

APPENDIX A

Roche Response to NJDEP Comments dated May 21, 2014

July 17, 2014



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July 17, 2014

New Jersey Department of Environmental Protection
Bureau of Case Management
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Attn: Donna Gaffigan, Case Manager

Re: *NJDEP Comments (Dated May 21, 2014) on the Site-Wide Ground Water RI Report*
Hoffmann-La Roche Inc.
340 Kingsland Street
Nutley, New Jersey
SRP PI #s 009949, 614465 & 625447
TRC Project No. 198233

Dear Ms. Gaffigan:

On May 21, 2014, the NJDEP provided Hoffmann-La Roche Inc. (Roche) with *revised* draft comments and background information for the Site-Wide Ground Water Remedial Investigation Report (GW RIR), Revision 3, dated April 2, 2014. These comments incorporated the Department's comments that were previously provided to Roche by e-mail on May 9, 2014.

On behalf of Roche, TRC Environmental Corp. (TRC) has prepared the following responses to the NJDEP's comments (dated May 21, 2014) on the GW RIR submitted for the Roche Nutley Site.

We note that many of NJDEP's comments below address specific soil contaminant detections. We appreciate the effort that the NJDEP has put forth in reviewing and compiling information on specific detections of soil contaminants, and their potential impact on ground water quality. The GW RIR presents the scope and findings of ground water RI activities conducted at the Site between 2007 and 2013. It places an emphasis on the current conditions and environmental quality of the Site. Past and recent IA-specific RI reports document the extent and magnitude of numerous IA or AOC-specific soil and ground water impacts across the Site. While some soil impacts have directly resulted in ground water contamination, others have not been significant enough to extend into the ground water and create a contaminant plume. In some instances, historic soil and ground water impact areas have been (or are in the process of being)

successfully remediated. An evaluation of individual AOCs and their documented and potential impact to ground water was provided in Appendix Q of the GW RIR.

For this report, historic soil and ground water contamination that is no longer present and/or soil impacts that have not resulted in ground water contamination at the Site, nor could reasonably be expected to have impacts in the future, are not relevant to the findings presented within the RI report.

General Comments

1. NJDEP Comment:

Page 45 of GW RIR: TRC states that of the more than 190 AOCs investigated at the Site, only a few IAs/AOCs were identified to possess soil impacts (related to former Roche operations) directly resulted in ground water contamination. DEP is in agreement that the recent investigation, 20 year after decommission of most operations, reworking of site soils and operation of IRMs has resulted in reduction in the overall shallow S1 top ground water; however, numerous sources over the few identified by TRC (IA-2, -9 and -10) remain across the Roche property as summarized in NJDEP comment No. 7 below.

Roche Response:

Between March 2013 and March 2014, Roche submitted to the NJDEP a total of 13 IA-specific RIRs. These reports document the extensive remedial investigation conducted for more than 190 AOCs identified at the Site. The LSRPs evaluated historic and recent Site data to assess soil quality (particularly within and/or in close proximity to the AOCs), determine if impacts to ground water had occurred, and identify potential contaminant sources. In the event that ground water contamination was confirmed by the LSRP, the investigation was deferred to the ground water team conducting the Site-wide ground water quality assessment and plume delineation. Therefore, any ground water impacts attributable to an AOC were incorporated into the GW RIR scope. In addition, Appendix Q of the GW RIR provided a summary of the Site IAs and their soil and ground water COCs by AOC.

The GW RIR presents the scope and findings of ground water RI activities conducted at the Site between 2007 and 2013. It places an emphasis on the current conditions and environmental quality of the Site. Past and recent IA-specific RI reports document the extent and magnitude of numerous IA or AOC-specific soil and ground water impacts across the Site. While some soil impacts have directly resulted in ground water contamination, others have not been significant enough to extend into the ground water and create a contaminant plume. In some instances, historic soil and ground water impact areas have been (or are in the process of being) successfully remediated.

In areas where soil impacts did historically impact ground water quality, those impacts would still be detectable today, or they were so minor that they have attenuated and are



no longer present. Ground water contamination would not have migrated from those areas to other portions of the facility without leaving a trail of contamination between the source area and the plume's current location. In every source area that has impacted ground water quality on-Site, the highest VOC concentrations are still found in the immediate vicinity of the source, typically with decreasing concentrations with distance from that source. Therefore, if there is no ground water impact directly below detected VOCs in soil today; those soil impacts did not cause ground water contamination in the past. Historic ground water impacts could not have migrated from and be found at some distance from the soil impact. The specific soil impacts identified by the NJDEP will be addressed in the response to Comment No. 7 below.

As previously stated, historic soil and ground water contamination that is no longer present and/or soil impacts that have not resulted in ground water contamination were not included in this report since they are not relevant to the findings discussion.

The specific soil impacts discussed by the NJDEP are further discussed in the response to Comment 7 (below).

2. NJDEP Comment:

Page 57 of RIR: As shown in Tables 5-1 through 5-7, fifteen metals (aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, iron, lead, manganese, nickel, sodium, thallium, and zinc) have been detected in the ground water at the Site at concentrations exceeding the GWQS. TRC states several metals (9/15) were detected in Zone S1 ground water, including lead, thallium, chromium, nickel, antimony, beryllium, cadmium, cobalt, and zinc. These metals were detected in low-lying portions of the Site, in areas where historic fill was used for construction backfill. The metal exceedance of individual GWQS shall be included in the site CEA. TRC's claim that the site has been impacted from "Historic or Artificial Fill" separate or prior from Roche's operations is not supported. In addition, the Roche Nutley property has been listed as a source of heavy metals in the Killiam Assoc. August 15, 1978 Passaic Valley Sewerage Commission Heavy Metals Source Determination Study.

Roche Response:

CEA: Appendix V of the GW RIR (April 2014) includes a written explanation of the proposed CEA components (constituents, extent and duration) for the Site. All ground water constituents exceeding the Ground Water Quality Standards (GWQS) were listed in the CEA documentation (Appendix V), which includes the above-referenced metals.

Metal Impacts: The distribution of elevated dissolved metals in ground water does not correlate well with areas of Roche's operations. Instead, the sporadic dissolved exceedances of lead, thallium, and other metals directly correlates and corresponds to areas where fill material is present. The attached maps (Attachment 1, Figures 1 through



9) show the ground water contaminant distributions and indicate that the distribution of metal contamination in ground water is directly attributable to and correlates with the distribution of fill materials. The distribution of total metals positively correlates with areas where the grade was raised with fill materials. It has been documented that these fill materials are made up largely of soil and contain some miscellaneous construction debris, garbage, and other materials (including coal cinders and ash), which are known to contain a suite of metals. Unfortunately, there are no historic records documenting Site-wide fill provenance, characterization and/or emplacement activities that have taken place over the facility's operational period. Aerial photographs indicate that much of the fill material (and all or virtually all in some places, such as in IA-14 and IA-15) was placed on the Roche Site by third parties from unknown off-Site sources prior to Roche acquiring the relevant parcels. It is also possible that some materials may have been generated on-Site (during past Site operations) and incorporated into the fill during multiple phases of Site redevelopment.

