Declaration For The Record of Decision

Site Name and Location

Tyson's Superfund Site
Upper Merion Township, Montgomery County, Pennsylvania
Operable Unit Three

Statement of Basis and Purpose

This decision document represents the selected remedial action for the Operable Unit Three at the Tyson's Superfund Site, in Upper Merion Township, Pennsylvania, developed in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), 42 U.S.C. § § 9601 et seq. and, to the extent practicable, the National Contingency Plan (NCP), 40 C.F.R. Part 300. This decision is based on the Administrative Record for this site.

The Commonwealth of Pennsylvania has concurred on the remedy.

Assessment of the Site

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this Record of Decision, may present an imminent and substantial endangerment to public health, welfare, or the environment.

Description of the Remedy

This remedy addresses containment and remediation of contaminated ground water by reducing the risks posed by the site through engineering and institutional controls.

The selected remedy includes the following major components:

- Installation of six additional recovery wells on the south bank of the Schuylkill River, expanding the existing interim ground water recovery system from seven recovery wells to thirteen recovery wells.
- Installation of ground water recovery wells on Barbadoes Island, unless a more suitable location for pumping ground water is determined during the design of this remedy.

ORIGINAL (Red)

- Construction of a pipeline, if necessary, beneath the Schuylkill River to transport contaminated ground water, pumped from Barbadoes Island, or more suitable locations as determined during design, to the existing treatment facility located on the south bank of the River.

- Investigation of hydrogeologic conditions on the north side of the Schuylkill River.

- Operation and maintenance of the ground water recovery system and ground water monitoring, for 30 years.

- Initiation of institutional controls restricting ground water use on Barbadoes Island and on the north side of the river within the contaminated groundwater plume.

Statutory Determinations

The selected remedy is protective of human health and the environment, attains Federal and State requirements that are applicable or relevant and appropriate, and is cost-effective as set forth in Section 121(d) of CERCLA. 42 U.S.C. § 9621(d) and Section 300.68 of the NCP. This remedy satisfies the statutory preferences as set forth in Section 121(b) of CERCLA, 42 U.S.C. § 9621(b), for remedies that employ treatment that reduce toxicity, mobility or volume as a principle element. Finally, it is determined that this remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable.

Because this remedy will result in hazardous substances remaining in the ground water, a review will be conducted within five years after commencement of remedial action to ensure that this remedy continues to provide adequate protection of human health and the environment.

Edwin B. Erickson
Regional Administrator
Region III

9/28/90
Date

ORIGINAL (Red)

Site Description and Summary of Remedial Alternative Selection for the Tyson's Superfund Site Montgomery County, Pennsylvania

Site Location and Description

The Tyson's Superfund site is an abandoned septic waste and chemical waste disposal site located in Upper Merion Township, Montgomery County, Pennsylvania (Figure 1). The approximate 4-acre plot, which constitutes a series of former unlined lagoons in a former sandstone quarry, is bordered by unnamed tributaries to the Schuylkill River on the east and west, a steep quarry high wall to the south, and a Conrail railroad switching yard to the north. The site is surrounded by residential areas to the south and west. The former sandstone quarry was apparently excavated into weathered and fractured bedrock along an east-west treading ridge, forming two bowl-like depressions divided by a bedrock ridge into eastern and western sides. The excavation can be described as a large eastern pit and a less well-defined western excavation that consists of a series of low benches. A high wall of up to 40 feet separates the former lagoon area from the Conrail tracks to the north, while the high wall to the south of the former lagoon area is as high as 100 feet above the former lagoons.

The Schuylkill River is the main source of drinking water in the area and supplies Norristown and parts of Philadelphia with intakes down river of the site. The River also has recreational uses including fishing and boating. Except for a couple of wells located upgradient from the site and in Norristown, groundwater is not used as a potable source in the area surrounding the Tyson's site. Groundwater flow is North towards the river.

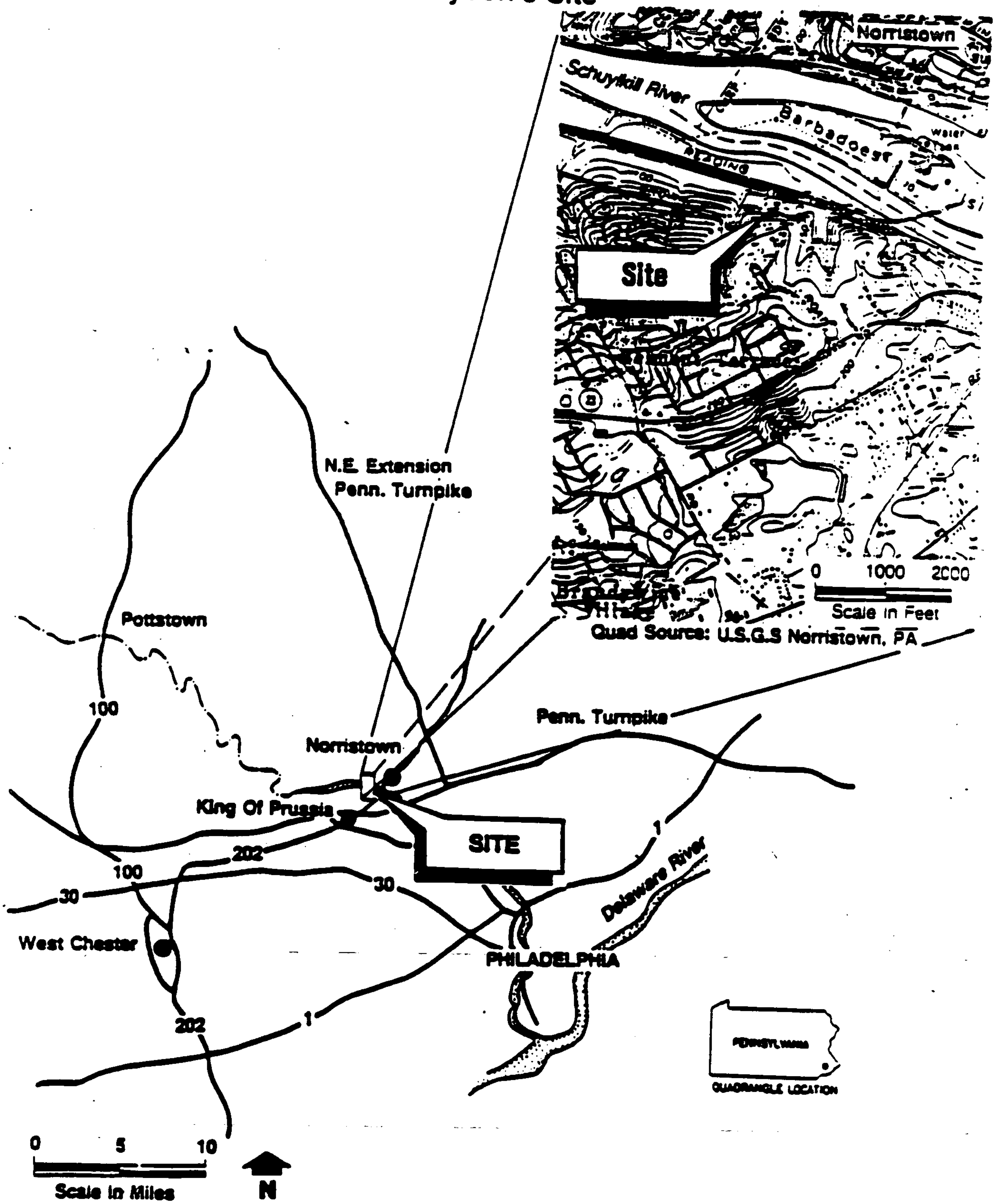
The Schuylkill River flood plain and the wetlands area is located north of the Conrail tracks and lies within the 100-year floodplain. Barbadoes Island is situated in the middle of the Schuylkill River directly north of the site. A former coal-fired electric power generating station operated by the Philadelphia Electric Company (PECO) currently occupies the island. The facility is currently used for company training, for equipment storage, and as an electrical substation.

The Township of West Norriton and the City of Norristown are located on the north side of the river. These areas are primarily residential and light commercial with some small manufacturing facilities.

Site History and Enforcement Activities

From 1960 to 1970 the site was owned and operated first by unincorporated companies owned by Franklin P. Tyson and then by

Figure 1
Location Map
Tyson's Site



ORIGINAL (Red)

Fast Pollution Treatment, Inc. The stock of this corporation was owned by the current owner of the land, General Devices, Inc. (GDI), and by Franklin P. Tyson. GDI was active in the management of Fast Pollution Treatment, Inc. The site was used for disposal of liquid septic tank wastes and sludges and chemical wastes that were hauled to the site in bulk tank trucks. The major responsible parties using the site for disposal were Ciba-Geigy Corp., Wyeth Labs Inc., Smith, Kline, Beckman Corp., and Essex Group Inc. It appears that as the lagoons were filled with wastes and subsequently covered, new lagoons were created.

In 1969, the property was purchased from Fast Pollution Treatment, Inc. by GDI. In 1973, the Pennsylvania Department of Environmental Resources (PADER) ordered the site owner, GDI, to close the facility. During closure, the lagoons were reported to be emptied of standing water, backfilled, and vegetated and the contents transported off site.

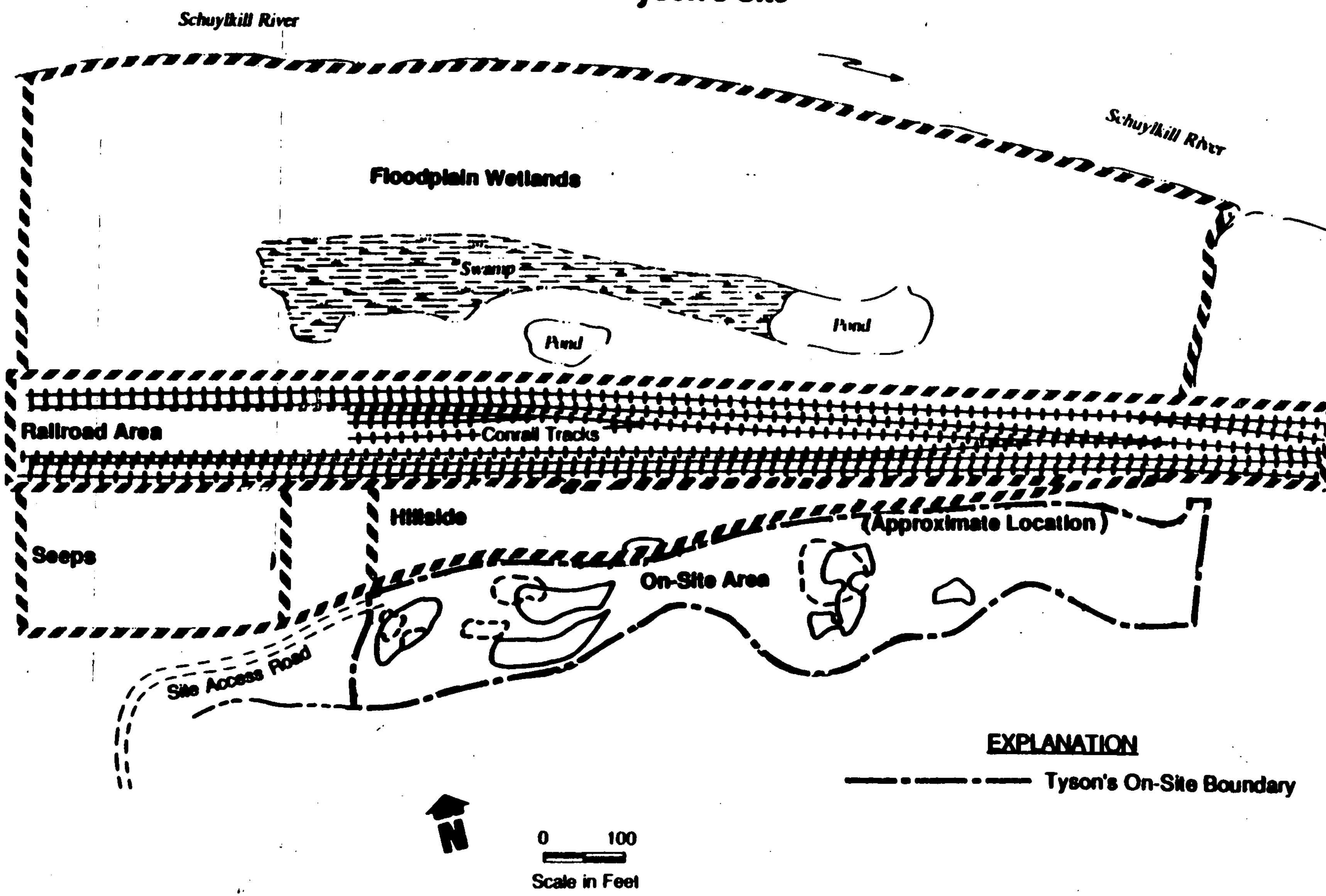
In January, 1983, EPA investigated an anonymous citizen complaint about conditions at Tyson's and subsequently determined that immediate removal measures were required. These measures included the construction of a leachate collection and treatment system, drainage controls and cover over the site, and the erection of a fence around the site.

Between January 1983 and August 1985, the U. S. Environmental Protection Agency (EPA) and its subcontractors conducted a series of investigations, primarily in what has been referred to as the on-site area. The on-site area was defined as the area south of the railroad tracks and within or immediately adjacent to the security fence erected during the emergency response measures (Figure 2). The on-site area encompasses the former lagoons. The Tyson's site was placed on the National Priorities List on September 21, 1984. In December 1984, EPA issued its Record of Decision (ROD) for the on-site area. The ROD selected excavation of the materials in the former lagoons and off-site disposal of these materials.

Following issuance of the ROD, EPA began remedial design for the selected alternative in January 1985. This design included additional borings throughout the lagoon area to define the volume of material to be excavated. In August 1985 through November 1985 EPA performed additional borings and magnetometer surveys throughout the lagoon area to better delineate the areas to be excavated.

In the fall of 1985, Ciba-Geigy Corporation agreed to conduct further investigations of the off-site area, the need for which was described in the December 1984 ROD. The off-site area is defined as the area outside the security fences that surround the former quarry dump site, including the deep aquifer (bedrock aquifer). The off-site area was subdivided into five sub-areas

Figure 2
Off-Site Operable Units
Tyson's Site



(Figure-2), including the Deep Aquifer, Hillside Area, Railroad Area, Floodplain/Wetlands and Seep Area.

In March 1986, Environmental Resources Management, Inc. (ERM) prepared and submitted to EPA Region III on behalf of Ciba-Geigy a draft of "The Work Plan for Remedial Investigation /Feasibility Study of Tyson's Site Off-Site Operable Unit." The final work plan was attached by EPA Region III to an Administrative Consent Order (ACO), signed by EPA and Ciba-Geigy Corporation on May 27 1986. Prior to submittal of the final version of the work plan, EPA granted Ciba-Geigy and ERM permission to conduct certain tasks of the Off-Site Operable Unit Remedial Investigation/ Feasibility Study (RI/FS) before the effective date of the ACO. Activities completed during this time have been termed "interim work" and consisted of monitoring well installation, testing, and sampling.

Based upon field observations during drilling and sampling and the analysis of ground water samples collected during the interim work, it was evident that the work as detailed in the March 1986 Work Plan would have to be amended prior to the completion of the Off-Site Operable Unit Endangerment Assessment (EA) and FS. The first Addendum to the Off-Site Operable Unit RI/FS Work Plan was prepared by ERM and submitted to EPA in July 1986. The scope of work for the first addendum included the installation of additional monitoring wells. Schuylkill River water and sediment sampling, residential and community well sampling on the north side of the River, dense nonaqueous phase liquid (DNAPL) testing and additional soil borings.

In November 1986 Ciba-Geigy Corporation initiated an on-site pilot study using an innovative vacuum extraction technology process. Due to zoning restrictions, the pilot study operated for only a short duration (less than 10 days). However, in May 1987, the pilot study was permitted to operate for more than three weeks.

On December 8, 1986, ERM submitted to EPA the Draft Off-Site Operable Unit RI and EA Reports for the Tyson's site. These reports presented the results of the investigation as originally detailed in the initial work plan and the first addendum to the work plan. Based on the results and conclusions of the Off-Site Operable Unit RI and EA, it was recommended that the selection of the potential remedial measures for the Hillside Area, Railroad Area, Floodplain/Wetlands Area, and the Seep Area Operable Unit be addressed in the Off-Site Operable Unit Feasibility Study (FS), However, regarding the deep aquifer and Schuylkill River it was recommended that additional tests be conducted prior to assessing potential remedial measures. The Off-Site Operable Unit FS did address alternatives for the portion of the deep aquifer which extends under the on-site area to the south bank of the Schuylkill River.

On March 24, 1987, a second addendum to the off-site RI work plan was submitted to EPA by Ciba-Geigy Corporation. This addendum included a detailed investigation of the Schuylkill River and the installation of wells on the north side of the river.

On July 29, 1987, Ciba-Geigy Corporation submitted the final draft Operable Units RI report to EPA which included the results of the second addendum. This report concluded that much of the site contamination, specifically the dense non-aqueous phase liquids (DNAPLS), were in the underlying bedrock and aquifer. The report also found that a dissolved portion of the DNAPLs was discharging into the Schuylkill River.

In June and July 1987, four responsible parties, Ciba-Geigy Corporation, SmithKline Beckman, Wyeth Laboratories, and Essex Group submitted a proposal to EPA for clean-up of the on-site (lagoon) areas, upgrading of the leachate collection system and cleanup of the tributary sediments. Additionally, the parties proposed to initiate groundwater remediation measures since the information contained in the draft Off-Site Operable Units RI report indicated that much of the contamination formerly in the lagoon areas was now in the aquifer system, down gradient of the site, and was discharging to the Schuylkill River.

The parties' proposal was based on a Comprehensive Feasibility Study (CFS) submitted to the Agency on June 15, 1987. The CFS was developed independently by Ciba-Geigy Corporation and was not formally commented on by EPA. The CFS incorporated the results of the innovative vacuum extraction process for clean-up of the lagoon soils, preliminary results of the Off-Site RI and additional studies for the installation of groundwater recovery wells. Some of the results of the CFS indicated that the contaminants in the bedrock underlying the lagoons would be a source of continuing contamination of backfilled soil used to replace soils excavated pursuant to EPA's ROD. The study raised the possibility that the remedy selected in the December, 1984 ROD would be of limited effectiveness without the installation of a barrier which would limit upward movement of contamination from the underlying bedrock.

As a result of the parties proposal based on the CFS, EPA negotiated a Partial Consent Decree with Ciba-Geigy Corporation, SmithKline Beckman, Wyeth Laboratories, and Essex Group to implement an innovative technology, vacuum extraction, that would be more effective than excavation in removing the contamination from the soils and underlying bedrock at the on-site area. In March, 1988 EPA revised the soil excavation ROD of December, 1984 to replace the excavation remedy with the innovative vacuum extraction remedy. The partial Consent Decree was signed and entered June 20, 1988. The vacuum Extraction process was put in full operation in November, 1988 and to date has removed approximately 100,000 pounds of organics from the contaminated soils on-site.

On August 23, 1988, ERM submitted, on behalf of Ciba-Geigy, the draft Off-Site Operable Unit FS to EPA. This report recommended a no-action alternative for the Seep Area, Railroad Area, Hillside Area, and Floodplain/Wetlands areas. The second ROD for the site signed on September 29, 1988 and based upon the Off-Site Operable Unit RI/FS Report, selected the no-action alternative for those areas of this second operable unit.

