DOCUMENTATION OF ENVIRONMENTAL INDICATOR DETERMINATION

RCRA Corrective Action
Environmental Indicator (EI) RCRAInfo code (CA750)
Migration of Contaminated Groundwater Under Control

Facility Name: **General Motors Corporation – Linden Assembly Plant**
Facility Address: **1016 West Edgar Road, Linden, New Jersey**
Facility EPA ID #: **NJD 002 186 690**

BACKGROUND

Definition of Environmental Indicators (for the RCRA Corrective Action)

Environmental Indicators (EI) are measures being used by the RCRA Corrective Action program to go beyond programmatic activity measures (e.g., reports received and approved, etc.) to track changes in the quality of the environment. The two EI developed to-date indicate the quality of the environment in relation to current human exposures to contamination and the migration of contaminated groundwater. An EI for non-human (ecological) receptors is intended to be developed in the future.

Definition of "Migration of Contaminated Groundwater Under Control" EI

A positive "Migration of Contaminated Groundwater Under Control" EI determination ("YE" status code) indicates that the migration of "contaminated" groundwater has stabilized, and that monitoring will be conducted to confirm that contaminated groundwater remains within the original "area of contaminated groundwater" (for all groundwater "contamination" subject to RCRA corrective action at or from the identified facility (i.e., site-wide)).

Relationship of EI to Final Remedies

While Final remedies remain the long-term objective of the RCRA Corrective Action program the EI are near-term objectives which are currently being used as Program measures for the Government Performance and Results Act of 1993, GPRA). The "Migration of Contaminated Groundwater Under Control" EI pertains ONLY to the physical migration (i.e., further spread) of contaminated ground water and contaminants within groundwater (e.g., non-aqueous phase liquids or NAPLs). Achieving this EI does not substitute for achieving other stabilization or final remedy requirements and expectations associated with sources of contamination and the need to restore, wherever practicable, contaminated groundwater to be suitable for its designated current and future uses.

Duration / Applicability of EI Determinations

EI Determinations status codes should remain in RCRAInfo national database ONLY as long as they remain true (i.e., RCRAInfo status codes must be changed when the regulatory authorities become aware of contrary information).

Facility Information

[Unless specified otherwise, references to "Section," "Table" and "Figure" refer to the sections, tables, and figures contained in the document, RCRA Environmental Indicator CA750 Report Determination of Current Releases to Groundwater Controlled -- *GM Linden Facility, Haley & Aldrich, Inc., September 2005.]*

The GM Linden facility ("The Facility") location is depicted on Figure 1. True north (TN) is north as presented on the United States Geological Survey maps depicting the Facility and its surrounds. Plant north (PN) is the direction historically used by the Facility to depict "north" at the Facility with respect to the building layout, which varies by approximately 56 degrees. All directions referenced in this report refer to plant north and are followed by (PN), unless noted by (TN).

The Facility is located on approximately 94 acres of land in an area of mixed industrial/manufacturing and commercial facilities. Small areas of residential development lie to the north(PN), east(PN), and south(PN) of the Facility. The Facility is located along Routes 1&9 in Linden, Union County, New Jersey, in the northwestern(TN) and northeastern(TN) portions of the 7.5 minute Perth Amboy, New Jersey and Arthur Kill, New York topographic quadrangles, respectively (Figure 1).

The GM Linden Facility is located within a commercial and industrial area of Linden, with some residential development immediately adjacent to the Facility to the south(TN). The Rahway River is located approximately 1-mile to the south(TN) of the Facility. Two smaller water bodies are within a ½-mile radius (northeast (TN)) of the Facility.

The Facility is currently zoned as Heavy Industrial and was most recently used for vehicle manufacturing. Surrounding areas are zoned for commercial/industrial or residential use. The nearest residential land is immediately south(TN) of GM owned property currently used as a parking lot. No hospitals are located within ½ mile of the Facility.

A review of the City of Linden's Master Plan (2000) indicates the GM Facility will remain zoned as a mixture of LI and HI (Light and Heavy Industrial). Land use in the immediate vicinity of the Facility is also expected to stay as currently zoned. At this time the City does not recognize nor indicate that there will be any future change in use in this area.

Surrounding land use includes:

- West Edgar Road (U.S. Route 1 and 9) and Linden Airport are located to the east(TN). - - Adjacent to Linden Airport to the south(TN) is Safety-Kleen, a facility that recovers spent organic solvents, and other industrial facilities;
- A commercial area and Stiles Street are located to the northeast(TN);
- Linden Avenue and railroad tracks are located to the northwest(TN) with mixed commercial and industrial activity located northwest(TN) of the tracks;
- A cogeneration facility is located to the southwest(TN);
- A small residential neighborhood is located south-southeast(TN) of Pleasant Street; and
- GM parking lots are located to the south-southwest(TN). Adjacent to the parking lots and the Pleasant Street neighborhood, is the Merck Corporation, a pharmaceutical manufacturing company.

The predominant drainage systems in the vicinity of the Facility are the Rahway River and the Arthur Kill. The Rahway River discharges into the Arthur Kill approximately four miles to the southeast(TN) of the Facility. Local drainage occurs in small creeks and brooks that drain into the Rahway River or directly into the Arthur Kill. The Rahway River is located approximately one mile to the south(TN) of the Facility.

Two local drainage ways are present near the Facility; Kings Creek which is located approximately 1/8-mile to the southwest(TN) of the Facility and West Brook (a.k.a, Morses Creek) which is located approximately ¼-mile to the northeast(TN) of the Facility. Kings Creek drains into the Rahway River. Morses Creek, which receives storm water runoff from the Facility via storm sewers, discharges into two small man-made reservoirs on a refinery site to the northeast(TN) of the Facility. According to the USGS 7.5-minute quadrangles, these reservoirs discharge directly into the Arthur Kill. Nearby surface water bodies are depicted on Figure 3.

These drainages connect to the Atlantic Ocean through the Newark Bay. A connection does not exist between these drainages and the surface water bodies used by New Jersey American Water as a potable supply, which includes the Canoe Brook Reservoir, the Wanaque Reservoir and the Passaic River, all located north(TN) of the Facility.

The Facility currently consists of one large assembly building, an attached administration building, several significantly smaller buildings, and the wastewater treatment plant (WWTP). The main assembly building occupies approximately 37.5 acres. Current and historic waste management facilities are located around the exterior of the main manufacturing building. The Facility is a RCRA-regulated generator. Rather than pursue a full operating permit, the Facility opted to stop functioning as a treatment, storage and disposal facility (TSDF) and changed its RCRA status from a TSDF to a generator. As such, the Facility submitted a closure plan in May 1989 for one indoor hazardous waste storage tank (SWMU 6 located in AOI 6) and two former outdoor hazardous waste container storage areas (AOIs 1 and 15). The Facility then closed its TSD units and changed its RCRA status to a generator. The Facility's EPA Identification Number is NJD 002 186 690.

The Facility is currently conducting a voluntary RCRA corrective action. The voluntary RCRA corrective action program also addresses provisions in a Memorandum of Agreement between GM and the New Jersey Department of Environmental Protection (NJDEP) dated February 27, 1995 (Case No. 95-01-25-1618-35).

The Facility is currently in the investigative stage of the site-wide RCRA corrective action program designed to gather the necessary data to develop a final remedy for the site. The current and following phases of the corrective action program will further refine and/or confirm the characterization of soil and groundwater contamination (off-site) in order to develop an optimal final remedy and a long-term groundwater monitoring system.

As part of the voluntary RCRA corrective action, GM committed to USEPA and NJDEP to complete the EI determinations for current human exposures under control (CA725) and migration of contaminated groundwater under control (CA750) by September 2004 and September 2005, respectively. USEPA, NJDEP, and GM have had regular project status meetings since then. GM submitted a CA725 Report (ENVIRON 2004) in September 2004 to USEPA and NJDEP that demonstrated current human exposures are under control at the Facility. The CA725 conclusion that human exposures are under control, has been verified by the USEPA (on 9/30/2004).

In the RCRA Facility Investigation (RFI)/Remedial Investigation (RI) completed to date, GM has performed activities to characterize the nature and extent of releases of hazardous waste and/or hazardous constituents at the Facility. These activities included preparation of a Current Conditions Report (ENCORE 2002) that identified 24 areas of interest (AOIs) at the Facility, and described the physical conditions, historical operations, and any previous investigation or remedial action at each AOI. The AOIs included all the solid waste management units (SWMUs) and areas of concern (AOCs) identified in USEPA's 1993 "Preliminary Assessment/Visual Site Inspection" report (USEPA 1993) and other areas at the Facility for which GM has knowledge of past management of hazardous waste or hazardous constituents. The Current Conditions Report evaluated each AOI and identified those where additional investigation was warranted. Rationale for not further investigating other AOIs was also provided in the Current Conditions Report.

Based on the information in the Current Conditions Report, GM identified 14 of the 24 AOIs for further investigation, and prepared RFI/RI Work Plan (H&A 2002) and addenda (i.e., sampling matrices) that described the objectives, approach, rationale, and procedures for these investigations. During the RFI/RI field investigations, five additional areas were identified for investigation, which brought the number of areas for field investigation to a total of 19 as discussed in Section 2.02 of the RFI/RI Report (H&A 2004). The objective of the RFI/RI field investigations was to collect data for determining whether a significant release of hazardous constituents had occurred at each area, and to characterize the extent of any release for determining whether the release poses unacceptable risk under current and reasonably expected future land use, or has adversely affected groundwater quality. The boundaries of the areas investigated during the RFI/RI is shown on Figure 2.

The RFI/RI Work Plan and addenda were submitted to and reviewed with USEPA and NJDEP prior to their implementation. The field investigations were conducted in accordance with these work plans and addenda, except where field conditions necessitated changes as discussed in the RFI/RI Report.

Four stages of field investigation have been conducted for this RFI/RI, including a preliminary, site perimeter groundwater investigation in July/August 2002, and three Field Event Stages (I, II, and III). Approximately 262 subsurface borings have been completed at the facility to characterize soil and groundwater conditions. A total of 68 overburden monitoring wells, 48 weathered bedrock monitoring wells, and 25 bedrock monitoring wells have been completed and sampled as part of the RFI/RI work. In addition, GM has conducted interim measures, including removal of an underground storage tank at AOI 26 and LNAPL collection and removal at MW-19S. Further, GM is currently reviewing a plan to remove the material beneath the Paint Mix Building. Due to the location, structural issues with the building must be addressed prior to removal activities. The data collected during the RFI/RI and the details of the data collection activities are provided in the RFI/RI Report. Further data collection for the RFI will be undertaken to facilitate the development and implementation of appropriate final corrective measures for the Facility.

1. Has all available relevant/significant information on known and reasonably suspected releases to the groundwater media, subject to RCRA Corrective Action (e.g., from Solid Waste Management Units (SWMU), Regulated Units (RU), and Areas of Concern (AOC)), been considered in this EI determination?

__X_ If yes - check here and continue with #2 below.

_____ If no - re-evaluate existing data, or

_____ If data are not available, skip to #8 and enter "IN" (more information needed) status code.

RATIONALE:

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All relevant information has been considered in preparing this report. Specifically, information from the following sources was reviewed to support the evaluation of whether migration of contaminated groundwater at the Facility is under control:

- Current Conditions Report (ENCORE 2002),
- RFI/RI Work Plan (Haley & Aldrich 2002),
- RFI/RI Report (Haley & Aldrich 2004), plus
- The findings of the Stage III (a, b, c and d) investigation activities.
- RCRA Environmental Indicator CA750 Report Determination of Current Releases to Groundwater Controlled -- GM Linden Facility, Linden, New Jersey, US EPA ID #NJD002186690, NJDEP CASE NO. 95-01-25-1618-35., Haley & Aldrich, Inc., September 2005.

The above reports/documents have been provided to USEPA and NJDEP. The Stage III groundwater investigation stratigraphic and hydrogeologic results are summarized in Section 2. The Stage III groundwater investigation analytical results are summarized below. These results will be included in a RFI/RI Report addendum.