The results of the metals analyses are presented on maps in Attachment 1. For Zone S1, individual maps were prepared for each metal, with different colors used to delineate exceedances of the GWQS detected in the unfiltered (totals) and filtered (dissolved) samples. Examination of these maps yields the following findings:

- a) Total metals were detected in low-lying areas in the center of the facility and in IA-10. The distribution of total metals positively correlates with areas where the grade was raised with fill materials. These fill materials contain a mixture of soil, miscellaneous construction debris, garbage, and other materials (including coal cinders and ash), which are known to contain a suite of metals.
- b) At most locations where total metals were detected, the filtered sample did not exceed the GWQS (with the exception of arsenic). This is indicative of the low solubility of most of the subject metals at prevailing ground water pHs (with arsenic being the notable exception). The absence of dissolved exceedances at locations where totals exceedances were detected indicates that the metals are not actually dissolved in ground water; the totals detections are due to the entrainment of cryptocrystalline soil particles that contain these metals in their crystal lattice, or in the case of fill materials, the metals are present in coal residues and other wastes included in the fill.
- c) A limited number of dissolved exceedances were detected for lead, thallium, nickel and antimony. There were no dissolved exceedances of chromium, beryllium, cadmium, cobalt or zinc. Dissolved lead and thallium exceedances were detected in monitoring wells both on the north and south margins of Route 3; the presence of these metals must relate to the fill used in these areas, as these wells are off-Site and upgradient of Roche (the subject wells on the south side of Route 3 are in the DOT Right-of-Way and not located on Roche property). The detection of exceedances of the GWQS for these metals along Route 3, distant from any Roche processes or process waste pipes, demonstrates the lack of correlation with Roche operations.

d) Arsenic detected in Zone S1 is likely related to the fill materials historically used on the Site, and is also present because arsenic is a documented trace metal in the Passaic Formation sandstones and mudstones. There is ample literature, including on the NJDEP website, documenting the presence of dissolved arsenic in ground water from wells installed in the Passaic Formation (Serfes, Michael E., 2004, Arsenic in NJ Ground Water, New Jersey Geological Survey Information Circular). With a few exceptions, arsenic is the only dissolved metal detected in deeper ground water, and its presence is clearly attributable to natural background in the Passaic Formation.

e) The NJDEP cites the presence of metals in a wastewater sample collected in 1978 at a discharge point to the Passaic Valley Sewerage Commission (PVSC). TRC has consulted this report, which indicates the presence of total metals (cadmium, chromium, lead, nickel, zinc and arsenic) in the range of 0.001 to 0.448 mg/L, or 1 to 448 parts per billion (ppb). Since the referenced metals results are for total (unfiltered) samples, the detected metals concentrations were likely the result of solid particles present in the sampled wastewater. The presence of metals as solids in wastewater once conveyed in Roche process lines cannot be correlated with the detection of total metals in ground water samples collected from wells. In addition, due to the low solubility of all of these metals (except arsenic, which was detected below the GWQS at 1 ppb in the cited wastewater sample), and due to the high organic content in wastewater, it is highly likely that there were no or very low levels of these metals actually dissolved in the wastewater. Therefore, any potential release from a Roche process waste line would not result in the generation of a metals plume. Furthermore, the maps of total metals exceedances (Attachment 1) show a ground water contaminant distribution that does not correlate with a process area or waste line. The broad distribution of metals exceedances positively correlates with low-lying areas of the Site that were filled to raise the grade.

It is well documented that ground water in the Passaic Formation typically has naturally occurring arsenic concentrations in the range of 1 to 20 ppb. The low (1 ppb) concentration of arsenic detected in the wastewater sample(s) was likely present in the process water that was pumped from Roche's supply wells. The bulk of the detected metal constituents can be attributed to the historic fill material present on-Site. Roche's sump pumps located in building basements likely pumped the metal-bearing particles (brought in as turbidity in the influent ground water) into the former Roche process sewer. One likely minor source of the other metals (lead, nickel, and zinc) is the metal piping and solders that conveyed process water throughout the plant. Vitamin and fine chemicals manufacturing at the Site ended in mid-2004 and pharmaceutical (dosage) manufacturing ended at the Site in December 2010. Recent (2011 through 2013) as well as historic analysis of the water discharged through Roche's waste lines to the PVSC trunk sewer showed the presence of these metals at ppb levels, indicating they are not reflective of operational wastes, since operations have ceased.

3. NJDEP Comment:

Page 58 of RIR: Most of the remaining dissolved metals (with concentrations exceeding the GWQS) were found in Zone S1, with the exception of one sample in Zone S3 for dissolved chromium. Excluding the naturally occurring background dissolved metals (Al, As, Fe, and Mn), there are no dissolved metals exceedances in the lower three hydrostratigraphic zones (D1, D2, and D3). The fact that exceedance of dissolved metals are detected in the surficial S1 zone and not the lower zones support that the metal related impacts are from site historic activities.

Roche Response:

If the term “site historic activities” relates to Site development, then yes, we agree that it is likely that during multiple phases of Site redevelopment, the fill material emplaced at the Site (in large part by third parties before Roche acquired the relevant parcels) would have contained metals prior to transport to the Site, and it is also possible that materials generated on-Site (during past Site operations) may have been incorporated into the fill.

As previously stated, the distribution of dissolved (filtered) metals is not consistent with areas of Roche operations. Instead, the sporadic dissolved exceedances of lead, thallium, and other metals directly corresponds to areas where fill material is present. There are few dissolved lead exceedances, but two of them are in the Route 3 Right-of-Way, on the north and south sides. The presence of dissolved lead at concentrations slightly above the GWQS of 5 ppb at these locations cannot be related in any way to Roche operations. The most likely explanation is that the fill used to raise the grade and construct Route 3 contained lead-bearing wastes. Emissions from cars on Route 3 could have also contributed lead when leaded gasoline was in use. The reason that the sporadic metal exceedances are only found in Zone S1 is because this is the only zone where ground water comes into contact with fill material.

The concept that the widespread presence of total metals exceedances, and the sporadic occurrence of dissolved metals, is somehow related to Site operations and discharges is not scientifically consistent with the chemical properties of the metals being discussed.