With regard to the deep aquifer, the Off-Site Operable Unit FS primarily focused on the recovery and treatment of contaminated groundwater south of the Schuylkill River. A recovery well network was designed by S. S. Papadopulos and Associates, Inc. (SSPA, 1988) to intercept contaminated groundwater along the south bank of the river. Many treatment alternatives were examined by the Off-Site Operable Unit FS as to their applicability for treatment of the contaminated ground water. Ground water recovery from a line of wells along the south shore of the River with treatment via steam stripping followed by liquid-phase carbon, if required as a polishing step, was selected as the ground water alternative in the second ROD for the Tyson's site.

At the conclusion of the Off-Site Operable Unit Feasibility Study (FS), it was determined that additional investigation of the extent of site-related compound migration in the deep aquifer north of the south bank of the Schuylkill River was required before remediation of the ground water affected by the Tyson's site could be fully addressed. Specifically, the objectives of the additional work described in the Third Addendum to the Off-site Operable Unit Remedial Investigation (RI) Work Plan were to:

- Complete, to the extent possible, the delineation of the extent of dissolved phase site-related compound migration in ground;

- Establish boundaries on the distribution of DNAPLS; and

- Obtain sufficient information relative to the mechanisms controlling the movement of ground water south, beneath, and north of the Schuylkill River so that alternatives for remediation of site-related compounds in the deep aquifer could be properly evaluated.

The Third Addendum Investigation included the sequential installation of additional monitoring wells on Barbadoes Island and on the north side of the River, along with extensive hydrogeologic testing and ground water sampling. As a result of these activities, sufficient information was obtained on the mechanisms of ground water flow and extent of site-related compounds to permit completion of a focused Feasibility Study for that portion of the deep aquifer that extended to the north bank of the River. The off-site operable unit third addendum RI and FS reports were submitted to EPA in May and June, 1990 respectively. Based on these reports it was determined that additional information on the relationship of the ground water in the deep aquifer north of the river to the river should be obtained.

Community Relations

The Third Addendum focused RI/FS, Proposed Plan and background documentation for the Tyson's site were made available to the public on July 24, 1990 in the local information and administrative record repository at the Upper Merion Township Municipal Library located in the Upper Merion Township Municipal Building, Upper Merion Township, Pennsylvania. Notice of the availability of these documents, of a public comment period, and a public meeting was published in both the Philadelphia Daily News and the Norristown Times Herald on July 24, 1990. A public comment period was held from July 24, 1990 through September 23, 1990. Additionally, a public meeting was held at 7:00 p.m. on August 9, 1990, at the Upper Merion Township Municipal Building. At this meeting, representatives from EPA and PADER answered questions about the Tyson's site and the remedial alternative under consideration. Written comments received during the public comment period are addressed in the Responsiveness Summary which is an attachment to this Record of Decision. The above actions satisfy the requirements of Sections 113(k) (2) (i-v) and 117 of CERCLA, 42 U.S.C. § § 9613(k)(2) (i-iv) and 9617.

Scope and Role of Operable Units

Between January 1983 and August 1985, EPA conducted a series of investigations, primarily in what had been referred to as the on-site area (operable unit 1). The on-site area encompasses the former lagoons (see figure 1). In March, 1988, EPA issued a revised Record of Decision (ROD) for the on-site area (operable unit #1) which selected a remedy proposed by Ciba-Geigy Corporation, namely soil vacuum extraction. This remedy, which is performing an in-place cleanup of contaminated soils was commenced at the site in November, 1988.

The second operable unit at the Site consist of contaminated groundwater in the bedrock aquifer up to the south bank of the Schuylkill River. This contaminated groundwater was discharging to the River. In September, 1988 EPA issued a second ROD to address treatment of contaminated groundwater discharging to the Schuylkill River along the south bank. This second ROD which was selected steam-stripping of the contaminated groundwater, as commenced at the Site in March, 1990.

The current ROD for, Operable Unit 3, addresses further remediation of the contaminated groundwater which has migrated beneath, and as far as, the north bank of the Schuylkill River. This contaminated groundwater is one of the primary concerns posed by the site. Additional investigations will be conducted on the north side of the River as part of the alternative selected for this operable unit. Based on the result of those investigations, a fourth operable unit may be identified and further remediation of the groundwater may be warranted.

Summary of Site Characteristics

Previous Groundwater Investigations

Conclusions from the groundwater investigations from the original Off-site RI and first and second addenda (except for wells north of the River) indicate that the deep bedrock aquifer between the former lagoons and the Schuylkill River is contaminated with a DNAPL and a dissolved phase derived from the DNAPL. The DNAPL, which is composed primarily of 1,2,3, trichloropropane, xylenes, ethylbenzene and toluene most probably entered the bedrock system through direct infiltration from the former lagoons, which were situated directly on or in the highly weathered and fractured bedrock. Once in the bedrock, the DNAPL flowed along the weathered bedding planes and fracture zones in the Lower Stockton Formation and coated and penetrated the walls of the fractures and bedding planes. The DNAPL has migrated through the deep aquifer as far as the south bank of the Schuylkill River to depths as great as 140 feet. The presence of residual DNAPL will continue to generate dissolved-phase contamination in the deep aquifer and is the present source of ground water contamination to the deep aquifer. The dissolved-phase contaimination consist of dissolved organic constituts such as trichlopropane, toluene, xylenes and ethylbenzene.

The groundwater flow direction in the deep aquifer is north toward the river. An upward flow gradient exist in the deep aquifer underlying the floodplain and indicates that both the ground water and dissolved phase contamination is discharging to the River within the regional ground water flow system.

Based upon the above conclusions, it was determined in the off-site FS and subsequently included in the September 1988 ROD that ground water recovery and treatment was necessary to address contaminated ground water discharging to the Schuylkill River.

Geology/Hydrogeology

Bedrock Geology

Based on the Third Addendum RI report, the bedrock underlying the area being investigated has been arbitrarily subdivided into three heterogeneous lithologic units as shown in Figure 3. A description of each of these units is provided below. The three units are, from deepest to shallowest: a coarse green arkosic sandstone; a purple arkosic sandstone; and a red siltstone and fine sandstone.

Green Arkosic Sandstone

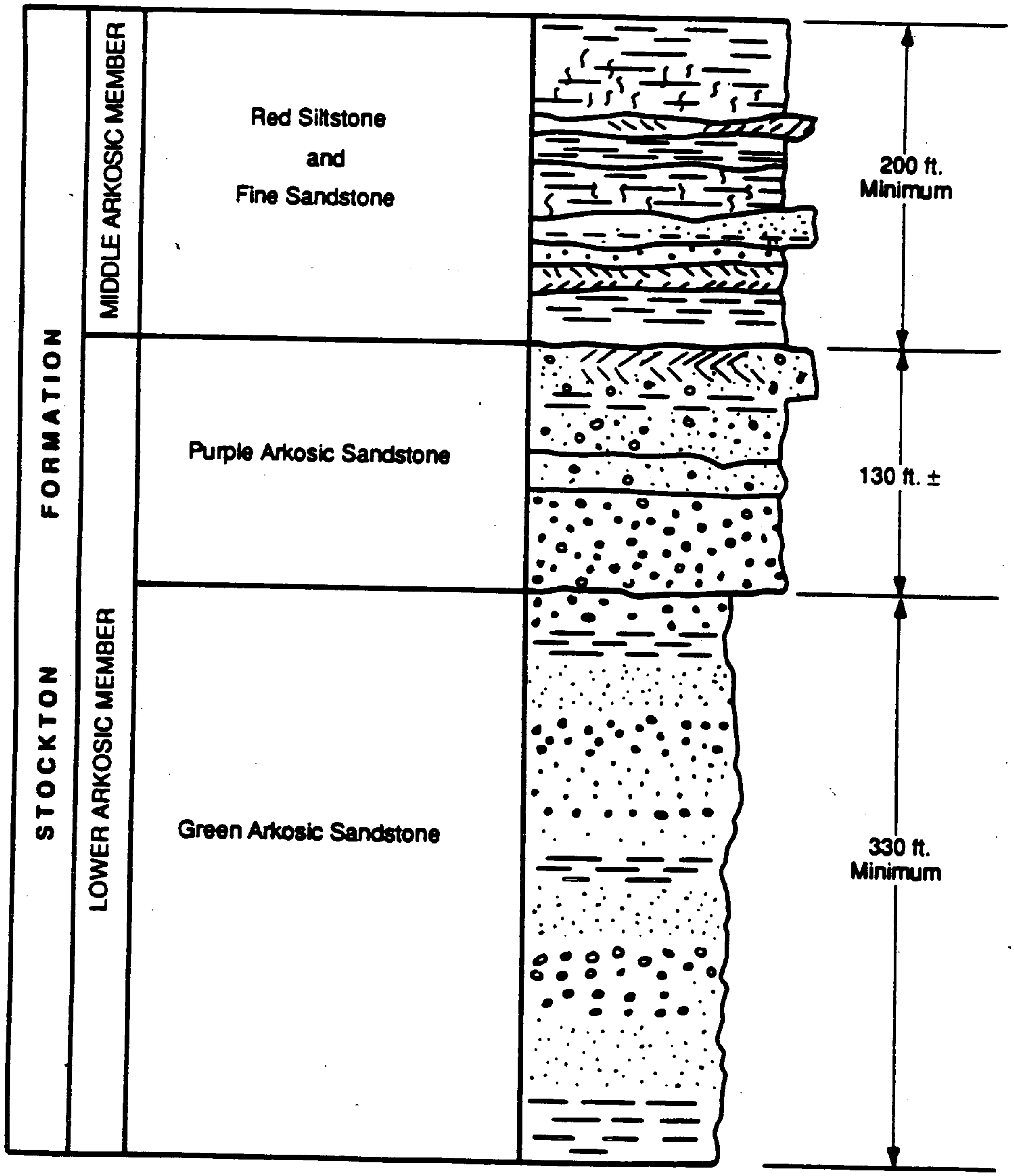
The lower, or deepest encountered, lithologic unit consists of medium coarse and very coarse-grained green arkosic sandstone. This unit will be arbitrarily called the lower unit of the Lower Arkosic Member of Stockton Formation. This unit has an average feldspar content greater than 25 percent. The feldspars vary in color from cream to orange, especially in the upper part of this unit. Lithic fragments observed in this unit include amphibolite, talc, serpentinite, schist, and shale. This unit was observed to be at least 330 feet thick at Deep Bedrock Well 1 (DB-1) on the north side of the river. In DB-2 this unit was observed to have a thickness of about 178 feet. This unit has also been encountered in wells on the south side of the Schuylkill River where minimum thicknesses of about 200 feet were observed. The overall color of this unit is pale greenish grey, bright green, and dark green. It contains interbeds of shale and sandstone, sometimes 10 to 30 feet thick, that do not appear to be continuous across the area. The shale is usually red to redbrown in color. Occasional dark green shales were also observed. Rocks similar in description to this unit appear to be fairly extensive laterally and have been encountered not only in DB-1 and DB-2 but also in MW-1 (the site background well on the south side of the river) and Cored Well (CW-4), CW-5, MW-15S, and MW-15D on the north side of the river.

The strata of this unit are probably highly susceptible to chemical weathering due to the instability of the feldspar grains. In Norristown, an example of this weathering was observed where a stone wall built upon an escarpment of this unit has been undercut due to weathering. CW-5, located on Barbados Island, was difficult to install due to the highly weathered nature of this unit. This unit is referred to in the RI report as the green arkosic sandstone.

Purple Arkosic Sandstone

The unit overlying the green arksic sandstone is arbitrarily called the upper unit of the Lower Arkosic Member of the Stockton Formation and consists of arkosic, medium to coarse grained and

Figure 3
Stratigraphic Column
Tyson's Site



No Scale

very coarse-grained sandstone and arkosic conglomerate with a few minor siltstone. This unit decreases in grain size upward. There is considerable variability in grain size within this unit, but generalizations can be described. Coarse grain sizes occur in this unit, including well rounded quartz pebbles near the base, lithic fragments, and red shale fragments. Rip-up clasts of red shale have been seen in conglomerates with the clasts within bedding suggestive of imbrication. True bedding planes are difficult to determine, and the unit occasionally contains dark lamellae suggestive of cross bedding. Cross bedding with lamellae is not visible in the underlying green arkosic sandstone. Colors of this unit range from dark grey, dark purple, pink, and reddish-brown, often with a distinctive salt-and-pepper appearance due to the presence of feldspar. Usually the individual grains are quite well cemented as observed in hand specimens. Drill rates were noticeably less in this unit in comparison to the finer grained overlying unit.

Topographically, the unit appears to be a ridge-former in comparison with the less resistant green arkosic sandstone. The thickness of this unit is estimated to be at least 100 feet and perhaps as much as 150 feet within the area of investigation. This unit is referred to in the RI report as the purple arkosic sandstone due to its purplish to grayish-purple tints, particularly towards the bottom of the unit.

Red Siltstone and Sandstone

Rocks at the site stratigraphically above the two units of the Lower Arkosic Member of the Stockton Formation described above have been identified as the Middle Arkosic Member of theStockton Formation. Rocks of the Middle Arkosic Member has been mapped by the Pennsylvania Topographic and Geologic Survey as occurring partially on the western end of Bardbadoes Island and also extensively on the north side of the Schuylkill River starting at a point just west of Haws Avenue and continuing westward.

Rocks in this upper unit were observed to be generally finer grained than those in the two underlying units and had a much greater proportion of red siltstone and shale. The general arkosic character of rocks, as observed in the Lower Arkosic Member, tends to disappear and the proportion of mica increases with decreasing depth. Grains are generally loosely to moderately cemented. Many shale units appear to have white discolored stringers and irregularly shaped spherical masses. These may be the remains of animal burrows in what were at one time muds at a shallow depth. Similar burrows occur less frequently in stratigraphically lower rocks.

Individual rock layers in all three of the units appear to have a high degree of variability, especially in the Middle Arkosic Member.This is in keeping with the probable alluvial fan (fluvial) depositional environment of many of these rocks. Due to this variability, units with thicknesses of 100 feet or more have been chosen for correlation.

Bedrock Hydrogeology

The bedrock aquifer at the Tyson's site is the Lower Member of the Stockton Formation. Recharge to the bedrock aquifer occurs in the areas south of the site where the Lower member is exposed or close to the surface. Both primary and secondary permeability are apparent in all three zones monitored in the bedrock aquifer. Primary permeability is contributed from the intergranular space between grains of material comprising the matrix of the bedrock. Primary permeability is variable depending on the competency of the matrix between the coarser grains. The matrix experiences variable degree of weathering observed at the site outcrops and in cores obtained during previous investigations. Highly weathered portions of the aquifer provide greater primary permeability due to the decomposition and removal of the matrix. In less weathered intervals, the argillaceous matrix fills the space between coarse grained material, thus reducing permeability.

Secondary permeability is contributed by discontinuities such as joints, fractures, faults, and weathered bedding planes. The occurrence of significant zones of enhanced secondary permeability is represented by fracture traces. The fracture traces are indicative of vertical planes of fracture concentration. These planes act as conduits for groundwater flow and represent preferred paths for the migration of contaminants in groundwater.

Groundwater and Schuylkill River water levels have been monitored at the site as part of a number of investigations. As part of the Third Addendum RI, water level elevations have been measured on a regular basis for the completed monitoring wells on Barbadoes Island and the north side of the river. Using the groundwater elevation data, an attempt was made to describe the occurrence of groundwater in the deep aquifer in the vicinity of the Tyson's site, both prior to and following the start up of the Interim Ground Water Recovery System (November 1988) An attempt was also made to describe the seasonal variations in water levels, the relationship of groundwater levels in the deep aquifer to the Schuylkill River, and the horizonal and vertical components of groundwater flow.

The potentiometric surface maps shown in figures 4, 5 and 6 reflect groundwater conditions on October 13, 1989 in the shallow, intermediate, and deep zones of the deep aquifer on the south side of the River prior to the initiation of pumping at the Interim Ground Water Recovery System. Within the shallow zone, the potentiometric surface reflects the surface topography with a

Figure 4

Shallow Potentiometric Surface
Tyson's Site - October 13, 1988

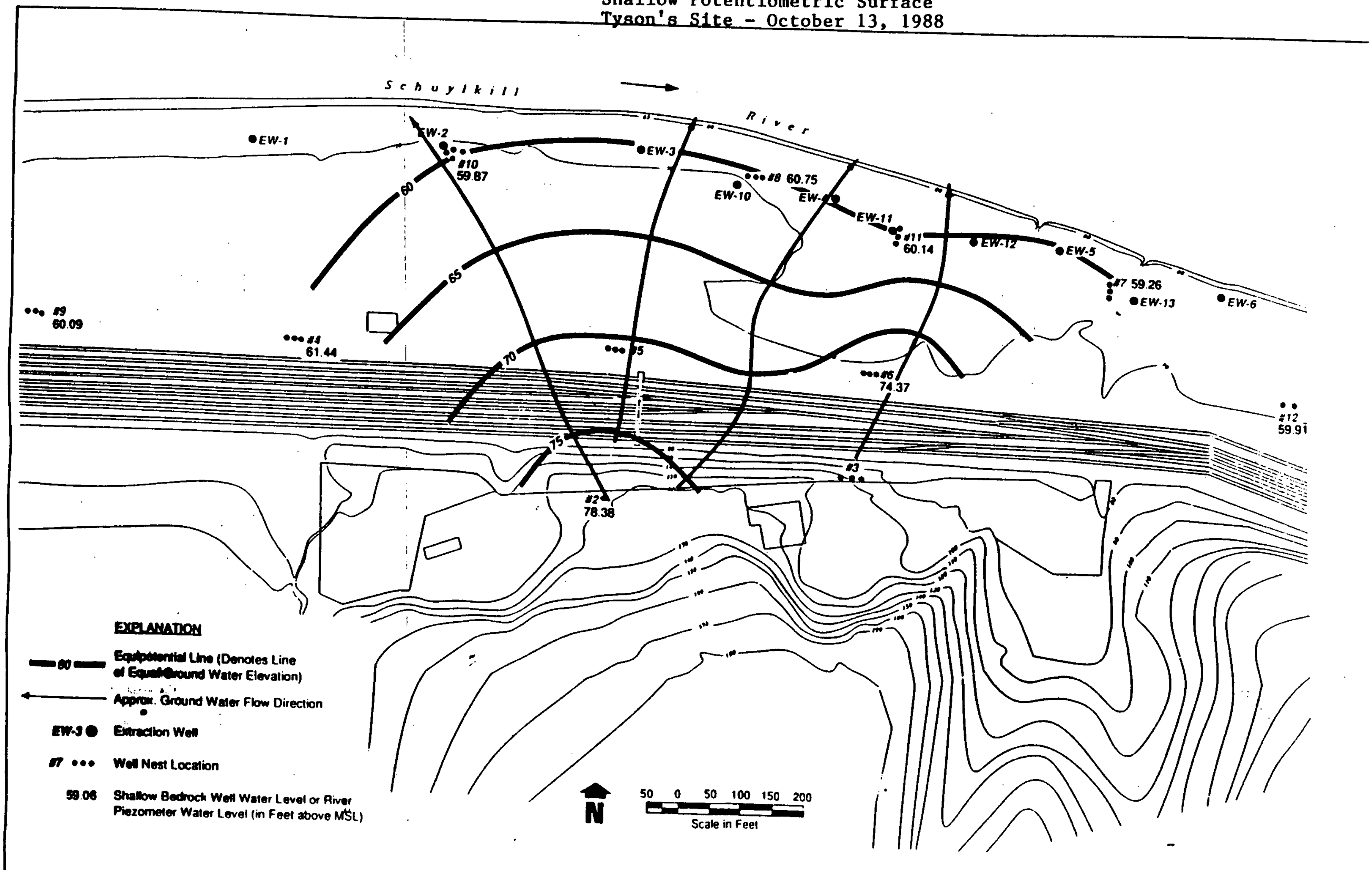
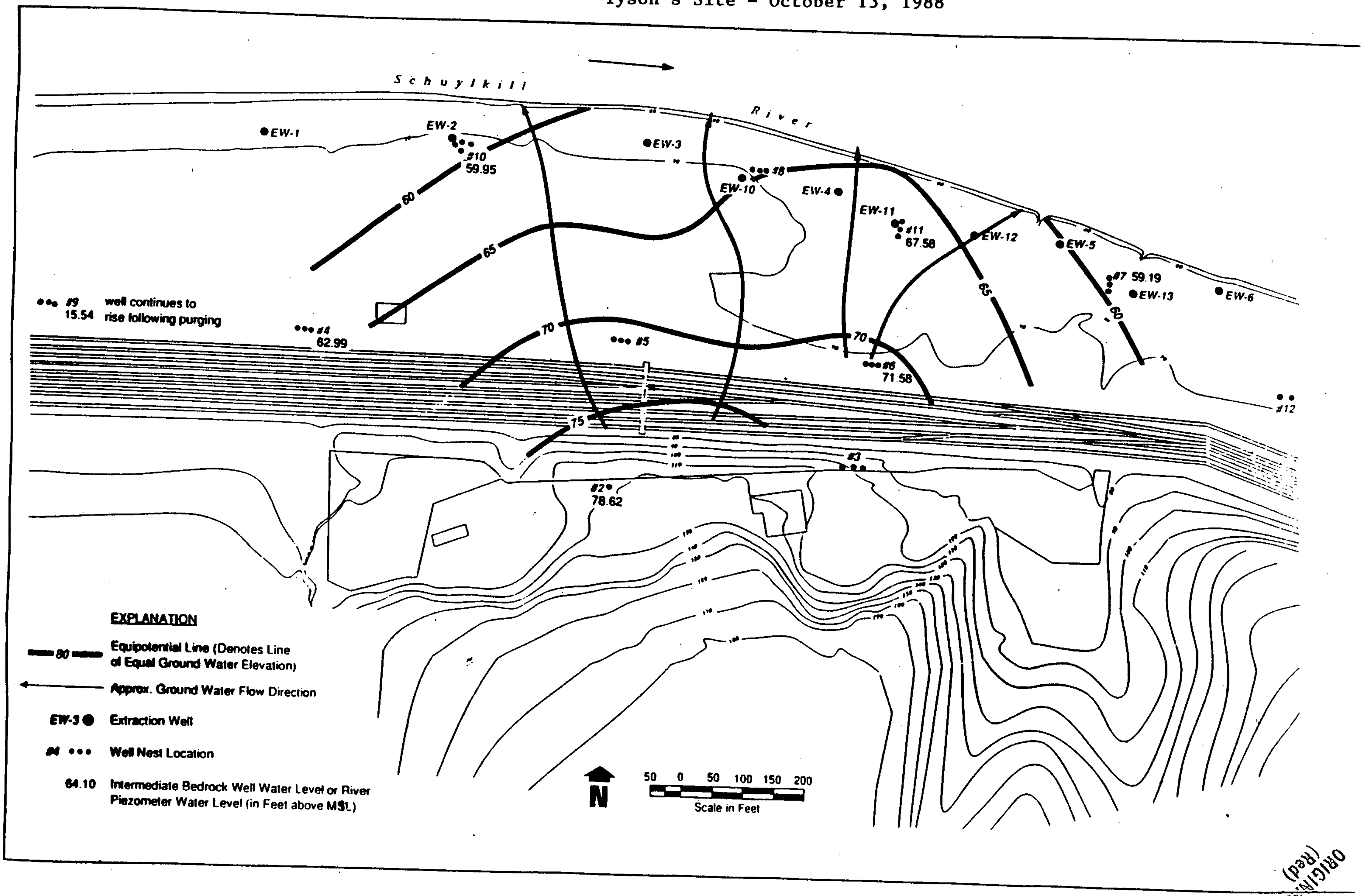