2. Is groundwater known or reasonably suspected to be "contaminated"[1] above appropriately protective "levels" (i.e., applicable promulgated standards, as well as other appropriate standards, guidelines, guidance, or criteria) from releases subject to RCRA Corrective Action, anywhere at, or from, the facility?

_X__ If yes - continue after identifying key contaminants, citing appropriate "levels," and referencing supporting documentation.

_____ If no - skip to #8 and enter "YE" status code, after citing appropriate "levels," and referencing supporting documentation to demonstrate that groundwater is not "contaminated."

_____ If unknown - skip to #8 and enter "IN" status code.

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According to the CA750 form: "Contamination" and "contaminated" describes media containing contaminants (in any form, NAPL and/or dissolved, vapors, or solids, that are subject to RCRA) in concentrations in excess of appropriate "levels" (appropriate for the protection of the groundwater resource and its beneficial uses).

In this CA750 evaluation, the presence of "contamination" is identified based on comparison of site characterization data for groundwater with conservative screening criteria. The screening criteria used in the comparisons and the comparison results are discussed in this section.

The data used in the comparisons do not include data determined to be not usable during data validation (i.e., R-qualified data). Concentrations qualified as estimated (e.g., J-qualified data) are included, and concentrations from duplicate samples have been averaged to obtain a representative concentration for each duplicate pair. The analytical data for all samples (including those for constituents not detected, R-

[1] "Contamination" and "contaminated" describes media containing contaminants (in any form, NAPL and/or dissolved, vapors, or solids, that are subject to RCRA) in concentrations in excess of appropriate "levels" (appropriate for the protection of the groundwater resource and its beneficial uses).

qualified data, and data for individual samples in duplicate pairs) are in Appendix F of the RFI/RI Report. Additional data collected during Stage III of the RFI/RI field investigation will be included with a future addendum to the RFI/RI Report.

Groundwater quality data from monitoring wells collected during the RFI/RI to date are summarized by the hydrogeologic zones discussed in Section 2 (i.e., overburden, weathered bedrock, and bedrock). These data include those from the April/May 2005 and August/September 2005 sampling events, which in limited instances, include preliminary laboratory data from recently installed monitoring wells. These instances are noted in the following discussion.

To facilitate discussion of the groundwater contamination results, the overburden and weathered bedrock intervals are further divided into four groups that correspond to geographic areas of the Facility.

Group 1 is the northwest(PN) corner of the facility;
Group 2 is the southwest(PN) corner of the facility;
Group 3 is the southeast(PN) corner of the facility; and
Group 4 is the northeast(PN) corner of the facility.
(See Figure 24).

The groundwater data from monitoring wells in the overburden, weathered bedrock, and bedrock flow zones are summarized on Tables 3.2.1 through 3.2.3 and Figures 25 through 36, respectively. The bedrock zones are divided into four fracture flow units as discussed in Section 2 (i.e., BFZ#1 to #4), and are discussed with the groups where they are most relevant

Tables 3.2.1, 3.2.2, and 3.2.3 show the constituents detected, their detection frequencies and range of detected concentrations among the overburden, weathered bedrock, and bedrock monitoring wells, and the ratios of the highest measured concentrations to the screening criteria. The screening criteria for the overburden, weathered bedrock, and bedrock groundwater data are USEPA maximum contaminant levels (MCLs) or equivalent risk-based drinking water criteria. In addition, the screening criteria for the overburden groundwater included site-specific groundwater contact criteria based on construction worker contact and industrial and residential groundwater vapor intrusion criteria. Derivation of the risk-based drinking water criteria and the site-specific groundwater contact and vapor intrusion criteria was discussed in Appendix M of the RFI/RI Report.

Groundwater that meets the definition of “contaminated” is identified on Tables 3.2.1 through 3.2.3 by comparing the highest concentration of each chemical in overburden, weathered bedrock, and bedrock groundwater to the screening criteria. The ratios of the highest concentrations to the screening criteria are shown on Tables 3.2.1 through 3.2.3. Ratios higher than 1 are considered to meet the definition of “contamination” and are highlighted. The most recent overburden, weather bedrock, and bedrock groundwater concentrations for each chemical at each monitoring well that are higher than the screening criteria are summarized on Tables 3.3.1 through 3.3.3, respectively.

As shown on Tables 3.2.1 through 3.2.3, constituents in overburden groundwater do not have concentrations that are higher than the screening criteria based on groundwater contact or vapor intrusion. However, several constituents in overburden, weathered bedrock, and bedrock groundwater have concentrations that are higher than the drinking water criteria. Among these constituents, some are believed to be unrelated to the Facility. Specifically, metals, including arsenic, barium, manganese, and mercury have been detected at various monitoring wells in the overburden, weathered bedrock, and bedrock at concentrations that are higher than drinking water criteria. However, these constituents are naturally occurring and their presence at concentrations above drinking water criteria shows no discernable association with particular areas of the Facility. In fact, these metals have concentrations above drinking water criteria at monitoring wells that are upgradient or side-gradient of the Facility, such as MW-43S, MW-47S, and MW-47W. Therefore, the presence of these constituents is not considered "contamination" for the purposes of the CA750 determination for the Facility. Other metals including cadmium, lead, selenium, and vanadium have had infrequent and inconsistent detections above the drinking water criteria across the site. In fact, the current concentrations of some of these constituents do not exceed screening criteria and are not considered to be contaminants for the purposes of the CA750 determination. Furthermore, these constituents generally do not exhibit a pattern of detections that would be consistent with a Facility impact.

In addition to the metals, bis(2-chloroethyl)ether (BCEE), which has been detected in groundwater at concentrations higher than the drinking water criterion, is also believed to be unrelated to Facility. Based on a review of chemical usage records at the Facility, BCEE was not used at the Facility. This is supported by extensive site characterization data collected during the RFI/RI, which shows that BCEE was not detected in any of the 238 RFI/RI soil samples, and was more prevalent and found at higher concentrations in deeper rather than shallower groundwater, as summarized below:

	Detected	Analyzed	Highest Concentration
Overburden	12	274	0.0065 mg/L
Weathered Bedrock	104	236	0.0430 mg/L
Bedrock	40	103	0.0290 mg/L

Also, BCEE was not detected in the soil or LNAPL found at the Paint Mix Building (AOI 6) or in the groundwater directly under the LNAPL. Furthermore, a review of groundwater sample results collected from 18 other GM facilities shows that BCEE was detected in only 2 of 2,173 samples. It should be noted that a review of groundwater data collected at the Merck Facility shows that BCEE has been found at higher concentrations (on the order of 0.190 mg/L) adjacent to the GM Linden Facility, and has been identified as a constituent of potential concern in groundwater for that site (Merck 2000). Therefore, the presence of BCEE is not considered "contamination" for the purposes of the CA750 determination for the Facility, but rather, is an indicator of off-site contamination that is present in groundwater that is also affected by the Facility.

Similarly, 1,2-dichloroethane, 1,1,2-trichloroethane, 1,1,2,2-tetrachloroethane, chloroform, and carbon tetrachloride have been identified at the Merck Facility as chemicals of primary concern for risk evaluation (Merck 2000). A review of detections of these compounds indicates that, similar to BCEE, these compounds are typically found at highest concentrations near the MW-47 cluster and the western(PN) property boundary, nearly 10-fold higher than in the Paint Mix Building area. Therefore, these compounds are also considered to be unrelated to the Facility for similar reasons to BCEE.

It should be noted that the off-site source of BCEE, 1,2-dichloroethane, 1,1,2-trichloroethane, 1,1,2,2-tetrachloroethane, chloroform, and carbon tetrachloride groundwater contamination is also known to be the source of several other VOCs that include benzene, chlorobenzene, 1,2-dichloroethene, toluene, trichloroethene, vinyl chloride, and xylenes. However, at least some of these VOCs are also known to be associated with the Facility, so that distinguishing the Facility's contribution of these VOCs from the off-site source is difficult at some locations. For the purposes of Question 2 of the CA750 determination, the presence of these constituents in groundwater (at least for some locations) is considered to meet the definition of "contamination" for the Facility.

Groundwater contamination is present at Group 1, Group 2, Group 3, and Group 4 study areas. Each Group shall be discussed further in the Response to Question #3 below.

References
References reviewed to prepare this EI determination are identified in the appendices that follow Question 8.

3. Has the migration of contaminated groundwater stabilized (such that contaminated groundwater is expected to remain within "existing area of contaminated groundwater"[2] as defined by the monitoring locations designated at the time of this determination)?

__X__ If yes - continue, after presenting or referencing the physical evidence (e.g., groundwater sampling/measurement/migration barrier data) and rationale why contaminated groundwater is expected to remain within the (horizontal or vertical) dimensions of the "existing area of groundwater contamination"2).

_____ If no (contaminated groundwater is observed or expected to migrate beyond the designated locations defining the "existing area of groundwater contamination"2) – skip to #8 and enter "NO" status code, after providing an explanation.

_____ If unknown - skip to #8 and enter "IN" status code.

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The migration of contaminated groundwater can be reasonably considered to be "stabilized," such that

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[2] "Existing area of contaminated groundwater" is an area (with horizontal and vertical dimensions) that has been verifiably demonstrated to contain all relevant groundwater contamination for this determination, and is defined by designated (monitoring) locations proximate to the outer perimeter of "contamination" that can and will be sampled/tested in the future to physically verify that all "contaminated" groundwater remains within this area, and that the further migration of "contaminated" groundwater is not occurring. Reasonable allowances in the proximity of the monitoring locations are permissible to incorporate formal remedy decisions (i.e., including public participation) allowing a limited area for natural attenuation.

existing plumes are not continuing to expand above levels of concern beyond the "existing area of contaminated groundwater." The following discussion presents the rationale and physical evidence (e.g., ground water sampling data) for this conclusion.

For the purpose of the CA750, groundwater contamination is considered to be reasonably delineated and is not expected to extend beyond the existing area of contaminated groundwater, while the site-wide corrective action program progresses to development of a site-wide final remedy.

To understand the groundwater contamination, a discussion of the site hydrogeolgy is in order. (A detailed description is included in Section 2.8.)

Hydrogeology

Groundwater at and in the vicinity of the Facility is present in three major intervals. These intervals are characterized as overburden (shallow and deep), weathered bedrock, and bedrock (semi-confined flow zones). The groundwater movement within these flow intervals is in response to hydraulic gradients, with flow from areas of higher to lower hydraulic head.

Groundwater recharge at the Facility is essentially zero, since the site is asphalt/concrete paved or covered by structures over 99% of the total surface area of the site. Regionally, infiltration varies from 0 to 20 inches per year. Southwest of the Rahway River, recharge is approximately 6 times greater than the northeast side of the river, with nearly 85% of the groundwater discharge originating from the southwest side (Merck, 2005).

Based on the RFI/RI investigation and as reported by Merck and Safety Kleen, groundwater flow in the overburden and weathered bedrock is predominantly south(TN) towards the Rahway River. In addition, groundwater investigations at the Facility indicate that there is generally a downward gradient from the overburden to the weathered bedrock flow zones, with the exception of areas near sewers where an neutral or upward gradient is apparent and believed to be due to water elevations in the sewers being lower than the potentiometric head in the adjacent groundwater. There is also a downward gradient from the weathered bedrock to bedrock flow zones. The following details groundwater flow conditions in each of these intervals.

Overburden

Overburden wells are typically screened across the water table, with some select wells installed in the deep overburden to confirm vertical groundwater flow patters. Based on groundwater elevations obtained during the RFI/RI field activities, groundwater flow in the overburden is predominantly plant south(PN) (Figures 11a through 11g). The hydraulic conductivity, based on rising head permeability testing, of the overburden is approximately 10-4 cm/sec (Table 2.8.3.1). Calculated hydraulic conductivity ranged from 10-2 to 10-4 cm/sec. This variability is representative of glacial drift encountered in borings throughout the Facility.

