

PILOT DEMONSTRATION FOR RADIOLOGICAL WASTE VOLUME REDUCTION FUSRAP MAYWOOD SUPERFUND SITE MAYWOOD, NEW JERSEY

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ABSTRACT

This paper presents a case study of a Pilot Demonstration performed at the Formerly Utilized Sites Remedial Action Program (FUSRAP) Maywood Superfund Site (FMSS) to evaluate waste volume reduction technologies. The paper presents the process used to select appropriate technologies, configuration of the systems tested, operational issues encountered, and preliminary results of the demonstration.

Over 200,000 cubic yards of radiologically contaminated soil is estimated to be present at the Maywood site. The Comprehensive Environmental, Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Contingency Plan (NCP) both indicate the need to evaluate alternative technologies to reduce the toxicity, mobility, or volume of hazardous substances, pollutants, or contaminants on Superfund Sites. Through the evaluation and potential use of the Pilot Demonstration treatment technologies not only are the regulatory mandates being satisfied, but there is the potential that their full-scale use could save the project several million dollars and reduce the project duration.

The technologies being evaluated include a gravel separation and rinse system and a soil sorting system. The gravel separation system consists of mechanical screens to remove material greater than 3/8-inch diameter. Previous investigations have indicated that material in this size fraction do not contain significant radiological contamination. The screening is followed by rinsing the >3/8 inch material to remove any adhering finer grained particles which may be radiologically contaminated. The gravel separation and rinse system is a closed system that filters and recycles the rinse water. The soil sorting system being utilized is called the Segmented Gate System that has been deployed at various Department of Energy (DOE) facilities. The purpose of the system is to sort out radiologically contaminated soil from clean soil. The system being used for the demonstration was fabricated and operated by Thermo NuTech. It consists of a soil feed belt passing below two Sodium Iodide detector banks. The detectors assay the soil based upon selected criteria and separate the soil into either a below criteria or above criteria stockpile. The two systems were piloted individually and in combination to optimize cost and performance.

Preliminary results of the Pilot Demonstration suggest that the gravel separation system and the radiological sorting system both generally functioned as intended. The initial observations made of the processed soil suggest that potential reuse on-site or alternative less costly disposal of the processed soil is viable.

INTRODUCTION

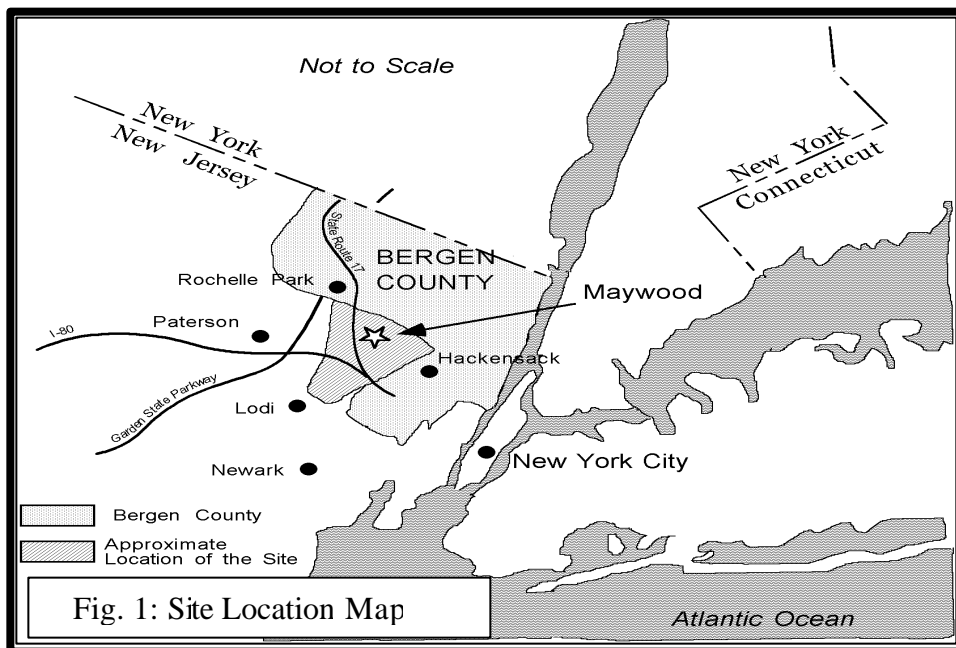
The Comprehensive Environmental, Response, Compensation, and Liability Act (CERCLA) at 2 USC 9621, establishes preferences that remedial actions utilize alternative treatment