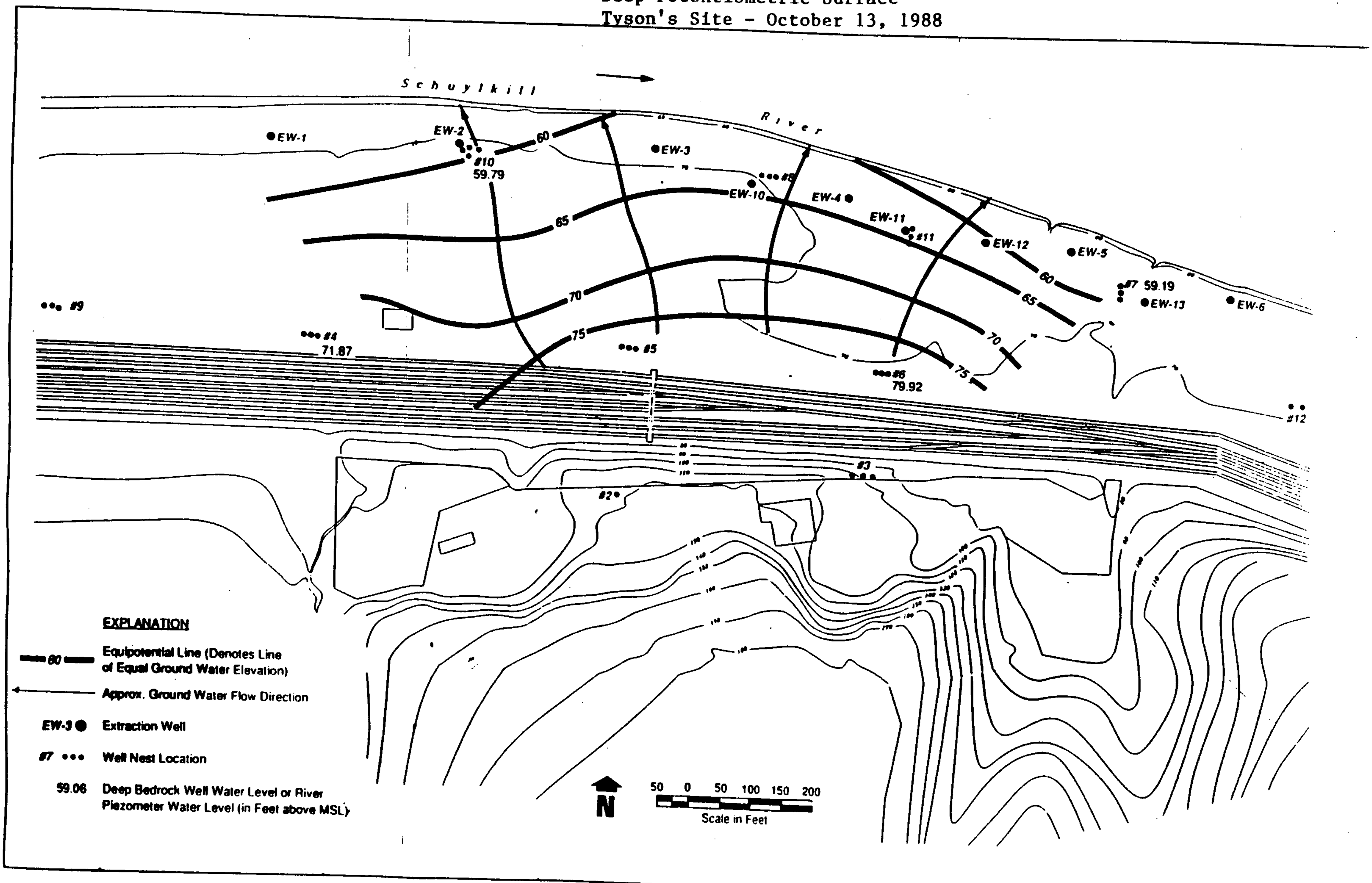
Figure 5
Intermediate Potentiometric Surface .
Tyson's Site - October 13, 1988



ORIGINAL (Red)

ORIGINAL (RED)

Figure 6
Deep Potentiometric Surface
Tyson's Site - October 13, 1988



ORIGINAL (Red)

gentle mounding in the center of the site and flow northward, towards the River. For the potentiometric surfaces of the intermediate and deep zones, the orientation of the ground water mound is skewed somewhat to the east. These potentiometric surfaces are consistent with those presented in the Off-Site Operable Unit RI Report. Hydraulic gradients within this portion of the deep bedrock range from 0.032 to 0.073 (dimensionless).

Potentiometric surface maps were not constructed for the deep aquifer beneath and north of the Schuylkill River. The greatly increased spacing between wells beneath and the variable well completion depths prevent construction of anything but a grossly interpretative potentiometric surface map.

Water levels in the shallow zones of wells installed on the island (CW-4 and CW-5) and Well Nest 15 (WN-15) on the north side of the River are nearly the same as the water levels in the Schuylkill River, indicating that there is a relationship between water levels in the shallow zone and the River. Water levels at installations north of the River (CW-3, CW-7, and CW-8) are nearly equal to or slightly higher (water level differences range between 0 to 4.7 feet) than the River, indicating that the potential is present for shallow ground water flow toward the River at these wells. The lack of monitoring points north of CW-3, CW-7 and CW-8 prevents the development of a potentiometric surface map extending north of the north bank of the Schuylkill River.

Figures 7 and 8 present vertical gradients at selected locations on April 17, 1990 (Interim Ground Water Recovery System operating). Upward vertical gradients between shallow, deep, and extra deep wells occur at well nests 3, 4, 5, 6, 8, 9, 10, and 11. These well nests are generally located in the central portion of the site south of the River. Upward vertical gradients in these well nests range from 0.09 to 0.21 (dimensionless). This upward vertical gradient adjacent to the River would be expected as the River represents a regional ground water discharge point.

An analysis of upward groundwater flow along the south bank of the River was completed as part of the Off-Site Operable Unit FS. Earlier, It had been predicted that the 1,2,3 trichloroprapane mass discharge to the river should result in a 1,2,3-trichloropropane concentration in the River of about 40 ug/1. In this calculation, it was assumed that all horizonal groundwater flow from south of the River discharged to the River. Historical data showed that 1,2,3-trichloropropane concentrations in the River were in the range of 0.5 to 2.0 ug/1, considerably less than that predicted.

ORIGINAL (Red)

Figure 7
North-South Trending Hydrogeologic Cross Section
Tyson's Site - April 2, 1990

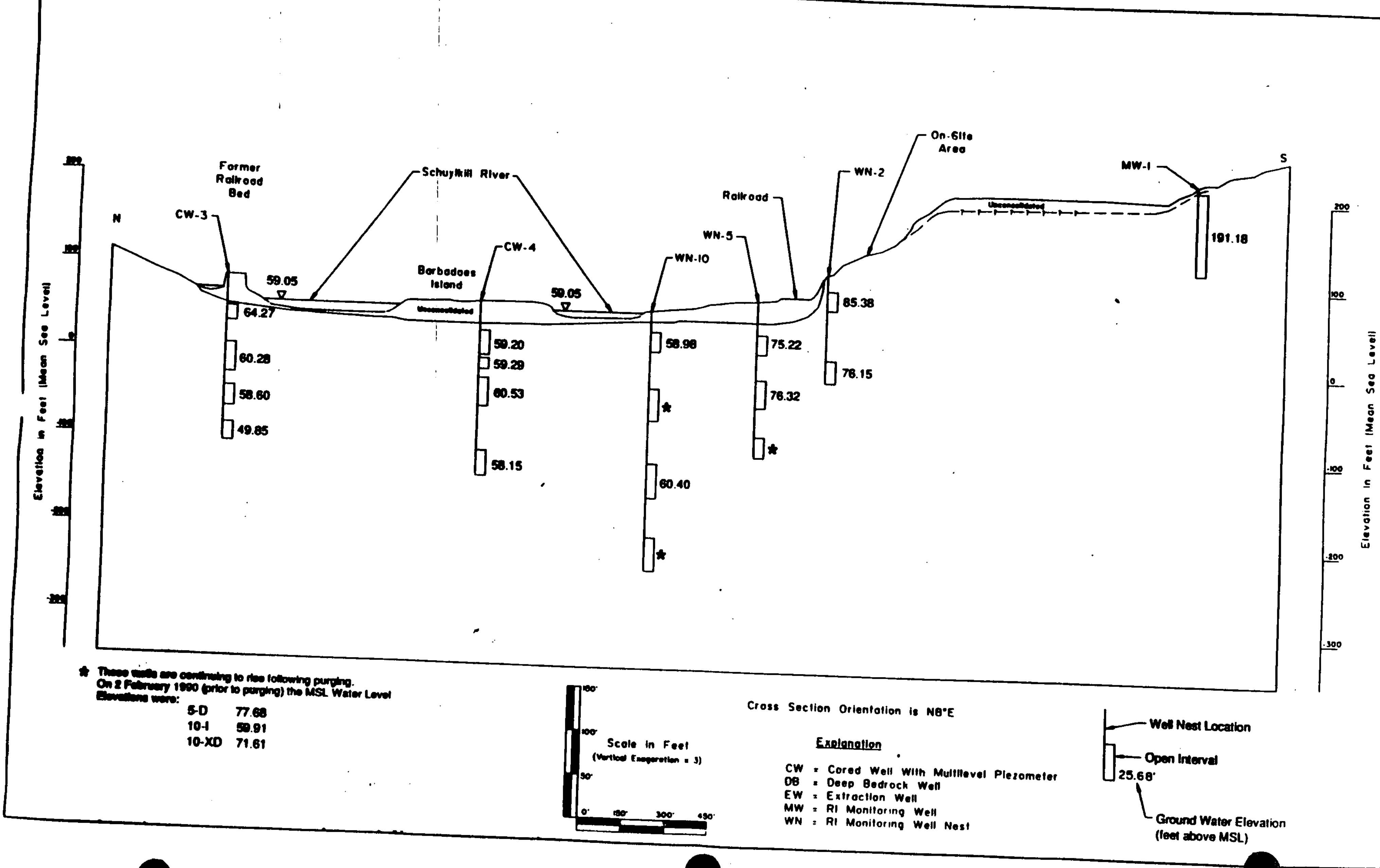
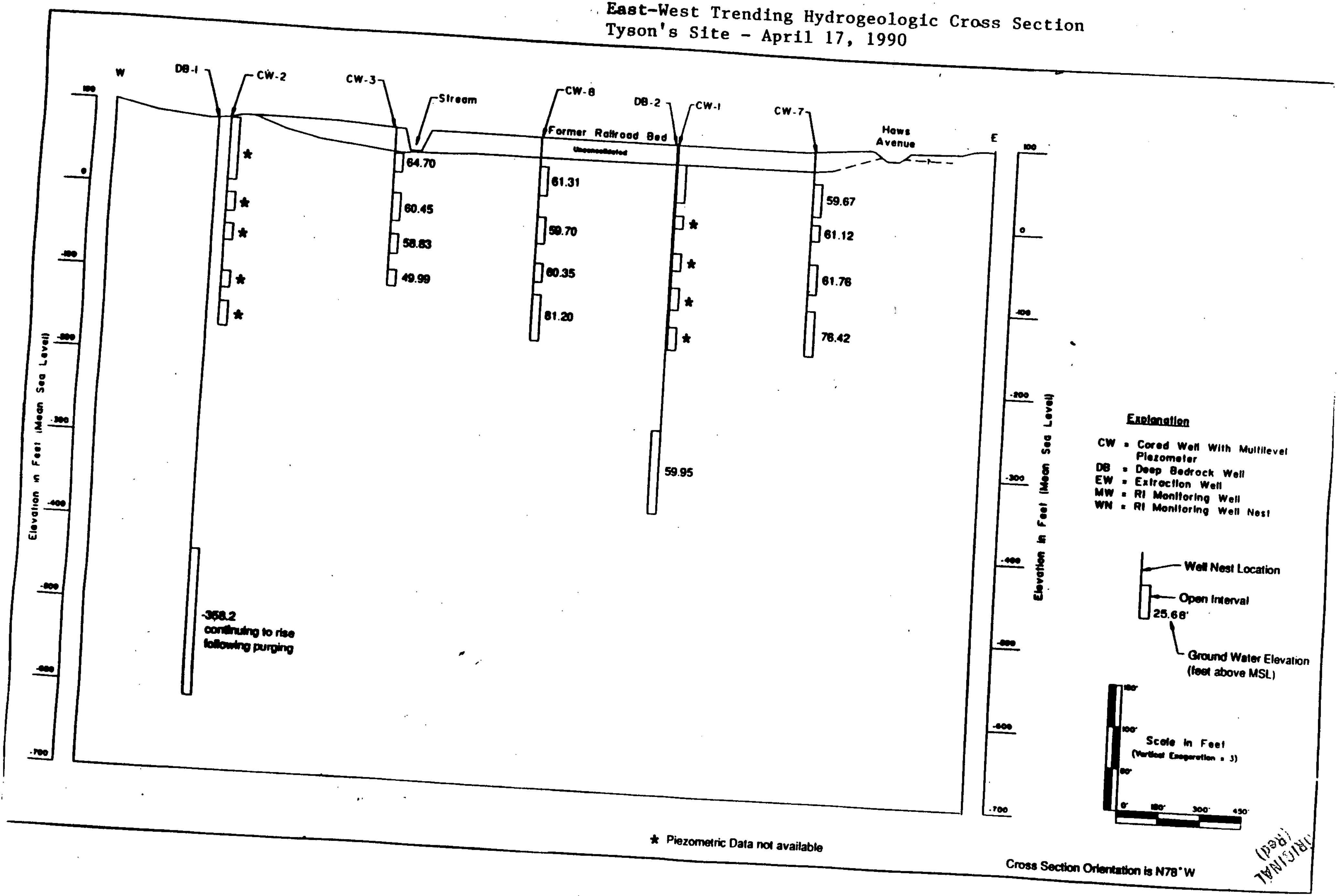


Figure 8
East-West Trending Hydrogeologic Cross Section
Tyson's Site - April 17, 1990



ORIGINAL (Red)

ORIGINAL (Red)

To account for the disparity between the predicted and observed 1,2,3-trichloropropane concentration in the River, a new analysis was completed considering spatial variations in permeability across the site. This analysis is based on observed hydraulic gradients near the River and an assumed 10:1 anisotropy of permeability across geologic bedding (along bedding permeability is ten times greater than permeability across bedding). The mass discharge calculated using this new analysis resulted in predicted concentrations of 1,2,3-trichloropropane in the River of 0.7 ug/l to 3 ug/l. These concentrations compared well with the actual observed concentrations in the River. The results of this analysis suggested that anisotropy along bedding is very important to consider when evaluating groundwater flow velocities in the Stockton Formation. Also, vertically upward components of ground water flow in the River occur only along a limited area (i.e., not all ground water discharges to the River, as was initially anticipated). Downward vertical gradients exist between the shallow and intermediate wells at well nests 7 and 12 on the south side of the River.

The ground water flow directions at the site have been determined with a high degree of confidence south of the Schuylkill River. This is a result of the extensive ground water investigations conducted on this portion of the deep aquifer. Ground water flow in the deep aquifer north of the south bank of the River is described as follows.

Vertical hydraulic gradients beneath Barbados Island are very low if present at all. Horizontal hydraulic gradients and directions of ground water flow in the shallow bedrock aquifer beneath of the river are low and poorly defined. Both strong upward hydraulic gradients CW-7 and CW-8 and strong downward hydraulic gradients (CW-3) occur between shallow and deep intervals monitored along the north bank of the River. Aquifer transmissivities determinations made during the installation of CW-7 and CW-8 indicate that aquifer transmissivities in the bedrock aquifer on the north bank of the river are likely to be similar to those seen previous testing south of the River.