Calculations performed on the overburden wells estimate the horizontal gradient to be approximately 0.002 to 0.008 ft/ft. Based on a comparison of vertical to lateral groundwater flux, vertical groundwater movement appears to dominate the groundwater movement in the overburden, with a downward vertical gradient of 0.05 ft/ft. An exception to this is in localized areas around storm and sanitary sewers, where the vertical gradient appears neutral or upward, due to the low water elevations in the sewers.

The potentiometric surface in the overburden tends toward the southwest(PN) corner of the

Facility property, with variations along the northern(PN) property boundary on Linden Avenue (Figures 11a through 11g). Furthermore, based on groundwater observations made throughout the RFI/RI, it appears that there are two controlling features for overburden groundwater at the Facility. These controlling features are: 1) sanitary sewers installed in the overburden along the plant west(PN) (Smith Street) and along plant south(PN) (West Edgar Road), and 2) a storm sewer installed in the overburden along Linden Avenue.

The sanitary sewers (Figure 13) installed along Smith Street and West Edgar Road, located along plant west(PN) and plant south(PN), respectively, have water levels that are up to 6 feet below the potentiometric surface of the overburden. The sanitary sewer is constructed of 30-inch diameter reinforced concrete pipe and the current integrity is unknown. The age of the sewer is not known, but a review of aerial photographs indicates that the sewer may have been installed in either the 1930's or 1940's. Due to the low water levels in the sewers and the age of the sewers, groundwater discharges into the sewers.

A schematic of the groundwater infiltration into the sewers is shown on Figures 14a through 14c, and a cross-sectional view of the alignment of the sanitary sewers is shown on Figure 15b. Monitoring well cluster MW-57S/MW-57W is the closest set of wells to the sanitary sewer (Figure 14a), completed nearly in the sewer backfill. At the MW-57S/MW-57W cluster, the sewer influence on the groundwater levels in the overburden and weathered bedrock is significant enough to depress both water levels to the nearly same elevation which coincides to the invert of the sewer.

Water levels on the Merck property in March 2005 (Figure 16), confirm the sewer influence on groundwater flow patterns. In essence the sewer is acting like a gaining stream (Freeze & Cherry pages 193 to 199, 1979), receiving water from the surrounding formation, creating a localized depression in the potentiometric surface. (Figure 14a to 14c).. Thus, groundwater appears to be controlled and captured along the sewer, with observed groundwater flow towards the sewer alignment from the north(PN) and south(PN) sides (e.g. MW-40S and MW-41S and Figures 12a through 12j) and from the east(PN) and west(PN) sides (e.g. MW-18S and MW-011B on Figure 16). Data presented in Merck's Hydrogeologic Report (March 2005) and Figure 16, which depicts the overburden potentiometric surface at both GM and Merck, supports this flow pattern.
In addition, a storm sewer (Figure 13) is installed in the overburden along Linden Avenue on the north(PN) side, and has water levels that are approximately up to 6 feet below the overburden potentiometric surface (Figure 14d and Figure 15a). The storm sewer is constructed of 48-inch diameter reinforced concrete pipe. The age of the storm sewer is not known, but a review of aerial photographs indicates that the sewer may have been installed in either the 1930's or 1940's. Similar to the sanitary sewers, the groundwater potentiometric surface appears to be controlled by the storm sewer with observed groundwater flow towards the sewer alignment from both the northern(PN) and southern(PN) sides (e.g. MW-43S to MW-44S). However, the influence appears to be intermittent along Linden Avenue, with sections that do not show influence or appear to be higher than surrounding area. This may be a result of the condition of the storm sewer, where certain sections of the sewer have a greater leakage inwards than others. These sections do not appear to affect the overall control of the groundwater flow into the storm sewer.

A groundwater potentiometric high anomaly is observed on the Linden Facility near MW-52S and MW-53S, with groundwater elevations in the overburden observed to be approximately 4 to 5 feet higher than elevations observed in surrounding wells. Further investigation of the groundwater high included the installation of additional shallow monitoring wells and test pits to refine its extent. Based on research and testing of the fire pipelines, plus the presence of former building footings in the area, it its believed that the water levels in MW-52S and MW-53S represent perched or impounded water conditions associated with the former building footing and do not represent general overburden groundwater conditions in the area. A groundwater potentiometric surface plan that excludes these two monitoring wells and based on measurements from September 12, 2005 is shown in Figure 12j.

A second groundwater potentiometric high has been observed near MW-25S, which appears to be related to a leaky fire main or hydrant. The Facility is currently in the process of repairing/replacing these leaks. The groundwater mound does not have a significant effect on overall groundwater flow in this area.

Weathered Bedrock

Weathered bedrock monitoring wells are screened within the weathered shale bedrock at intervals based upon packer testing and rock quality designation (RQD<30%). As detailed below, the extreme weathering of this unit creates sufficient permeability to allow the unit to behave as a porous media. Based on groundwater elevations obtained during the RFI/RI field activities, groundwater flow in the weathered bedrock is predominantly south/southwest(PN) (Figures 17a through 17i). Packer testing and slug testing performed during and after completion of the monitoring wells indicated a hydraulic conductivity of approximately 10-3 to 10-4 cm/sec (Tables 2.8.3.1 and 2.8.3.2). Due to extreme weathering of this bedrock, the hydraulic conductivity is assumed to be same in the vertical and horizontal directions.

Calculations performed on the weathered bedrock wells estimate a horizontal gradient of approximately 0.002 to 0.005 ft/ft. Based on a comparison of vertical to lateral groundwater flux, lateral flow appears to dominate groundwater movement, with a small component of vertical flow. The vertical gradient is downward to the bedrock fracture zones at an approximate gradient of 0.017 ft/ft, except in localized areas around sewers, where the sewer water elevations are much lower than the potentiometric surface. Although the vertical gradient is greater that the horizontal gradient, the lower permeability of the receiving unit (intact portions of the competent bedrock at approximately 10-6 cm/sec) do not allow as much vertical movement of groundwater as is laterally transmitted in the weathered bedrock. Only near the subcrop of the bedrock flow zones, discussed below, is there sufficient receiving permeability to transmit significant quantities of groundwater.

The potentiometric surface in the weathered bedrock tends toward plant south/southwest(PN) (Figures 17a through 17i). Furthermore, based on groundwater observations made throughout the RFI/RI, it appears that there are two controlling features for weathered bedrock groundwater at the Facility. These controlling features are: 1) sanitary sewers installed in the overburden along the plant west(PN) (Smith Street) and plant south(PN) (West Edgar Road), and 2) a storm sewer installed in the overburden along Linden Avenue (Figure 13).

The sanitary sewers installed along Smith Street and West Edgar Road, located along plant west and plant south(PN), respectively, have water levels that are up to 6 feet below the potentiometric surface of the weathered bedrock. As discussed above, overburden groundwater infiltrates into the sewer, thus creating a depressed water table immediately at and adjacent to the sewer in the overburden (Figures 14a through 14c, and Figure 15b) Since the overburden groundwater levels are lowered below the potentiometric level of the weather bedrock in the vicinity of the sewers, a localized upward vertical gradient is created. As shown above at the MW-57S/MW-57W cluster (Figure 14a) the sewer can depress the potentiometric, such that the water elevations match the sewer invert. This is similar to groundwater discharge beneath a gaining stream (Freeze & Cherry pages 193 to 199, 1979). Thus, groundwater appears to be controlled and captured along the sewer, with observed groundwater flow towards the sewer alignment from both the north(PN) and south(PN) sides (e.g. MW-40W and MW-41W and Figure 17a through 17i). A similar condition can be seen to exist along the storm sewer that runs from north to south along the Facility’s western boundary, based on the potentiometric head measured in weathered bedrock monitoring wells on the Facility boundary (figure 14d and Figure 15a). Based on a review of the data in Merck reports, the Merck facility does not appear to have weathered bedrock monitoring wells in this area, but groundwater flow toward the sewer from the Merck facility is evident based on head measurements at Merck's shallow monitoring wells near the sewer.

Bedrock Fracture Zones

The bedrock geology and hydrogeology of the area has been documented by many researchers to be very complex (Michalski 1997). Regional literature indicates that bedrock flow zones exist and consist of dipping, semi-confined, weathered, and fractured bedrock strata. The RFI/RI investigation activities have confirmed that the local hydrogeologic system is consistent with the Newark Basin regional hydrogeologic conceptual model (Michalski 1997), which consists of a dipping, leaky multi-unit aquifer system (LMAS) overlain by a weathered transition zone and overburden.

Four primary bedding plane permeable fracture zones have been identified at the Facility through the RFI/RI investigation activities. These zones have been labeled as bedrock flow zones (BFZs) #1, #2, #3 and #4, and represent bedding plane joints/fractures in the siltstone bedrock. The subcrop of these units are depicted on Figure 13.

A discussion on Groups 1 through 4 with its relevant groundwater impacts and existing extent of contamination follows:

Group 1 (northwest(PN))

Overburden

Manganese was detected in some of the monitoring wells in this group (as well as in the other groups) at concentrations higher than the drinking water criterion (Table 3.3.1 and Figure 25). In addition, arsenic was detected in monitoring wells MW-18S and MW-24S at concentrations higher than the drinking water criterion drinking water criteria. As discussed in Section 3.1, manganese and arsenic are naturally occurring constituents in groundwater and not considered related to Facility activities.

Trichloroethene, 1,2-dichloroethane*, chlorobenzene*, cis-1,2-dichloroethene, 1,1-dichloroethene, benzene, tetrachloroethene and vinyl chloride were found at concentrations higher than the drinking water criterion in many of the monitoring wells in Group 1 (Table 3.3.1 and Figure 25). The most recent samples do not indicate the presence of chlorobenzene*, cis-1,2-dichloroethene, 1,1-dichloroethene, and tetrachloroethene at concentrations greater than their respective drinking water criterion. The source of VOC contamination is believed to be, in part, related to past activities at the former sludge pit adjacent to the Paint Mix Building. Based on the results of surrounding and downgradient wells from the Paint Mix Building (MW-18S, MW-22S, MW-23S, MW-25 S, and MW-26S) the extent of VOC contamination has been delineated in this area and appears to be limited to the immediate vicinity of the Paint Mix Building. In addition, trichloroethene at MW-49S was only detected at a low concentration of 7 ug/L during one event above the drinking water criterion. The most recent sampling (August at 1 ug/L) is below the drinking water criterion, which indicates that contamination is not currently present at this location. Therefore, the limits of VOC contaminated groundwater in the overburden from the GM Linden Facility, for all practical purposes, appear to be reasonably defined and stable and is not expected to migrate significantly beyond the existing area of contamination.

BCEE was detected in monitoring wells MW-31D and MW-34D at concentrations higher than the drinking water criterion (Table 3.3.1 and Figure 25). As discussed in Section 3.1, BCEE and several other VOCs as identified above, are considered to be un-related to Facility activities and suggests an off-site contribution to the area.

Benzo(a)anthracene and benzo(a)pyrene were detected in monitoring well MW-31S at concentrations slightly higher than the drinking water criteria in November 2003 (Table 3.3.1 and Figure 25). The source of these SVOCs may be related to the past activities at the sludge pit. Based on the results of surrounding wells, the extent of SVOCs has been delineated in this area. Therefore, the limits of SVOC groundwater contamination in the overburden from the GM Linden Facility, for all practical purposes, appear to be reasonably defined and stable and is not expected to migrate significantly beyond the existing area of contamination.

* Refer to Section 3.2 and Response to Question #2 for a discussion of these constituents which do not appear to be Facility related.

<u>Weathered Bedrock</u>
Manganese was detected at concentrations above the drinking water criterion at several of the monitoring wells in this group (Table 3.3.2 and Figure 26). Exceedances were last noted at two of the wells in this group in November 2003 in monitoring wells MW-34W and MW-37W, with concentrations from subsequent samples not exceeding the drinking water criterion. Arsenic was detected in concentrations exceeding the drinking water criterion at monitoring wells MW-36W, MW-47W and MW-49W (Table 3.3.2 and Figure 26). As discussed in Section 3.1, manganese and arsenic are naturally occurring constituents in groundwater and not considered related to Facility activities.