technologies to the maximum extent practicable in providing permanent and significant reduction of toxicity, mobility and volume of hazardous substances, pollutants or contaminants. Additionally, the National Oil and Hazardous Substances Contingency Plan (NCP) at 40 CFR 300.430, mandates that an assessment be performed of the degree to which the remedy employs recycling, or treatment, that reduces toxicity, mobility, or volume of hazardous substances, pollutants or contaminants. Pursuant to these regulations, the evaluation of waste volume reduction has been a stated objective of the FMSS project since it was initiated.

The United States Army Corps of Engineers (USACE) has contracted Stone & Webster Environmental Technology & Services (Stone & Webster) to perform remediation of the FMSS, in Maywood, Lodi, and Rochelle Park, New Jersey. In support of the volume reduction initiative, Stone & Webster has evaluated soil processing technologies and conducted a soil processing demonstration project in support of the remediation effort. These soil processing technologies offer promise in substantially reducing the volume of soil requiring disposal as radioactive waste.

BACKGROUND

The FMSS is located on the former site of the Maywood Chemical Works in Maywood, New Jersey as shown in figure 1. The chemical works manufactured a variety of industrial products, which involved the processing of thorium and lithium compounds. It is apparent from historical records of the chemical works that wetlands on the western portion of the property were filled in as the need arose to expand the facility. Additionally, retention ponds were constructed on the western end of the property in order to stabilize and store residual waste slurries and unrecoverable wastes from the manufacturing processes.



Previous remedial investigations and characterizations of the FMSS during the 1980s and early 1990s have shown that the property soils are contaminated with radioactive material, primarily in the form of Thorium-232 (Th-232), Radium-226 (Ra-226), and Uranium-238 (U-238), as well as various other non-radiological contaminants. Remediation will necessitate the identification, removal, transport and disposal of contaminated surface and subsurface soils.

Previous characterizations of the site have shown that the volume of in-situ soil that may be required to be remediated is significant, approximately 200,000 cubic yards. Remediation in the form of excavation and offsite disposal of contaminated soil is being considered at the FMSS. This type of remediation invariably results in the excavation of soil below the radiological cleanup levels. This "over-excavation" of material incurs additional costs in transport and disposal of soils. Unless the volume of soil requiring such offsite disposal is appropriately managed, remediation will incur a significant cost in the disposal of the material alone.

Given the radioactive materials present at the FMSS, a limited number of options are available for reducing the volume of soil disposed of as radiologically contaminated material. The most suitable options are physical separation techniques. By employing a soil processing technology that can separate soil that is radiologically below criteria from radiologically contaminated soil, remediation costs may be reduced through more efficient soil management. Soil management relates to such aspects as soil excavation, transport, processing, and ultimate disposal. Soil management can result in creating streams each with different handling requirements ranging from offsite disposal, to reuse at the FMSS.

In the latter part of the 1990s, characterizations and treatability studies were performed on the soils from the FMSS. The intent of these investigations was to identify soil groupings throughout the site and determine if particle-size separation techniques would be effective in separating the excavated volume of material into contaminated and non-contaminated fractions. The primary sources for the data used were from geologic boring data from the characterizations performed during the 1980s and late 1990s, as well as additional data from limited geologic boring and soil sampling programs.

The treatability studies evaluated costs for implementing soil separation technologies at the FMSS. Essentially, the treatability studies were performed in two parts; characterization of the FMSS soils, and development of a conceptual flowsheet, or process simulation, for a production-scale soil treatment plant. The conceptual flowsheet used mathematical modeling of the results of the characterization to assess the feasibility of selected separation technologies in providing volume reduction of the contaminated fractions. Results from the soil treatability studies concluded that: significant cost savings may be realized by combining soil processing and reuse at the FMSS; and, that a further assessment of soil processing technologies was warranted.