Horizontal hydraulic gradients and directions of ground water flow on the north side of the River could not be determined. Shallow ground water may discharge toward or into the Schuylkill River. Due to the presence of both strong upward and downward vertical hydraulic gradient at wells north of the river, deeper components of ground water flow are not well defined. A strong upward gradient at depth suggests that a portion of the ground water flow is towards the River. Downward hydraulic gradients at CW-3 suggest that this feature may be acting as a drain with ground water possibly flowing to the north. The potential for ground water pumping, geologic structures i.e., faulting), and hydraulic properties of the aquifer to affect ground water flow near this well are not understood.

Nature and Extent of Contamination

Deep Aquifer Ground Water Quality

The vertical distribution of site-related compounds was assessed by installing the monitoring wells with sampling intervals that roughly correspond to one another from near the former lagoons to the north side of the Schuylkill River. In general, the monitoring wells near the former lagoons had sampling intervals (open hole completions) in the upper 50 feet, 75 to 150 feet, and 150 to 200 feet. These sampling interval depths were then projected so that wells could be installed north of the River with open intervals that correspond to those installed south of the River. Eeep Bedrock Well 1(DB-1) is an example of a downdip well installed on the north side of the River that corresponds to a depth at which DNAPL was found in well nest 8 on the south side of the River. Some of the shallower sampling intervals in the Waterloo Multi-Level Piezometers (WMLPs) installed on the island and north of the River do not correspond in depth to intervals monitored on the south side of the River but do, however, provide valuable information on the distribution of site-related compounds and ground water hydraulics.

The horizontal distribution of site-related compounds was determined by successive installations of additional monitoring wells to the east and west of existing wells in which site-related compounds had been found. These lateral locations, either multiple wells or WMLPs, were used to further assess the vertical distribution at depth.

Over 70 groundwater samples have been collected as part of the Third Addendum Investigation. Most of these samples were analyzed for Toxic Compound List (TCL) volatile organic compounds, TCL semi-volatile organic compounds, TCL inorganic compounds, 1,2,3-trichloropropane, and the classic parameters of total organic carbon, total suspended solids, hardness, alkalinity, and total iron.

As per the Off-Site Operable Unit RI Report, the organic fraction found in the highest concentration throughout the Third Addendum Investigation were the volatile organics. Of the volatile organics, 1,2,3-trichloropropane was the organic compound found most frequently and at the highest concentrations. Other volatile organic compounds commonly detected at elevated concentrations include xylenes, toluene, and ethylbenzene. These are also the major compounds that constitute the site's DNAPL. Because 1,2,3-trichloropropane was the most commonly detected compound in the ground water samples and is a major component of the DNAPL, it has served as the tracer compound for the Tyson's

ORIGINAL (Red)

site. Table 1 presents a summary of analytical results for 1,2,3-trichloropropane and other commonly detected volatile organic compounds in RI monitoring wells.

As described in the Off-Site Operable Unit RI Report, physical evidence of DNAPL is not always easy to obtain, even if a DNAPL is present near the well or in sufficient concentration to impact the water quality at a well location. The rule of thumb is that if dissolved-phase organic concentrations approach 10 percent of the equilibrium solubility concentration for a particular organic compound, then it is quite possible that a DNAPL is present. The major component of the DNAPL, 1,2,3-trichloropropane, has a solubility of 1,900 mg/l; therefore, dissolved-phase 1,2,3-trichloropropane concentrations of about 190 mg/l are considered to be indicative of a DNAPL presence.

The bedrock aquifer is subdivided into shallow intermediate, and deep zones, although, these are not to be considered as distinguishable, individual flow zones. The following is a summary of the ground water quality in each of these zones:

Shallow Zone

An isoconcentration map of the distribution of site-related compounds in the shallow zone is presented in Figure 9. In the upper 50 feet of bedrock, the center of the plume has migrated from the former lagoons downdip (northwesterly) and at a 30 degree angle to strike (north) from the former lagoons. Concentrations of volatile organic compounds in these wells (3-S, 5-S, 6-S, and 11-S) are in the hundreds of mg/l, indicative of a DNAPL influence on ground water quality. The lateral boundaries (east and west) of the plume in the shallow bedrock south of the River are well defined by the results from samples collected annually at well nests 9 and 12 and other samples collected at extraction well 6 (EW-6) where site-related compounds have not been detected or found at very low concentrations (less than 5ug/l 1,2,3-trichloropropane).

CW-4 is located on Barbadoes Island directly across from wells on the south bank of the River where the highest concentrations of site-related compounds have been detected (in well nests 8, 10, and 11). At CW-4, site-related compounds were found at the 37- to 58-foot interval. A second well installation (CW-5) on the island to the east of CW-4 has had no detections of site-related compounds, thus providing an eastern limit to the plume geometry on the island for the shallow groundwater zone.

North of the river in the shallow zone, site-related compounds have been detected at CW-1, CW-2, CW-3, and CW-8, due north of CW-4 where the highest levels of site-related compounds were found. The concentrations of 1,2,3-trichloropropane in CW-1 in the shallow zone, as defined by intervals 4 and 3 (87 to 105 feet

Table 1

Ground Water Sampling
Summary of Results
Volatile Organic Compounds
Tyson's Site
All Concentrations in mg/l

Well Identification	Interval Designation	Open Interval (feet)	Number of Times Sampled	Range of Concentration of Selected Volatile Organic Compounds (mg/l)				
				TCP	Toluene	Xylene	Ethylbenzene	Maximum Volatiles*
MW-1	S	20.5-100	3	ND-0.0012	ND	ND	ND	0.001
WN-2	S	29.5-51	1	30	ND	1.6	ND	32.2
	I	110-135	2	1.9-6.6	ND	0.011-0.09	ND-0.001	6.69
WN-3	S	23-44	1	380	32	64	8.8	509
	I	75-90	2	810-1400	31-36	40-57	6.4-9.0	1520
	D	123-175	2	0.067-0.140	0.037-0.051	0.08-0.25	0.012-0.031	1.62
WN-4	S	32-62	1	22	ND	ND	ND	22.3
	I	84-110	2	2.5-3.4	ND-0.001	ND-0.01	0.002-0.006	3.41
	D	133-175	2	22-110	ND-0.05	ND-0.11	ND-0.04	110
WN-5	S	30-60	1	230	2.1	41	6	286
	I	80-122	2	0.29-1.7	ND	ND	ND	1.71
	D**	156-180	2	ND-0.09	0.006-0.17	3.5-4.9	0.4-0.73	20.7
WN-6	S	30-50	1	800	41	54	9	939
	I	75-95	2	1100-1200	17-18	22-26	3.7-4.5	1260
	D	115-173	2	6.4-55	0.076-0.76	0.34-1.8	0.045-0.27	58.5
WN-7	S	30-72	3	0.23-0.83	ND-0.094	ND	ND	0.414
	I	143-163	2	0.48-0.78	ND	ND	ND	0.797
	D**	189-214	2	0.04-0.19	ND	ND-0.003	ND	0.218
WN-8	S	30-60	3	1.3-6.3	ND-0.012	ND-0.067	ND-0.006	6.39
	I	115-135	2	150-640	1.2-3.5	3.8-14	0.3-2.4	662
	D	163-183	2	7.7-15	ND	ND-0.002	ND	15.1
WN-9	S	32-72	3	ND	ND	ND	ND-0.001	0.004
	I	117-157	3	ND	ND	ND	ND	0.014
	D	188-223	3	ND-0.069	ND	ND	ND	0.011
WN-10	S	32-56	3	0.160-6	0.08-0.12	0.23-0.37	0.05-0.1	3.38
	I	97-137	2	400-480	0.36-1.1	2.7-4.2	0.43-0.7	485
	D	183-222	2	20-100	ND-0.06	0.045-1.7	ND-0.079	104
	XD	268-307	2	69-120	ND-0.31	ND-2.5	ND-0.46	125
WN-11	S	44-84	3	730-1000	15-21	21-23	ND-3.9	1050
	I	109-149	2	220-490	3.3-5.7	7.3-24	1.1-3.2	525
	D	180-220	2	6.7-20	0.054-0.79	0.15-1.9	0.021-0.29	35.2
WN-12	S	60-100	3	ND-0.043	ND	ND	ND	1.46
	D	145-185	3	ND-0.017	ND	ND	ND	0.017
MW-13	S	20-70	1	0.260	0.003	0.018	0.003	0.296
MW-14	S	20-70	1	16	0.390	0.36	ND	16.8

ORIGINAL (Red)

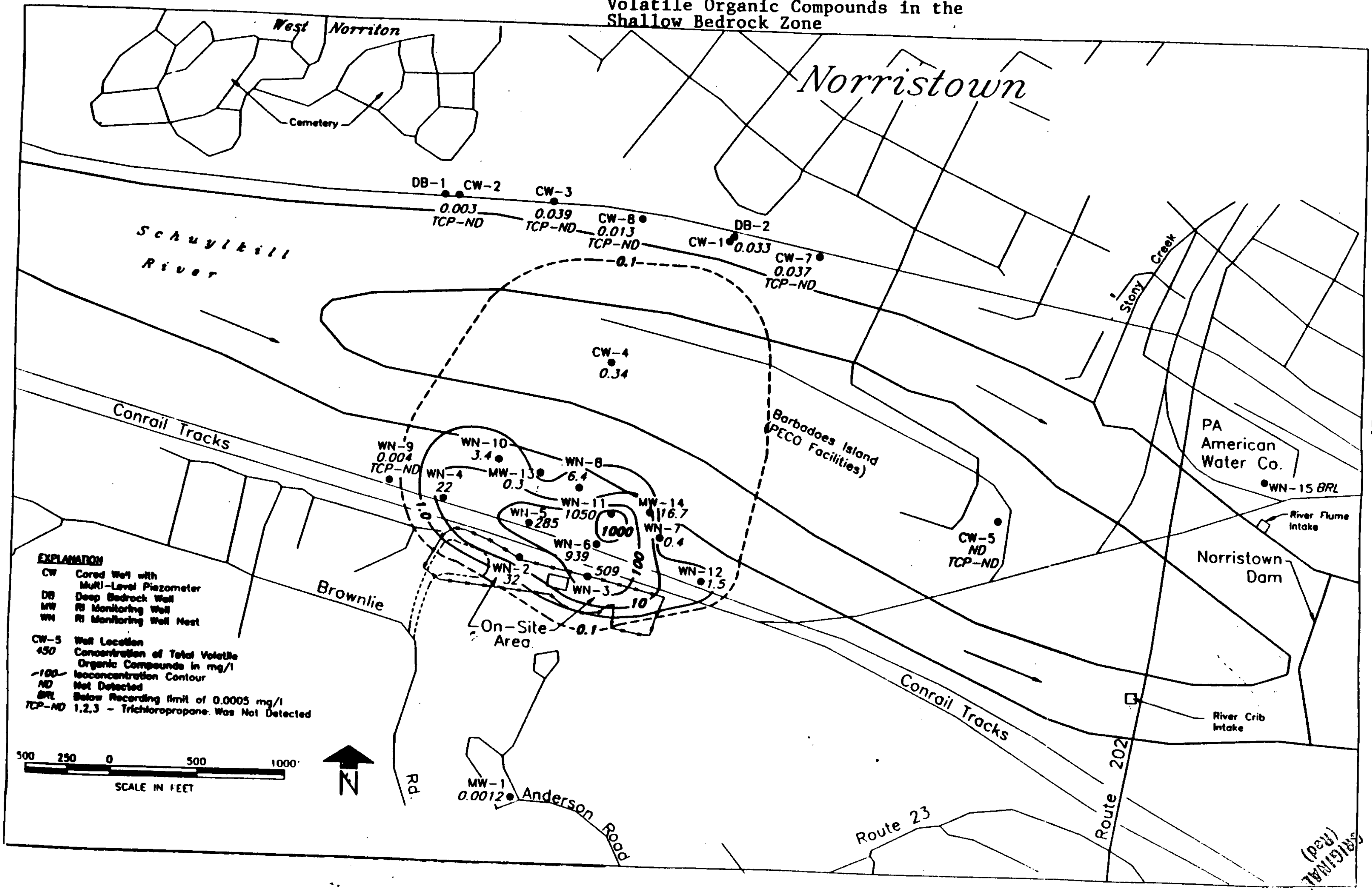
Table 1 (Cont'd)

Ground Water Sampling
Summary of Results
Tyson's Site

Well Identification	Interval Designation	Open Interval (feet)	Number of Times Sampled	Range of Concentration of Selected Volatile Organic Compounds (mg/l)				
				TCP	Toluene	Xylene	Ethylbenzene	Maximum Volatiles*
CW-1	4	97-106	4	0.0081-0.027	0-0.003	ND	ND	0.033
	3	132-158	4	0.15-0.43	0-0.009	ND	ND	0.440
	2	175-201	4	0.79-2.4	0-0.01	ND	ND	2.90
	1	223-250	4	2.9-6	0-0.024	ND	ND	5.83
CW-2	4	88-110	3	ND	0-0.003	ND	ND	0.003
	3	127-147	3	ND	0-0.006	ND	ND	0.008
	2	183-203	3	ND	0-0.009	ND	ND	0.009
	1	221-250	2	ND	ND	ND	ND	0.002
CW-3	3	77-112	2	ND	ND-0.002	ND	ND	0.039
	2	127-158	2	ND	0.002	ND	ND	0.002
	1	170-199	2	ND	0.001-0.004	ND	ND	0.004
CW-4	4	37-58	2	0.057-0.34	ND-0.002	ND	ND	0.340
	3	66-78	2	30-90	0.007-0.2	0.007-0.38	ND	91.1
	2	87-121	2	84-250	0.043-0.12	0.1-0.24	ND-0.006	258
	1	170-199	2	180-1,200	0.07-5.2	0.02-7	0.17-1	1220
CW-5	3	35-79	2	ND	ND	ND	ND	ND
	2	98-130	2	ND	0.004-0.006	ND	ND	0.008
	1	169-201	2	ND	0.004-0.005	ND	ND	0.005
CW-7	4	41.45-61.0	1	ND	ND	ND	ND	0.037
	3	91.1-110.65	1	ND	ND	ND	ND	0.056
	2	138.7-178.7	1	ND	ND	ND	ND	0.038
	1	195.3-247	1	ND	0.002	ND	ND	0.009
CW-8	4	38.3-72.7	1	ND	0.012	ND	ND	0.013
	3	96.65-130.6	1	ND	0.001	ND	ND	0.001
	2	154.4-178.95	1	ND	ND	ND	ND	0.002
	1	192.3-249	1	0.009	0.017	ND	ND	0.025
DB-1	Open Hole	822.15-907	1	ND	ND-0.009	ND	ND	0.003
DB-2	Open Hole	350-450	1	0.12	ND	ND	ND	0.127
WW-15	S	35.1-55	2	ND-0.00015	ND	ND	ND	0.0002
	D	79.75-126	2	ND-0.0032	ND	ND	ND	0.003

Note: * Total Volatile Concentrations have been rounded to three significant figures.
ND - None detected.

Figure 9
Isoconcentration Map of Total Volatile Organic Compounds in the Shallow Bedrock Zone



and 132 to 155 feet), ranges from 0.0031 mg/1 to 0.43 mg/1. 1,2,3-trichloropropane was not detected in the shallow zones of CW-2, CW-3, and CW-8. Only low concentrations of toluene were detected in the shallow intervals of these wells. Therefore, the absence of detectable concentrations of site-related compounds in the shallow intervals at CW-2, CW-3, CW-7, CW-8 and well 15-S allows the lateral boundaries of the plume east and west along the north bank of the river to be approximated

Intermediate Zone

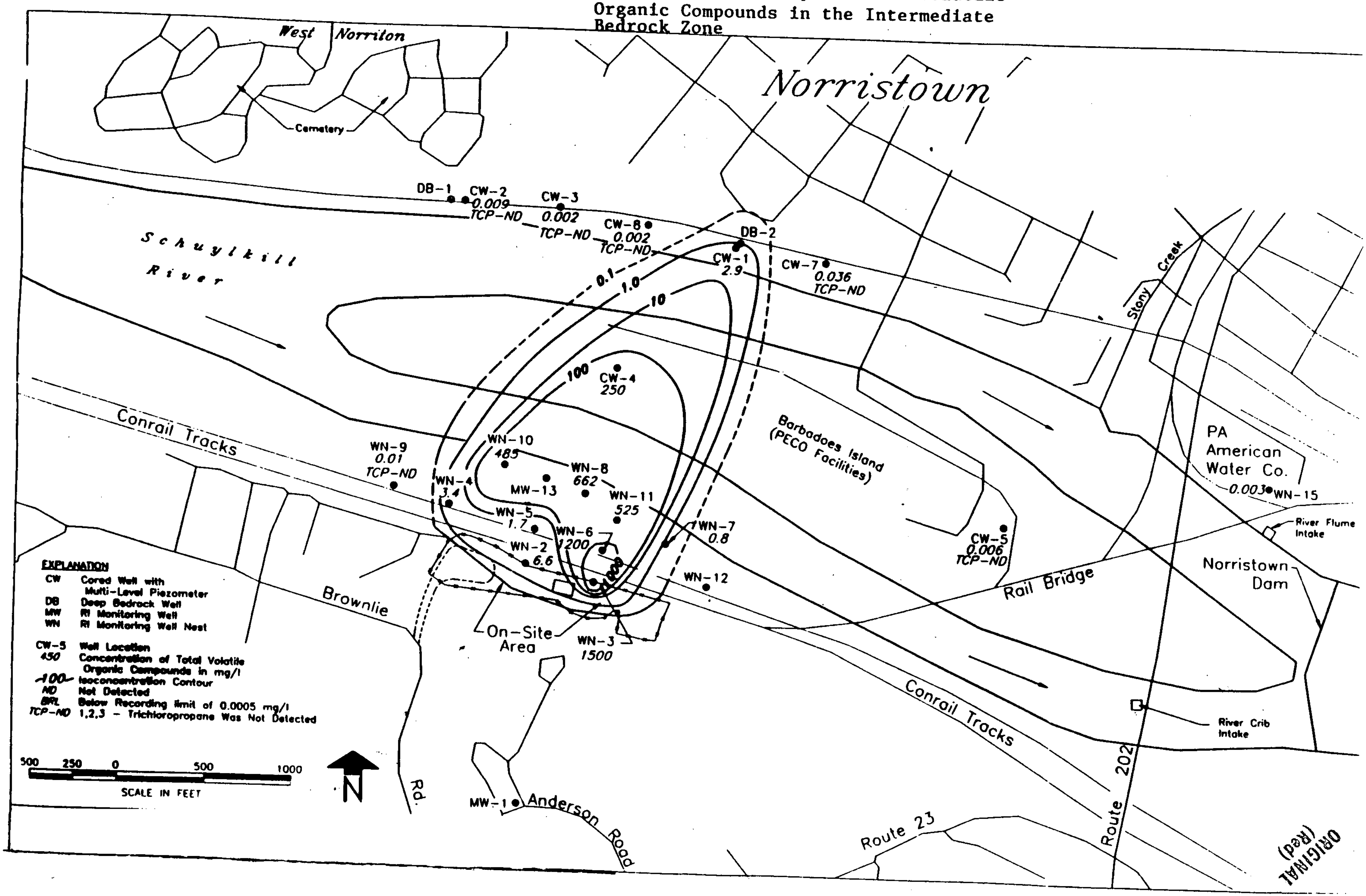
Figure 10 is an isoconcentration map of total volatile organics in the intermediate zone. In general, the highest concentrations of site-related compounds were detected in intervals completed in the intermediate zone. South of the river at depths of 100 to 150 feet, the highest concentrations of site-related compounds are present both in a downdip direction at a 30 degree angle to strike. Concentrations of volatile organics in wells in this central portion remain high, in the hundreds of mg/1, with the observation of measurable quantities of DNAPLs at wells 81 and 31. Again, the lateral extent of the plume south of the River is noted by the absence or near absence of detectable concentrations of site-related compounds at well nests 9 and 12.

