86</u>
Water temperature, °C	12.4	12.7	12.2
Air temperature, °C	17.5		
Air pressure, mm of Hg	760		
Collecting agency (Code #)	1028		
Analyzing agency (Code #)	80020		
Specific conductance, field, uSeimens/cm	370	354	359
Oxygen dissolved, mg/l	0.3	0.0	0.3
pH (field)	7.5	7.4	7.3
pH (laboratory)	7.4	7.4	
Alkalinity, mg/l CaCO ₃	145	146	
Nitrogen NH ₄ dissolved as N, mg/l N	0.01	0.021	
Nitrogen NO ₂ dissolved as N, mg/l N	0.01	<0.01	<0.010
Nitrogen, dissolved, KJD, mg/l N	0.2	<0.2	0.90
NO ₂ +NO ₃ as N dissolved, mg/l N	0.151	<0.1	0.100
Phosphate, dissolved ortho as P, mg/l P	0.021	0.031	0.021
Calcium dissolved, mg/l Ca	46	45	46
Magnesium dissolved, mg/l Mg	14	13	14
Sodium dissolved, mg/l Na	10	13	10
Potassium dissolved, mg/l K	1.6	1.6	1.5
Chloride, mg/l Cl	12	12	12
Sulfate dissolved, mg/l SO ₄	18	22	20
Fluoride dissolved, mg/l F	0.1	<0.1	0.10
Silica dissolved, mg/l SiO ₂	28	26	25
Barium dissolved, ug/l Ba	360	340	350
Beryllium dissolved, ug/l Be	1	<0.5	1
Cadmium dissolved, ug/l Cd	1	<1.0	<1
Cobalt dissolved, ug/l Co	3	<3.0	<3
Copper dissolved, ug/l Cu	10	<10.0	<10
Iron dissolved, ug/l Fe	120	100	12
Lead dissolved, ug/l Pb	10	10	<10
Manganese dissolved, ug/l Mn	120	160	170
Molybdenum dissolved, ug/l Mo	10	10.0	<10
Strontium dissolved, ug/l Sr	380	400	390
Vanadium dissolved, ug/l V	6	<6.0	<6
Zinc dissolved, ug/l Zn	11	7.0	<3
Lithium dissolved, ug/l Li	6	4.0	7
Dissolved solids sum, mg/l	173	220	
Depth below LSD, ft	19.6	22.2	
Specific conductance, lab, uSiemens/cm	276	260	

Table 26

WATER QUALITY MONITORING DATA
FORRESTAL CAMPUS, PRINCETON UNIVERSITY

Test Well 10

<u>Parameter Name</u>	<u>4-24-86</u>	<u>7-24-86</u>	<u>10-29-86</u>
Water temperature, °C	12.5	12.9	12.0
Air temperature, °C	17.5		
Air pressure, mm of Hg	760		
Collecting agency (Code #)	1028		
Analyzing agency (Code #)	90020		
Specific conductance, field, uS/cm	350	346	307
Oxygen dissolved, mg/l	0.3	0.1	0.5
pH (field)	7.6	7.4	7.5
pH (laboratory)	7.6	7.6	
Alkalinity, mg/l CaCO ₃	145	142	
Nitrogen NH ₄ dissolved as N, mg/l N	0.05	0.041	
Nitrogen NO ₂ dissolved as N, mg/l N	0.01	<0.01	<0.010
Nitrogen, dissolved, KjD, mg/l N	0.2	<0.2	0.40
NO ₂ +NO ₃ as N dissolved, mg/l N	0.1	<0.1	0.100
Phosphate, dissolved ortho as P, mg/l P	0.021	0.021	0.021
Calcium dissolved, mg/l Ca	45	43	46
Magnesium dissolved, mg/l Mg	12	11	12
Sodium dissolved, mg/l Na	9.7	9.6	9.7
Potassium dissolved, mg/l K	1.7	1.7	1.6
Chloride, mg/l Cl	11	11	12
Sulfate dissolved, mg/l SO ₄	15	19	17
Fluoride dissolved, mg/l F	0.1	0.1	0.10
Silica dissolved, mg/l SiO ₂	27	26	25
Barium dissolved, ug/l Ba	390	410	390
Beryllium dissolved, ug/l Be	0.5	<0.5	1
Cadmium dissolved, ug/l Cd	1	1	<1
Cobalt dissolved, ug/l Co	3	<3	<2
Copper dissolved, ug/l Cu	10	<10	<10
Iron dissolved, ug/l Fe	370	390	510
Lead dissolved, ug/l Pb	10	<10	<10
Manganese dissolved, ug/l Mn	290	300	300
Molybdenum dissolved, ug/l Mo	10	<10	<10
Strontium dissolved, ug/l Sr	410	420	410
Vanadium dissolved, ug/l V	6	<6	<6
Zinc dissolved, ug/l Zn	3	7	<3
Lithium dissolved, ug/l Li	7	10	?
Dissolved solids sum, mg/l	211	210	
Depth below LSD, ft	12.6	22.2	
Specific conductance, lab, uS/cm	352	349	