A full assessment of any processing options requires an identification of appropriate technologies that are compatible with the FMSS soil groups and an economic evaluation of each technology. The effectiveness of the system types being considered relies on specific characteristics of the feed soil. For the pilot demonstration the two principal soil characteristics are grain size and contaminant distribution. Both characteristics can be measured with relative ease and reasonable estimates of the potential success of the processing systems can be made. A technology

evaluation was performed in early 1999 to initially assess the viability of implementing physical separation technologies at the FMSS. Gaps in the available data regarding the soil conditions at the site were identified as a result of this evaluation. To fill these data gaps, a test pit program was performed. Using this additional data, appropriate technologies were selected for a pilot demonstration study.

Technology Evaluation

The technology evaluation served to evaluate and rank systems within several categories of soil processing technologies: gravel separation, radiological soil sorting, and soil washing. Vendors provided system information in response to a questionnaire sent to them. Vendor information was evaluated and each system numerically ranked using a set of evaluation criteria and weighting factors established as relevant and appropriate to the assessment and reflective of the following criteria: Efficacy, Safety, Environmental, Schedule, and Cost.

The gravel separation operation is basically a coarse screening system to remove material greater than six (6) inches in nominal diameter, followed by a vibrating screen that separates soil particles larger than 3/8 inch in nominal diameter. The separated material (i.e., gravel) is then rinsed in a closed system.

Radiological sorting is a process that continuously assays a soil stream and directs soil that exceeds a selected threshold activity level to an above criteria stockpile. The remaining soil with radioactivity less than the selected threshold value is directed to a below criteria stockpile. Radiological sorting is most effective when the contamination is not homogeneously distributed in the soil mass. That is, within a given volume of soil there is likely to be a measurable soil volume that is below the selected criteria as well as soil that exceeds the selected criteria. Investigations to date at the FMSS show that the site soils likely meet these criteria.

Soil washing is a water-based process for scrubbing soils ex-situ to remove contaminants. The process removes contaminants from soils, or reduces the volume of contaminated soil, through particle size separation, gravity separation, and attrition scrubbing. The concept of reducing soil contamination through the use of particle size separation is based on the finding that most contaminants tend to bind, either chemically or physically, to clay, silt, and organic soil particles. Washing processes that separate the fine clay and silt particles from the coarser sand and gravel soil particles effectively separate and concentrate the contaminants into a smaller volume of soil that can be further treated or disposed.

As part of this evaluation, an economic assessment was prepared that compared the total remediation cost for the site utilizing a variety of technologies. Due to the uncertainties in some key variables, including the fraction of material below cleanup criteria and soil grain sizes, a parametric study was performed to examine the potential cost savings for a wide range of values for these parameters. The results of the parametric study indicated that the economics of performing volume reduction on the FMSS soils were viable for a wide range of conditions. Nevertheless, the need to minimize the uncertainties related to soil and radioisotope relationships was defined and a limited test pit program was performed to address data gaps in the existing site

information. Gathering this supplemental information was required to facilitate an evaluation of the applicability of the technology.

Engineering Test Pit Program

In August of 1999, an engineering test pit program was performed to gather more detailed information on subsurface soils. Specifically, the objective of the engineering test pit program was to provide an engineering correlation between data from the test pits and previous data, which was generated from soil borings. In order to provide a more accurate evaluation of the performance of the technologies, an assessment of the assumptions made in the technology evaluation was also performed using the results of the test pit program.

Findings from this test pit program concluded that the majority of the contamination was associated with the <3/8 inch material and that the percentage of coarse material (greater than 3/8" diameter) was greater than originally anticipated. The soils at the portion of the site that was evaluated could generally be divided into the following zones: overburden, retention pond, soil surrounding the retention pond, and soil below the retention pond. The lower zone soils (below the retention pond) generally appeared to be both radiologically and chemically uncontaminated. The distribution of radiological contamination showed a high degree of heterogeneity within each zone. This heterogeneity enhanced the potential benefits of the applicability of the soil sorting system.