Lead is a typical example. The solubility of lead is lowest under prevailing neutral ground water pH. Therefore, virtually all lead in any wastewater would be in particulate form. As such, in the case of a discharge of wastewaters containing lead, the particles could not be transported far from the discharge source. Any small concentrations of lead that might be dissolved in wastewaters similarly could not migrate more than a few feet in unsaturated or saturated soil and would be irreversibly precipitated under prevailing ground water pHs. Due to lead’s high cation exchange capacity, dissolved lead in a hypothetical discharged wastewater would sorb to soil particles in the immediate proximity of the spill, and neither dissolved or total lead would be detectable in the analysis of a ground water sample collected a few feet away. The widespread and



pervasive presence of total metal exceedances is due to the entrainment of metal-bearing particles in the historic fill, since the preparation of an unfiltered sample will acidify and solubilize metals in the particles. The sporadic detection of lead exceedances in dissolved samples is probably due to the occasional passage of nano-scale coal/ash or other cryptocrystalline particles passing through the 40-micron filter used to prepare the samples for filtered (dissolved) analysis.

4. NJDEP Comment:

Page 66 of RIR: Since the concentrations of these compounds are not sufficiently high to generate expansive contaminant plumes, it has been concluded that these localized, soil-related exceedances are associated with either natural background conditions (e.g., aluminum, iron, manganese, arsenic), the presence of artificial fill (e.g., SVOCs and other metals) or off-Site sources (pesticides along the railroad right of way and on residential properties) that are unrelated to any of the discharges investigated during this RI. TRC's statement that the plumes are not expansive contaminant plumes and associated with background condition is counter intuitive, since background condition or regional formation impacts would be expansive by definition. The background and off site impacts to site metals have not been established. These localized metals exceedance areas are more indicative of site releases and require to be incorporated into a site CEA.

Roche Response:

As previously stated, all ground water constituents exceeding the GWQS were listed in the CEA documentation (Appendix V), which included the SVOCs, metals and pesticides.

The relationship of heavy metals (e.g., lead, thallium) to fill materials was discussed extensively in the responses to Comments No. 2 and 3, above. Their presence in ground water samples is not due to the migration of a dissolved plume, since the low solubility of metals at prevailing ground water pH would prohibit the formation of such a plume. The presence or absence of these metals in ground water samples collected at off-Site properties will depend entirely on whether those wells were installed in areas where the grade was raised using similar fill materials. Since the fill is not homogeneous it is unlikely that metal exceedances in ground water would be expansive or regional.

With respect to aluminum, iron, and manganese, these are common constituents of earth material. Clay minerals are aluminosilicates, and virtually any unfiltered ground water sample collected in native or reworked glacial till (as found on the Site¹) will show high aluminum concentrations due to their usually high clay content. The red color of the Passaic Formation rocks, and the weathered soils derived from them, is due to high percentages of iron oxides and hydroxides. Small amounts of manganese oxides and

¹ Glacial till is found above the bedrock at multiple locations throughout the Site.



hydroxides are often found in geochemical association with these iron-bearing minerals. There were no Site operations that used raw materials containing high percentages of aluminum, iron, or manganese. There is no basis in Site history, geochemistry, or ground water science to invoke Site releases as the cause of widespread concentrations of aluminum, iron, and manganese.

There were no Site operations that used raw materials containing arsenic. As previously stated, there is ample literature (including on the NJDEP's website) documenting the naturally occurring presence of arsenic in ground water derived from the Passaic Formation in the range of 1 to 30 ppb. There is no basis in Site history to invoke Site releases as the cause of widespread concentrations of arsenic, and the available literature indicates that the source of arsenic in ground water is related to the dissolution of arsenic-bearing mineral in the Passaic Formation.

NJDEP guidance does not allow the filtering of ground water samples designated for SVOC analysis. Therefore, any particulates of soil, coal residue, asphalt or other anthropogenic materials containing PAHs (or metals) that become entrained in a collected ground water sample will bias the sample results (high) for those compounds. Despite this high potential, there were only 17 exceedances of the GWQS for benzo(a)pyrene and benzo(a)anthracene out of a total of 467 samples analyzed for SVOCs in the September 2013 sampling event. These PAHs were randomly distributed in low-lying areas of the Site, where fill was used to raise the grade. Furthermore, the exceedances of NJDEP's stringent GWQS of 0.1 ppb for these PAHs were all less than 0.5 ppb. The random distribution of PAHs in ground water, and the lack of a defined concentration gradient or association of these compounds with any specific Roche process area, demonstrates that the presence of these compounds do not correlate with the former Site operations. The PAHs in question were never chemicals used in Roche processes. The fact that the sporadic PAH exceedances were only detected in Zone S1 in low-lying areas where historic fill was used in Site grading activities, is indicative that the source of these very low-level concentrations (0.13 to 0.47 ppb) are related to the presence of PAHs adsorbed onto soil, mixed with ashes or finely divided coal or asphaltic material in the fill in the immediate vicinity of the sampled monitoring well.

With the exception of two locations, all the pesticide exceedances of the GWQS are for dieldrin. Most of the dieldrin exceedances are located in a strip parallel to the NF/Norfolk Southern railroad that separates IA-10 from the rest of the Roche property, and in the residential area south of the Site. Dieldrin was used primarily as a termite treatment prior to 1980. There is no indication that Roche ever used dieldrin at the Site. The absence of widespread dieldrin exceedances in the interior of the Roche Site also supports the conclusion that dieldrin was not a pesticide used by Roche. The observed dieldrin exceedances suggest this compound was likely used by the railroad to protect the wood supports for the tracks, and by residents and exterminators to protect houses from termites.

5. NJDEP Comment:

Page 77 of RIR: On-site source of ground water contamination list Former Roche Operations: Historic Fill (SVOC, Metals, Pesticides) and Non-Roche Source: historic fill placed prior to Roche ownership and requires clarification. The areas of historic fill placement prior to Roche ownership is limited and poorly defined. However, area of documented historic fill has not been established and the site Roche Campus has historic defined operational areas and/or purchase property with undefined historic operations in expanse of the Roche Nutley/Clifton Campus.

Roche Response:

See responses to Comments No. 2, 3 and 4 above regarding historic fill material. The 1998 Preliminary Assessment Report for the Site states that there are no facility records of fill material management during Site development (i.e., fill sources, fill quantities, fill placement locations, time frames). The Roche property, purchased in 1928, was an abandoned Farm. The railroad and Valley Drain existed at that time, as boundaries of the property to the west and east. As noted in the response to Comment No. 2, based on aerial photographs, much of the fill material (and all or virtually all in some places, such as in IA-14 and IA-15) was placed on the Roche Site by third parties prior to Roche acquiring the relevant parcels.

