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LIQUID EFFLUENT MONITORING PROGRAM AT THE PACIFIC NORTHWEST LABORATORY

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ABSTRACT

The Pacific Northwest Laboratory (PNL) is conducting a program to monitor the waste water from PNL-operated research and development facilities on the Hanford Site. The purpose of the program is to collect data to assess administrative controls and to determine whether discharges to the process sewer meet sewer criteria.

Samples have been collected on a regular basis from the major PNL facilities on the Hanford Site since March 1994. A broad range of analyses has been performed to determine the primary constituents in the liquid effluent. The sampling program is briefly summarized in the paper. Continuous monitoring of pH, conductivity, and flow also provides data on the liquid effluent streams. In addition to sampling and monitoring, the program is evaluating the dynamics of the waste stream with dye studies and is evaluating the use of newer technologies for potential deployment in future sampling/monitoring efforts.

Information collected to date has been valuable in determining sources of constituents that may be higher than the Waste Acceptance Criteria (WAC) for the Treated Effluent Disposal Facility (TEDF). This facility treats the waste streams before discharge to the Columbia River.

INTRODUCTION

The Pacific Northwest Laboratory (PNL) performs research and development (R&D) for the U.S. Department of Energy (DOE) at the Hanford Site in southcentral Washington state. Liquid waste streams that serve the laboratories in these R&D facilities may contain many different chemicals and radionuclides. These waste streams are treated at the Treated Effluent Disposal Facility (TEDF) and discharged to the Columbia River. PNL manages the waste streams with administrative controls that require approvals before discharge to the sewer system. Additionally, PNL conducts a liquid effluent monitoring program to characterize the waste streams and assess the effectiveness of the administrative controls for specific buildings and systems. This paper describes that program and discusses preliminary results for PNL's liquid effluent monitoring on the Hanford Site.

BACKGROUND

Research and development activities are performed in a number of DOE-owned facilities at the southern part of the Hanford Site called the 300 Area. PNL conducts environmental, biological, and nuclear research in these facilities. The large number of activities and the changing nature of project-oriented research cause the waste streams from the facilities to be highly variable. In addition, past use of the sewer systems was less stringent than present use, and holdup in the piping from past practices may contribute to present day discharges.

Process areas in the facilities are served by two liquid waste systems:

- the Retention Process Sewer (RPS), which serves areas with the potential to discharge radioactive materials
- the Process Sewer (PS), which serves all other laboratory areas.

Wastewater entering the RPS is diverted to a radioactive liquid waste system if contamination is detected. Normally, however, this stream is not contaminated and is routed to the PS. The PS is treated at the TEDF, operated by Westinghouse Hanford Company (WHC), and discharged to the

Columbia River. The quality of the RPS and PS streams is of concern because they may contain radioactive or hazardous chemicals that may be released to the environment (the Columbia River) after treatment at TEDF. Previously, the PS was discharged to process trenches, where the wastewater percolated into the soil near the Columbia River. Past operations discharged radioactive and chemical contaminants to the trenches. To avoid driving these contaminants further into the ground water, efforts were made to minimize the flow, and the TEDF was designed and built.

Previous characterization data on the 300-Area liquid-effluent streams are sparse. A number of grab samples were taken in 1989 to provide information for the design of the TEDF (Westinghouse Hanford Company 1989). However, the sampling was not extensive enough to fully characterize the streams. In addition, several subsequent changes impacted the nature of the PS and RPS streams. These changes include an extensive waste minimization effort that was conducted to reduce the PS flow to the process trenches, shutdown of some of the 300-Area facilities, and changes in R&D activities in the remaining facilities.

The TEDF was designed from the limited data set and operates under extremely restrictive technology-based regulatory requirements. The National Pollutant Discharge Elimination System (NPDES) Permit that governs the TEDF discharges to the Columbia River limits the concentration of a number of different constituents to parts per billion (ppb). Because the TEDF began operations only recently (December 1994), a limited set of operating data has accrued and the treatment capability of the plant is not known. WHC has taken a conservative approach and incorporated many of the discharge limits directly into its Waste Acceptance Criteria (WAC) for the plant, rather than allowing higher criteria based on credit for plant treatment.