Following this evaluation, the use of soil processing was considered viable. The program also provided design basis input to system selection/sequencing and soil acquisition for the Pilot Demonstration.

In addition, the engineering test pit program found that chemical contamination existing at the site had the potential for exceeding certain cleanup criteria. While the chemical contaminants would not affect the pilot plant's process, they may have an affect on possible soil reuse or offsite disposal options. Therefore, in-situ material was sampled for chemical contaminants prior to excavation for the Pilot Demonstration to characterize the material to be processed. Material processed during the Pilot Demonstration was sampled to determine if chemical contaminants were being concentrated in any particular process stream.

PILOT DEMONSTRATION

Based on the results of the technology evaluation and the test pit program, a pilot demonstration consisting of the deployment of a dry gravel separation and rinse system and a radiological separation system was recommended. The engineering test pit program found substantial quantities of clean material greater than 3/8 inch in diameter, supporting gravel separation. An underlying premise of the pilot demonstration was that the separation of material less than 3/8 inch diameter would remove material that is above the selected criteria for radiological contamination. A dry gravel separation system was selected based on these soil analytical results, as well as the desire to minimize water usage and to simplify the management of the process waste streams. The program also concluded that in-situ contaminant distribution (heterogeneity) supported radiological sorting.

The Pilot Demonstration focused on determining the effectiveness of the two soil management technologies in separating excavated material into components above and below selected radioactivity criteria, and evaluating the benefits of materials management of the resulting processed soils. The demonstration was conducted such that all required system operational and soil contaminant data were collected to evaluate the systems' performance and reasonably project and establish full-scale system design/performance economics.

OBJECTIVES

The objective of the Pilot Demonstration was to evaluate the applicability of the gravel separation and radiological sorting technologies to the FMSS soils. Success of this objective will be measured by the effectiveness of the soil processing technologies to; 1) significantly reduce the volume of radiologically contaminated soils, 2) provide community benefits relating to waste transport and disposal, and 3) reduce costs in remediation of the FMSS.

APPROACH

During the operation of the Pilot Demonstration program, the process technologies were evaluated by measuring the radiological contamination, chemical contamination and weight of pre- and post-processed materials. The following determinations were made during the demonstration:

- Characteristics of the soils prior to processing (radiological, chemical, and physical);
- Impacts that excavation and soil handling had on the contaminant distribution in the processed soil and its impact on soil processing;
- Characteristics of the separated soil (radiological, chemical and physical) to evaluate how effectively soil processing separated below criteria soil from radiologically contaminated soil;
- Evaluation of soil disposal and reuse alternatives;
- Evaluation of costs and/or cost benefits for implementing the technologies in a full-scale operation.

Pilot Demonstration

The pilot demonstration collected the required data to evaluate the two technologies and quantify cost and cost savings associated with implementing a full scale processing operation. Approximately 8,000 tons of soil was processed during the pilot demonstration