6. NJDEP Comment:

Page 77 of RIR: The conclusion that the most significant on-Site sources (displaying the highest VOC contamination attributed to former Roche operations) were discharged in IA-9 and IA-2 are directly related to the main operational area but do not include the process waste handling and collection associated with IA-11 and IA-15 in addition to other Roche related source areas summarized in comment No. 7 below.

Roche Response:

While the GW RIR states that, “The sampling results from on-Site monitoring wells indicate that the most significant on-Site sources (displaying the highest VOC contamination attributed to former Roche operations) were discharged in IA-9 and IA-2”, other on-Site sources are identified and these include:

- Former Roche Operation: IA-6-Former Building Sump (Chlorobenzene, 1,4-Dioxane);
- Former Roche Operations: IA-10-Former Building 104 Loading Dock/Building 70 (Chlorinated VOCs);
- Former Roche Operations: Utility Corridor in IA-7, IA-3, IA-11 and IA-15



(Chlorinated VOCs);

The identified PCE impacts to ground water in IA-3 and IA-7 are in the immediate vicinity of the former alignment of the Clifton-Allwood Municipal Sewer. While Roche process lines parallel the former sewer alignment near the southwest corner of Building 115 in IA-3, recent Pre-Design Investigation (PDI) work indicates that the extent of VOC contamination aligns with the municipal sewer. Therefore, the municipal sewer is likely to be the major or only contributor in this area. In IA-7, the detected VOC impact to ground water is located on the former alignment of the municipal sewer south of Building 123. Recent PDI work confirms that the impact is narrowly confined to that alignment. There are no Roche process lines near this ground water impact, and it is now clear that the impact in IA-7 derives entirely from the former alignment of the Clifton-Allwood Municipal Sewer. The identified areas of ground water impact with PCE and other chlorinated solvents in IA-11 and IA-15 are in immediate proximity to Clifton and Nutley municipal sanitary sewer lines. Videotapes of the municipal sewers indicate the presence of numerous cracks and breaches occurring in IA-11 and IA-15, similar to the condition of the sewers further north and west (i.e., IA-12). As such, while the impacts in IA-11 and IA-15 may have received some contribution from Roche process lines and other operational activities, a significant portion of the VOC mass detected in ground water in these areas is likely attributable to releases from the municipal sewers. Recent PDI work and examination of the soil data in greater detail indicate that the impacts in IA-11 probably are mostly attributable to the municipal sewers. Additional PDI work in IA-15 is ongoing and will provide more data to assess the relative contribution of process lines (and perhaps practices of Roche's predecessor on IA-15) and the municipal sewers that transect this area.

7. NJDEP Comment:

Based on the below identified summarized individual Investigation Areas (IAs) site related source areas targeting PCE, along with the significant downward vertical flow component from Zone S1 to the deeper intervals (S2, S3) have cause the present day bedrock plume:

Roche Response:

Roche will address each of the specific soil data cited below. For each of these IAs, figures were prepared showing the cited soil data, surrounding soil data, and ground water data from the nearest monitoring wells. These figures are included in Attachment 2. A detailed discussion for each reference provided by the NJDEP is as follows:



NJDEP Comment:

IA-1/5

- *AOC 144; historic DNAPL at 60 ppm PCE concentration in 2009 B29-3 soil boring associated with a clay lenses at 3 to 3.5 feet bgs.*

Roche Response:

Numerous borings were drilled and sampled in the area of the cited soil boring and the high concentration [60 parts per million (ppm)] was not reproduced during subsequent sampling activities. During the 2013-2014 IA-1/5 RI, soil Boring S-144-10 was drilled at the same location as 2009 Boring B29-3. The sample collected from 3.0 to 3.5 feet below ground surface (bgs) contained 0.732 ppm of PCE and 0.0248 ppm of TCE. The sample collected from 5 to 5.0 feet bgs had 0.007 ppm of PCE. At least eight additional soil borings were drilled within 30 feet of Boring B29-3 (Figure 1, Inset 1); seven showed no exceedances of the most stringent PCE soil standard and the PCE concentration detected in the other boring was 0.007 ppm.

Therefore, the high PCE concentration detected in 2009 at a depth of 3 feet bgs was not reproducible or confirmed. If PCE was discharged in this area, the extensive recent soil sampling demonstrates that it was localized and limited in extent. Monitoring well MW-135 (installed in August 2011 and located approximately 7 feet from Boring B29-3) showed no PCE exceedance when sampled in October 2011, September 2013, or December 2013. The absence of high PCE concentrations in the soil (2009), and the complete absence of PCE in ground water immediately adjacent to Boring B29-3, indicates that it is an isolated area of soil contamination at 3 feet bgs that did not migrate vertically to the water table. Therefore, the soil quality in AOC 144 in no way contributed to the PCE impacts in ground water.

NJDEP Comment:

IA-1/5 (continued)

- *VOCs including benzene, cis-1,2-dichloroethylene, tetrachloroethylene and vinyl chloride were detected in boring B69-6 and B69-8 above the NJDEP's DIGWSSL and/or RDCSRS.*

Roche Response:

The soil borings cited are actually located in IA-4, just east of the IA-1/IA-4 boundary. Boring B-69-8 (Figure 1, Inset 2) actually shows no soil exceedances for these compounds, but Boring B69-7 shows exceedances for benzene and cis-1,2-dichloroethylene. The area that encompasses these soil borings was delineated with clean samples during the 2013-2014 IA-1/5 RI. The nearest Zone S1 well in a downgradient direction, well MW-2 located approximately 90 feet to the southeast, was sampled 40 times between 1989 and 2002, and showed a PCE concentration of 2.6 ppb in one event



in 1997, and showed no exceedance in the other events. Recent ground water sampling in 2013 and 2014 showed no PCE exceedance. The nearest Zone S2 well is well MW-226B to the southeast, which shows no PCE exceedance.

The lack of ground water impact in the vicinity of the cited borings demonstrates that the detections of PCE and other chlorinated ethenes in soil had no measurable adverse impact on ground water quality, and did not contribute to the delineated plumes at any depth interval.

NJDEP Comment:

IA-1/5 (continued)

- *Well PW-32 was approximately completed to 650 feet deep and produced approximately 310 gallons per minute and various spills occurred in the early 1980s. PW-32 production well data from 1990 indicate GWQC exceedance of hexane, 1,1,1-TCA chlorobenzene and benzene which historically was also detected in shallow IA-1 ground water.*

Roche Response:

The production wells captured water from areas beyond the Site. Some of the VOCs detected in historic samples (Figure 1, Inset 3) collected from the supply wells may have originated from on-Site releases, and others were likely drawn in from off-Site sources. The detection of VOCs in the supply wells is not an indication that a particular VOC was discharged on-Site.