Selenium was detected in concentrations exceeding the drinking water criterion at monitoring well MW-47W in February 2005 (Table 3.3.2 and Figure 26). Subsequent samples obtained from this well have not indicated the presence of selenium at a concentration greater than the drinking water criterion. Monitoring well MW-47W is side-gradient from the facility, which suggests that it is un-related to Facility activities nearby this area, as detailed in Section 3.1. The concentrations also appear to be localized to MW-47W, which coincide with the VOC detections at this well, as discussed below.

Trichloroethene, 1,1,2-trichloroethane, 1,1-dichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, tetrachloroethene, benzene, carbon tetrachloride*, chlorobenzene*, chloroform*, 1,2-dichloroethane*, methylene chloride, and vinyl chloride were detected at concentrations greater than their respective drinking water criterion at many wells in the Group 1 area (Table 3.3.2 and Figure 26). Detections of VOCs in the weathered bedrock groundwater in this area (Figure 37 is an illustration of the TCE patterns in this area) indicate two distinct potential source areas co-mingled in this area: one associated with the Paint Mix Building and the other associated with the Merck North Plant Landfill which is located off-site just west[PN] of MW-47W.

These two areas are discussed below:

> <u>Paint Mix Building Area</u>: The highest concentrations of VOCs above the drinking water criteria are located immediately north(PN) of the former sludge pit at MW-31W. Groundwater flow patterns this area are towards the southwest[PN], towards MW-18W, and MW-23W. Monitoring wells, MW-18W, MW-23W, MW-26W, and MW-54W downgradient of the Paint Mix Area do not indicate the presence VOCs or SVOCs in groundwater. Thus, the VOC detections appear to be limited to the immediate vicinity of the Paint Mix Building. Therefore, the limits of VOC groundwater contamination in the weathered bedrock for this area from the GM Linden Facility, for all practical purposes, appears to be reasonably defined and stable and is not expected to migrate significantly beyond the existing area of contamination..

Possible Off-site source (Merck North Plant Landfill Area): MW-47W exhibits the highest VOC and SVOC concentrations among the wells in this group, with a nearly 50-fold decrease in concentrations towards MW-66W and MW-35W at the Paint Mix Building. BCEE and several other VOCs considered to be unrelated to Facility activities were also detected at the highest levels in this monitoring well, approximately 10 to 20 times higher than near the Paint Mix Building. Investigations have detected constituents not related to GM operations as far side-gradient of the Merck North Plant Landfill as MW-22W.

As discussed in Section 2.4, Merck reported that its North Plant Landfill is unlined and received liquid solvent and laboratory waste from the 1940s to 1970s. This landfill is located immediately west of MW-47W. Non-aqueous flow from the landfill following relic bedding plane fractures to the northeast[PN] and a sloping top of weathered bedrock to the east[PN] and southeast[PN] could facilitate a distribution of contaminants, which would be independent of the current predominant weathered bedrock flow direction to the southwest[PN]. Based on the proximity of MW-47W to the Merck landfill and the constituent mix, it appears that this second source area is unrelated to Facility activities.

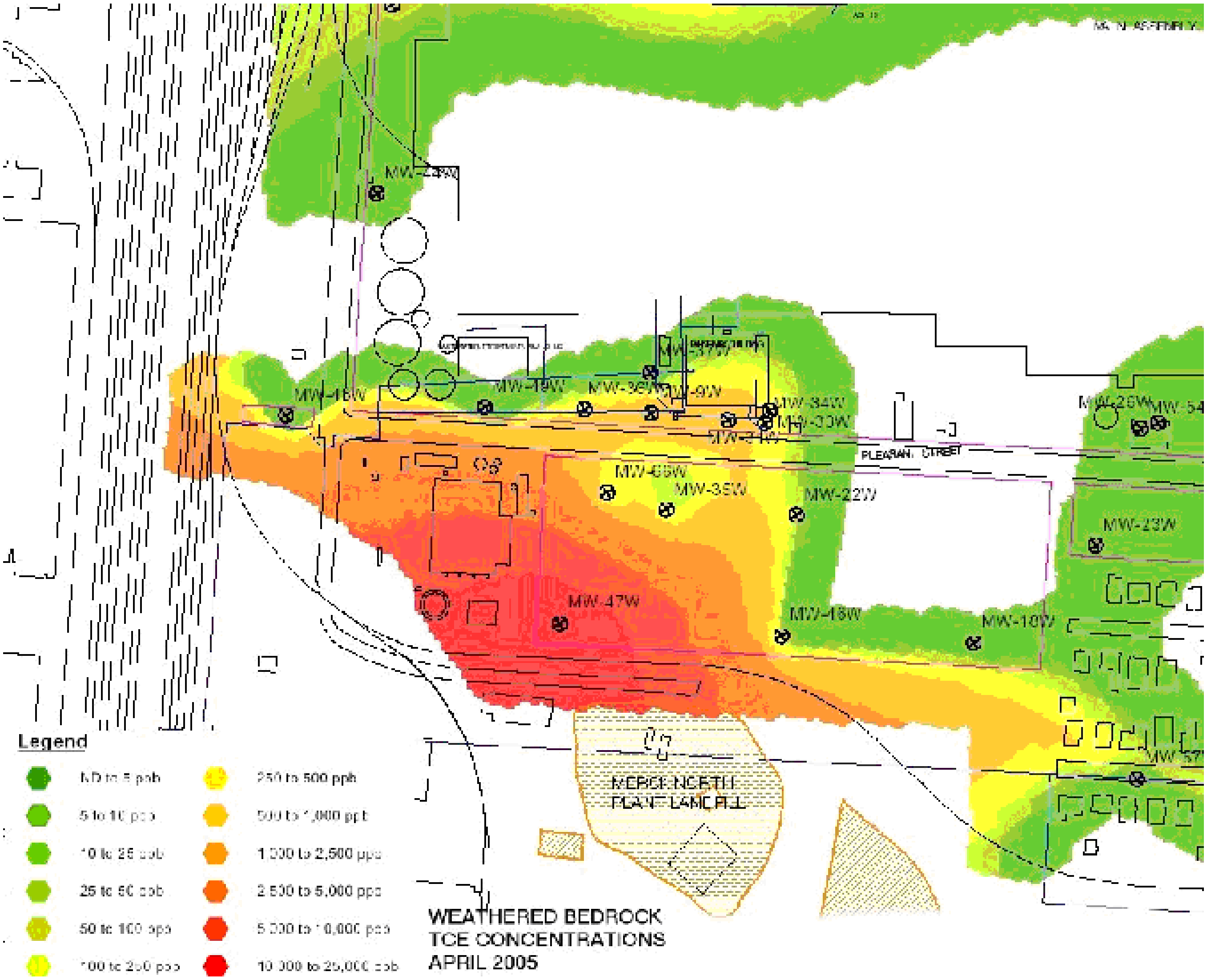
Like MW-47W, monitoring well MW-46W is believed to be predominantly affected by the Merck landfill based on its similar proximity. The historic mechanisms that resulted in the contamination of groundwater at MW-47W would likely have also caused the groundwater contamination at MW-46W. In addition, MW-46W is currently downgradient of MW-47W, rather than the Paint Mix Building.,

Regardless of the source of constituents in this area, groundwater flow patterns indicate that groundwater west(PN) of the area is captured by the sanitary sewer that is aligned with Smith Street, as discussed in Section 2.7.4.2 and 3.2.1.2. Therefore groundwater VOC contamination in the weathered bedrock appears to be reasonably defined and stable and is not expected to migrate beyond the existing area of contamination.

* Refer to Section 3.2 and Response to Question #2 for a discussion of these constituents which do not appear to be Facility related.

See contour diagram focusing on Group 1 below.

[The contour diagram is for illustrative purpose and is based on available datapoints. This is an excerpt of Figure 37. (Note that MW-47 is at the edge of the corner of GM property.) As additional data is gathered the contours will be re-evaluated and refined. However, from the diagram the possibility of an off-site source is apparent. This scenario is expected to be verified



and/or refined as the on-going corrective action program progresses towards development of a site-wide final remedy.]

<u>Bedrock Flow Zone #2</u>

Arsenic has been detected in concentrations greater than the drinking water criterion in monitoring wells MW-43B, MW-47B, MW-49B and MW-66B (Table 3.3.3 and Figure 27). As discussed in Section 3.1, arsenic is a naturally occurring constituent in groundwater and not considered related to Facility activities. Vanadium was detected in monitoring well MW-49B at a concentration greater than the drinking water criterion in April 2005 (Table 3.3.3 and Figure 27). This is the first exceedance of the drinking water criterion for vanadium in BFZ#2, so no consistent pattern is present. As discussed in Section 3.1, the sporadic and infrequent detections of several metals does not indicate a pattern that would be consistent with a Facility impact. Downgradient monitoring wells MW-43B and MW-44B do not indicate detections of vanadium above drinking water criterion, thus it appears that this constituent has been adequately defined and appears to be limited in extent.

Several VOCs (trichloroethene, 1,1,2-trichloroethane*, 1,2-dichloroethane*, benzene, chlorobenzene, chloroform*, cis-1,2-dichloroethene, tetrachloroethene, trans-1,2-dichloroethene, vinyl chloride, 1,1-dichloroethene, carbon tetrachloride*, methylene chloride and 1,1,2,2-trichloroethane*) have been detected at concentrations exceeding the drinking water criterion at monitoring wells in BFZ #2 (Table 3.3.3 and Figure 27). Similar to the weathered bedrock interval, VOCs have been detected in BFZ #2 between the Paint Mix Building and the Merck North Plant Landfill (Figure 37 is an illustration of the TCE patterns in this area). As discussed in Section 2.8, BFZ #2 subcrops to the weathered bedrock beneath both the Paint Mix Building and Merck North Plant Landfill. Thus, it is believed that both areas have impacted this flow zone. However, the presence of BCEE and other VOCs unrelated to the Facility in many of the wells in this zone indicates that groundwater in this area is most significantly affected by the North Plant Landfill. Specifically, a review of the concentrations of trichloroethene and BCEE in BFZ#2, from east to west(PN), indicate an approximate 10-fold increase in groundwater concentrations with increasing distance from the Paint Mix Building, with the highest detected concentrations of both constituents at MW-47B which is located just west of the Merck Landfill

The September 2005 groundwater flow pattern, as discussed in Section 2.7.4.3 and 3.2.6, indicates a primarily western(PN) direction of flow, with a neutral zone in the vicinity of the Paint Mix Building investigation area. The flow pattern appears to have changed somewhat during RFI/RI investigation activities . However, based on local and regional aquifer properties and influences, groundwater flow in BFZ#2 will ultimately be towards the west(PN), where it enters Merck's CEA, and is captured by the Merck pumping or discharges to the Rahway River (Merck 2005).

Furthermore, as discussed in Section 2.8 based on regional hydrogeology information, it is anticipated that groundwater is unlikely to flow down-dip in the bedrock flow zones, due to decrease in permeability and lack of a discharge location. If groundwater flow patterns change direction from the expected west, northwest(PN) direction, groundwater flow would likely flow towards the east, given natural discharge points (e.g. local water bodies and flow zone subcrops). The downgradient monitoring well on the east(PN) side of the Facility is MW-16B. Groundwater quality data from this well for the last two sampling events show that no chemical has a concentration higher than the drinking water criteria. Therefore, the limits of groundwater contamination in the BFZ#2 for this area from the GM Linden Facility, for all practical purposes, appears to be reasonably defined and stable and is not expected to migrate significantly beyond the existing area of contamination. As the site corrective action program progresses towards a site-wide final remedy, further water-level measurements are planned for this zone, as discussed in Response to Question #7.

* Refer to Section 3.2 and Response to Question #2 for a discussion of these constituents which do not appear to be Facility related.

Group 2 (southwest(PN)))

Overburden

Manganese was detected at concentrations above the drinking water criterion at several of the monitoring wells in this group (Table 3.3.1 and Figure 28). Arsenic was also detected at MW-17S above the drinking water criterion. As discussed in Section 3.1, manganese and arsenic are naturally occurring constituents in groundwater and not considered related to Facility activities. Further, overburden groundwater is captured by the sanitary sewer that is aligned along West Edgar Road (Figures 12a through 12j).