TABLE 27

NONRADIOACTIVE QA RESULTS (SPLIT SAMPLES)

<u>Parameter</u>	<u>4/28/86</u>		<u>9/22/86</u>	
	<u>a1</u>	<u>a2</u>	<u>b1</u>	<u>b2</u>
Alkalinity, mg/l CaCO ₃ eq.	14	12	62	52
BOD ₅ mg/l O ₂	1	<1	<1	<1
Calcium Hardness, mg/l CaCO ₃ eq.	40	12	52	56
Chromium, Total, mg/l Cr	<.02	<.02	<.02	<.02
Chromium, Hex., mg/l Cr	<.02	<.02	<.02	<.02
COD, mg/l O ₂	11	7.0	3.8	3.8
Copper, mg/l Cu	<.02	<.02	<.02	<.02
Dissolved Oxygen, mg/l O ₂	9.4	9.8	8.8	8.8
EDTA, mg/l Cu eq.	*	*	.02	.03
Total Coliform Count MPN/ 100 ml	>2400	540	150	240
Iron, mg/l Fe	.38	.30	.72	.74
Total Kjeldahl Nitrogen, mg/l	.3	.5	.5	.9
Nitrate Nitrogen, mg/l N	.74	.56	.68	.60
Oil & Grease, mg/l	<.5	<.5	<.5	<.5
pH	6.45	6.85	6.6	6.7
Phosphate, Total mg/l P	<.2	<.2	<.2	<.2
Phosphate, Ortho mg/l P	<.2	<.2	<.2	<.2
Solids - Dissolved, mg/l	103	109	133	130
Solids - Suspended, mg/l	18	4	20	21
Manganese, mg/l Mn	.01	.01	<.01	<.01
Chloride, mg/l Cl	13	7	16	17
Sulfate, mg/l SO ₄	30	21	24	25
Turbidity, NTU	15	3.8	9.6	14
Zinc, mg/l Zn	.02	.02	<.01	<.01
Clarity	Sl. Cloudy	Sl. Cloudy	Sl. Cloudy	Sl.
Cloudy				

*no results

TABLE 28

QA/QC EPA LAS VEGAS LOSS-CHECK PROGRAM 1986

<u>SAMPLE DATE</u>	<u>TYPE SAMPLE</u>	<u>KNOWN VALUES HTO CONCENTRATION (pCi/l) PLUS EXPECTED LAB PRECISION</u>	<u>PPPL VALUES (pCi/l)</u>
4/25/86	Urine	4423 +/- 442	4560 4380 4340
6/13/86	Water	3125 +/- 360	2880 2920 2980
11/7/86	Urine	5257 +/- 526	5190 5040 5300

TABLE 29

FERTILIZER, PESTICIDES, AND HERBICIDE APPLICATION (C187)FERTILIZER

(Applied by University)

10-6-4 50% Organic

A Site	1000 lbs.
B Site	1800 lbs.
C Site	1200 lbs.
D Site	1000 lbs.