At CW-4, concentrations of 1,2,3-trichloropropane in the intermediate intervals (intervals 2 and 3, 65 to 78 feet and 87 to 121 feet, respectively) range from 30 to 250 ppm. The intermediate intervals at CW-5 to the east of CW-4 remain free of site-related compounds. North of the River at CW-1, site-related compounds were found at the intermediate intervals (3 and 2) with concentrations higher than those found in the shallower intervals. The highest 1,2,3-trichloropropane was 2.9 mg/1 in interval 3. Again there were no detected concentrations of site-related compounds in the wells along the PECO right-of-way to the east or west of CW-1.

Deep Zone

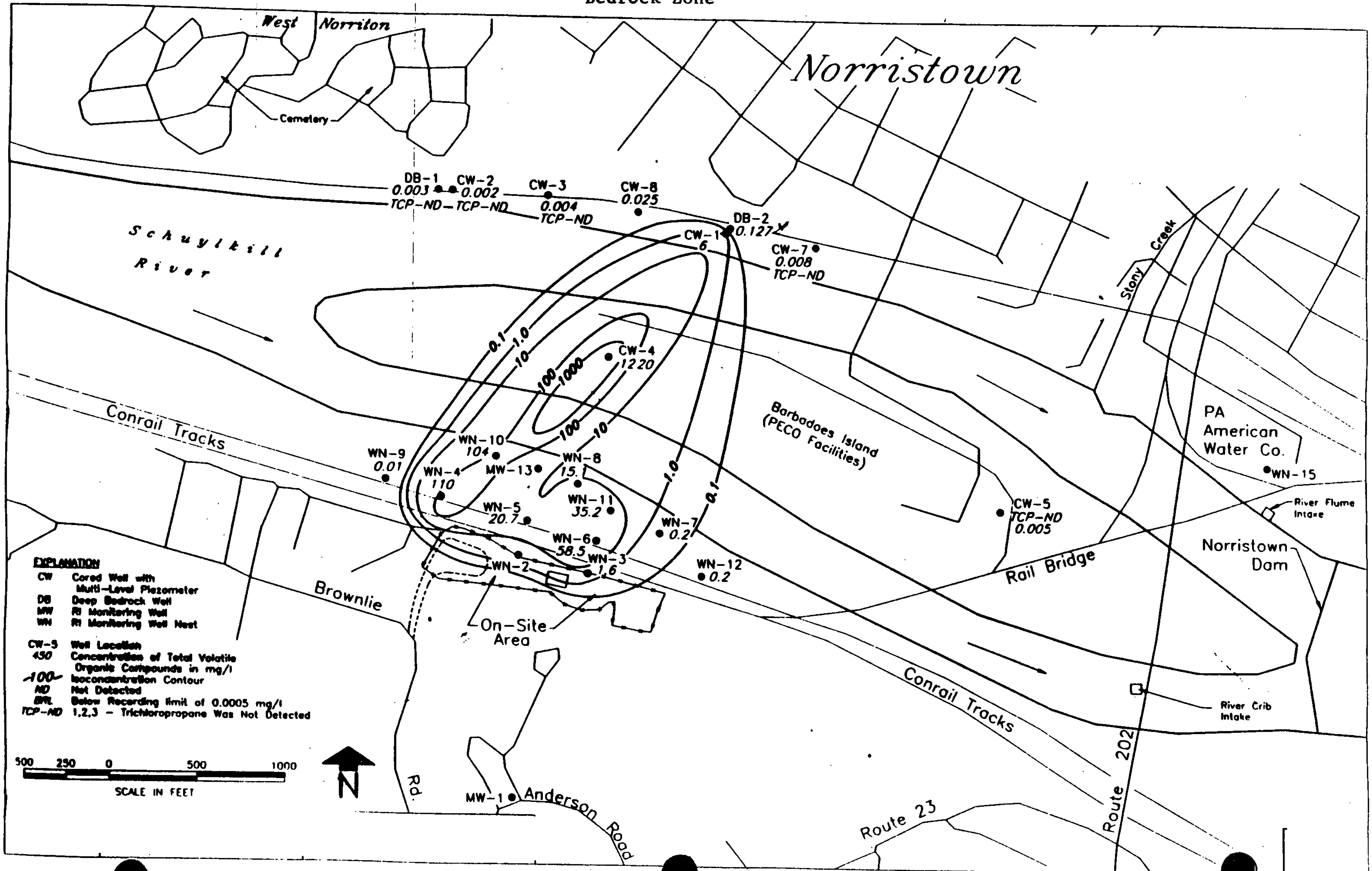
Figure 11 is an isoconcentration map of the total volatile organic concentrations in the deep zone. In the deep zone south of the river, the central portion of the contaminant plume has shifted to the west and is centered around well nest 10 (10-D and 10-XD). At this location, concentrations of 1,2,3-trichloropropane ranged from 20 mg/1 to 120 mg/1. To the east at well nests 8 and 11, ground water quality in these deeper intervals is much improved (15.1 mg/1 and 35.2 mg/1 total volatiles, respectively compared to overlying zones at these locations. This water quality trend was confirmed by the resampling of these wells in February and March 1990. Again, with regard to the lateral boundaries of the plume, the low levels of detected site-related compounds in well nests 9 and 12

Figure 10
Isoconcentration Map of Total Volatile Organic Compounds in the Intermediate Bedrock Zone



ORIGINAL (Red)

Figure 11
Isoconcentration Map of Total Volatile Organic Compounds in the Deep Bedrock Zone



and EW-6 confirm the lateral extent of contamination in the deeper zone.

The highest concentrations of detected 1,2,3-trichloropropane were found at CW-4 on Barbadoes Island at concentrations as high at 1,200 mg/l. No site-related compounds were detected at CW-5 to the east of CW-4.

Similar to CW-4, the wells on the north side of the Schuylkill River where site-related compounds were detected also showed a consistent increase in concentration with depth from the shallow to intermediate to deep bedrock zones. The highest concentration of 1,2,3-trichloropropane (6 mg/l) was found at CW-1 in the 223- to 250-foot interval. Significantly lower concentrations (0.006 mg/l) were detected at CW-8.

To determine the extent of site-related compound migration from the former lagoons to the north side of the Schuylkill River at depth, DB-2 was installed with an open interval of 350 to 450 feet. Concentrations of 1,2,3-trichloropropane in a sample obtained from this well are much lower (0.12 mg/l) than the 1,2,3-trichloropropane concentrations detected in the deeper intervals of the adjacent CW-1.

DNAPL

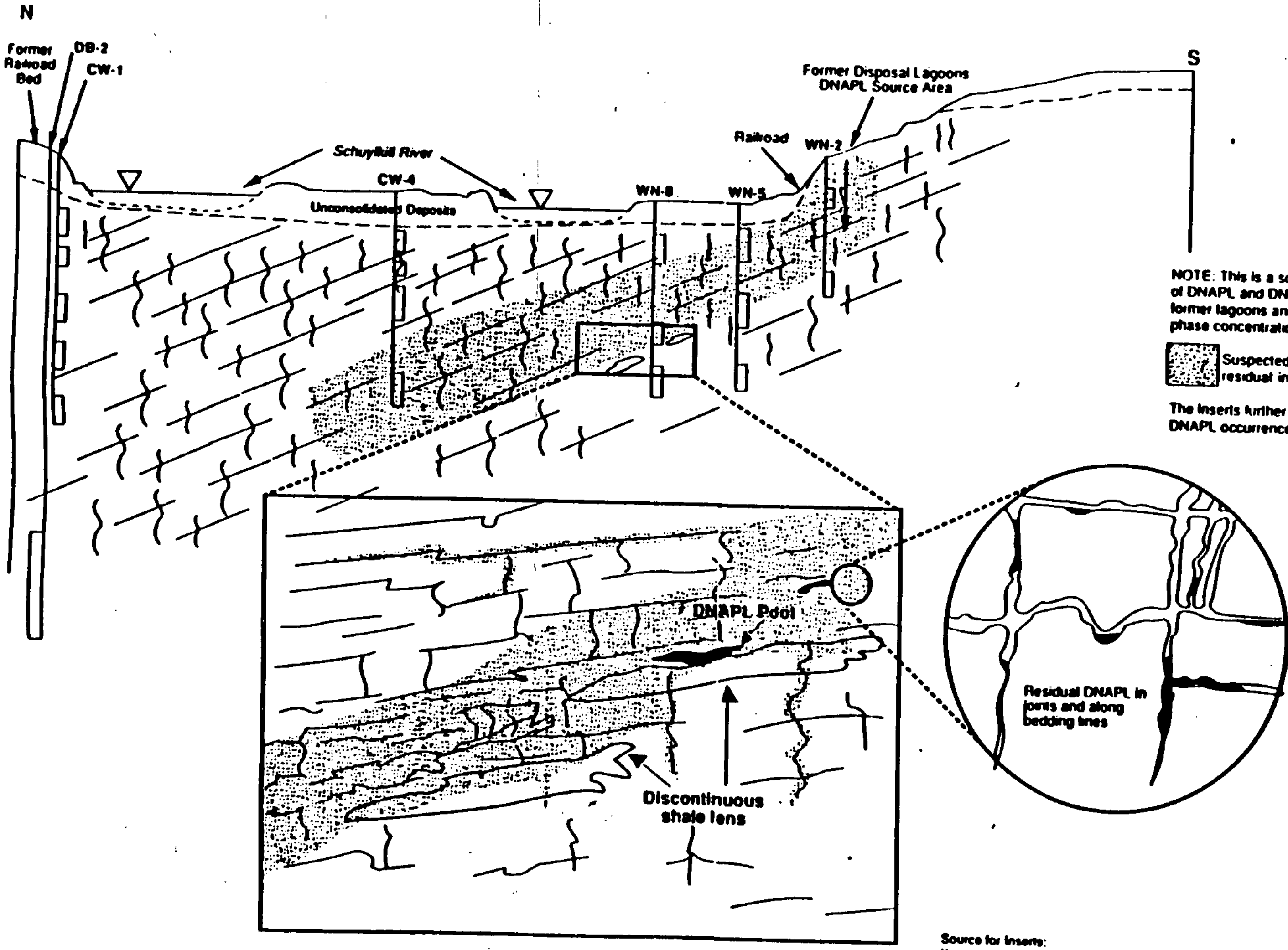
Figure 12 provides a conceptual schematic of the DNAPL movement from the former lagoons in the deep aquifer. It is thought that the DNAPL moved downward through joints along weathered bedding planes in a downdip direction. In this manner, joints and bedding planes become coated with DNAPL. In the past, observations of DNAPL have been noted atop one of the secondary porosity preferential paths, a thin, discontinuous shale unit seen in the center of the site at well nests 3,6,11 and 8. This unit, however, cannot be continuously mapped from the former lagoons to the north side of the river. Based upon the physical observation of DNAPLs and the "10 percent of solubility rule" of thumb, the extent of the DNAPL plume has been characterized as extending from beneath the former lagoons to a depth of approximately 135 feet south of the Schuylkill River to at least a depth of 200 feet beneath Barbados Island. There is no indication from the data available that there is a DNAPL present beneath the north bank of the Schuylkill River.

Community Well Investigation

A sample submitted for TCL volatiles and 1,2,3-trichloropropane analysis was collected from a well at Morabito's Bakery at 757 Kohn Street in Norristown, on January 11, 1990. None of the TCL volatile organic compounds were detected in this sample. Only two other ground water receptors were identified on the north side of the River during the Third Addendum Investigation. One

Figure 12

Conceptual Schematic of DNAPL Movement- Cross Sectional View
Tyson's Site



NOTE: This is a schematic of the suspected extent of DNAPL and DNAPL residual originating from the former lagoons and as indicated by dissolved phase concentration in CW-4.

Suspected area of DNAPL and DNAPL residual in this cross-sectional view

The inserts further show the possible modes of DNAPL occurrence.

Source for Inserts:
Waterloo Centre for Ground Water Research, short course - Dense Immiscible Phase Liquid Contaminants (DNAPLs) in Porous and Fractured Media, November 1989.

well, located at 49 Buttonwood Street, would not allow a sample to be collected. This well is reportedly not used as a drinking water supply. Another well located at the Norristown State Hospital was sampled and the results indicate that site-related compounds have not impacted the water quality used at the hospital.

Summary of Site Risks

The risk assessment performed on the deep aquifer at the Tyson's site during the third addendum RI/FS primarily reiterates previous risk assessment conclusions on the deep aquifer found in the off-site RI/FS report in 1987. Ground water and surface water were identified as the media at the site to which human exposure populations may be exposed.

In November 1987 a document entitled "Calculation of Cleanup Levels for the Former Lagoon Area - Tyson's Site" was submitted to EPA. This document was prepared in concert with USEPA for the purpose of establishing soil cleanup levels for remediation by vacuum extraction of the former lagoon area. To calculate appropriate soil cleanup levels, health-based acceptable intake levels for each compound in the former lagoons were first identified. The health-based acceptable intake levels included large safety factors or highly conservative assumptions and thus, represented fully protective levels. The soil levels necessary to achieve these acceptable intake levels were then calculated using hypothetical exposure scenarios. The exposure scenaros were jointly selected by USEPA and ERM and were intended to result in soil levels that would be fully protective of human health. One of these scenarios was hypothetical potable use well at the boundary of the former lagoon area that assumed 1) any residual soil contamination (i.e., remaining after vacuum extraction) was released into the ground water from which the well draws, and 2) a lifetime of exposure to the water from the well for all uses.

Once the calculations were done for each of the exposure scenarios, the scenario producing the most stringent cleanup requirement was selected as the soil cleanup level. In almost every instance, the most stringent level was the scenario which assumed that soil contamination gives rise to ground water contamination and that a residential well drawing only this contaminated ground water was used for all household purposes for a lifetime.

The health-based acceptable intake level for compounds detected in the former lagoons for the hypothetical well scenario have been the only calculations ever conducted for acceptable levels of Tyson's site compounds in ground water. Table 2 provides the acceptable chronic water exposure levels provided in the above mentioned report.

The complete text of the document "Calculation of Cleanup Levels or former Lagoon Area - Tyson's Site" can be found attached to the Memorandum of Understanding dated June 16, 1987 and the Administrative Order of Consent for the vacuum extraction technology dated February 17, 1988. Table 2 provides the acceptable chronic water exposure levels provided in this report.

The calculation of 1,2,3-trichloropropane's potency factor used to derive the acceptable 1,2,3-trichloropropane chronic exposure level shown in Table 1-1 was detailed in Appendix G of the Off-Site Operable Unit Endangerment Assessment, (ERM, 1987). Since toxicological information was not available for 1,2,3-trichloropropane in 1987, and acceptable levels were not available from USEPA, an oral and inhalation potency factor was derived for this compound. The potency factors were based on only those chloroalkanes and bromochloropropanes which were classified as Group B and established carcinogenic potency factors. The potency factor for 1,2,3-trichloropropane was calculated to be $1.x10^{-1}$ (mg/kg/day). This interim potency factor was calculated specifically for the Tyson's site and was to be used until new toxicological information becomes available. To date, no new toxicology information for 1,2,3-trichloropropane has been released from the USEPA or National Toxicology Program. This is important since 1,2,3-trichloropropane is the most significant indicator compound for the site and is the compound monitored in the Schuylkill River regarding the effectiveness of the Interim Ground Water Recovery System.

On July 29, 1987 ERM submitted to USEPA on behalf of CIBA-GEIGY the Off-Site Operable Unit RI Report which included as volume 5 the endangerment assessment for the off-site operable units including the ground water in the deep aquifer to the south bank of the Schuylkill River. This EA was focused on the river as being the only receptor of site-related compounds from the Tyson's site, specifically at the Pennsylvania American Water Company crib intake in the south channel of the Schuylkill River approximately 2,000 feet down river from the Tyson's site. It was determined that the most important compound for the site was 1,2,3-trichloropropane. The pathway of concern was from the former lagoons via the bedrock aquifer to the Schuylkill River. At the time that this report was prepared, it was considered that all ground water in the bedrock aquifer containing site-related compounds discharged to the Schuylkill River. The exposure scenario or receptors of site-related compounds at the crib intake included drinking and showering by humans. The EA for the off-site operable units used as its basis for water quality the limited river water and sediments data obtained during the Off-Site Operable Unit RI and information made available from the Philadelphia Water Company for its two downriver intakes (approximately 12 to 13 miles down river from the site).

Table 2

Tyson's Site
Acceptable Levels in Ground Water

COMPOUND	Chronic water expsoure, mg/L oral
ANILINE	6.1E-03
ANTHRACENE	7.00E + 00
BENZENE	2.20E - 04
BENZOIC ACID	7.00E - 01
BIS(2-ETHYLHEXYL)PHTHALATE	2.5E-03
2-BUTANONE	1.80E + 00
CHLOROBENZENE	6.00E - 02
2-CHLORONAPHTHALENE	1.10E - 01
2-CHLOROPHENOL	1.00E - 01
CHRYSENE	1.50E - 06
CYCLOHEPTATRIENE	2.00E - 02
CYCLOHEXANONE	2.30E + 01
DI-N-BUTYL PHTHALATE	3.50E + 00
DI-OCTYL PHTHALATE	6.30E - 01
DICHLOROBENZENES	* * * *
2,4-DIMETHYLPHENOL	2.80E - 01
N,N-DIMETHYL-1,3-PROPANEDIAMINE	6.50E - 01
DODECANE	3.90E + 00
ETHYLBENZENE	6.80E - 01
1-ETHYL-2-METHYLBENZENE	1.20E - 01
FLUORANTHENE	2.10E - 01
HEXADECANE	2.20E + 01
HEXADECANOIC ACID	2.00E - 02
METHYLENE CHLORIDE	1.60E - 03
2-METHYLNAPHTHALENE	5.30E - 01
2-METHYLPHENOL/4-METHYL PHENOL	1.80E + 00
4-METHYL-2-PENTANONE	1.80E + 00
N-NITROSODIPHENYLAMINE	7.10E - 03
NAPHTHALENE	1.4E-01
NITROBENZENE	1.80E - 02
1,1-OXYBIS-(2-ETHOXYETHANE)	8.50E - 01
PHENANTHRENE	2.50E - 01
PHENOL	1.4E+00
PYRENE	3.8E-05
TERTRACHLOROETHENE	2.30E - 04
TETRAMETHYLUREA	7.60E - 01
TOLUENE	2.00E + 00
1,2,4-TRICHLOROBENZENE	2.30E - 01
1,3,5-TRICHLOROBENZENE	2.30E - 01
TRICHLOROETHENE	1.10E - 03
1,2,3-TRICHLOROPROPANE	3.50E - 04
1,2,4-TRIMETHYLBENZENE	3.00E + 00
TRIDECANE	4.10E - 01
UNDECANE	1.80E - 01
O-XYLENE	1.20E - 01

* 1,2 Dichlordbenzene 3.1E+00
* 1,3 Dichlordbenzene 3.1E+00
* 1,4 Dichlordbenzene 1.5E-03

ORIGINAL (Red)

During the Off-Site Operable Unit RI and subsequent FS, the approach was to focus on remediation at the receptor and not aquifer restoration. This was done for two reasons:

* There are no wells extracting ground water between the site (no known or identified receptors) and the south bank of the Schuylkill River, and

* The presence of a large volume of DNAPL at depth in the fractured bedrock aquifer made it impossible to reasonably consider any alternative for aquifer restoration with means currently available. During the five year review required under SARA, this will need to be revisited.

Considering the above, all subsequent analyses of risks posed by ground water in the deep aquifer focused on the ground water which discharged to the Schuylkill River and the impacts of the discharged ground water on river water quality. The Interim Ground Water Recovery System was designed and installed to maintain an acceptable level of 1,2,3-trichloropropane at the crib intake.