Trichloroethene was detected at concentrations greater than the drinking water criterion at monitoring well BEC-8D during January and October of 2003 (Table 3.3.1 and Figure 28). The most recent samples obtained from BEC-8D have not had detections of trichloroethene greater than the drinking water criterion. The three groundwater sampling events conducted in February, April, August 2005 have used low-flow groundwater sampling techniques. This technique is considered to be more representative of natural groundwater conditions than the purge and sample techniques used during January and October of 2003, when the detections occurred. Therefore, based on the recent results from February, April, and August 2005, trichloroethene is not currently present in the groundwater in this group above drinking water criteria.

Carbon tetrachloride* was detected at MW-57S at a concentration greater than the drinking water criterion during the August 2005 sampling event. This well has had low level detections prior to this event, but all concentrations were below the drinking water criterion. As discussed in Section 3.1, carbon tetrachloride is not considered related to the facility. The MW-57 cluster is installed immediately adjacent to the sanitary sewer aligned with Smith Street. As discussed in Section 2.8, groundwater in the immediate vicinity of the sanitary sewers tends to exhibit an upward gradient, with groundwater discharge into the sewer. Groundwater elevation measurements at MW-57S and MW-57W are nearly identical, which appear to coincide with the invert of the sanitary sewer in this area. Concentrations of carbon tetrachloride in groundwater in MW-57W are nearly double that observed in MW-57S. This suggests that the source of carbon tetrachloride in the overburden groundwater is originating in the weathered bedrock. Further, this confirms that groundwater discharges into the sanitary sewer. Given that carbon tetrachloride was only detected at the MW-57 cluster, the extent of this constituent is limited. Therefore, the limits of groundwater contamination in the overburden for this area from the GM Linden Facility, for all practical purposes, appear to be reasonably defined and stable and is not expected to migrate significantly beyond the existing area of contamination.

* Refer to Section 3.2 and Response to Question #2 for a discussion of these constituents which do not appear to be Facility related.

<u>Weathered Bedrock</u>
Lead, manganese and vanadium were detected in monitoring well MW-41W during the November 2004 groundwater sampling event above the drinking water criterion (Table 3.3.2 and Figure 29). Subsequent samples obtained since November 2004 have not indicated any exceedences of the drinking water criterion for these constituents. Thus indicating that they are not currently present in the groundwater in this group above drinking water criteria.

Cadmium was detected at MW-17W at a concentration slightly higher than the drinking water criterion (0.0054 mg/L) (Table 3.3.2 and Figure 29). This is the first exceedance of the drinking water criterion for cadmium in Group 2 weathered bedrock groundwater, so no consistent pattern is present. As discussed in Section 3.1, the sporadic and infrequent detections of several metals does not indicate a pattern that would be consistent with a Facility impact. Further, overburden groundwater is captured by the sanitary sewer that is aligned along West Edgar Road (Figures 12a through 12j).

Trichloroethene, 1,1-dichloroethene, cis-1,2-dichloroethene, and vinyl chloride were detected at several monitoring wells in this group at concentrations greater than the drinking water criteria (Table 3.3.2 and Figure 29). The highest concentrations were observed in monitoring well MW-48W, furthest from the Facility, with a decreasing concentration gradient eastward(PN) along the West Edgar Road sanitary sewer alignment towards the Facility. No detections have been observed in the upgradient monitoring wells adjacent to the Facility (MW-29W, MW-30W, MW-58W, and MW-59W) above the drinking water criterion. These upgradient wells indicate that the groundwater contamination in the weathered bedrock does not appear to be attributable to the Facility, and therefore the extent has been delineated. The source of the constituent concentrations at MW-48W appears to be from an off-site source, based on concentration gradients which indicate that the source is west(PN) to southwest(PN) of the Facility. As discussed in Section 2.4, there are numerous potential off-site sources in the vicinity of this area, however limited information is available on the actual off-site source. Based on groundwater elevations in this area in relation to the sanitary sewer, as discussed in Section 2.8, groundwater from the weathered bedrock is being captured by the sanitary sewer (Figures 17a through 17i).

Carbon tetrachloride* was detected in monitoring well MW-57W at a concentration greater (May 2005 at 8 ug/L and 9 ug/L and August 2005 at 100 ug/L) than the drinking water criterion (Table 3.3.2 and Figure 29). Carbon tetrachloride was not found in the suspected source area in Group 1 near the Paint Mix Building and is rarely detected in other on-site groundwater samples (and never in 190 RFI/RI soil samples). As discussed in Section 3.1, carbon tetrachloride appears to be related to an off-Site source. Therefore, the carbon tetrachloride does not appear to be related to the Facility activities in this area or upgradient of this area. Regardless, based on groundwater elevations and water elevations in the sanitary sewer along the alignment of Smith Street, as discussed in Section 3.3.2.1; groundwater is being captured by the sanitary sewer. Therefore, the limits of groundwater contamination in the weathered bedrock for this area from the GM Linden Facility, for all practical purposes, appear to be reasonably defined and stable and is not expected to migrate significantly beyond the existing area of contamination.

* Refer to Section 3.2 and Response to Question #2 for a discussion of these constituents which do not appear to be Facility related.

<u>Bedrock Flow Zone #3</u>
Trichloroethene was detected above drinking water criterion at MW-63B and MW-55B, on the upgradient side of the Facility in this unit. Samples from the most recent sampling events, April and August 2005, indicated VOCs in MW-55B were below drinking water criteria. Based on the groundwater flow in BFZ#3 from the northeast to southwest(PN), it appears that the detections at MW-63W are a result of an off-Site source Further the lack of downgradient detections from MW-63B above drinking water criterion indicate that the extent of the constituent is bounded for this portion of BFZ #3.

Laboratory analytical results from MW-18B have indicated several VOCs (1,2-dichloroethane*, benzene, carbon tetrachloride*, chloroform*, methylene chloride and trichloroethene) above the drinking water criterion (Table 3.3.3 and Figure 30). Recent sampling events indicate also several of the same VOCs above drinking water criterion at MW-49BD (1,2-dichloroethane*, benzene, methylene chloride, trichloroethene, and vinyl chloride) (Table 3.3.3 and Figure 30). Based on aquifer testing results discussed in Section 2.7.4.3, BFZ#2 and BFZ#3 are vertically hydraulically linked. Therefore, with the downward hydraulic head from BFZ#2 to BFZ#3, it is likely the presence of VOCs within this unit is a result of VOCs present in the area in BFZ#2, as discussed in Section 3.3.1.3.

Regardless of the source of constituents in BFZ#3, the groundwater flow pattern indicates that groundwater moves toward the Merck facility and Merck's CEA. Concentrations of these constituents are significantly lower than those being address on the Merck facility, where Merck is actively pumping and addressing discharges to the Rahway River. Therefore, the limits of contaminated groundwater from the GM Linden Facility, for all practical purposes, appear to be reasonably defined and stable and is not expected to migrate significantly beyond the existing area of contamination.

* Refer to Section 3.2 and Response to Question #2 for a discussion of these constituents which do not appear to be Facility related.

Bedrock Flow Zone #4

Laboratory analytical results from the November 2004 sampling event indicated that manganese at MW-8B (Table 3.3.3 and Figure 31) was detected above the drinking water criterion. Manganese was not identified to be above the drinking water criterion in subsequent sampling events in February and April 2005. The February and April 2005 sampling events have been conducted using low-flow groundwater sampling technique. This technique is considered to be more representative of natural groundwater conditions that the techniques used previously. Regardless, as discussed in Section 3.2, manganese is a naturally occurring constituent in groundwater and not considered related to Facility activities.

Based on the detections of VOCs in shallower bedrock units (BFZ#2 and BFZ#3) in the vicinity of the Paint Mix area and the downward groundwater gradient between the bedrock flow zones, an additional well (MW-49B4) was installed in BFZ #4 for this area. Laboratory analytical results from MW-49B4 have indicated several VOCs (1,2-dichloroethane*, benzene, trichloroethene, and vinyl chloride) above the drinking water criterion (Table 3.3.3 and Figure 31). The detection of BCEE and 1,2-dichloroethane suggest a potential impact from the off-site source discussed in Section 3.3.1.3. A comparison of the constituents and concentrations to MW-49BD (BFZ #3), indicates many additional compounds are detected in MW-49B4 that are not present in BFZ #3 in the area, as well as an increase in contaminant concentrations in BFZ #4. This further indicates that constituents detected in MW-49B4 are related to an offsite source.

Regardless of the source of constituents at MW-49B4, the groundwater flow pattern indicates that groundwater moves to the Merck facility and Merck's CEA. Concentrations of constituents at MW-49B4 are significantly lower than those being address on the Merck facility, where Merck is actively pumping on this zone and addressing discharges to the Rahway River. Therefore, the limits of contaminated groundwater from the GM Linden Facility, for all practical purposes, appear to be reasonably defined and stable and is not expected to migrate significantly beyond the existing area of contamination.

* Refer to Section 3.2 and Response to Question #2 for a discussion of these constituents which do not appear to be Facility related.

Group 3 (southeast(PN))

Overburden

Arsenic and manganese were detected above the drinking water criterion during the April 2005 sampling event at several monitoring wells in this group (Table 3.3.1 and Figure 23). As discussed in Section 3.1, manganese and arsenic are naturally occurring constituents in groundwater and not considered related to Facility activities. Cadmium was also detected above the drinking water criterion at BEC-7D (Table 3.3.1 and Figure 32). Downgradient wells in this group (MW-61S, MW-62S, and MW-69S) do not indicate cadmium above drinking water criterion, thus the extent of cadmium appears adequately defined. In addition, as discussed in Section 3.1, sporadic and inconsistent detections of cadmium do not appear to be indicative of an Facility-related impact. Regardless, based on the lack of detections above the drinking water criterion downgradient from these well, the extent of groundwater impact is limited in extent. Further, overburden groundwater is captured by the sanitary sewer that is aligned along West Edgar Road (Figures 12a through 12j). Therefore, the limits of contaminated groundwater from the GM Linden Facility, for all practical purposes, appear to be defined and stable.

Laboratory analytical results from September 2005 indicated that benzene at MW-79S (Table 3.3.1 and Figure 32) was detected above the drinking water criterion. Based on the September 12, 2005 groundwater flow patterns for this area, the detection of benzene appears to be from an off-Site source. Downgradient monitoring well MW-69S does not exhibit detectable levels benzene, which indicates that the extent of benzene in overburden groundwater in this area is limited.

Further, overburden groundwater is captured by the sanitary sewer that is aligned along West Edgar Road

(Figures 12a through 12j, Figure 14c, and Figure 15b)). Capture of groundwater in this area results from the same hydrogeologic conditions as demonstrated with wells on both the north(PN) (MW-41S) and south (PN) (MW-40S) sides of the sanitary sewer in Group 2 in the southwest(PN) corner of the Facility (Figure 14b). In fact, the sanitary sewer invert elevation is approximately 2-feet deeper than that in the southwest(PN) corner of the site. As such, the resulting inward potentiometric head from overburden groundwater to the sewer is approximately 5-feet along West Edgar Road. Thus, it is reasonably expected that groundwater infiltration into the sanitary sewer in Group 3 is as much or greater than observed in Group 2, where capture is demonstrated with water table elevation measurements on both sides of the sewer.

Although current groundwater elevation data are not available on the south(PN) side of West Edgar Road in the Aviation Plaza Shopping Center, historical data are available. Information obtained through the NJDEP via Open Public Records Act (OPRA) indicates that overburden, weathered bedrock, and bedrock monitoring wells were installed for the redevelopment of a portion of the former Linden Airport property, immediately south(PN) of West Edgar Road and south(PN) of the GM Linden Facility. Based on available records, which includes well completion reports and water level measurements, water levels were obtained from the Aviation Plaza wells near the GM Linden Facility as recently as March 2003. The Aviation Plaza wells were not originally tied into a mean sea level datum, as is done for the GM Linden Facility. A recent survey by GM of the monument used for the original monitoring well elevations helps establish an approximate elevation basis for the historic water level measures. However, due to uncertainties in the datum, interpretation of the Aviation Plaza wells is being presented as a qualitative comparison only until well access is obtained to verify the data.