PESTICIDES

(Applied by University)

A Site	No pesticides applied
B Site	No pesticides applied
C Site	No pesticides applied
D Site	No pesticides applied

HERBICIDES

<u>DATE</u>	<u>LOCATION</u>	<u>PRODUCT</u>	<u>AMOUNT</u>
4/12/86	C-Site	Balan (Pro Lawn)	500 lbs.
6/5/86	TFTR Electrical Yards & Sub	Arsenal (Cyanamid)	6 pts in 300 gal. of water
6/6/86	A&B Electrical Subs	Arsenal (Cyanamid)	6 pts in 300 gal. of water
6/14/86	C-Site	Spike 80W (Pocono Turf)	10 lbs.
	D-Site	Spike 80W (Pocono Turf)	10 lbs.
6/27/86	C-Site Receiving Yard	Arsenal (Cyanamid)	2 pts in 100 gal. of water
7/1/86	Canal Water Pump House	Arsenal (Cyanamid)	0.7 pts in 35 gal. of water
9/9/86	C-Site	Spike 80W (Pocono Turf)	10 lbs.
		Roundup (C&B)	2.25 gal.
		Princep Caliber 90 (RFB Co)	10 lbs.

Fig. 1. S-1 Spheromak

Fig. 2. RFTF

Fig. 3. Princeton Large Torus (PLT)

Fig. 4. Princeton Beta Experiment (PBX)

Fig. 5. Tokamak Fusion Test Reactor (TFTR)

FIG. 6

Wind Rose
 Joint Frequency Data for TFTR
 84/ 1 to 86/12
 Elevation 30 m
 For All Stability Classes (100.0%)

FIG. 7

Wind Rose
 Joint Frequency Data for TFTR
 84/ 1 to 86/12
 Elevation 60 m
 For All Stability Classes (100.0%)

Wind Speed (m/s)

10.0	and above
7.0	to 10.0
5.0	to 7.0
3.0	to 5.0
2.0	to 3.0
1.5	to 2.0
1.0	to 1.5
0.75	to 1.0
0.22	to 0.75

Center = Calm %

FIG. 8
80 km (50-MILE) RADIUS OF SITE

FIG. 9
IMMEDIATE SITE VICINITY
(5-MILE RADIUS)

Fig. 10.
Plasma Physics Laboratory
James Forrestal Campus
Princeton University, Princeton, NJ

FIG. 11
1974 POPULATION ESTIMATES WITHIN ANNULAR SECTORS 0-10 MILES*

*Taken from TFTR/FSAR
FIGURES 2.1.2-1

*Taken from TFTR/FSAR
Figure 2.1.2-3

FIG. 13
PPPL C AND D SITES AND ENVIRONMENTAL MONITORING LOCATIONS

1. Auditorium
2. Offices
3. TFTR Control
4. Technical Shop
5. TFTR Experimental Area
6. Motor Generator
7. Maintenance & Utility
8. Pump House
9. Cooling Tower
10. New Parking
11. Retention Basin
12. Switchyard Expansion
13. Liquid Effluent Collection Tanks
14. Field Coil P.C. Building
15. Neutral Beam P.C. Building
16. Gas Tank Farm Area

W1, W10	New D-site wells
EZB	Exclusion Zone Boundary
RMS-B	Fence
RMS-1	Baseline Radiation Monitoring Station & Old Meteorological Tower
RMS-2	Radiation Monitoring Station
RMS-3	"
RMS-4	"
D-1	Ditch 5 Surface Water Sample Location
D-2	Ditch 5 Surface Water Sample Location
B-1	Bee Brook Surface Water Sample Location
B-2	Bee Brook Surface Water Sample Location
MET	Meteorological Tower
E-1	Elizabethtown Sample Location
W-4	Well #4 (C-site)
W-5	Well #5 (C-site)

FIG. 14
MILLSTONE RIVER BASIN OFFSITE WATER SAMPLE LOCATION

FIG. 15
 PLANNED OFF-SITE MONITORING LOCATIONS