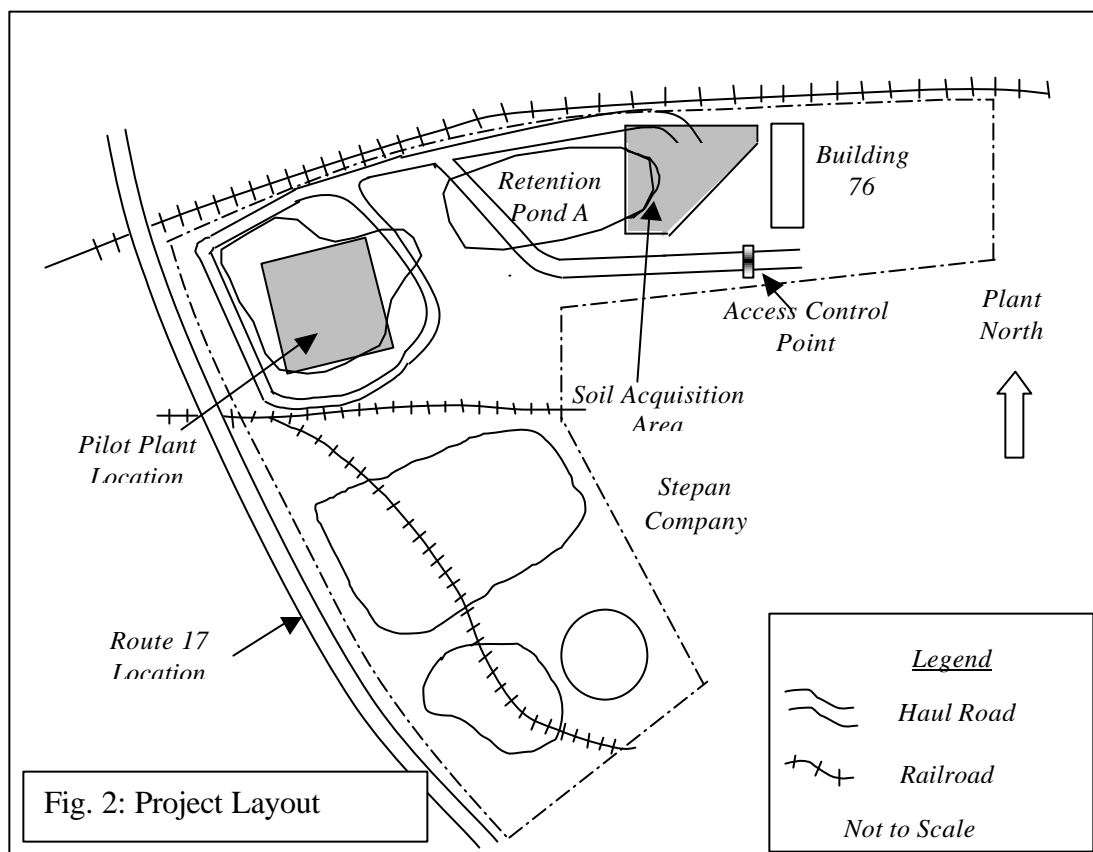
Equipment Sequencing

- A gravel separation system was used as the initial step in the pilot demonstration. This system was expected to remove fifteen percent of the process flow as greater than 3/8" diameter material. The use of finer screen sizes was investigated as part of the pilot demonstration. Retention pond material however, was not processed through the gravel separation system, due to the uniform fine-grained nature of the retention pond material.
- A radiological sorting system was used as the second system. It received the soils

processed by the gravel separation system, and was the only system for processing retention pond materials. The sorting efficiency for the proposed system was estimated at 50 to 80 percent removal, assuming a setpoint equivalent to a Sum-of-the-Ratios (SOR) of one. This sorting efficiency is based on the percentage of "cells" (5 foot by 5 foot by 1-foot grids) with an SOR less than one within a given zone.

PILOT PLANT OPERATIONS

This section provides the description for the major elements that make up the pilot demonstration plant and the soil acquisition. The pilot plant consists of two systems, the gravel separation system with a rinse unit and the soil sorting system. Both systems are moveable and can be relocated as the remediation work progresses through the site. The pilot plant is located at the northwest portion of the Maywood Interim Storage Site (MISS), one of the properties of the FMSS. The soil acquisition area is sited east of the pilot plant as shown in Figure 2.



SYSTEM DESCRIPTION

Gravel Separation System

The Gravel Separation System consists of two main groups of components: the gravel separation system and the gravel rinse system. The gravel separation operation is a coarse screening system to separate material greater than six (6) inches in nominal diameter, followed by a vibrating