NJDEP Comment:

IA-2

- *The high PID reading in soil boring logs 85-46 and T8-C2 and analytical results in the area of former UST #7 clearly indicated that a release has occurred at the site. The IA-2 RAWP development has informally begun at the property, with In-Well Air Stripping (IWAS) system, configuration from Accelerated Remediation Technologies, Inc. (ART).*

Roche Response:

Roche is in agreement with the NJDEP – significant releases of benzene, methylene chloride, chloroform and toluene occurred in the IA-2 tank farm. The delineation of the horizontal and vertical extent of these impacts was initiated in the IA-2 RI and has been advanced through two phases of PDI work. The horizontal and vertical extent of these impacts will be refined in the IA-2 PDI Report that will be included in the Annual Ground Water Progress Report scheduled for submittal to the NJDEP in the Fall of 2014. Please note that NJDEP's reference to the IWAS system as being part of the Remedial Action Work Plan (RAWP) implementation for IA-2 is incorrect. The IWAS in IA-2 was



conducted as a pilot test for a potential Interim Remedial Measures (IRM). While the IWAS pilot test indicated the technology was effective, Roche may select another technology for the IRM for IA-2. All of this work is part of an IRM for IA-2 ground water, and is not the final RAWP for ground water.

NJDEP Comment:

IA-2 (continued)

- *Contaminants detected in ground water associated with Building No. 30 (AOC 145) A detailed discussion of the contaminants detected in ground water was to be included in the Ground Water RIR. This potential source area remains.*

Roche Response:

The data demonstrate that ground water in the immediate vicinity of Building 30 is minimally impacted; the significant impacts are in the former tank farm in IA-2, as described in the previous paragraph. As per the Remediation Road Map Matrix (May 2014) and the IA-2 RIR (July 2013), Building 30 (AOC 145) is not a contributing source of ground water contamination and warrants no further action (NFA). While IA-specific Remedial Investigation Reports (e.g., IA-2 RIR) focused on reporting soil contamination and potential impacts to ground water on an AOC-specific basis, the Site-Wide GW RIR (April 2014), addressed ground water contamination on a Site-wide basis and provided a short summary on AOC-related impacts (to soil and ground water) in a table included as Appendix Q.

NJDEP Comment:

IA-3

- *Elevated PCE concentrations with results of 0.19, 0.34, 0.22, and 0.32 ppm have been identified during 2003 at depth in the saturate zone soil samples (from 15 to 18 feet below ground surface [bgs]) at locations G-42, G-43, G-45 and G-66, respectively. These saturated zone PCE concentrations represent source material that may have been released from Roche process sewer manhole MHP IVP-31.*

Roche Response:

The NJDEP characterizes PCE concentrations in soil that are less than 1 ppm as “elevated”, but these do not constitute “source material” that would definitively generate a PCE plume in ground water. Monitoring well MW-81 (Figure 2, Inset 1 and Graph), located about 20 feet from Boring G-43, was sampled more than 45 times from 1996 through 2013. PCE was detected once in 1998 at a concentration of 4.6 ppb, and subsequently, was never detected above the GWQS of 1 ppb in any other event. The absence of PCE in well MW-81 is evidence that the PCE detections in soil cited above, all less than 1 ppm, did not contribute to the ground water impacts detected in any zone. Moreover, elsewhere in their comments, the NJDEP refers to VOC concentrations in soil



in the range of 1 to 5 ppm as indicative of “source material” that would account for the PCE plumes of 100s of ppb in ground water. In TRC’s experience, chlorinated solvent plumes with concentrations in the range of 100s to 1,000s of ppb are usually associated with source material in soil with chlorinated VOC concentrations in the 10s and 100s of ppm. The general absence of chlorinated VOC concentrations in soil in excess of 10 ppm across the Site is indicative of the relatively minor contribution to ground water quality from the on-Site AOCs.

NJDEP Comment:

IA-3 (continued)

- *The recent 2013 resample of the saturated zone G-49 and G-50 “soil samples”, indicate that PCE remains during the January 2013 sampling.*

Roche Response:

The recent re-sampling at Boring G-49 detected PCE at a concentration of 0.006 ppm, barely above the NJDEP’s Default Impact to Ground Water Soil Screening Level (DIGWSSL) for PCE, and far too low to represent a source of ground water contamination.

NJDEP Comment:

IA-3 (continued)

- *Recent zone 1 ground water analytical results for April and May 2013, which reports for IA-3 a maximum PCE concentration in ground water of 24.1 ppb (location MW-187) has reduced from a historic 10 year earlier April 17, 2003 reading of 190 ppb at location G-61.*

Roche Response:

Monitoring well MW-187 (Figure 2, Inset 1) is located 15 feet west of the Clifton-Allwood Municipal Sewer. The historical detection of 190 ppb and current detection of less than 100 ppb of PCE are most likely related to historical releases from the sewer, for which there is incontrovertible evidence north and south of this location. The detection of 0.16 ppm of PCE in a soil sample at Boring G-6 could not be the cause of 190 ppb of PCE in well MW-187, 65 feet away.

NJDEP Comment:

IA-3 (continued)

- *RIR reports that the IA-8 sub areas (D, F and G) reportedly consist of both lined and unlined active storm sewers and process sewers and former and existing utility trenches that were used for subgrade chemical transfer.*



Roche Response:

There are numerous Roche storm and process sewers that transect the property. The Zone S1 VOC map (Figure 23 in the GW RIR) indicates where persistent plumes of chlorinated solvents occur on the Site; it is this map (depicting the uppermost ground water quality) that would be indicative of the sources of that contamination. There were numerous process lines in the eastern part of IA-3, and other portions of the facility, but the only locations where chlorinated VOC contamination is prevalent, in IA-12, IA-3, IA-7 and IA-11, is where the process lines are co-located with the current or former alignment of the Clifton-Allwood Municipal Sewer.

NJDEP Comment:

IA-3 (continued)

- *Lining, sealing, abandonment or removal of the Roche Process Sewer lines within IA-3.*

Roche Response:

See response to previous comment (Bullet # 4) regarding the general lack of correlation between ground water contaminant plume(s) and the location of Roche process lines in IA-3.

NJDEP Comment:

IA-3 (continued)

- *Wastewater from the Building Nos. 59 and 68 reportedly contained several solvents that were discharged to a chemical resistant glass sewer system that penetrated the foundation at various locations and the building was decommissioned in 1998, over 15 years ago.*

Roche Response:

There is no significant ground water contamination in the vicinity of these buildings.