PNL, as the primary contributor to the waste stream, is providing information on the nature of the PNL waste streams to provide a level of control that will neither cause TEDF to violate regulatory requirements nor harm TEDF's treatment train. These data will confirm that discharges to TEDF can be treated to or are already at levels that cause no harm to the environment.

PNL's administrative controls require pre-discharge evaluation of liquid effluents against sewer criteria. Sampling of the major facility PS and RPS streams provides a measure of the effectiveness of these controls. In addition, continuous monitoring of flow, conductivity, and pH is being initiated to provide continuous information on waste stream use and chemistry.

SAMPLING ACTIVITIES

Sampling stations were constructed for the major PNL-operated facilities in the 300 Area. Construction of the sampling stations was a multi-year task. Sampling was initiated at the stations as soon as the flow-proportional samplers were operational, in most cases before station installation was complete. Sampling was also performed at the end-of-pipe (a location downstream of the point of confluence for all 300 Area process and retention process sewer streams) and at other facilities accessible with a portable sampler. Figure 1 is a map of the 300 Area showing the sampled sites.

The first facilities were sampled in March 1994. Twenty-four hour composite samples were taken weekly from March to October of 1994. In addition, grab samples for analysis of volatile organics and the following background samples were taken:

- influent to the 300-Area water-treatment facility (raw river water)
- effluent from the treatment facility (treated river water supplied to the 300-Area facilities)
- alternative water supply from the city of Richland

Twenty-four hour composite samples were also taken during non-business hours (weekends) twice a month.

After October, sampling frequency was reduced to twice a month and regular background sampling was discontinued. Focus shifted to sampling during normal business hours because more sampling stations were on-line by that time, and the first sixth months of sampling had reduced the need for background and off-shift sampling. During fiscal year 1994, the 24-hr composite data on volatile organic compounds were not significantly different from the grab samples. Consequently, grab samples were no longer collected, and analyses for volatile organic compounds were performed on the 24-hr composites.

A broad range of analyses were performed on the samples. The analyses were initially selected based on constituents listed in the WHC WAC, the proposed U.S. Environmental Protection Agency (EPA) NPDES permit for the TEDF, EPA drinking water standards, information from a survey of PNL staff on discharge activities, and historical data. The general chemical parameters and classes of constituents identified for monitoring are shown in Table 1. SW-846 analysis methods were used.

CONTINUOUS MONITORING AND PROGRAM DEVELOPMENT ACTIVITIES

Systems for continuous monitoring of effluent flow, pH, and conductivity have been permanently installed at the building sampling stations. These systems gather real-time data to aid in identifying trends in sewer usage. These data may also provide some correlation with the composite sampler results for each building.

Data from six of the facilities will be collected through the Facilities Management Control System (FMCS) when upgrades to the FMCS are complete. Stand-alone data-logging systems are being installed for the other two buildings, where the FMCS is unavailable.

Liquid effluent characterization and sampling technologies were evaluated under PNL's Effluent Monitoring Program. PNL performed dye studies to determine waste stream dynamics, and evaluated the use of the following methods for routine sampling deployment:

- field-transportable gas chromatograph/mass spectrometer (GC/MS) to measure volatile organic compounds (VOCs)
- adsorptive stripping voltametry (ASV) to measure chemical uranium
- solid phase extraction (SPE) for preconcentration and cleanup of liquid samples in the laboratory or the field.

RESULTS

PNL issued a report on the status of the program at the end of fiscal year 1994 (Riley et al. 1994). At that time (30 September 1994), process liquid effluents were discharged to process trenches, and the TEDF NPDES permit was not finalized. Results were compared to EPA drinking water standards.

Except for bis(2-ethylhexyl)phthalate, concentrations of chemicals detected and levels of radiologic parameters measured at end-of-pipe were below the EPA drinking water standards. In many cases, the measured values were 10 to 10,000 times less than the standards. Bis(2-ethylhexyl)phthalate, a chemical common in plastic formulations and ubiquitous in the environment, is believed to be an artifact of sampling; its presumed source is the Tygon® sampling line.