Exposure Assessment

The indicator compounds, pathways, receptors, and exposure scenarios, addressed in the third addendum Focused FS remain identical to those previously assessed in the off-site RI/FS. That is, dissolved phase 1,2,3-trichloropropane the major component of the DNAPL, entering the river via discharge from the bedrock aquifer with the ultimate receptor being the users of surface water taken from the river at the crib intake.

The third addendum Focused FS is solely concerned with ground water in the deep aquifer to the north bank of the Schuylkill River. The receptor of this contamination is the Schuylkill River. Although the presence of site-related compounds in monitoring wells on the north side of the river has been documented and will need to be addressed further, it presents an excess human cancer risks presently estimated at $2x10^{-2}$. This level of $2x10^{-2}$ means that no more than two out of one hundred people exposed for their entire lifetimes are at risk of developing cancer from ingesting this contaminated well water. One ground water receptor, the Norristown State Hospital, has been identified on the north side of the River. Sampling results from this well indicate that site-related compounds have not impacted the water quality used at the hospital.

Toxicity Assessment

The relationship between the extent of exposure to a contaminant and the potential for adverse effects was evaluated during the

ORIGINAL (Red)

toxicity assessment process in the off-site RI/FS. Cancer potency factors (CPFs) were identified for potential carcinogenic contaminants, and reference doses (RFDs) (which are labelled 'AIC', 'AIS', or 'ADI') were identified for chemicals exhibiting noncarcinogenic effects. CPFs and RFDs used for the toxicity assessment are presented in Table 3.

Cancer potency factors (CPFs) have been developed by EPA's Carcinogenic Assessment Group for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic chemicals. CPFs, which are expressed in units of $(mg/kg\text{-}day)^{-1}$, are multiplied by the estimated intake of a potential carcinogen, in mg/kg-day, to provide an upper-bound estimate of the excess lifetime cancer risk associated with exposure at that intake level. The term "upper bound" reflects the conservative estimate of the risks calculated from the CPF. Use of this approach makes underestimation of the actual cancer risk highly unlikely. Cancer potency factors are derived from the results of human epidemiological studies or chronic animal bioassays to which animal-to-human extrapolation and uncertainty factors have been applied.

Reference doses (RfDs) have been developed by EPA for indicating the potential for adverse health effects from exposure expressed in units of mg/kg-day, are estimates of lifetime daily exposure levels for humans, including sensitive individuals which are believed not to cause adverse health effects. Estimated intakes of chemicals from environmental media (e.g., the amount of a chemical ingested from contaminated drinking water) can be compared to the RfD. RfDs are derived from human epidemiological studies or animal studies to which uncertainty factors have been applied (e.g., to account for the use of animal data to predict effects on humans). These uncertainty factors help ensure that the RfDs will not underestimate the potential for adverse noncarcinogenic effects to occur.

Comparison to Applicable or Relevant and Appropriate Requirements (ARARs)

Groundwater Contaminant-Specific ARARs

For the purposes of the Third Addendum Focused FS, effluent limits after groundwater treatment were derived in the Off-Site Operable Unit FS from those ARARs applicable to the River. When more than one effluent limit was available for a given compound, the most stringent of the limits was employed. These include the discharge limits assigned by PADER, MCLGs, and surface water criteria (Table 4). As shown on Table 4, there are many compounds detected in the groundwater in the deep aquifer that do not have effluent limits. For these compounds, risk-based concentrations were derived in the Off-Site Operable Unit FS. Since these concentrations are derived based on human

Table 3

SUMMARY OF TOXICOLOGICAL INFORMATION FOR THE INDICATOR CHEMICALS (CONCENTRATIONS IN mg/l, UNLESS OTHERWISE SPECIFIED)

RELEVANT REQUIREMENTS, CRITERIA, ADVISORIES OR GUIDANCE	ARSENIC	BARIUM	BENZENE	TETRACHLORO-ETHYLENE	TRICHLORO-ETHYLENE	ETHYL-BENZENE	CHLORO-BENZENE	XYLENE	TOLUENE	1,2,3-TRICHLORO-PROPANE	CHLOROFORM	1,2,4-TRICHLORO-BENZENE
EPA MCL (proposed)	0.05 (PR)	1	0.005	NA	0.005	NA	1 (HBN)	NA	2	NA	0.1	0.7 (HBN)
EPA MCLG (proposed)	NA	1.5	0	0		0.68	0.06	0.44	NA	NA	0	NA
EPA WATER QUALITY CRITERIA												
fish and drinking water	0.0000022	1	0.00066	0.0008	0.0027	1.4	0.49	NA	14.3	NA	0.00019	NA
fish only	0.0000175	NA	0.04	0.00885	0.0807	3.28	NA	NA	424	NA	0.0157	NA
protection of aquatic life	0.19	<50	<5.3	<5.3	<22	<32	<0.05	NA	<17.5	NA	<28.9	<.25
EPA DRINKING WATER HEALTH ADVISORIES												
1 day 10 kg (70 kg)	0.05	NA	0.233	N.A.	N.A.	N.A.	1.8	NA	18	NA	NA	NA
10 days 10 kg (70 kg)	0.05	NA	0.233	N.A.	N.A.	N.A.	1.8	NA	6	NA	NA	NA
chronic 10 kg (70 kg)	0.05 (0.05)	1.8	NA	N.A.	N.A.	N.A.	9 (30)	NA	1.09	NA	NA	NA
OSHA 8 hr TWA (mg/m3)	0.01	0.5	30	670	540	435	350	435	375	300	240	NA
ACGIH 8 hr TWA (mg/m3)	0.2	0.5	30	335	270	435	350	435	375	300	50	40
NONCARCINOGENIC EFFECTS												
RISK CHARACTERIZATION												
ORAL (mg/kg/day) AIC	NA	5.10E-02	NA	NA	NA	1.00E-01	2.70E-02	1.00E-02	3.00E-01	NA	NA	2.00E-02
AIS	NA	NA	NA	2.00E-02	NA	9.70E-01	NA	1.00E-01	4.30E-01	NA	NA	NA
ADI	NA	NA	NA	NA	5.40E-01	1.00E-01	6.00E-01	5.40E-01	NA	NA	NA	NA
INHALATION (mg/kg/day) AIC	NA	1.40E-04	NA	NA	NA	NA	5.70E-03	4.00E-01	1.50E+00	NA	NA	NA
AIS	NA	1.43E-03	NA	NA	NA	NA	5.30E-02	6.90E-01	1.50E+00	NA	NA	8.00E-02
ADI	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	2.60E-02
MEDIAN EFFECTIVE DOSE (mg/day) ORAL	1.00E+00	4.90E+00	85.5	1.48E+03	9.50E+00	7.24E+02	5.60E+01	NA	2.89E+03	NA	NA	3.73E+01
INHALATION	1.00E+00	4.90E+00	1.7	7.27E+03	1.05E+00	7.24E+02	7.18E+01	NA	2.89E+03	NA	NA	3.73E+01
CARCINOGENIC EFFECTS												
POTENCY FACTOR [1/(mg/kg/day)] ORAL	1.50E+01	NA	5.20E-02	5.10E-02	1.00E-02	NA	NA	NA	NA	0.1*	8.10E-02	N.A.
INHALATION	5.00E+01	NA	0.026	1.70E-03	4.63E-03	NA	NA	NA	NA	0.1*	7.00E-02	N.A.
10% EFFECTIVE DOSE (mg/kg/day) ORAL	7.88E-03	NA	3.7	3.23E+00	5.58E+00	NA	NA	NA	NA	NA	6.00E-01	N.A.
INHALATION	7.88E-03	NA	3.7	3.23E+00	5.58E+00	NA	NA	NA	NA	NA	6.00E-01	N.A.
CANCER RISK INHALATION AT 1 ug/m3	1.26-7.6E-3	NA	0.0000041	NA	4.10E-06	NA	NA	NA	NA	NA	2.30E-06	N.A.
WATER (E-6 RISK)	4.30E-04	NA	0.00066	8.85E+00	2.70E-03	NA	NA	NA	NA	NA	1.90E-01	N.A.
CLASSIFICATION, EPA	A	NC	A	B2	B2	NC	NC	NC	NC	B2*	B2	NC
CLASSIFICATION, IARC	1	3	1	2	2B/3	3	3	3	3	3	2B	3

KEY:

PR = PRIMARY DRINKING WATER STANDARD

HBN = HEALTH BASED NUMBER EPA OFFICE OF SOLID WASTE

I = 51 FR 39429

N. A. = NOT APPLICABLE

BB = EPA 1972 WATER QUALITY CRITERIA (BLUE BOOK)

EDE = EQUIVALENT DOSE ESTIMATE FROM OFFICE OF SOLID WASTE

* For the purposes of this Endangerment Assessment, ERM has made the assumption that TCP is a B2 carcinogen and developed an interim potency index of 1.00 E-01 (1/(mg/kg/day)) as described in Appendix H.

ORIGINAL (Red)

Table 4

Applicable and Relevant or Appropriate Requirements (ARARs) and Limits
Tyson's Site Water Treatment

Compound	Discharge Limits for Treated Water from the Tyson's Site* (ug/L)	MCLs (1)	Human Health (2)	Surface Water Quality Criteria: Human Health (3) Water & Fish (mg/L)	Human Health (3) Fish Only (mg/L)	Aquatic Life (2) Acute (mg/L)	Aquatic Life (2) Chronic (mg/L)
Volatiles							
Acetone							
Benzene		5.00E - 03	1.00E - 03	6.60E - 04	4.00E - 02	6.40E - 01	1.28E - 01
Chlorobenzene		1.00E - 01	2.00E -02	4.88E - 01		1.18E + 00	2.36E - 01
Chloroform		1.00E - 01**	2.00E -04	1.90E - 04	1.57E - 02	1.94E + 00	3.89E - 01
1,1-Dichloroethane							
1,2-Dichloroethene (total)		1.00E - 01	3.50E - 01			6.75E + 00	1.35E + 00
1,2-Dichloropropane						1.06E + 01	2.16E + 00
cis-1,3-Dichloropropene		5.00E - 03	8.70E - 02	8.70E - 02	1.41E - 02	3.05E - 01	6.10E - 02
Ethylbenzene	2.670.E+03	7.00E - 01	1.40E + 00	1.40E - 03	3.28E - 03	2.90E + 00	5.60E - 01
Methylene chloride			5.00E - 03			1.18E + 01	2.37E + 00
4-Methyl-2-pentanone							
Tetrachloroethene		5.00E - 03	7.00E - 04	8.00E - 04	8.85E - 03	6.95E - 01	1.39E - 01
Toluene	1.520E+03	2.00E + 00	1.43 E + 01	1.43E + 01	4.24E + 02	1.65E + 00	3.30E -01
Trichloroethene		5.00E - 03	3.00E - 03	2.70E - 03	8.07E - 02	2.25E + 00	4.50E - 01
1,2,3-Trichloropropane							
Total Xylenes	9.70E+02	1.00E + 01					
Semivolatiles							
Aniline	1.00E + 02						
Phenol	2.40E+01	3.50E + 00	3.00E - 01	3.50E - 03		1.00E + 02	2.00E + 01
1,3-Dichlorobenzene		6.00E - 01	4.00E - 01			3.45E - 01	6.90E - 02
1,4-Dichlorobenzene		7.50E - 02	4.00E - 01			7.30E - 01	1.46E - 01
1,2-Dichlorobenzene		6.00E - 01	4.00E - 01			8.20E - 01	1.64E - 01
Nitrobenzene			3.00E - 02	1.98E + 01		4.04E + 00	8.10E - 01
Benzoic Acid							
1,2,4-Trichlorobenzene			7.00E - 01			1.30E - 01	2.60E - 02
Naphthalene			1.00E - 02			1.35E - 01	4.30E - 02
Di-n-butyl phthalate			3.40E + 01			1.05E - 01	2.10E - 02
Cresol							
2,4-Dimethylphenol							
N-Nitrosodiphenylamine			5.00E - 03			2.95E - 01	5.90E - 02

*Based upon a PADER calculated dilution factor
**Total trihalomethanes
Blanks indicate that ARARs for these compounds are not available

1)Includes proposed MCLs or MCLGs (Fed. Reg., May, 1989)
2)Proposed PA Water Quality Toxics Management Strategy (25 PA Code Chapter 16)
3)USEPA (1986) Water Quality Criteria

ORIGINAL (Red)

consumption, they are applicable "at the tap", and were adjusted to account for dilution that could occur between the crib intake on the River and the effluent point of discharge to the River. In addition to effluent limits and risk-based standards, there is a reporting requirement for non-regulated organic compounds in the River of 0.5 ppb. This value is being used as the acceptable concentration at the River crib for 1,2,3-trichloropropane against which the effectiveness of the Interim Ground Water Recovery System is being monitored.

The Pennsylvania ARAR for groundwater for hazardous substances is that all groundwater must be remediated to "background" quality as specified by 25 PA code Sections 264.90 through 264.100, formerly 25 PA Code Section 75.264(n). The Commonwealth of Pennsylvania also maintains that the requirement to remediate to "background" is also found in other legal authorities.

Risk Characterization

Excess lifetime cancer risks for the Tyson's Site were determined by multiplying the daily intake of chemicals from environmental media by the cancer potency factors. These risks are probabilities expressed in scientific notation (i.e., $1x10^{-6}$). An excess lifetime cancer risk of $1x10^{-6}$ indicates that an individual has a one in a million chance of developing cancer as a result of site-related exposure to a carcinogen over a 70-year lifetime. The EPA recommended upper bound for lifetime cancer risks is between $1x10^{-4}$ and $1x10^{-7}$ however, the point of departure, as described in the NCP, is considered to be $1x10^{-6}$. See 40CFR 300.430.

The estimated excess lifetime cancer risks for ingestion by an off-site adult is $2x10^{-2}$.

Potential concern for noncarcinogenic effects of a single contaminant in a single medium is expressed as the hazard quotient (HQ) (i.e., the ratio of the estimated intake derived from the contaminant concentration in a given medium to the contaminant's reference dose). The HQs for all contaminants in a medium are added to obtain the Hazard Index (HI). The HI provides a reference point for gauging the significance of multiple contaminant exposures within a single medium or across media. A hazard index less than or equal to 1 indicates that there is no significant risk of adverse health effects.

The HI derived for the groundwater medium is summarized below:

Exposure to Ground Water

POPULATION	INGESTION
Offsite Adult	28

The results of the estimated excess lifetime cancer risks and noncarcinogenic hazard indices indicate the primary adverse health risk posed by the Tyson's Site is due to potential ingestion of offsite contaminated ground water from the deep aquifer. Cancer risks for exposure to surface water (i.e. Schuylkill River are within the EPA recommended guidelines. Thus, both the cancer risk and Hazard Index justify a remedial action at this site.

Actual or threatened releases of hazardous substances from this Site, if not addressed by implementing the response action selected in the ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment.

Description of Alternatives

As described in the Third Addendum Investigation Report, hydraulic gradients north of the Schuylkill River are not fully defined and the potential for discharge of contaminated groundwater to the River or further northward migration of site-related compounds cannot be fully quantified. Therefore, this discussion of remedial alternatives extends only to the north bank of the river. Some further investigation of the north side of the river will be performed as part of the design and construction of any alternative selected. The alternatives evaluated include the best demonstrated available technology (BDAT) to achieve the primary treatment level as defined by effuent limitations. The four remedial alternatives evaluated in the Focused FS are briefly summarized below:

Alternative #1 — No Action

The Superfund program is required to evaluate the "No Action" Alternative. For the Tyson's site, the No Action Alternative would consist of no additional remedial action beyond the operation of the Interim Ground Water Recovery and Treatment System on the south bank of the river, and continued monitoring of its effectiveness. This alternative would be selected only if the Site posed little or no risk to public health or the environment from hazardous substances as addressed in the Superfund law. Long-term monitoring (30 years) of the groundwater, surface water and sediment would be performed.

There are no capital costs associated with the No Action Alternative. The annual operation and maintenance costs including monitoring are estimated to be $330,000. Present net worth for 30 years, using a 10% discount rate, would be $3,100,000.

ORIGINAL (Red)

Alternative #2 — **Extension of Interim Ground Water Recovery System**

This alternative expands the existing interim ground water recovery system from seven ground water recovery wells to thirteen ground water recovery wells. Under this alternative, three additional recovery wells would be installed to depths of 185 feet and four of the existing wells would be deepened to the same depth to extend the ground water capture zone on the south side of the river to its full designed vertical and horizontal extent. Also, a long term (30 year) monitoring program consisting of groundwater, surface water and sediment sampling would be implemented.

The implementation requirements for this alternative are minimal and the estimated implementation timeframe is expected to be 8 months. The groundwater restoration timeframe is at least 30 years. Institutional controls would also be implemented as part of this alternative.

The capital cost for installation of the additional wells and deepening the existing wells is estimated to be $550,000. The annual operation and maintenance costs including monitoring are estimated to be $440,000. Present net worth cost for 30 years, using a 10% discount rate, would be $4,700,000.

Alternative #3A — **Groundwater Recovery on Barbadoes Island**

This alternative includes the installation of recovery wells on Barbadoes Island in addition to the extended well network on the south side of the Schuylkill River, as discussed in alternative 2. This alternative would be designed to capture ground water affected by site-related compounds emanating from sources on the south side of the River and beneath Barbadoes Island. Treatment of ground water recovered from wells on Barbadoes Island would require piping the recovered ground water beneath the Schuylkill River to the existing treatment facility on the south side of the River. The existing treatment facility would need to be upgraded to accommodate the additional volume.

The implementation requirements for this alternative include gaining access to Barbadoes Island and obtaining permits from the Delaware River Basin Commission (DRBC). The estimated timeframe to implement this alternative is expected to be at least 2 years. The groundwater restoration timeframe is at least 30 years. Institutional controls would also be implemented as part of this alternative.

The estimated capital cost for this alternative would be $2,200,000. The annual operation and maintenance costs including monitoring are estimated to be $840,000. Present net worth costs for 30 years using a 10% discount rate would be $10,100,000.

Alternative # 3B

Groundwater Recovery and Treatment on Barbadoes Island

This alternative includes the installation of recovery wells on Barbadoes Island in addition to the extended well network on the south side of the Schuylkill River as discussed in alternative 2. This alternative would also require the construction of a ground water treatment facility on Barbadoes Island. The treatment facility would be similar to the existing treatment facility on the south side of the River. This alternative would also be designed to capture ground water affected by site-related compounds emanating from sources on the south side of the River and beneath Barbadoes Island.

The estimated capital cost for this alternative would be $5,200,000. The annual operation and maintenance costs including monitoring are estimated to be $890,000. Present net worth cost using a 10% discount rate would be $13,500,000.

The implementation requirements for this alternative include gaining access to Barbadoes Island and obtaining permits from the DRBC and the Army Corps of Engineers. The estimated timeframe to implement this alternative is expected to be at least 2 years. The groundwater restoration timeframe is at least 30 years. Institutional controls would be implemented as part of this alternative.

Comparative Analysis of Alternative

A detailed analysis was performed on the four alternatives using the nine evaluation criteria presented in Table 5 in order to select a remedy. The following is a summary of the comparison of each alternatives' strength and weakness with respect to the nine evaluation criteria.

Overall Protection of Human Health and the Environment

It is anticipated that the effluent limits (Table 2) for the discharge of treated ground water would be met for all four alternatives. As reported in the Third Addendum Investigation Report, there is no apparent impact to river water quality from groundwater discharging to the River from the vicinity of the Island. This was concluded since the pumping on the south side of the River has no apparent impact at the monitoring wells on the Island and since the concentration of 1,2,3-trichloropropane in the River as noted above has been essentially reduced to below the 0.5 ppb reporting limit. Apparently, any groundwater in the

ORIGINAL (Red)

Table 5 . DESCRIPTION OF EVALUATION CRITERIA

Overall Protection of Human Health and the Environmental - addresses whether or not a remedy will: cleanup a site to within the risk range; result in any unacceptable impacts; control the inherent hazard (e.g., toxicity and mobility) associated with a site; and minimize the short-term impacts associated with cleaning up the site.