NJDEP Comment:

IA-3 (continued)

- *Records reviewed during the soil removal of contaminated soil in 1999 that the excavation of all the soil underlying the lower tier of Building 68 resulted in the removal of over 8,000 tons of contaminated soil and 750 tons of rock from AOCs 1 and 169. The primary contaminants detected in the soil from this bedrock depression area of AOCs 1 and 169 were volatile compound (VOC) and semi-VOC tentatively identified compounds (TICs).*

Roche Response:

In the IA-3 excavation area, the target VOC was methylene chloride (Figure 2, Inset 2, AOC 57). In all the soil samples collected, there were no detections of PCE above the DIGWSSL and one, very low detection of TCE. Therefore, this area was not a source of PCE or TCE to ground water. The cleanup was very effective, since the ground water in IA-3 now shows no methylene chloride exceedances.

NJDEP Comment:

IA-4

- *PCE DNAPL concentrations in both soil and groundwater in overburden just south of IA-4 Building No. 42.*

Roche Response:

It is unclear what sample the NJDEP is referring to with the term “PCE DNAPL”. In searching the database, only one soil sample was identified that displayed VOC concentrations over 1 ppm. This sample was collected from 5.5 to 6 feet bgs at Boring 142-54 (Attachment 2, Figure 3 - Inset 1). This sample displayed detections of toluene (1,190 ppm), chloroform (661 ppm), methylene chloride (23 ppm), PCE (6 ppm) and chlorobenzene (2 ppm). The PCE concentration is three to four orders of magnitude lower than what the U.S. Environmental Protection Agency (USEPA) would consider an indication of DNAPL-impacted soil [USEPA, 1994. DNAPL Site Characterization. OSWER Publication 9355.4-16FS].

Moreover, this boring is surrounded by samples that displayed no VOC exceedances. A monitoring well located 5 feet to the southeast, MW-177, has shown no exceedances of any VOC except benzene, indicating that the chlorinated VOCs in the isolated impacted soil (found in one boring at 6 feet bgs) have had no impact on ground water quality, and in no way contributed to the PCE contamination found in ground water elsewhere on the Site. Monitoring well MW-177 is one of several wells in a portion of IA-4 and IA-1 where the shallow ground water has been found to be impacted with benzene. This benzene impact is being further delineated as part of an ongoing PDI.

The PCE concentrations in ground water and soil referenced by the NJDEP are addressed in the discussion on IA-9, as there are borings and wells south of the IA-4 boundary (Attachment 2, Figure 3 - Inset 2) that show there are no impacts above the DIGWSSL and GWQS for soil and ground water, respectively, in the area of Former Building 42.

NJDEP Comment:

IA-4 (continued)

- *Historic potential site related releases from movement of waste solvent (Building No. 43 incinerator) prior to the mid-1980s operations related to Building No. 44 and waste solvent burning as fuel.*

Roche Response:

There is no shallow ground water contamination in the vicinity of Building 43. The shallow ground water in the vicinity of Building 44 is impacted with benzene and less than 4 ppb of vinyl chloride. The benzene is attributable to a heating oil spill (documented in the IA-4 RIR).

NJDEP Comment:

IA-4 (continued)

- *AOC 142; PCE concentration detected at 5.56 ppm at boring 142-54 at 5.5 to 6.0 feet bgs.*

Roche Response:

As stated above (response to Bullet #1), it is unclear what sample the NJDEP is referring to. A database search of the soil samples collected within and in close proximity to AOC 142 did not produce a sample with elevated PCE concentrations at Boring 142-54. Only one soil sample collected from 5.5 to 6 feet bgs at Boring 142-54 displayed a PCE concentration of 0.895 ppm (Attachment 2, Figure 3 - Inset 1).

Due to the absence of VOC contamination in surrounding soil samples and non-detect PCE levels in downgradient monitoring well MW-177, it can be concluded that the soils in AOC 142 did not contribute to the PCE contamination found in ground water in the immediate area of former Building 44 or other Site areas.

NJDEP Comment:

IA-4 (continued)

- *Building No. 39 sump and oil water separator.*

Roche Response:

We are unclear about the nature of this comment. These sumps were addressed in the IA-4 RIR (Section 1.1 Response to NJDEP January 31, 2014 Final Comments, page 2,



comment 9 and in Section 5.2, page 56). Figure 3 (Inset 2) provided under Attachment 2 shows the Building 39 sumps/oil water separator.

NJDEP Comment:

IA-6 (primarily metals and PAHs)

- *The difference between metal unfiltered (total) and filtered ground water results do not appear that large; however, a site CEA for the site related list of metals needs to be proposed. Based on deeper bedrock and surrounding up-gradient and regional metal concentrations the reported list of metals are not background or natural.*

Roche Response:

Please see the responses to Comments No. 2, 3, and 4, regarding metals in ground water.

NJDEP Comment:

IA-6 (continued)

- *The 2004 IRM for Building 86 foundation drain captures around 8 gallons per minute (gpm) and needed to be supplemented with a capture system of shallow bedrock and basement recovery wells RW-51 and RW-96.*

Roche Response:

The IRM system in IA-6 is currently under evaluation, and a PDI (currently in progress) is gathering additional data regarding the lateral and vertical extent of chlorobenzene and 1,4-dioxane in ground water. The results of this PDI will be used to select and design an IRM to address these compounds.

NJDEP Comment:

IA-6 (continued)

- *4,000 tons of PAH-impacted soils that were removed from AOCs 132, 152, 155 and 157 for off-site disposal in 2007.*

Roche Response:

Please see the responses to Comments No. 2, 3, and 4, regarding PAHs in ground water.

NJDEP Comment:

IA-7

- *The 6/5/13 sample from the sump contained PCE and TCE concentration groundwater sample results at 25 ppb and 5.1 ppb, respectively, appear to be associated with the shallow bedrock zone 1 plume. The reported sump pump operates at 20 to 40 gpm (reported during the DEP pre IA-7 submittal meeting).*

Roche Response:

The sump in the small building east of former Building 85 removed ground water from surrounding areas; this ground water likely contained PCE and TCE from the identified impact to the north, along the former alignment of the Clifton-Allwood Municipal Sewer west of former Building 85 (monitoring wells MW-192 and MW-193) or from the recently identified release that caused the plume along the former alignment of the Clifton-Allwood Municipal Sewer (southeast of the sump). The pump in the sump had a capacity to pump 20 to 40 gallons per minute (gpm), but it did not operate continuously. Sump pumps typically operate intermittently, and during dry periods may not pump any water for many days.