Notwithstanding limitations of the historical elevation data, a review of the water level elevations on the Aviation Plaza indicates that there is a groundwater gradient to the north(PN) towards the sanitary sewer in West Edgar Road (Figure 38) (e.g. Aviation Plaza wells MW-113, MW-105). This indicates that groundwater flow converges on the sanitary sewer from the north(PN) and south(PN) sides, with the lowest point being the sanitary sewer. Further, although measured in different periods of time, groundwater elevations in the Aviation Plaza wells are up to two-feet higher than observed at GM Linden well MW-62S which is adjacent to the sewer. This difference is greater than the typical seasonal fluctuation observed in the overburden. Thus, this gradient is an indication that groundwater is flowing to the sewer.

GM is continuing to pursue access to the wells installed in the Aviation Plaza, immediately south(PN) of the GM Linden Facility to update the water level information from these wells. Based on available data, the limits of contaminated groundwater in the overburden from the GM Linden Facility, for all practical purposes, appear to be reasonably defined and stable and is not expected to migrate significantly beyond the existing area of contamination.

* Refer to Section 3.2 and Response to Question #2 for a discussion of these constituents which do not appear to be Facility related.

<u>Weathered Bedrock</u>

Trichloroethene was detected in several wells in Group 3 at concentrations greater than the drinking water criterion (Table 3.3.2 and Figure 33). In addition, cis-1,2-dichloroethene, vinyl chloride and 1,2-dichloroethane* were detected in MW-63W at concentrations greater than the drinking water criteria (Table 3.3.2 and Figure 33). As detailed above (Section 3.3.3.1), weathered bedrock groundwater is captured by the sanitary sewer that is aligned along West Edgar Road (Figures 17a through 17i).

Based on a review of well installation records for the Aviation Plaza wells, there are four wells completed in the weathered bedrock, near our Group 3 area. Groundwater elevations from March 2003 in the monitoring wells installed in the weathered bedrock interval on the Aviation plaza, indicate up to one-foot higher water levels than observed at MW-62W which is adjacent to the sewer (Figure 39). This difference is greater than the typical seasonal fluctuation observed in the weathered bedrock, and is an indication that groundwater is flowing to the sewer. Based on this information, the sanitary sewer is the lowest point, with groundwater flow is converging from the north(PN) and south(PN). Thus, the sanitary sewer is the lowest point of relief. This corresponds to the anticipated water level depression near the sanitary sewers (Figure 14b) and is consistent with the data generated on the western(PN) side of the GM Linden Facility.

The weathered bedrock, based on drilling observations at the GM Linden Facility, is a very weathered material, which creates a high vertical permeability and conductivity. Conversely, the permeability of the underlying competent bedrock is low. Although the bottom of the weathered bedrock is approximately 40-feet below the invert of the sanitary sewer, the top of the weathered bedrock is only 12-feet below the sanitary sewer invert. Further, the potentiometric surface, as measured from the bottom of the weathered bedrock (MW-62W) is approximately 3.5-feet above the top of sanitary sewer. These observations, coupled with the discussion above (Section 3.3.3.1), indicate weathered bedrock groundwater is captured by the sanitary sewer that is aligned along West Edgar Road.

GM is continuing to pursue access to the wells installed in the Aviation Plaza, immediately south(PN) of the GM Linden Facility to update the water level information from these wells. Based on available data, the limits of contaminated groundwater from the GM Linden Facility, for all practical purposes, appear to be reasonably defined and stable and is not expected to migrate significantly beyond the existing area of contamination.

* Refer to Section 3.2 and Response to Question #2 for a discussion of these constituents which do not appear to be Facility related.

Group 4 (northeast(PN))

Overburden

Arsenic, manganese, barium, cadmium and vanadium were detected at several wells in concentrations above the drinking water criterion during the RFI/RI groundwater sampling events (Table 3.3.1 and Figure 34). As discussed in Section 3.1, arsenic, manganese, and barium are naturally occurring constituents in groundwater and not considered related to Facility activities. Cadmium and vanadium have had infrequent detections above drinking water criterion, and no consistent spatial pattern is present. Therefore, there does not appear to be a Facility-related source for these compounds. Lead was detected in monitoring well BEC-2S in January 2003 and at BEC-11S in February 2005 at concentrations greater than the drinking water criterion (Table 3.3.1 and Figure 34). Subsequent groundwater samples have been collected that have not had concentrations greater than the drinking water criterion since the exceedences were encountered. As discussed in Section 3.2.4.1, groundwater in the northeast(PN) corner of the facility appears to be captured by the storm sewer along Linden Avenue. Therefore, the limits of contaminated groundwater for these constituents from the GM Linden Facility, for all practical purposes, appear to be defined and stable.

Mercury was detected in monitoring well BEC-5D during the April 2005 sampling event at a concentration greater than the drinking water criterion (Table 3.3.1 and Figure 34). Monitoring well BEC-5D is located along the northern(PN) property boundary along Linden Avenue. The source of the mercury appears to be off-site, based on groundwater flow direction (Figures 12a through 12j). Downgradient monitoring wells in Groups 1, 2, or 3 have not indicated any detection of mercury above the drinking water criterion. Therefore, the limits of contaminated groundwater for this constituent from the GM Linden Facility, for all practical purposes, appear to be defined and stable.

Trichloroethene was detected in monitoring wells BEC-5D, BEC-9S and MW-01D at concentrations higher than the drinking water criterion (Table 3.3.1 and Figure 34). The last exceedances at MW-01D occurred in October 2003 and subsequent concentrations have not exceeded the drinking water criterion. The source of trichloroethene at monitoring wells BEC-5D and BEC-9S are off-site, based on groundwater flow direction.

Groundwater flow at BEC-9S tends toward the east(PN), and appears to be captured in the storm sewer aligned along Linden Avenue (Figures 12a through 12j).

1,2-Dichloroethane* was detected in monitoring well BEC-5D at a concentration greater than the drinking water criterion in August 2002 (Table 3.3.1 and Figure 34). Subsequent groundwater samples obtained from BEC-5D have not had concentrations of 1,2-dichloroethane greater than the drinking water criterion. BCEE was also detected in monitoring well BEC-5D at concentrations greater than the drinking water criterion (Table 3.3.1 and Figure 34). As discussed in Section 3.2, these constituents appear to be unrelated to Facility activities and suggest an off-Site source. Further, groundwater flow confirms that the source for these constituents are likely off-Site (Figure 12a through 12j). Therefore, the limits of VOC and SVOC contaminated groundwater from the GM Linden Facility, for all practical purposes, appear to be reasonably defined and stable and is not expected to migrate significantly beyond the existing area of contamination.

<u>Weathered Bedrock</u>

Manganese was detected in concentrations greater than the drinking water criteria at monitoring wells BEC-4D, MW-42W and MW-55W. Arsenic was detected at concentrations greater than the drinking water criteria at BEC-1B, which has been abandoned (Table 3.3.2 and Figure 26). As discussed in Section 3.1, manganese and arsenic are naturally occurring constituents in groundwater and not considered related to Facility activities.

Trichloroethene, benzene, 1,2-dichloroethane*, tetrachloroethene, 1,1-dichloroethene, cis-1,2-dichloroethene and vinyl chloride were detected in many of the monitoring wells in Group 4, at concentrations greater than the drinking water criteria (Table 3.3.2 and Figure 35). Eight of the monitoring well locations which indicated VOCs also had detections of BCEE as well as 1,2-dichloroethane detected at concentrations greater than the drinking water criteria (Table 3.3.2 and Figure 35). As discussed in Section 3.2, BCEE and 1,2-dichloroethane are considered to be unrelated to Facility activities and suggest that the detections may be related to off-Site influences. Groundwater flow patterns in the vicinity of MW-14W, MW-15W, and BEC-1D indicate that the detections of VOCs and BCEE are from an upgradient source. Trichloroethene and 1,1-dichloroethene were detected at concentrations above the drinking water criterion at MW-68W. Based on the September 12, 2005 groundwater flow patterns, would indicate groundwater flow off-site to the northeast(PN). However, groundwater flow patterns also indicate that the storm sewer along the Linden Avenue alignment captures groundwater in this northeast(PN) corner of the facility.

Trichloroethene and 1,1-dichloroethene were also detected at concentrations above the drinking water criterion at monitoring well MW-16W, which based on the September 12, 2005 groundwater flow pattern, appears to flow towards Group 3. Detections of VOCs at other monitoring wells in this Group also appear to be directed into Group 3. Weathered bedrock groundwater in Group 3 is ultimately captured in the sanitary sewer along Routes 1 and 9. Therefore, the limits of VOC and SVOC contaminated groundwater in the area from the GM Linden Facility, for all practical purposes, appear to be reasonably defined and stable and is not expected to migrate significantly beyond the existing area of contamination.

* Refer to Section 3.2 and Response to Question #2 for a discussion of these constituents which do not appear to be Facility related.

<u>Bedrock Flow Zone #1</u>

Laboratory analytical results from last four sampling events at MW-15B have indicated several VOCs (1,2-dichloroethane*, benzene, and trichloroethene) slightly above the drinking water criterion (Table 3.3.3 and Figure 36). In addition, VOCs (1,2-dichloroethane* and trichloroethene) and one SVOC (BCEE) were detected above drinking water criterion during the last three sampling events at concentrations slightly above their respective drinking water criterion at MW-45B (Table 3.3.3 and Figure 36). Based on the downward gradient from the weathered bedrock to bedrock and the interaction of the weathered bedrock and bedrock groundwater at the subcrop area discussed in Section 2.7.4.3, it is likely that these low level detections of VOCs and SVOCs (BCEE) are resulting from the weathered bedrock interval.

Based on the September 12, 2005 groundwater flow patterns for BFZ#1, groundwater flow appears to be to the east-northeast(PN). Regional information, as discussed in Section 2.8, indicates that groundwater in these bedrock flow zones ultimately interact with surface water features (e.g. rivers and creeks). The groundwater flow direction in BFZ#1 at this part of the Facility differs from that reported in regional studies (Michalski 1997) and that identified by Merck(2005) which have identified the Rahway River (to the west) as the discharge feature for bedrock flow zones in the area. This suggests that a different surface feature (e.g., Morses Creek) could be the controlling feature for groundwater from BFZ#1 at this part of the Facility. An evaluation of the potential surface water impact from these concentrations is discussed in Response to Question #4.

* Refer to Section 3.2 and Response to Question #2 for a discussion of these constituents which do not appear to be Facility related.

<u>References</u>

References reviewed to prepare this EI determination are identified in the appendices that follow Question 8.

4. Does “contaminated” groundwater discharge into surface water bodies?

__X__ If yes - continue after identifying potentially affected surface water bodies.

_____ If no - skip to #7 (and enter a “YE” status code in #8, if #7 = yes) after providing an explanation and/or referencing documentation supporting that groundwater “contamination” does not enter surface water bodies.

_____ If unknown - skip to #8 and enter “IN” status code.

RATIONALE:

[Unless specified otherwise, references to “Section,” “Table” and “Figure” refer to the sections, tables, and figures contained in the document, RCRA Environmental Indicator CA750 Report Determination of Current Releases to Groundwater Controlled -- GM Linden Facility, Haley & Aldrich, Inc., September 2005.]

No surface water body exists at the Facility. Surface water bodies near the Facility are shown on Figure 4 (which is the same as Figure 4 in the RFI Report). The nearby surface water bodies include Morses Creek, Kings Creek, and the Rahway River. As discussed in Section 3.3, groundwater that is considered “contaminated” for the purposes of the CA750 determination has a potential to enter storm sewers at certain locations and then discharge to Morses Creek. In addition, contaminated groundwater in Bedrock Flow Zone #1 could discharge to Morses Creek since this Flow Zone intersects Morses Creek and contaminated groundwater in this Flow Zone at the northeast corner of the Facility flows toward Morses Creek.