Compliance with ARAR's - addresses whether or not a remedy will meet all the applicable or relevant and appropriate requirements of other environmental statues and/or provide grounds for invoking a waiver.

Long-term Effectiveness and Permanence - refers to the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup goals have been met.

Reduction of Toxicity, Mobility, or Volume through Treatment - refers to the anticipated performance of the treatment technologies that may be employed in a remedy.

Short-term Effectiveness - refers to the period of time needed to achieve protection, and any adverse impacts on human health and the environment that may be posed during the construction and implementation period until cleanup goals are achieved.

Implementability - describes the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement the chosen solution.

Cost - includes the capital for materials, equipment, etc. and the operation and maintenance cost.

Support Agency Acceptance - indicates whether, based on its review of the RI, FS and the Proposed Plan, the State concurs with, opposes, or has no comment on the preferred alternative.

Community Acceptance - will be assessed in the Record of Decision following a review of the public comments received on the RI, FS, and the Proposed Plan.

vicinity of the Island which discharges to the River does not have a measurable impact on River water quality.

Alternatives 3A and 3B protect human health and the environment by capturing ground water affected by site-related compounds emanating from sources on the south side of the River and beneath Barbados Island, thereby reducing the potential for further migration of contaminants to the north side of the River. Effluent limits for the discharge of treated ground water to the River would be met for all four alternatives.

Compliance with ARARs

SARA requires that remedial actions meet applicable or relevant and appropriate requirements (ARARs) of other environmental laws. These laws may include: The Toxic Substances Control Act, the Clean Water Act, the Resource Conservation and Recovery Act, and any state law which has stricter requirements than the corresponding federal law.

A "legally applicable" requirement is one which would legally apply to the response action if that action were not taken pursuant to Sections 104, 106, or 122 of CERCLA. A "relevant" and appropriate requirement is one that, while not "applicable", is designed to apply to problems sufficiently similar that their application is appropriate. A list of ARAR's for each of the considered alternatives is presented in Table 6. All of the alternatives will meet ARAR's, and no waivers will be required.

Long-Term Effectiveness and Permanence

The presence of the DNAPL in the deep aquifer will require that ground water recovery to minimize the discharge of site-related compounds to the River be conducted for a prolonged period. The length of time required cannot be predicted at this time, but can be evaluated at each of the five-year effectiveness reviews as more information on the occurrence, nature, and recoverability of DNAPLs becomes available, both for the site and in the scientific community.

For each of the alternatives, long-term management will be required, including monitoring of the effectiveness of the recovery and treatment system. During operation of the treatment system(s), monitoring of the River water and ground water quality and treatment system effluent will be required. Contingencies for modifying any of the alternatives and, therefore, providing additional protection to the river water receptors will be required for each of the alternatives.

Reduction in Mobility, Toxicity, or Volume (MTV)

The need to recover ground water establishes from the outset the

TABLE 6
FEDERAL ACTION SPECIFIC ARARs

Standard, Requirement Criteria, or Limitation	Citation	Description	Aplicable/ Relevant and Appropriate	Comment
Standards Applicable to Generators of Hazardous Waste	42 U.S.C Part 262 Subparts A-E	Establishes standards for generators of hazardous waste	No/Yes	ARAR for all alternatives if remedial action alternative involves offsite transportation of either soil or source material for treatment or disposal.
Standards Applicable to Transporters of Hazardous Waste	40 C.F.R. Part 263	Establishes standards which apply to transporters of hazardous waste within the U.S.	No/Yes	ARAR for all alternatives. If remedial action involves offsite transportation of soil or source material for treatment or disposal.
Occupational Safety & Health Act	29 U.S.C. 1910 & 1926	Regulates worker health & safety in industry & construction.	Yes/No	ARAR for alternatives 2,3A & 3B. Under 40 C.F.R. 360.38, requirements of the Act apply to all response activities under the NCP

TABLE 6 cont'd
FEDERAL ACTION SPECIFIC ARARs

Standard, Requirement Criteria, or Limitation	Citation	Description	Applicable/ Relevant and Appropriate	Comment
Occupational Safety & Health Act	29 CFR 1910-120 or 54 FR 9294	Health & Safety standards for employees engaged in hazardous waste operations.	Yes/No	Applies to all respones activities. ARAR for all alternatives.
Hazardous Materials Transportation Act	49 U.S 1801-1813	Regulates Transportation of hazardous materials	Yes/No	Only if an alternative developed would involve transportation of hazardous materials. ARAR for all alternatives.
Hazardous Materials Transportation Requlations	49 C.F.R. Parts 107, 171-177	Requlates transporation of hazardous materials.	Yes/No	(Same as above)
Construction Requirement	Army Corps of Engineers Section	Regulates Construction on wetland/floodplains		ARAR for alternatives 3A and 3B since these involves construction of a pipeline under the River & construction of a treatment facility on Barbadoes Island respectively

TABLE 6 cont'd
STATE ARARs

Standard, Requirement Criteria, or Limiation	Citation	Description	Applicable/ Relevant and Appropriate	Comment
		Chemical Specific		
PA Air Quality Standards	25 PA Code Section 127.1 & Section 127.11	Establishes air emmission control	Yes/No	ARAR for all alternatives since contaminants will be stripped by steam.
PA Air Quality Standards	25 PA Code Sections 123.1,123.2, 123.3,and 123.41	Establishes air emmission limitations for fugitive odor and visible emmissions	Yes/No	ARAR for all alternatives since contaminants will be stripped.
PA Air Quality Standards	25 PA Code Section 121.7	Prohibition of air pollution	Yes/No	ARAR for all since contaminants will be air stripped.
"Background" Quality for Ground Water	25 PA Code Chaper Section 264.90 through 264.100	Hazardous substances in ground water must be remediated to "background" quality	Yes/No	ARARs for all alternatives since contaminants of concern exceed background.

TABLE 6 cont'd
STATE ARARs

Standard, Requirement Criteria, or Limiation	Citation	Description	Applicable/ Relevant and Appropriate	Comment
		Chemical Specific		
National Pollution Discharge Elimination System (NPDES)	25 PA Code Sections 92.1 through 92.79	Establish Discharge Limitations	Yes/No	. ARAR for all alternatives treated groundwater will be discharged to River
Water Quality Standards	25 PA Code Section 93.1 through 93.9	Establish Water Quality Standards	Yes/No	ARAR for all alternatives treated groundwater will be discharged to River
		ACTION-SPECIFIC ARARs		
Hazardous waste generation, transportation, storage & treatment	25 PA Code sections 260 through 265 & 270	Regulates hazardous waste generation, transportations, storage & treatment	Yes/No	ARARs for all alternatives since they invole transportation of source material
Residual waste generation, transportation, storage & treatment.	25 PA Code Sections 75.21 through 75.38	Regulates residual generation, transportation, storage & treatment	Yes/No	ARARs for all alternatives since they involve generation & transportation of source material

TABLE 6 cont'd
LOCATION-SPECIFIC ARARs

Standard, Requirement, Criteria, or Limitation	Citation	Description	Applicable/ Relevant and Appropriate	Comment
Wetlands & Floodplain regulations	25 PA Code Sections 269.22 and 269.23	Prohibit siting of treatment facilities in the 100 year floodplain & in wetland areas	Yes/No	ARRA for alter-3B since this involves con-struction of treatment facility.
Dam Safety and Waterway Management	25 PA Code Section 105.1 through 105.423	Regulates water obstruction, encroachments and wetlands	Yes/No	ARAR for alter-natives 3A & 3B since these in-volve construction of pipeline and treatment facility respectively
Scenic Rivers Act	25 PA Code Section 269.50	Requirement for con-structing a facility within a protected river corridor	Yes/No	ARAR for alter-natives 3B since this involves construction of a treatment facility.

need for reducing the toxicity and volume of the site-related compounds in the Schuylkill River. Site-related compound toxicity and volume in the river are reduced by ground water recovery as shown by the proven effectiveness of the Interim Ground Water Recovery System. All four alternatives incorporate treatment. For the purpose of this FFS, it is anticipated that treatment for Alternatives 3A and 3B will be Aqua Detox, as it is for Alternatives 1 and 2. It is anticipated that Aqua Detox will continue to meet the limits established for the site. Upon completion of additional studies to be conducted during the design of a potential recovery system on the island, it may be determined that another treatment alternative would be more suitable for Altebrnaative 3A and 3B. Information such as volume and concentration of compounds to be treated could dictate choosing a more appropriate treatment system of the ground water recovered from the island wells.

According to AWD Technologies, Inc. Aqua Detox is capable of removing 92 of the 110 volatile compounds listed in CFR 40, July 1, 1986, by the EPA. Further, such systems have the demonstrated capability to remove these compounds to the very low parts per billion ppb range. This represents remediation that goes several orders of magnitude beyond that of conventional stripping systems, since conventional strippers will normally achieve only 80 to 95 percent removal, thus requiring additional treatment. Typically, carbon beds are added to attain final water effluent levels in the ppb range that are required by current environmental standards. With Aqua Detox, carbon beds are typically not required.

<u>Short-Term Effectiveness</u>

Each of the alternatives described consists of pumping and treating ground water such that the water quality at the Pennsylvania American Water Company crib intake is maintained at the acceptable levels currently achieved by Alternative 1. From the data obtained, the Interim Ground Water Recovery System (Alternative 1) had the immediate impact of improving the River water quality at the crib intake by reducing the 1,2,3-trichloropropane concentration to below the 0.5 ppb reporting limit. Alternatives 3A and 3B would provide prevention of further migration of contaminants beyond the north bank of the River.

For Alternatives 3A and 3B ground water treatment would include either the construction of a treatment facility on Barbadoes Island or piping recovered ground water across a navigable section of the Schuylkill River to the treatment system on the south side of the river. Short-term risks for workers would be associated with the construction of the pipe line, the upgraded treatment facility or a new treatment facility, and the installation of wells on Barbadoes Island. For Alternatives 1

ORIGINAL (Red)

and 2, the treatment facility has already been constructed. Alternative 2 would require the installation of additional recovery wells and, thus, there would be a need to safeguard the health and safety of site workers during drilling and well installation.

The risk of exposure to residuals generated during water treatment is expected to be minimal, as organic residuals would be taken off-site in closed containers for all of the alternatives. If contaminated ground water is piped across the Schuylkill River for Alternative 3B, the pipe could potentially fail and contaminated water could be released directly to the Schuylkill River. Precautions against failure of th piping monitoring for leak detection would be required.

Implementability

The Interim Ground Water Recovery System has been on-line for over a year and as described previously, has been shown to be effective at reducing the discharge from the deep aquifer of site-related compounds to the river. The treatment system for the Interim Ground Water Recovery System was sized to handle anticipated flows and concentrations for the 13 well Full Ground Water Recovery System so implementability of bringing on line the additional wells on the south side of the River (Alternative 2) would only require the installation of the wells and associated pumps, piping, and hardware.

Implementing Alternatives 3A and 3B will require gaining access to Barbadoes Island from Pennsylvania Electric Power Company (PECO) for installation of recovery wells and possibly a treatment facility. If the recovered ground water were to be treated at a facility on the south side of the River, the water would have to be piped either over or under the river (cost estimates have only been developed for installing a pipe under the River). This will require extensive permitting and monitoring. Permit requirements, such as NPDES, may need to be revisited for Alternatives 2 and 3. A permit must also be secured from the Delaware River Basin Commission (DRBC) for Alternative 3A and 3B. A permit from the Army Corps of Engineer will be required from the construction of pipleine as discribed in Alternative 3A.

Cost

For Alternative 1, the estimated O&M costs are $330,000. For Alternative 2, the estimated capital and O&M costs for $520,000 and $440,000, respectively. For Alternative 3 in which a pipe is used to bring recovered ground water from Barbadoes Island to the existing Aqua Detox treatment facility, the estimated capital costs and O&M costs are $2.2 million and $840,000, respectively. If Alternative 3 includes the construction of an Aqua Detox treatment facility on Barbadoes Island, the estimated capital and O&M costs for this alternative are about $5.2 million and $890,000, respectively. All three alternatives will require similar levels of monitoring to determine short- and long-term effectiveness.

State Acceptance

The Commonwealth of Pennsylvania has concurred with the selected remedial alternative.

Community Acceptance

Community acceptance is assessed in the attached Responsiveness Summary. The Responsiveness Summary provides a thorough review of the public comments received on the RI/FS and the Proposed Plan, and U.S. EPA's and PADER's responses to the comments received.

Description of the Selected Remedy

After careful consideration of the proposed remedial alternatives, EPA's preferred alternative for the Tyson's site is Alternative 3A, Groundwater Recovery on Barbadoes Island. Under this alternative, groundwater recovery wells would be installed on Barbadoes Island and also on the south side of the River to extend the existing well network to 13 recovery wells. This alternative would be designed to capture groundwater affected by site-related compounds emanating from sources on the south side of the River and beneath Barbadoes Island. The point of compliance will be throughout the contaminated plume outside the areas overlying known or suspected DNAPL sources. Contaminated groundwater recovered from the wells installed on Barbadoes Island would be piped beneath the River to the existing interim ground water treatment system. This existing treatment system would need to be upgraded to accommodate the additional volume. This alternative would also include groundwater and surface water monitoring to ensure the effectiveness of the groundwater recovery and treatment as measured against the ARAR's in table 6 and to monitor the concentrations of contaminants in the ground water and surface water. Groundwater and surface water sampling will be performed for a period up to five years with formal review of the Site after 5 years, pursuant to Section 121 (c) of CERCLA. If, during this time, additional contamination is detected, the risk posed by that contamination would be determined and appropriate action taken.

In order to contain the dissolved plume immediately overlying the DNAPL sources and to restore the other contaminated portion of the aquifer to its beneficial use, the remediation system implemented in this alternatives would operate until site-specific remediation goals are achieved. Thus the aquifer would

ORIGINAL (Red)

be remediated until the contaminant levels reach the MCLs, Non-zero MCLGs, or background, whichever are lower.

If implementation of the selected remedy demonstrates, in corroboration with hydrogeological and chemical evidence that it will be technically impracticable to achieve and maintain the remediation goals throughout the area of attainment, the EPA in consultation with the Commonwealth of Pennsylvania, intends to amend the ROD or issue an Explanation of Significant Differences to inform the Public of alternative groundwater goals.

It should be noted, however, that while EPA has selected the Barbadoes Island as the location of the recovery system, a public comment submitted on behalf of Ciba Geigy Cooperation (see the Responsiveness Summary attachment to this ROD) has suggested that another location for pumping the groundwater would be more appropriate. While EPA does not have sufficient data to agree with that suggestion in its selection of the remedy, EPA is aware that Ciba-Geiby is collecting more data concerning that issue. If as a result of that data, EPA decides to locate the recovery system at another location, EPA will publish an explanation of significant difference at that time.

<u>The rationale for selection of this alternative is based on four factors:</u>

1. The extension of the interim groundwater recovery system to 13 wells on the south side of the River will further prevent the discharge of contaminated groundwater to the River.

2. The installation of ground water recovery wells on Barbadoes Island will prevent the northward migration of contaminated ground water.

3. The treating of the recovered ground water beneath Barbadoes Island and on the south side of the river will help in restoring the bedrock aquifer.

4. The selected remedy offers the most cost-effective solution while still providing adequate protection of human health and the environment.

<u>Cost Estimate for Alternative 3A</u>

Estimated Installed Capital Costs

Installation of 13-well recovery well systems south of river (cost detailed in Alternative II).	$520,000
Installation of 6 wells/header system to pipeline beneath Schuylkill River.	$916,000

Design and permitting (note a minimum of 130 to 150 day Pennsylvania review period)	70,000
Installation of double-walled line beneath Schuylkill River (350 gpm maximum designed flow)	450,000
Installation of instrumentation, pumps, holding tank, and pump station.	75,000
System Upgrades (influent, effluent pumps, and hardware)	20,000
Contingency (30% for new capital costs)	$184,500
Estimated Total Installed Capital Costs	**$2,235,500**
Estimated O&M Costs	
Annual Treatment System O&M, including electric power propane (steam) labor maintenance two laboratory sample/month* disposal of organics**	$710,000
Maintenance of recovery wells, including: submersible pumps well header well rehabilitation	$124,000
Estimated Total O&M Costs	**$834,000**

* Analytical cost $2,000/sample.

** Organic condensate disposal cost is based on 15 gallons/day production, which has a disposal cost of $6/gallon

Statutory Determinations

EPA's primary responsibility at Superfund sites is to implement remedial actions that are protective of human health and the environment. Section 121 CERCLA also establishes several other statutory requirements and preferences. The selected remedy must be cost effective and utilize a permanent solution to the maximum extent practicable. The selected remedial action must comply with all applicable or relevant and appropriate requirements set forth by State and Federal environmental regulations, unless such

ORIGINAL (Red)

requirements are waived in accordace with CERCLA Section 121. Finally, EPA must consider the statutory preference for remedial actions that permanently reduce the toxicity, mobility, and volume of the site-related wastes. The following sections discuss how the selected remedy meets the statutory requirements and preferences set forth by Section 121 of CERCLA.

Protection of Human Health and the Environment

The risk as assigned by EPA and associated with the contaminated ground water on the north side of the River identified ingestion of this groundwater as the only significant exposure pathway having an adverse effect on human health or the environment. The selected remedy would protect human health and the environment by containing the contaminated ground water and preventing it from migrating further north towards Norristown. Also, the selected remedy would further prevent discharge of contaminated ground water to the river.

Compliance With Applicable or Relevant and Appropriate Requirements

The selected remedial action will comply with all applicable or relevant and appropriate location-, action-, and chemical-specific requirements (ARARs). The Pennsylvania ARAR for ground water for hazardous substances is that all ground water must be remediated to "background" quality as specified by 25 Pa. Code Sections 264.90 through 264.100. The Commonwealth of Pennsylvania also maintains that the requirement to remediate to background is also found in other legal authorities. A complete listing of ARARs developed during the comparative analysis of alternatives is presented in Table the ARARs specific to the selected remedy are presented below.

Chemical-specific ARARs

- 25 PA Code Section 264.90 through 264.100 "Background" quality for ground water remediation

- 25 PA Code Section 127.1, and 127.11 Pennsylvania Air Quality Standards

- 25 Pa Code Section 123.1, 123.2, 123.31 and 123.41, Pennsylvania Air Quality Standards for establishing air emission limitations for fugitive, odor and visible emissions.

- 25 PA Code Section 121.7, Prohibition of Air Pollution

- 25 PA Code Sections 92.1 through 92.79, National Pollution Discharge Elimination System (NPDES) for treated groundwater discharge limitations.

- 25 PA Code Sections 93.1 through 93.9, Establish water Quality Standards.

Location Specific ARARs

- 25 PA Code Sections 269.22 and 269.23, prohibits siting of treatment facilities in the 100-year floodplain and in wetland areas, respectively.

- 25 PA Code Section 105.1 through 105.423 regulates water obstruction, encroachments, and wetlands.

- Pennsylvania Scenic Rivers Act and 25 PA Code Section 269.50 requirements for constructing a facility within a protected river corridor.

Action specific ARARs

- 25 PA Code Sections 260 through 265, and Section 270 regulates hazardous waste generation, transportation, storage and treatment

- 25 PA Code Sections 75.21 through 75.38, regulates residual waste generation, transportation, storage and treatment

- 29 CFR Parts 1910 and 1926, Occupational Health and Safety Act requirements are applicable to all response activities

Cost-Effectiveness

The selected remedy is cost-effective because it has been determined to provide overall effectiveness proportional to its costs, thse net present worth value being $10,100,000. The selected remedy is less costly than alternative 3B and provides a level of protection of human health comparable to that provided by other remedies.