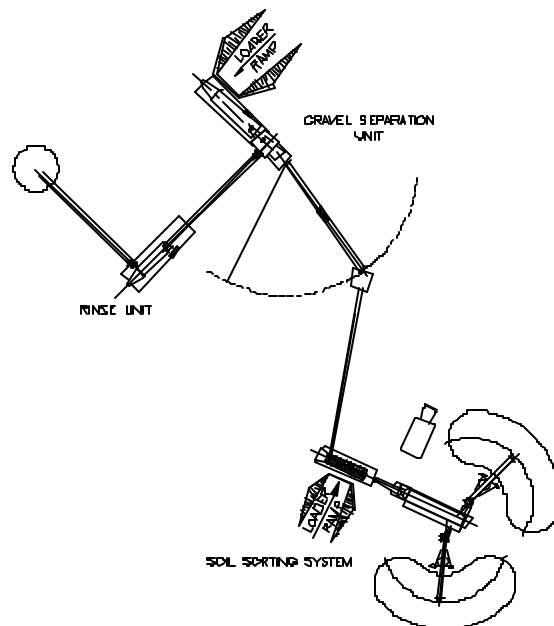
screen that separate soil particles larger than 3/8 inch in nominal diameter. After the vibratory action, two streams are formed from the separation, material greater than 3/8" but less than 6" and material less than 3/8". The separated material greater than 3/8" (i.e., gravel) is then conveyed through a radial conveyor belt to be rinsed to remove fine sand and silts adhering to the separated gravel. The rinse water passes through a filtration system to remove the fines and the filtered water is recycled back to the rinse unit forming a closed system. There are no cleaning agents or detergent added to the rinse water. The less than 3/8-inch stream is directed via a conveyor to a feed hopper for the radiological sorting system. Figure 2 shows the equipment layout of the individual units that comprise the pilot plant.

Radiological Sorting System

The radiological sorting system utilizes two banks of NaI detectors, calibrated to specific energy windows, which represent the contaminants of concern (Th-232 + Ra-226, U-238). The detectors then signal a segmented gate, which opens or closes to divert the section of soil (typically about 2 pounds) to the above or below criteria stockpile. The Radiological Sorting System continuously assays a soil stream and directs soil that is below a selected threshold activity level to a "below criteria" stockpile. The remaining soil with radioactivity above the selected threshold value is directed to an "above criteria" stockpile.

PILOT DEMONSTRATION PLANT

FIGURE 3



SOIL ACQUISITION AREA AND EXCAVATION

The area west of Building 76, As shown in Figure 2, was the selected location for the soil acquisition. The review of site data, showed the area west of Building 76 on the MISS property

had soil that was radioactively contaminated, and that the contamination was not evenly distributed through the soil mass. This area also contained fine grained lagoon sediments, and granular "overburden" and "surrounding" soil as defined in the Results of 1999 Engineering Test Pits Program at MISS. Contamination in the soil west of Building 76 was generally shallow and accessible without having to remove large quantities of "clean" overburden. The area was comprised of gravel, sandy-silt and silty-sand.

The dimensions of the excavation was approximately 190 feet by 165 feet at the ground surface, excavated to 6 feet in depth on a 1.5(H) to 1(V) slope at all sides. The extent of the excavation began about 65 feet west of Building 76, along the northern boundary of the site and projecting about 40 feet into Retention Pond A. The surface area excavated is partitioned into two areas identified as Stages I and II. Based on previously collected data, the Stage I excavation area was thought to be predominantly granular soils while the Stage II excavation area represented the retention pond sediment and its granular overburden. However during the excavation of the Stage I soils, a significant amount of retention pond material was encountered. As a result of this discovery, modifications were made to the planned excavation. Radiological heterogeneity and particle size distributions, the primary soil characteristics contributing to the operational performance, were adequately represented by the material processed from the modified soil acquisition area. Substantial quantities of overburden and surrounding soil were processed. Sufficient retention pond material was processed and an evaluation of the impacts on handling and processing was made.

Data Collection

A grid system was established over the area of soil to be excavated. Each grid was 5 feet x 5 feet x 1 foot deep (i.e., 25 ft³ of material). The grid system was established to aid in the designation and tracking of soils during excavation and processing. The surface of the soil to be excavated was scanned using a linked NaI-Global Positioning System (GPS) system. Areas of soil were referenced to the grid to locate and document radiological contamination. The radiological contamination mapped by the linked NaI-GPS system was used to guide the excavation. The grid system was used to select the soil to be processed.