A report summarizing the data and providing results for the 1994 calendar year is being prepared. The WHC WAC were revised after TEDF started operations in December, when a final NPDES permit was in place. The report compares calendar-year results to the TEDF WAC for constituents listed in the NPDES permit and to EPA drinking water standards for constituents that have drinking water standards and are not specified in the WAC.

Concentrations of chloroform and other trihalomethanes in the water supplied to the facilities periodically exceeded the WHC WAC. The trihalomethanes are apparently chlorination byproducts from treatment of the raw river water supplied to the facilities. Some metals (aluminum, copper, zinc) are present in facility discharges at concentrations exceeding the TEDF WAC. The metals are believed to be from steam condensate; steam is supplied to the facilities from a central steam plant, and aging steam piping may be the source. High (ppm) levels of organic solvents have occasionally been detected in facility effluents and are believed to be caused by discharges into laboratory sinks.

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Although concentrations of these constituents have exceeded the WAC at individual facilities, the WAC has not been exceeded at end-of-pipe.

Only trace levels of radioactivity have been detected in the effluent stream except at one facility where the gross alpha activity is consistently slightly elevated (some are above the TEDF WAC of 15 pCi/L gross alpha), even during the offshift sampling. The source of this activity is believed to be holdup in the piping from past work with uranium.

Concentrations and clearance times for contaminants at end-of-pipe were highly dependent on waste-stream flow rates, dispersion, and the mechanical actions of sumps. Dilution factors ranged from 8 to 50 at the facility closest to end-of-pipe and from 470 to over 600 at the facility farthest away. Clearance times ranged from minutes at the closest facility to hours at the facility farthest away from end-of-pipe. All three technologies evaluated (GC/MS, ASV, and SPE) showed some promise for future liquid effluent monitoring.

CONCLUSIONS

PNL's liquid effluent sampling program can assess the administrative controls used to manage the waste streams from the major PNL facilities in the 300 Area. Preliminary information to date show that the liquid effluent from PNL facilities contains relatively low levels of contaminants relative to EPA drinking water standards. Some constituents (trihalomethanes and some metals) may exceed the TEDF WAC because of influent water treatment and piping corrosion. In these cases the WAC, which is below drinking water standards, may be unnecessarily restrictive. Holdup in the piping of one facility may be contributing to slightly elevated alpha activity in current discharges. PNL facilities may sporadically discharge organic solvents at concentrations exceeding the TEDF WAC. TEDF process sampling has shown that these excursions have not impacted their effluent limits; future revisions to the WHC WAC may become less restrictive.

To date, no violations of the TEDF NPDES permit have occurred. PNL monitoring, in conjunction with administrative controls may have a positive effect on awareness effluent discharges and their impacts.

REFERENCES

Westinghouse Hanford Company. 1989. Waste Stream Characterization Report. WHC-EP-0287, Richland, Washington.

Riley, R.G., M.Y. Ballinger, E.G. Damberg, J.C. Evans, A.S. Ikenberry, K.B. Olsen, R.M. Ozanich, and C.J. Thompson. 1994. Characterization and Monitoring of 300 Area Facility Liquid Waste Streams: Status Report. PNL-10147, Pacific Northwest Laboratory, Richland, Washington.

Table 1. Parameters and Constituents Analyzed.

General Chemical Parameter
- alkalinity
- chemical oxygen demand
- total dissolved solids
- total carbon
- total organic carbon