Utilization of Permanent Solutions to the Maximum Extent Practicable

EPA has determined that the selected remedy represents the maximum extent to which permanent treatment technologies can be utilized in a cost effective manner for the Tyson's Site. Of those alternatives that are protective of human health and the environment and comply with ARARs, the EPA has determined that the selected remedy provides the best balance in terms of short-term effectiveness; implementability; cost; reduction in

ORIGINAL (Red)

The selected remedy does offer a high degree of long term effectiveness and it will significantly reduce the risks to human health posed by the contaminated ground water. The excess human cancer risk at the North Bank of the Schuylkill river has been estimated at $2x10^{-2}$ which is above EPA's recommended upper bound of $1x10^{-4}$ to $1X10^{-6}$ Due to the relative high risk associated with the contaminated ground water, EPA has determined that the use of the selected remedy is justifiable. Although 3B offers a comparable level of protection of human health and the environment, the EPA has slected alternative 3A, which can be implemented relatively quickly; will have little or no adverse effects on the surrounding community; and will cost considerably less than alternative 3B.

Preference for Treatment

By recovering and treating the ground water with steam-stripping process the selected remedy addresses one of the principal threats posed by the site threough the use of treatment technologies. Therefore, the statutory preference for remedies that employ treatment as a principal element is satisfied.

Documentation of Significant Changes

The preferred alternative originally proposed in the Proposed Plan is also the preferred alternative selected in the ROD. There have been no significant changes made to the selected remedy in the time period between the issuance of the Proposed Plan on July 23, 1990 and the signing of the ROD approximately ten weeks later.

It should be noted, however that while EPA has selected the Barbadoes Island as the location of the recovery system, a public comment submitted on behalf of Ciba-Geigy Corporation (see the Responsiveness Summary attachment to this ROD) has suggested that another location for pumping the groundwater would be more appropriate. While EPA does not have sufficient data to agree with that suggestion in its selection of the remedy, EPA is aware that Ciba-Geigy is collecting more data concerning that issue. If as a result of that data, EPA decides to locate the recovery system at another location, EPA will publish an explanation of significant differences at that time.

ORIGINAL (Red)

RESPONSIVENESS SUMMARY
OPERABLE UNIT #3 - TYSON'S DISPOSAL SITE

This community relations responsiveness summary is divided into the following sections:

Section I **Overview** - A discussion of EPA's preferred remedial alternative for Operable Unit #3 at Tyson's Disposal Site and the public's response to this alternative.

Section II **Background of Community Involvement and Concerns** - A discussion of the history of community interest and concerns raised during remedial planning activities at Tyson's Disposal Site.

Section III **Summary of Major Comments Received During the Public Meeting, Public Comment Period and Agency Responses** - A summary of comments and responses categorized by topic.

I. Overview

EPA's preferred alternative for Operable Unit #3 of the Tyson's Disposal Site (the Site) is alternative #3A, Ground Water Recovery on Barbados Island, outlined in the Proposed Remedial Action Plan. Operable Unit #3 addresses further remediation of the contaminated ground water which has migrated beneath, and as far as, the north bank of the Schuylkill River.

The preferred alternative calls for the expansion of the ground water recovery system on the south side of the Schuylkill River from seven wells to thirteen wells and the installation of recovery wells on Barbados Island. This alternative would be designed to capture ground water affected by Site-related compounds emanating from sources on the south side of the river and beneath Barbados Island. Treatment of ground water recovered from wells on Barbados Island would require piping the recovered ground water beneath the Schuylkill River to the existing treatment facility on the south side of the river. The existing treatment facility would need to be upgraded to accommodate the additional volume. This alternative would also include ground water and surface water monitoring and analysis to ensure the effectiveness of the ground water recovery and treatment. Sampling will be performed for a period up to five years with a formal review taking place after five years. If, during this sampling, additional contamination is detected, the risk posed by that contamination would be determined and the appropriate action taken.

Based on currently available information, EPA anticipates that this alternative will be protective of human health and the environment.

During the public comment period, written comments regarding the selection of a remedial alternative were received by EPA. A public meeting was also held on August 9, 1990 . Generally, the residents seemed to be in agreement with the Proposed Plan. Four residents voiced their questions and concerns to EPA staff during the meeting. These comments and EPA's answers will be summarized in Section III of this report.

II. BACKGROUND OF COMMUNITY INVOLVEMENT AND CONCERNS

Community interest in the Tyson's Disposal Site began in 1983 when EPA received an anonymous complaint from a citizen regarding odors emanating from the Site. This complaint prompted the initial investigation of the Site.

Since 1983, EPA has conducted a series of Remedial Investigations/Feasibility Studies (RI/FS) on the Site's operable units and has issued Records of Decision (RODs) for Operable Unit #1, the on-Site area that encompasses the lagoons, and Operable Unit #2, which consists of contaminated ground water in the bedrock aquifer up to the south bank of the Schulykill River.

Upper Merion Township officials have been involved with all aspects of the Site, although residents living near the Site have been mostly interested in the former lagoon area of the Site. Public meetings were held before the first ROD was issued in 1985 announcing soil excavation as the selected cleanup alternative for the on-Site area. There was also community interest in 1987 when EPA revised the ROD for Operable Unit #1 to include vacuum soil extraction as the preferred alternative as opposed to soil excavation. A public meeting was held at that time and a responsiveness summary was written to answer the public's questions and concerns.

There was not much community interest in the off-Site areas, Operable Unit #2, when EPA placed newspaper advertisements describing the cleanup alternatives in September 1988. No comments were received during the public comment period and although the opportunity for a public meeting was provided, the community did not express interest in having a meeting. The alternative selected for the cleanup of Operable Unit #2 called for air and steam stripping of contaminated ground water. The cleanup commenced in November 1988.

However, since the construction of the air stripping tower (Operable Unit #2) located near the Site on the south side of the river, concerns have been voiced by members of the community who live closest to the tower. These residents feel that the height of the tower is unsightly and could reduce the real estate values of their properties. EPA staff have met with the spokesperson for this group and have agreed to review the specific complaints that have been made, review EPA's past efforts to involve the community and consider what action to take in response to the dissatisfaction.

A public meeting on the cleanup alternatives selected for Operable Unit #3 was held on August 9, 1990. Approximately twenty people attended the meeting.

The concerns voiced at the public meeting and the comments received during the public comment period about EPA's preferred alternative, other remedial alternative preferences and EPA's responses are described below.

III. SUMMARY OF MAJOR COMMENTS RECEIVED DURING THE PUBLIC MEETING, OPEN PUBLIC COMMENT PERIOD AND AGENCY RESPONSES

EPA'S PREFERRED ALTERNATIVE

1. Comments were made regarding the visual impact of the preferred remedial alternative #3A. Could the air stripping tower perform the same function if it were located on Barbados Island as opposed to the south side of the river? Is there an alternative cleanup technology available that would not require the 40-foot air stripping tower already in place?

EPA Response: The implementation of the preferred alternative will not require an extension of the present tower, heightening of the tower or the installation of another tower. The modification to the present treatment facility will involve installing some additional pumps on Barbados Island or on the south side of the river which will not be noticeable.

It is reasonable to say that yes, the tower could be located on Barbados Island and perform the same function. However, at this time, everything is situated on the south side of the river because when the tower was installed we did not know what was going on beneath the river on the north side , and it was imperative that we prevent any further discharge of ground water to the river.

There are other treatment technologies for contaminated ground water. However, at the time, EPA felt that the air stripping tower was the best alternative for Operable Unit #2.

2. A resident asked if any ground water receptors other than Norristown State Hospital have been identified in the area? And have any other ground water receptors been identified that may have contaminants associated with the Tyson Disposal Site?

EPA Response: There were a few residents on the south side of the river who still have ground water wells. Those wells were sampled and found to be clean. We have identified numerous wells on the Norristown side, some of which were installed in the 1800s that do not exist anymore. Norristown State Hospital and a bakery, who

ORIGINAL (Red)

denied us access to sample the well, are the only two ground water receptors that have been identified.

3. Do you have any idea by what mechanism the contamination from the Tyson's Disposal Site would have been drawn in the northeast direction of the Site under and across from the river?

EPA Response: We believe that the DNAPLs and ground water are following the fracture system in the bedrock that goes to several hundred feet below the surface. There was a strong gradient on the south side that discharged ground water to the river and there was some under flow beneath the river which continues to migrate toward the north. This was determined during the remedial investigation. The contamination may have moved naturally towards the north side of the river or may have been induced by pumping centers on the north side of the river. Without additional wells it cannot be definitively stated.

4. Is that flow going toward Norristown State Hospital?

EPA Response: We're not sure. Without wells placed further north, we can't get flow patterns to see exactly where the ground water is flowing. We're going to put additional wells in between the north bank of the river and Norristown State Hospital to see if ground water is continuing to migrate northward or if there is some sort of divide where ground water will actually move toward the river. Until we install those additional wells north of the river, we can't be sure where the hydraulic gradient is.

5. In a fractured rock system, isn't it possible that water might flow for a distance in one direction and then, intercepting a fracture, flow in another direction?

EPA Response: Yes, if there are major structural features. The definition of flow and fracture is very difficult.

6. Has there been any attempt to identify any structural features that flow from the Site or from an extension of this Site that goes in another direction? And, is there any intention to look in any other direction other than north for such fracture and migration.

EPA Response: Yes, a fracture trace analysis was conducted in 1987 and wells were located as best as possible to intercept these fractures. One of the difficulties we've had with understanding what is happening with the gradients and directions of ground water flow north of the river is that our wells are installed in a line on the north bank of the Schuylkill River. Therefore, we don't have a three dimensional picture of what is happening. It is hoped that this next round of well installation will be able to develop that information.

ORIGINAL (Red)

7. A comment was asked in regards to risk assessment. The resident asked for an explanation of how the risk assessments listed in the Proposed Remedial Plan is derived and on what particular contaminants they are based?

EPA Response: The risks at the Tyson's Disposal Site are almost entirely attributable to 1,2,3 - Trichloropropane. Although EPA has no high quality data indicating that this compound is a carcinogen, EPA has assumed it has a carcinogenic potency similar to that of analogous chlorinated solvents. EPA has applied this carcinogenic potency factor to an assumed residential use of contaminated ground water involving ingestion of two liters per day for a 70 year lifetime.

8. Have tests been taken on areas that lie south of the Site? If so, has there been any migration of contaminants to the south?

EPA Response: The ground water flow direction is to the north on the south side of the river. Upgradient wells (south of the Site) do not indicate Site contamination.

The Upper Merion Township Advisory Committee had several comments and questions regarding the alternatives described in EPA's Proposed Remedial Action Plan. The committee found Alternative #1, No Action, and Alternative #2, Extension of Interim Ground Water Recovery System unacceptable. Also, before endorsing either Alternative #3A or #3B, the committee would like answers to the following questions:

1. What cautionary design and operation procedures have been considered to minimize the possibility of a leak and/or rupture of the proposed pipeline under the Schuylkill River in association with Alternative #3A, and what type of monitoring will be associated to ensure that a leak has not occurred?

EPA Response: During the pipeline design phase, we will look at leak warning systems for the pipeline that will react if a rupture or leak should occur.

2. Will the pipe under the river be constructed of double piping, i.e., a pipe within a pipe?

EPA Response: We will also look into the feasibility and cost of construction for double pipe during the design phase.

3. Will the ground water extracted from the wells be pushed through the pipeline using pumps on Barbados Island, thereby putting the transmitted fluid under positive pressure, or will additional pumps be installed on the south side of the river to pull the fluid through the pipeline, thereby putting the transmitted fluid under negative pressure?

ORIGINAL (Red)

EPA Response: These options will be considered during the design phase of the cleanup.

4. Have the costs of permitting a pipeline under the Schuylkill River been included in the projected economic cost for Alternative #3A?

EPA Response: Yes, the permit costs were included in the cost analysis.

5. Have the potential economic and environmental costs associated with a potential leak and/or rupture of the pipeline been taken into consideration in the development of the cost estimate? In particular, do the potential economic and environmental costs of a pipeline leak/rupture negate the $3,400,000 difference in projected costs between Alternative #3A and #3B?

EPA Response: Costs associated with leak and/or rupture have not been developed at this time. This analysis can be performed during the design phase of the cleanup.

6. Is there a substantial difference in the estimated time to fully activate Alternative #3A versus Alternative #3B? If so, what are these projected times? Was estimated time to fully activate treatment considered in EPA's recommendation of Alternative #3A?

EPA Response: No, there is not a substantial time difference involved. Both of the Alternatives will take at least two years to fully activate.

7. There is evidence indicating that pollutants have spread northward, beyond Barbados Island. Was the possibility that additional ground water treatment on the north side of the river could eventually be necessary taken into consideration in EPA's recommendation of Alternative #3A? If so, what was the nature of this analysis?

EPA Response: EPA is interested in long-term control of the dissolved plume associated with the DNAPL source under Barbados Island. Ground water pumping and treatment on the north side of the river may augment or replace pumping on Barbados Island as long as sufficient hydraulic control can be maintained over the contaminant plume. Once the additional investigations on the north side of the river have been completed, any necessary changes in the location of pumping wells can be made at that time.

REMEDIAL ALTERNATIVE PREFERENCE

Several comments were received stating a preference for Alternative #2, Extension of Interim Ground Water Recovery System as opposed to EPA's preferred Alternative #3A, Ground Water Recovery on Barbados

Island. These comments deal with both policy and technical issues and are summarized below:

1. Comments were received stating that EPA's selection of the preferred alternative for Operable Unit #3 is contrary to the National Contingency Plan (NCP) because it does not utilize containment and is inconsistent with or precludes implementation of the expected final remedy.

EPA Response: It appears that the objectives of the selected remedy to pump and treat ground water at Barbados Island may not be fully understood. The Remedial Investigation/Feasibility Study documented ground water contamination in the deep portion of the bedrock aquifer which is currently used as a potable water supply source. EPA, in accordance with the NCP, intends to restore the aquifer to its beneficial uses where technically feasible and utilize containment in those areas where restoration is not appropriate.

The notion of containment is the issue most central to the remedy selected by EPA. The Remedial Investigation reported that DNAPLs exist under Barbados Island and that substantial quantities of the DNAPL constituents are present as dissolved contaminants in the ground water under the island and on the north banks of the Schuylkill River. Present understanding of DNAPL existence indicates that the DNAPL may be present in pools, or as coatings on fractures and pore space and will continue to act as a source for dissolved contaminants which may then move with ground water flow. It is clear that the DNAPL residing in the aquifer may act as a source for many, many years and restoration of that portion of the aquifer is most probably unattainable.

However, management of the dissolved plume can be accomplished so that further spreading is mitigated and areas of the aquifer which may be actually or potentially down gradient of the DNAPL source are protected. To best manage and confine the plume in the aquifer, EPA chose a pumping location as close as possible to the continual source area. Neither the hydraulics nor the limit of contamination on the north side of the river have been adequately defined. It is not known if a natural gradient or one artificially induced has drawn contamination to the north side of the river. However, as long as DNAPLs exist under Barbados Island and are not present under the north side of the river (as reported in the RI/FS document), a plume of dissolved contamination, which may move naturally or could potentially move under pumping conditions, exists in the aquifer. To adequately control this plume of dissolved contaminants, EPA believes pumping and treating is best managed closest to its source area at Barbados Island. This action can thereby prevent the plume's further migration, reduce risk at locations where the plume currently exists and restore and maintain as much of the aquifer as possible to useable conditions.

ORIGINAL (Red)

2. A comment questioned whether pumping on Barbados Island will provide further measures of protection for the river water.

EPA Response: Refer to the response given to question #1 above.

3. A comment was received which stated that there are no health based risks or environmental reasons for taking any further action to address the impact of ground water discharge into the river.

EPA Response: One of EPA's primary objectives is to contain the contaminant plume in the aquifer. At this time, the extent of that plume is still not entirely known. That being the case, potential discharges to the river from the aquifer that we have not yet discovered may raise these health based risks and environmental concerns.

4. Several comments were made stating that the presence of DNAPLs in the bedrock aquifer precludes restoration of the aquifer as a goal that can be accomplished in the foreseeable future.

EPA Response: As stated in response to Question #1, the goal of this selected alternative is to manage the dissolved plume associated with the DNAPL contamination. It is clear that the presence of DNAPLs in the aquifer may act as a source of contamination for a very long time and that restoration of that part of the aquifer is most probably unattainable.

5. A comment was received which stated that the selected alternative is unnecessary because the recovery well system on the south side of the river has blocked the flow of contaminated water to the river and there are no present uses of the ground water on Barbados Island or on the north side of the river.

EPA Response: This statement is incorrect. While the "south side" recovery well system blocks flow from the "south side", there is contaminated ground water that has already migrated beyond that point in a northerly direction under the river. Norristown State Hospital located on the north side of the river is a ground water receptor.

6. A comment was received stating that the installation of ground water recovery wells on Barbados Island prior to obtaining a more complete understanding of the dynamics of ground water flow and its impact on the presence of Site-related compounds beneath the island and on the north side of the river would be premature and may impact the overall effectiveness of an ultimate ground water remedy. It was stated that disturbing the bedrock aquifer system by pumping on Barbados Island could prevent us from ever understanding the mechanisms responsible for the presence of Site-related compounds north of the river.

EPA Response: EPA believes that containment remedies can best be managed by locating them closest to the source area; however, if Ciba Geigy and their technical support staff can prove that sufficient hydraulic control of the contaminant plume can be maintained without pumping on Barbados Island, then the pumping wells can be relocated during the design phase of the remedial action.

Furthermore, if new information can be provided showing that pumping on Barbados Island would be detrimental to our objectives stated above, the pumping wells could then also be relocated during the design phase of the remedial action. These considerations have been included in the remedy selection in the Record of Decision.

As a final point, the selected preferred alternative was initially presented and supported in the Feasibility Study provided to EPA by Ciba Geigy.

7. A comment was made questioning whether pumping ground water from the full recovery system on the south side of the river and/or whether pumping ground water from wells on Barbados Island will have an impact on the presence of Site-related compounds on the island and north of the river.

EPA Response: As Dr. Cherry states in his comments to EPA, "The lack of hydraulic response in piezometers on Barbados Island and on the north side of the river due to the shutdown of the Interim Ground Water Recovery System on the south side of the river suggests poor hydraulic connection beneath the river."

8. A comment was received stating that ground water pumping remedies should be currently focused on reducing the potential effects on existing identified receptors and then on protection of future possible receptors because we have been unable to identify any ground water users north of the Schuylkill River except for the Norristown State Hospital.

EPA Response: This approach is inconsistent with EPA's policy and the requirements under the Superfund Amendments and Reauthorization Act (SARA) that state the cleanup goal is to restore the aquifer to its current and future potential beneficial uses.

9. One reviewer provided hypothetical scenarios of flow on the north side of the river either towards the river or away from the river and indicated that the selected remedy is not appropriate for either scenario. The review also stated that under flow conditions toward the river, no further remedial action may be necessary.

EPA Response: Since these scenarios are merely speculative and additional information will be gained during the investigations on

ORIGINAL (Red)

the north side of the river, it is not feasible at this time to make any conclusions regarding the use of institutional controls or pumping solely on the north side of the river.

10. Concerns have been raised that pumping near the DNAPL previously identified under Barbados Island might destabilize the DNAPL contamination in such a way as to cause contamination of the Schulykill River.

EPA Response: This is a curious concern because Ciba Geigy is currently pumping and planning to increase pumping on the south side of the river where the presence of DNAPLs have been confirmed. However, the reviewer has referenced a document, prepared for the reviewer, that describes the mechanisms of DNAPL destabilization which has not yet been made available to EPA. Once this document has been published any relevant implications for the Tyson's Disposal Site will be evaluated at that time.