The soil selected, called a batch represented one of the following scenarios:

- Granular material to be processed through the gravel separation system only;
- Granular material with radiological activity near the cleanup level;
- Granular material with radiological activity near the offsite disposal facility acceptance criteria;
- Retention pond material with radiological activity near the cleanup level;
- Retention pond material with radiological activity near the offsite disposal facility acceptance criteria;
- Material that was above the cleanup criteria (i.e., hot spot);
- Material that was below the cleanup criteria (i.e., below criteria);
- Material that was a combination of both above and below criteria.
- Retention pond material to be processed through the gravel separation system only;

Once a batch was designated, a smaller subset of the batch, known as a "slug" was selected. This smaller, more manageable quantity of soil was used to track activity and weight to compare pre-processing radiological measurements with those of the separated stockpiles at the conclusion of the processing. The data were used to evaluate mixing/dilution of soil contamination resulting from excavation, handling and processing.

Throughout the course of the pilot demonstration, substantial sampling of both the slug and batch was performed. 13 slugs and 40 batches were chosen for processing through the gravel separation and rinse system, and the soil sorting system. Sampling frequencies were dependent on the volume of soil being processed. The frequency of sampling increased during slug processing to gather the detailed data to evaluate the mixing/dilution effects caused by soils handling.

The slug consisted of nine 5' X 5' grids that were established within the soil acquisition area. In order to locate an appropriate sampling location within each grid of the slug, a NaI-GPS walkover was repeated for each grid of the slug. An average count rate for each grid was determined and a grab sample was collected at that location to represent that grid. The sample was sieved to $<3/8$ and then sent to the onsite laboratory for gamma spectroscopy analysis. Once one sample from each grid was collected, the slug was then excavated and stockpiled for processing. Samples were collected from three locations during the processing of the slug. The first location was at the feed conveyor for the radiological sorting system. The second and third locations were from the below and above criteria conveyors at the discharge of the radiological sorting system. The samples were collected at ten-minute intervals at each of the three locations in order to represent the total volume of the slug being processed. A total of approximately 130 in-situ samples and 200 processed samples were collected throughout the course of the demonstration for slug processed soil.

After the slug processing was complete, the associated batch was then excavated and stockpiled. During batch processing, samples were collected from several different locations within the gravel separation and rinse systems, and the soil sorting system. An initial sample was collected from each stream at the one cubic yard mark and then every 50 cubic yards thereafter. The process streams consisted of the >6 " oversize material, $3/8 - 6$ " material separated by the gravel system, and $< 3/8$ soil. The $<3/8$ process stream was assayed by the radiological sorting system and directed into the above or below criteria stockpiles. The sorting criteria were varied during the pilot demonstration to evaluate performance at different set criteria. Samples collected from these varying streams were analyzed for both chemical and radiological parameters. Chemical parameters included VOCs, SVOCs, Pesticides, PCBs, TAL Metals, TRPH, and waste characteristics such as reactivity and pH. This analysis was used to assist in characterizing the material for final disposal. A total of approximately 200 chemical samples was collected during the course of the pilot demonstration and sent to an off-site lab for analysis. Supplementary QA/QC samples were also collected and sent off-site. In addition, four to five samples were collected between the gravel system and the rinse system to evaluate the contribution the rinse unit made to the cleaning of the gravel. The samples collected between the gravel and rinse systems were analyzed for gamma spectroscopy only.