NJDEP Comment:

IA-7 (continued)

- *The BEHP, antimony, arsenic, beryllium, cadmium, chromium, cobalt, lead, nickel, and sodium exceedance to be addressed as part of the Site-Wide Ground Water RI has not been appropriately addressed.*

Roche Response:

The BEHP detected in ground water is believed to be a sampling/laboratory artifact. It is not truly present in the ground water at the Site. The metals in ground water are addressed in the response to Comments Nos. 2, 3, and 4.

NJDEP Comment:

IA-7 (continued)

- *It is important to note that all of IA-7 consists of reworked material following various historic removals of UST systems, process and sanitary drain lines, former buildings and various site operations with limited documentation of site conditions during each historic event.*

Roche Response:

It is unclear what the NJDEP is asking for in the comment about the reworking of soil/fill material in IA-7. IA-7 and other portions of the facility have been reworked. Part of that reworking was the work performed decades ago by others to install replacement pipes for the Valley Drain and the Clifton-Allwood Municipal Sewer. While conditions may have not been documented during these reworking events, the current extensive soil and ground water database provides a thorough understanding of any ground water impacts that might have resulted from past practices.

NJDEP Comment:

IA-7 (continued)

- *AOC 62: Two containment trenches were located in this area. It appears that the northern containment trench drain was tied into the nearby process waste sewer and the southern containment trench drain was tied into the storm sewer.*

Roche Response:

We do not disagree that the trench drain may have been connected to the storm sewer. Neither the drain or storm sewer have had any impact on ground water quality, as evidenced by the lack of any VOC exceedances in nearby monitoring well MW-36, or in downstream and downgradient monitoring wells MW-42 and MW-19A.

NJDEP Comment:

IA-9

- *A historic discharge from the AOC 40 area has resulted in DNAPL/product levels of PCE in both soil and ground water. This historic release of PCE would have been captured along the open high permeability fractured zones within the bedrock aquifer during historic process wells PW-20, PW-33, and PW-37 withdrawal on the western portion of the site.*
- *Based on the discussed trench and on-site process sewer system upgrade in 1990 at the dumpster storage and hazardous waste disposal area, discharges occurred at the surface into the containment trench and process sewer network.*
- *Since most of the Roche related historic spills, surface releases and subsurface process waste line breaks have been documented to occur prior to 1990 (process line re-lining) and based on the known properties of PCE release to the environment, PCE would move / migrated as a DNAPL or repeated release over time, and would reach the water table within a period of a few weeks following each release.*
- *It is important to note that the IA-8 2001 and 2005 process pipe investigation occurred 8 to 13 years after the 1990 upgrade/relining and the recent 2013 RIR sampling investigation occurred 23 years after the 1990 upgrade.*

- *The soil staining and analytical results in soil are indicative of DNAPL/product. Cross sections have not been prepared through AOC 49 hazardous waste storage area (north of Building 73) and the cross section that were presented in the IA-9 RIR do not reflect the precise details which are shown on the soil logs or the high percentage of natural clay weathered parent bedrock material or historic residue PCE adsorption/absorption via clay particles.*
- *The key issue in referencing SB-49 soil results is the high PCE soil concentrations (7,630 and 1,640 ppm) which reflect DNAPL/product that was historically released at the site.*
- *The resampling of the February 2, 2013 sample F-87/6-6.5 on November 6, 2013 (sample F-87A) indicated a PCE increase from the initial concentrations of 0.2 ppm to 22 ppm and confirms the variability of the residue DNAPL/product and soil type.*
- *Monitoring well MW-170 has identified various chlorinated volatile organics (C-VOC) above their respective 1% solubility limits. The May 25, 2013 and December 11, 2013, ground water sample results from well MW-170 identified PCE concentrations of 54,300 ug/L and 7,400 ug/L, respectively. Well MW-152 indicates a PCE concentration of 1,640 ug/L, which is also over the 1% solubility value for PCE (1,500 ug/L).*
- *AOC 49; based on the DNAPL/product residue that is presently confined to the 5 to 11 feet below grade corresponds with a distinct native soil clay horizon. In addition, the PCE was historically discharged (pre-1990) at the site over a sufficient period of time for adsorption/absorption on to the natural weathered clay particles.*

Roche Response:

The potential DNAPL transport mechanism that is expressed above is not supported by actual Site data.

Soil borings and monitoring wells installed in a pipe trench on the north side of Building 73 in IA-9 show that PCE was released in the form of DNAPL into the backfill in that trench. The highest PCE concentration detected in the trench backfill was about 8,000 ppm. USEPA documents have identified soil concentration of 1% of total mass – 10,000 ppm – as indicative of DNAPL in soil [USEPA, 1994. DNAPL Site Characterization. OSWER Publication 9355.4-16FS]. The NJDEP has hypothesized that this DNAPL migrated out of the trench and accounts for a considerable portion of the VOC mass that has been found in the ground water of the deep bedrock (Zones D1 and D2), east of First Avenue. This DNAPL migration scenario is not possible in light of the actual data and evidence. This evidence includes:

- a) The evidence of DNAPL was found in the trench backfill from depths of approximately 7 to 13 feet bgs. The large number of samples showing less than 1 ppm of PCE in soil between 13 feet bgs and the bottom of the trench at about 17 feet is evidence that the



DNAPL was retained in the trench backfill and never penetrated to the bottom of the trench, and therefore never entered the bedrock. A cross-section through the trench, showing the concentrations of chlorinated ethenes (predominantly PCE), is provided as Figure 4 of Attachment 2. The downward migration of PCE DNAPL was probably impeded by the presence of a 3-foot thick clay layer found in the trench between 12 and 15 feet bgs. As can be seen on Figure 4, no VOC exceedances (even of the DIGWSSLs) were detected in any soil sample collected below a depth of 15 feet bgs. The lack of vertical penetration in the IA-9 pipeway, and the likely role of the clay layer between 12 and 15 feet bgs in impeding that migration, is in stark contrast to the situation under the municipal sanitary sewer in IA-12. In IA-12, the Clifton-Allwood Municipal Sewer was installed directly on top of the bedrock surface at a depth of about 13 feet bgs. When PCE DNAPL migrated out of collapsed sections of the municipal sewer in IA-12, the DNAPL came into immediate contact with fractured bedrock, and migrated vertically through fractures to a depth of at least 41 feet bgs, as directly observed in recent PDI work.