Contaminated groundwater in the overburden and weathered bedrock at the Facility is not expected to discharge to Kings Creek, which is located on the Merck site. As discussed in Section 2.8.3, the sanitary sewer that runs between the Facility and Merck controls groundwater flow in the overburden and weather bedrock so that contaminated groundwater in these saturated zone from the Facility does not flow across to Merck. To the extent that contaminated groundwater in bedrock flows toward the Rahway River, it would merge into far more significant groundwater contamination at the Merck site. According to Merck (2004), contaminated groundwater in bedrock at its facility is being controlled by its pumping, and to the extent that contaminated groundwater discharges to the Rahway River, such discharge would be insignificant.

Table 3.5.1 summarizes the monitoring well locations where contaminated groundwater has a potential to discharge to Morses Creek. The potential significance of these discharges of contaminated groundwater to Morses Creek is discussed below in Response to Question #5.

References

References reviewed to prepare this EI determination are identified in the appendices that follow Question 8.

5. Is the discharge of "contaminated" groundwater into surface water likely to be "insignificant" (i.e., the maximum concentration of each contaminant discharging into surface water is less than 10 times their appropriate groundwater "level," and there are no other conditions (e.g., the nature, and number, of discharging contaminants, or environmental setting), which significantly increase the potential for unacceptable impacts to surface water, sediments, or eco-systems at these concentrations)?

____ If yes - skip to #7 (and enter "YE" status code in #8 if #7 = yes), after documenting: 1) the maximum known or reasonably suspected concentration[3] of key contaminants discharged above their groundwater "level," the value of the appropriate "level(s)," and if there is evidence that the concentrations are increasing; and 2) provide a statement of professional judgment/explanation (or reference documentation) supporting that the discharge of groundwater contaminants into the surface water is not anticipated to have unacceptable impacts to the receiving surface water, sediments, or eco-system. (See discussion above).

__X__ If no - (the discharge of "contaminated" groundwater into surface water is potentially significant) - continue after documenting: 1) the maximum known or reasonably suspected concentration[4] of each contaminant discharged above its groundwater "level," the value of the appropriate "level(s)," and if there is evidence that the concentrations are increasing; and 2) for any contaminants discharging into surface water in concentrations3 greater than 100 times their appropriate groundwater "levels," the estimated total amount (mass in kg/yr) of each of these contaminants that are being discharged (loaded) into the surface water body (at the time of the determination), and identify if there is evidence that the amount of discharging contaminants is increasing.

_____ If unknown - enter "IN" status code in #8.

RATIONALE:

[Unless specified otherwise, references to "Section," "Table" and "Figure" refer to the sections,

[3] As measured in groundwater prior to entry to the groundwater-surface water/sediment interaction (e.g., hyporheic) zone.

tables, and figures contained in the document, RCRA Environmental Indicator CA750 Report Determination of Current Releases to Groundwater Controlled -- GM Linden Facility, Haley & Aldrich, Inc., September 2005.]

To make this determination, the most recent groundwater data from monitoring wells nearest the locations where contaminated groundwater is likely to enter storm sewers are compared to 10 times the screening criteria (as recommended in the CA750 Form). This comparison is summarized in Table 3.5.2, which shows all groundwater concentrations that are higher than the screening criteria, and the ratios of the concentrations to the screening criteria. Ratios that exceed 10 have been highlighted to identify situations where the discharge of contaminated groundwater to storm sewers or directly through bedrock/surface water interactions cannot be considered insignificant according to EPA guidance for answering this question.

As shown on Table 3.5.2, the only ratios that exceed 10 are those for TCE at monitoring wells BEC-5D (0.05 mg/L), MW-68W (0.10 mg/L), and MW-45B (0.076 mg/L). However, as discussed in Section 3.3.4, the presence of TCE (along with other chemicals) at BEC-5D is likely due to an off-site source upgradient of the Facility. Therefore, aside from the presence of TCE at MW-68W and MW-45B, all other situations where contaminated groundwater enters storm sewers can be considered to be insignificant discharges to surface water.

The potential significance of the discharge of TCE in groundwater to Morses Creek is discussed in Response to Question 6 below.

References

References reviewed to prepare this EI determination are identified in the appendices that follow Question 8.

6. Can the discharge of "contaminated" groundwater into surface water be shown to be "currently acceptable" (i.e., not cause impacts to surface water, sediments or eco-systems that should not be allowed to continue until a final remedy decision can be made and implemented[5])?

_X__ If yes - continue after either: 1) identifying the Final Remedy decision incorporating these conditions, or other site-specific criteria (developed for the protection of the site's surface water, sediments, and eco-systems), and referencing supporting documentation demonstrating that these criteria are not exceeded by the discharging groundwater; OR 2) providing or referencing an interim-assessment[6], appropriate to the potential for impact, that shows the discharge of groundwater contaminants into the surface water is (in the opinion of a trained specialists, including ecologist) adequately protective of receiving surface water, sediments, and eco-systems, until such time when a full assessment and final remedy decision can be made. Factors which should be considered in the interim-assessment (where appropriate to help identify the impact associated with discharging groundwater) include: surface water body size, flow, use/classification/habitats and contaminant loading limits, other sources of surface water/sediment contamination, surface water and sediment sample results and comparisons to available and appropriate surface water and sediment "levels," as well as any other factors, such as effects on ecological receptors (e.g., via bio-assays/benthic surveys or site-specific ecological Risk Assessments), that the overseeing regulatory agency would deem appropriate for making the EI determination.

____ If no - (the discharge of "contaminated" groundwater can not be shown to be "currently acceptable") - skip to #8 and enter "NO" status code, after documenting the currently unacceptable impacts to the surface water body, sediments, and/or eco-systems.

____ If unknown - skip to 8 and enter "IN" status code.

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[5] Note, because areas of inflowing groundwater can be critical habitats (e.g., nurseries or thermal refugia) for many species, appropriate specialist (e.g., ecologist) should be included in management decisions that could eliminate these areas by significantly altering or reversing groundwater flow pathways near surface water bodies.

[6] The understanding of the impacts of contaminated groundwater discharges into surface water bodies is a rapidly developing field and reviewers are encouraged to look to the latest guidance for the appropriate methods and scale of demonstration to be reasonably certain that discharges are not causing currently unacceptable impacts to the surface waters, sediments or eco-systems.

RATIONALE:

[Unless specified otherwise, references to “Section,” “Table” and “Figure” refer to the sections, tables, and figures contained in the document, RCRA Environmental Indicator CA750 Report Determination of Current Releases to Groundwater Controlled -- GM Linden Facility, Haley & Aldrich, Inc., September 2005.]

The potential discharge of TCE in groundwater to Morses Creek via storm sewers is expected to be acceptable considering the concentrations of TCE in groundwater that may discharge to the creek and conservative health-based criterion appropriate for evaluating potential exposure to TCE in surface water in the creek.

As discussed in Section 5.04.D.2 of the RFI Report, recreational waders could be exposed to surface water in Morses Creek in the section downstream of the Linden Avenue municipal storm sewer outfall, which discharges stormwater contributions from the Facility and groundwater that enters the sewers. Potential exposure of recreational waders is possible only in limited areas that are reasonably accessible because much of Morses Creek in the vicinity of the Facility is fenced, or runs in underground culverts. No significant exposure of aquatic receptors to TCE is expected. As discussed in Appendix L of the RFI Report, this section of Morses Creek is not an environmentally sensitive area, and neither USEPA nor NJDEP has found it necessary to establish an ambient water quality criterion based on aquatic life for TCE (and for most VOCs in general).

A health-based criterion for recreational contact with TCE in surface water was calculated using the exposure factors for recreational waders that were discussed in Section 5.04.E.4 of the RFI Report and toxicity values that were discussed in Section 5.05 of the RFI Report. Using a target cancer risk of 10-5 and a target hazard quotient of 1, the criterion is approximately 3 mg/L. The highest concentration of TCE in groundwater that likely discharges to storm sewers is 0.10 mg/L, but this concentration is expected to be greatly reduced by mixing with stormwater and uncontaminated groundwater that enters the sewer. Even though the TCE concentration that reaches Morses Creek is expected to be much lower, the concentration of 0.10 mg/L is already lower than the recreational contact criterion, and therefore, can be used to conclude that discharge of TCE in groundwater to Morses Creek is currently acceptable.

References

References reviewed to prepare this EI determination are identified in the appendices that follow Question 8.

7. Will groundwater monitoring / measurement data (and surface water/sediment/ecological data, as necessary) be collected in the future to verify that contaminated groundwater has remained within the horizontal (or vertical, as necessary) dimensions of the "existing area of contaminated groundwater?"

__X_ If yes - continue after providing or citing documentation for planned activities or future sampling/measurement events. Specifically identify the well/measurement locations which will be tested in the future to verify the expectation (identified in #3) that groundwater contamination will not be migrating horizontally (or vertically, as necessary) beyond the "existing area of groundwater contamination."

____ If no - enter "NO" status code in #8.

____ If unknown - enter "IN" status code in #8.

RATIONALE:

[Unless specified otherwise, references to "Section," "Table" and "Figure" refer to the sections, tables, and figures contained in the document, RCRA Environmental Indicator CA750 Report Determination of Current Releases to Groundwater Controlled -- GM Linden Facility, Haley & Aldrich, Inc., September 2005.]

In order to confirm that the existing areas of groundwater contamination originating from the Facility remain stable, the monitoring wells listed on Table 3.7.1 will be sampled annually for the VOCs, BCEE, and Inorganics. The wells listed in Table 3.7.1 were selected based on their location relative to the location of current groundwater contamination and groundwater flow directions in each of the water bearing units (overburden, weathered bedrock, and bedrock flow zones). At a minimum four quarters of groundwater samples will be collected from each monitoring well.

Coupled with the groundwater sampling activities, groundwater level measurements will be obtained from all wells in Table 3.7.1, on a quarterly basis, with the exception of monitoring wells MW-52S and MW-

53S, due to historic water level issues. Data quality objectives and validation will remain the same as established in the QAPP in the RFI Work Plan and Addenda.

Groundwater sampling and water level measurements are proposed through 2007, after which the monitoring program will be reviewed in conjunction with the corrective measure proposal.

Evaluation of the RFI groundwater characterization data has identified contaminated groundwater in the overburden, weathered bedrock and the bedrock flow zones, in each of the evaluation groups. In general, based on groundwater flow patterns, sewer influences, and downgradient wells, the limits of contaminated groundwater from the GM Linden Facility, for all practical purposes, appear to be defined and stable. However, along the northern(PN) portion of the site, groundwater that is considered "contaminated" for the purposes of the CA750 determination has a potential to enter storm sewers at certain locations and then discharge to Morses Creek. A review of the data indicates that potential discharges to Morses Creek will be much lower than the health-based criterion risk exposure. Thus, the discharge of TCE in groundwater to Morses Creek is currently acceptable.

Therefore, it is concluded that the migration of contaminated groundwater from the GM Linden Facility is under control. Further, monitoring will be conducted to confirm that contaminated groundwater from the GM Linden Facility remains within the existing area of contamination.

<u>References</u>

References reviewed to prepare this EI determination are identified in the appendices that follow Question 8.

8. Check the appropriate RCRAInfo status codes for the Migration of Contaminated Groundwater Under Control EI (event code CA750), and obtain Supervisor (or appropriate Manager) signature and date on the EI determination below (attach appropriate supporting documentation as well as a map of the facility).

__X__ YE - Yes, "Migration of Contaminated Groundwater Under Control" has been verified. Based on a review of the information contained in this EI determination, it has been determined that the "Migration of Contaminated Groundwater" is "Under Control" at the **General Motors Corporation – Linden Assembly Plant**, EPA ID# **NJD 002 186 690**, located at **1016 West Edgar Road, Linden, New Jersey**. Specifically, this determination indicates that the migration of "contaminated" groundwater is under control, and that monitoring will be conducted to confirm that contaminated groundwater remains within the "existing area of contaminated groundwater." This determination will be re-evaluated when the Agency becomes aware of significant changes at the facility.