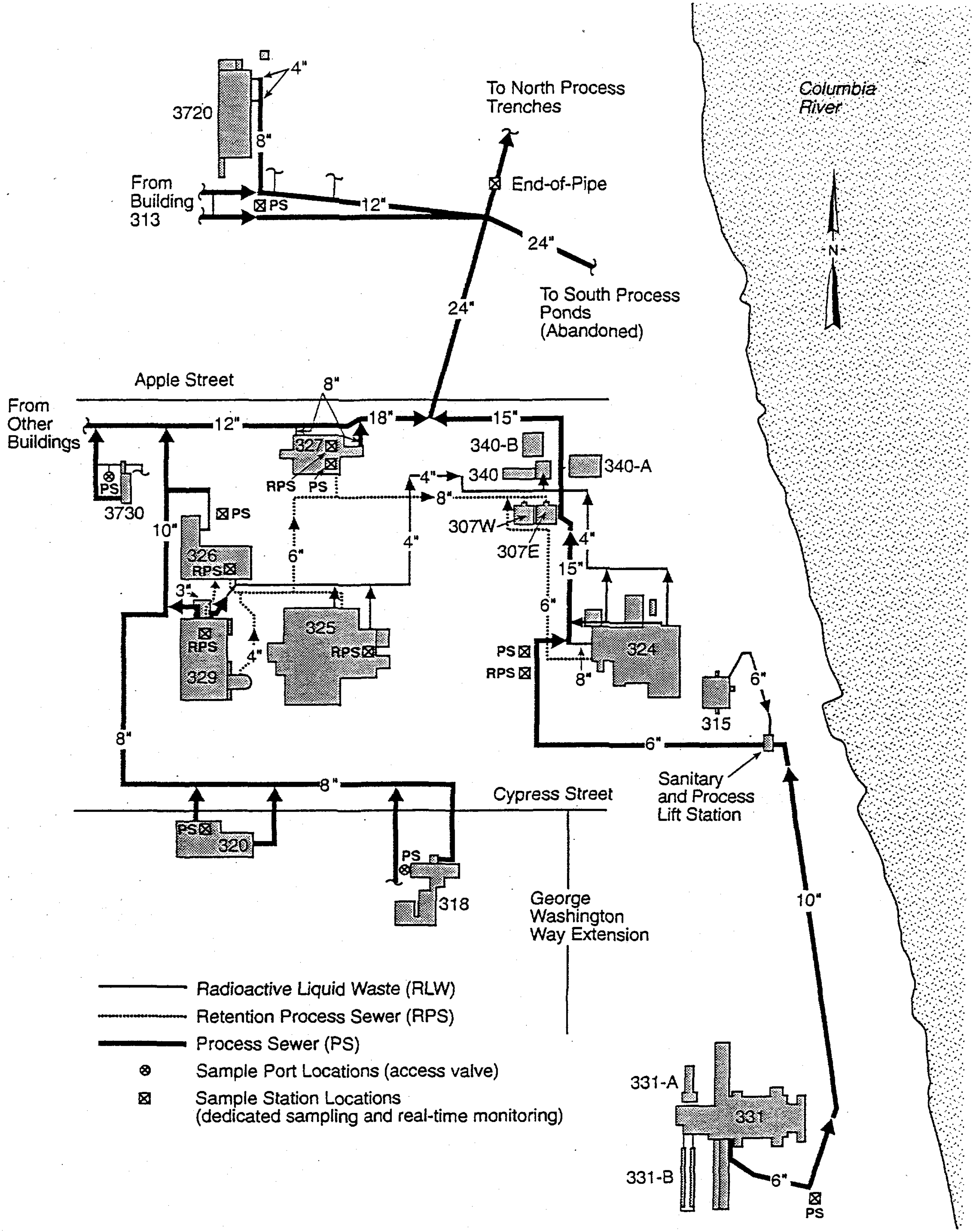
Ammonia and Anions
- ammonia
- cyanide
- sulfides
- other anion

Metals
- heavy metals
- other cations

Volatile Organic Compounds

Semivolatile Organic Compounds

Radiological Parameters
- gross alpha
- gross beta
- tritium



Columbia River
N
To North Process Trenches
End-of-Pipe
To South Process Ponds (Abandoned)
3720
4"
8"
12"
24"
From Building 313
PS
Apple Street
From Other Buildings
12"
8"
18"
15"
327
RPS
PS
340-B
340
340-A
3730
10"
PS
326
RPS
6"
4"
8"
307W
307E
15"
3"
329
RPS
325
RPS
324
PS
RPS
315
Sanitary and Process Lift Station
Cypress Street
320
PS
318
George Washington Way Extension
10"
331-A
331
331-B
Radioactive Liquid Waste (RLW)
Retention Process Sewer (RPS)
Process Sewer (PS)
Sample Port Locations (access valve)
Sample Station Locations (dedicated sampling and real-time monitoring)

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