OBSERVATIONS

During the performance of the pilot demonstration several important observations were made. These observations enhanced the understanding of the performance of the entire system including operational issues such as debris in the soil, moisture content, limitation on excavation methodologies, material handling, dust and noise. These observations are discussed below. The gravel separation system performed well with a feed rate of 100 to 150 tons per hour. Gravel extraction was about 25 percent leaving 75 to 113 tons per hour of sifted soil for radiological sorting. However, the amount of fine-grained soil carried-over with the gravel was higher than anticipated. The carry-over was due to two situations that were observed during operations. The first situation observed was the effect of fabric and pieces of plastic sheeting and sods that are part of the soil mass. Geotextile fragments and plastic sheeting "raft" fines over the screen deck, preventing all the fine grained soil from falling through the screen. Some of these materials do pass through the screen and retain the soil within it through the shaker into the rinse unit as part of the gravel. The second situation observed was that compacted silt and clay within the soil mix were not completely reduced by attrition during the gravel separation. The compacted silt/clay fragments were retained on the gravel screen as fragments and passed to the coarse side of the gravel separation. When the silt/clay fragments were transported up the stacking conveyor, and dumped into the gravel stockpile, the soil fragments were crushed to fine-grained soil. In addition, the separated coarse (+3/8) continue to generate fine particles due to abrasion and crushing that results from drops through the chute and over the stacker conveyor belts. The carry-over and "rafting of the fines required modification to the rinse unit and necessitated additional sump storage capacity to capture the fine sand and silt at the discharge end of the rinse unit prior to filtration.

Attempts were made to process retention pond material by feeding directly into the radiological sorting unit and by feeding into the gravel separation system. The retention pond sediments have a high water content, about 40% as determined in the field lab by oven drying. When the sediments are shaken or vibrated, they quickly changed to a pasty consistency and adhered to the surfaces of the soil processing components and did not journey properly on the conveyor belts. Without pretreatment to reduce the water content, processing the retention pond sediments with the pilot plant processing systems will not be possible.

The radiological sorting system processes at approximately 25 tons per hour. Employing a 30 cubic yard surge hopper between the gravel separation unit and the radiological sorting system accommodated the differences between the throughput of the two units. The hopper allowed for continuous SGS operation. The SGS system ran continuously, but stopped periodically to measure soil density. Otherwise the unit had minimal down time due to electrical, mechanical, or software related disruptions.

The excavated soil fed to the gravel separation system consisted of native soil, backfill, construction and organic debris, and remnants of geotextile fabric and polyethylene sheeting. The construction debris including concrete reinforcing bars and structural steel accelerated the wear on the conveyor belts. The belts were rated moderate-duty, and several belt tares occurred. Belt repair accounted for most of the gravel unit's "down time". Heavy-duty belts are needed to handle the debris laden soil at the FMSS and will significantly reduce the belt repair

downtime. The steel and the flexible screens used on the screening plant held up well despite the debris that was processed with the soil.

A major concern regarding the performance of the pilot plant was the degree of mixing that occurred during the excavation and the handling of the soil from the soil acquisition area. The benefits of radiological sorting are minimized in proportion to the degree of mixing that takes place. Sampling of soil before and after processing will enable the degree of mixing to be quantified. At the writing of this paper, final test results were not available; nevertheless field observations made during the pilot indicate that sufficient heterogeneity can be preserved to beneficially employ the radiological sorting system.

Dust monitoring in the vicinity of the pilot plant was performed continuously during operations. Portable dust monitors and personnel dust monitoring devices were employed. During the performance of the work no dust exceedances were recorded.

During the performance of the pilot program, processed soil was extensively sampled, weighed using belt scales and bucket scales, and transported to a designated load-out area. The degree of handling was significantly more than what would be required during remediation. During remediation the level of sampling would be less and conveyor belt scales would track the process streams mass. Transport of material to load-out or reuse stockpiles could be simplified through the integration of conveyors systems.

The rinse unit of the gravel separation system was able to remove the fine-grained soil off the gravel despite the large amount of fines that were carried-over during the gravel separation. The high fines required significant effort to clean the sediment collection sump and overworked the water filtration system. Future considerations will include the installation of a sediment-handling component similar to a belt filter, and a more robust water clarification system.

Overall the systems employed during the pilot demonstration performed well. As at preparation of this paper, a complete analytical data package has not been created. Laboratory analyses have not been completed and the evaluations of those data have yet to be performed. Nevertheless observations made during the pilot operation suggest the viability of integrating the systems demonstrated during the pilot operation into the remediation of the Maywood site.