_____ NO - Unacceptable migration of contaminated groundwater is observed or expected.

_____ IN - More information is needed to make a determination.

REFERENCES

Agency for Toxic Substances and Disease Registry (ATSDR). 2000. Toxicological Profile for Chromium. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

American Conference of Government Industrial Hygienists (ACGIH). 2003. 2003 TLVs and BEIs. ISBN: 1-882417-40-2.

Anderson. 1968. Geology and Ground-Water Resources of the Rahway Area, New Jersey. State of New Jersey, Department of Conservation and Economic Development. Special Report No. 27.

Britton, R., Coffee, C., Brudereck, J. 2001. Potential Cross-Contamination of a Leaky Multi-Unit Bedrock Aquifer System Following Routine Sampling Protocols. Presented at Fractured Rock 2001, Toronto, Canada.

Dougherty, J., Soo, A., Alvey, R., Evolving Conceptual Models and Monitoring Well Reconstruction in the Passaic Formation in New Jersey.

Department of Health and Human Services (DHHS). 1997. NIOSH Pocket Guide to Chemical Hazards. DHHS(NIOSH) 97-140. June.

Efron, B. and R.J. Tibshirani. 1998. An Introduction to the Bootstrap. Chapman & Hall/CRC, Boca

Raton.

ENVIRON Corporation. 2000. Human Health and Ecologic Risk Assessment, Merck Rahway Facility. April.

ENVIRON International Corporation. 2003. Health-Based Evaluation of Data to Streamline RCRA Facility Investigations (RFIs) at General Motors Facilities. October.

Haley & Aldrich. 2002. RCRA Facility Investigation Workplan and New Jersey Remedial Investigation Workplan. General Motors Vehicle Manufacturing - Linden Assembly. July 29.

Haley & Aldrich, Inc., 2005. RCRA Environmental Indicator CA750 Report Determination of Current Releases to Groundwater Controlled -- GM Linden Facility, Linden, New Jersey, US EPA ID #NJD002186690, NJDEP CASE NO. 95-01-25-1618-35., September 2005.

Jury, W. A., D. Russo, G. Streile, and H. E. Abd. 1990. Evaluation of volatilization by organic chemicals residing below the soil surface. Water Resources Research. 26(1):13-20.

Johnson, P. C., and R. A. Ettinger. 1991. Heuristic model for predicting the intrusion rate of contaminant vapors into buildings. Environ. Sci. Technol. 25(8):1445-1452.

Merck. 1991a. RCRA Facility Investigation Rahway Facility, Facility Background Report. October.

Merck. 1991b. RCRA Facility Investigation Rahway Facility, Phase I Report. October.

Merck. 1994. RCRA Facility Investigation Rahway Facility, Phase II Report. March.

Merck & Co., Inc. 1994. RCRA Facility Investigation Merck Rahway Facility Phase II Report. Prepared by Dames & Moore, Bethesda, MD. March.

Merck. 1996a. RCRA Facility Investigation Rahway Facility, Corrective Measures Study. August.

Merck. 1996b. 1995 Interim Groundwater Monitoring Rahway Facility. May.

Merck. 1998. Soil Cleaning Unit Treatability Variance Application. April.

Merck. 1998. Soil Cleaning Unit Soil Reuse Proposal. September.

Merck. 2000b. Response to NJDEP Comments on the Hydrogeologic Assessment Report for Monitoring Wells MW-30MP and MW-34MP and Recovery Well RW-1. November 1999.

Merck. 2004b. 2003/2004 Annual Remedial Report. September.

Michalski, A., Britton, R. 1992. Integrated Use of Multiple Techniques for Contaminant Investigations in Fractured Aquifers: A Case Study from the Newark Basin, New Jersey. Proceedings of the Focus Conference on Eastern Groundwater, p. 809-826.

Michalski, A., Britton, R. 1997 The Role of Bedding Fractures in the Hydrogeology of Sedimentary Bedrock – Evidence from the Newark Basin, New Jersey. Groundwater, Vol. 35, No. 2, p. 318-327.

Michigan Department of Environmental Quality (MDEQ). 1998. Environmental Response Division, Operational Memorandum #18, Technical Supporting Document. August.

Michigan Department of Environmental Quality (MDEQ). 2002. Administrative Rules for Part 201, Environmental Remediation, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as Amended. Generic Cleanup Criteria and Screening Levels. December.

Morin, R., Carleton, G., Poirier, S. 1997 Fractured-Aquifer Hydrogeology from Geophysical Logs; The Passiac Formation, New Jersey. Groundwater, Vol. 35, No. 2, p. 328-338.

National Oceanic and Atmospheric Administration (NOAA). 1993. Comparative Climatic Data for the United States Through 1993.

Nemickas, B. 1976. Geology and Ground-Water Resources of Union County, New Jersey. U.S. Geological Survey Water-Resources Investigation Report 76-73.

New Jersey Administrative Code 7:9-6. (N.J.A.C. 7:9-6). Ground Water Quality Standards. January 7, 1993.

New Jersey Administrative Code 7:26D. (N.J.A.C. 7:26D) Proposed Rule entitled Cleanup Standards for Contaminated Sites. February 3, 1992. (Soil cleanup criteria pursuant to this proposed rule were last revised on May 12, 1999, and were obtained from http://www.state.nj.us/dep/srp/regs/scc/).

Olsen, P., Kent, D., Cornet, B., Witte, W., Schlische, R. 1996 High-Resolution Stratigraphy of the Newark Rift Basin (Early Mesozoic, eastern North America). GSA Bulletin, V. 108, No. 1, p. 40-77.

Redmond, R., Starcher, R., Sigerson, A. , Groundwater Flow and Contaminant Migration in the Brunswick Group (Newark Basin). Proceeding of the Focus on Eastern Regional Ground Water, Burlington, Vermont, p. 3-16.

United States Environmental Protection Agency (USEPA). 1987. Hazardous Water Treatment, Storage and Disposal Facilities (TSDF) – Air Emission Models, Documentation. Research Triangle Park. December.

United States Environmental Protection Agency (USEPA). 1989. Office of Emergency and Remedial

Response. Risk Assessment Guidance for Superfund. Volume I, Human Health Evaluation Manual. Washington, DC. EPA/540-1-89-002. OSWER Directive 9285.7 01a. December.

United States Environmental Protection Agency (USEPA). 1991a. Human health evaluation manual, supplemental guidance: "Standard default exposure factors." Memorandum from T. Fields, Jr., Office of Emergency Remedial Response, to B. Diamond, Office of Waste Programs Enforcement. OSWER Directive 9285.6-03. March 25.

United States Environmental Protection Agency (USEPA). 1991b. Role of the baseline risk assessment in Superfund remedy selection decisions. Memorandum from Don R. Clay to Regional Directors. OSWER Directive 9355.0-30. April 22.

United States Environmental Protection Agency (USEPA). 1992. Office of Research and Development. Dermal Exposure Assessment: Principles and Applications. EPA/600/8-91/011B. January.

United States Environmental Protection Agency (USEPA). 1995a. Emissions, Monitoring, and Analysis Division. Office of Air Quality Planning and Standards. SCREEN3 Model user's guide. EPA-454/B-95-004.

United States Environmental Protection Agency (USEPA), 1995b. Office of Air Quality Planning and Standards. Compilation of air pollutant emission factors. Volume I: Stationary point and area sources. AP-42, Fifth Edition.

United States Environmental Protection Agency (USEPA). 1995c. Office of Air Quality Planning and Standards. Guidelines for predictive baseline emissions estimation procedures for Superfund Sites, ASF-21. EPA-451/R-96-001. November.

United States Environmental Protection Agency (USEPA). 1997a. Health Effects Assessment Summary Tables (HEAST). FY 1997 Update. EPA-540-R-97-036. July.

United States Environmental Protection Agency (USEPA). 1996. Office of Solid Waste and Emergency Response (OSWER). Soil Screening Guidance: Technical Background Document, 2nd Ed. EPA/540/R95/128. May.

United States Environmental Protection Agency (USEPA). 1997b. Office of Health and Environmental Assessment. Exposure Factors Handbook. Washington, DC. EPA/600/P-95/002Fa. August.

United States Environmental Protection Agency (USEPA). 1997c. Office of Solid Waste and Emergency Response (OSWER). The Lognormal Distribution in Environmental Applications.

EPA/600/R-97/006. December.

United States Environmental Protection Agency (USEPA). 1998. Office of Solid Waste and Emergency Response (OSWER). Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities. Peer Review Draft. EPA530-D-98-001A. July.

United States Environmental Protection Agency (USEPA), 2000. Update to supplemental guidance to RAGS: Region 4 Bulletins. March 2000 revision. U.S. Environmental Protection Agency, Region 4, Waste Management Division, Office of Technical Services, Atlanta, GA.

United States Environmental Protection Agency (USEPA). 2001. Office of Emergency and Remedial Response. Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA/540/R/99/005. September.

United States Environmental Protection Agency (USEPA), 2002. Region 9 Preliminary Remediation Goals (PRGs) 2002. October.

United States Environmental Protection Agency (USEPA), 2003a. User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings. Office of Emergency and Remedial Response, Washington D.C., June.

United States Environmental Protection Agency (USEPA). 2003b. Office of Solid Waste and Emergency Response (OSWER). Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil. December.

United States Geological Survey 2003. Major Aquifers in New Jersey. http://nj/water.usgsg.gov/gw/aquifer.html.

URS Corporation. 2001. Rahway Plant, Remedial Action Work Plan. May.

URS Corporation. 2001. Rahway Plant, Remedial Action Work Plan, Quality Assurance Project Plan. May.

URS Corporation. 2001. Proposed Child Development Center Second Addition, Site Assessment, Merck Rahway Plant. June.

URS Corporation. 2001. Baseline Ecological Evaluations, Merck & Co., Inc., Rahway Site. September.

URS Corporation. 2001. Rahway River Waste and Sediment Sampling 2001. September.

URS Corporation. 2002. 2001/2002 Annual Remediation Report, Rahway Plant. September.

URS Corporation. 2002. March 2002 Baseline Groundwater Sampling Report. September.

URS Corporation. 2002. Remedial Action Work Plan Amendment Attachment: Freshwater Wetlands Mitigation Proposal. December.

URS Corporation. 2003. Quarterly Remediation Report September 1 to November 30, 2002, Rahway Site. January.

URS Corporation. 2003. 2002/2003 Annual Remediation Report. September.

URS Corporation. 2003. 2002/2003 Groundwater Management Report (Part 1 of 2). September.

URS Corporation. 2003. 2002/2003 Groundwater Management Report (Part 2 of 2). September.

URS Corporation. 2003. Quarterly Remediation Report September 1, 2003 to November 30, 2003, Rahway Site. December.

URS Corporation. 2004. Quarterly Remediation Report March 1 to May 31, 2004, Rahway Site. June.

URS Corporation. 2004. Quarterly Remediation Report December 1, 2003 to February 29, 2004, Rahway Site. March.

URS Corporation. 2005. Hydrogeologic Summary Report, Rahway Site. March.

Reviewed by:

_______________________________ Date: ____________________
Clifford Ng, RPM
RCRA Programs Branch
EPA Region 2

________________________________ Date: ____________________
Barry Tornick, Section Chief

RCRA Programs Branch
EPA Region 2

Approved by:

Original signed by: Date: September 30, 2005
Adolph Everett, P.E., Chief
RCRA Programs Branch
EPA Region 2

Locations where references may be found:

References reviewed to prepare this EI determination are cited within the text of each response and listed by number after the response to Question 8. Referenced materials are available for review at two separate locations.

USEPA Region 2, RCRA Records Center, located at 290 Broadway, 15th Floor, New York, New York, 10007-1866.

New Jersey Department of Environmental Protection Office, located at 401 East State Street, Records Center, 6th Floor, Trenton, New Jersey, 08625.

Contact telephone numbers and e-mail:

Clifford Ng, EPA RPM
(212) 637-4113
ng.clifford@epamail.epa.gov