- b) The presence of DNAPL in the trench backfill did not have an impact on the adjacent bedrock ground water quality. Monitoring wells installed in Zone S1 adjacent to, but outside of, the trench showed very low or no VOCs. A map showing VOCs in Zone S1 in the vicinity of the trench is shown in Figure 5A (Attachment 2). As shown on the cross-section and this Zone S1 map, no VOCs were detected in monitoring well MW-262A, a well drilled into the upper bedrock (still in Zone S1) directly below the most impacted area within the trench backfill, and disproving any hypothetical vertical migration.
- c) The presence of DNAPL in the trench backfill did not have an impact on the underlying bedrock ground water quality. To confirm this interpretation, in the past 2 months Roche installed a number of monitoring wells into Zone S2, approximately 30 to 50 feet bgs, on the north and south sides of the piping trench, and along the eastern margin of former Building 73. These wells were sampled during the June 2014 quarterly sampling event. The data will be presented to the NJDEP in the Annual Ground Water Progress Report. A map showing the VOC concentrations in these wells is provided as Figure 5B (Attachment 2). The chlorinated ethenes detected in the wells immediately adjacent to the impacted areas in the trench were all below 7 ppb, as compared to approximately 110,000 ppb inside the trench, indicating only a very low concentration VOC plume has diffused from the pipe trench into the underlying bedrock. The absence of elevated concentrations of dissolved PCE in these wells is clear evidence that DNAPL did not migrate beyond the base or sides of the trench, and additionally, virtually no dissolved contamination exited the trench.
- d) The absence of significant PCE (and breakdown products) in Zone S1 and S2 wells in close proximity to the pipe trench is evidence that the IA-9 pipeway release did not result in the migration of high VOC concentrations to the deep bedrock. Nowhere on the Site has a high VOC plume separated from the source and migrated a considerable lateral or vertical distance without a continuous trail of higher VOC concentrations behind it.

This data set clearly demonstrates that the PCE released within the pipeway backfill never migrated out of the bottom of the trench nor diffused into the rock matrix adjacent to the trench. If that hypothetical migration had ever occurred, high VOC concentrations would remain to this day in the adjacent and underlying bedrock. Roche has installed such a concentrated monitoring well network in this area into both Zones S1 and S2 that if any migration of high VOC concentrations had occurred, those high concentrations would have been detected in several of those wells, but no total chlorinated ethane concentration above 10 ppb has been detected in any of the wells immediately adjacent to and below the DNAPL in the trench.

- e) The NJDEP claims that the pumpage of production wells drew down contamination from IA-9 and contributed to the VOC plumes that have been delineated east of First Avenue in deep Zones D1 and D2, from about 80 to 250 feet bgs. The large dataset compiled during the RI indicates that the pumpage of supply wells PW-20 and PW-37 east of First Avenue did not draw VOCs from the shallow zones into Zones D1 and D2. For example, more than 2,000 ppb of toluene was detected in a pipe trench on the east side of Building 73, which is closer to PW-20 and PW-37 than the DNAPL-containing pipe trench on the north side of Building 73. However, no toluene exceedances (which is more than 10 times more soluble than PCE) has been detected in any Zone D1 or D2 well east of First Avenue. Further, exceedingly high concentrations of chloroform (up to 1,400,000 ppb), benzene (up to 61,400 ppb) and methylene chloride (up to 47,000 ppb) have been detected in Zone S1 and Zone S2 ground water in the former tank farm in IA-2. By contrast, no exceedances of these three compounds have been detected in Zone D1 or Zone D2 wells east of First Avenue. There is no known mechanism by which the pumping of these production wells would have selectively drawn PCE downward and not induced the migration of toluene, chloroform, benzene, and methylene chloride, all of which are more soluble than PCE.

In summary, all the data clearly indicate that the DNAPL identified in the pipe trench on the north side of Building 73 never migrated out of the trench, either laterally or vertically. Furthermore, it did not result in the generation of dissolved plume that migrated into the underlying bedrock, even in the immediate vicinity of the trench. Therefore, this isolated, contained DNAPL occurrence has not contributed at all to the chlorinated VOC plumes delineated in Zones S1 and S2, and certainly not to the plumes in deeper zones.

NJDEP Comment:

IA-10

- *The historic fill distribution and impacts from site operations, Clifton City Dump [former City of Clifton Municipal Dump] distribution, and coal waste across the site have documented impacts.*

Roche Response:

The former dump (operated by others prior to Roche's acquisition of the parcels), located in the northern part of IA-10 (Figure 6) has been extensively investigated. Several constituents of concern (COCs) have been detected at the dump, including metals, SVOCs and PCBs. However, the VOC compounds detected in soil in the dump include toluene and xylenes - no chlorinated VOC compounds were detected in soil at concentrations exceeding the soil cleanup criteria. Furthermore, the monitoring wells installed in close proximity to the dump have consistently shown PCE concentrations less than 10 ppb. It is evident that the dump is not a source of chlorinated VOCs to ground water.

NJDEP Comment:

IA-10 (continued)

- *AOC 22, likely associated with historic chlorinated solvent releases at the site and/or adjacent properties.*

Roche Response:

AOC 22 did not have any impact on ground water quality. Monitoring well 22RI-MW-1 showed no VOC exceedance.

NJDEP Comment:

IA-10 (continued)

- *AOC 53, Past releases of limited quantities (each less than 55 gallons) of ethylene glycol, monomethyl ether, PCE, hydrochloric acid (HCl) and methylene chloride occurred between 1981 and 1991.*

Roche Response:

Of the compounds listed above, only PCE was detected in monitoring wells near Building 106 (AOC 53), at concentrations slightly above the GWQS. Ground water sampling results from two sampling events conducted in this area do not indicate the contamination is attributable to the former raw materials storage area. Ground water in AOC 53 is impacted with VOCs that are associated with the Deluxe property to the west, and not related to the former raw materials storage area comprising AOC 53. The PCE plume migrating in shallow ground water from Deluxe onto the western portion of IA-10, including the area of Building 106, was discussed in Section 4.4.8.8 of the GW RIR.

NJDEP Comment:

IA-10 (continued)

- *AOC 66 –Former City of Clifton Dumping Area, VOC and SVOC concentrations identified in the test pits are consistent with landfill material.*

Roche Response:

See response to above NJDEP (Bullet # 1) comment, regarding VOC impacts to ground water. There are no significant SVOC exceedances in ground water in this area (see Figure 30, GW RIR).

NJDEP Comment:

IA-10 (continued)

- *AOC 186: Former Building 104, PCE, TCE, and/or vinyl chloride was also detected in the soil, specifically, these soil samples are identified as B104-24-1 (i.e., 1' below ground surface), B104-36-1.5, B104-23-6, B104-39-10, B104-28-7 and B104-26-9.5.*

Roche Response:

The NJDEP is correct that chlorinated VOCs were released in the vicinity of former Building 104. The impact to ground water quality from these releases has been thoroughly delineated by the RI and subsequent PDI work. The lateral extent of this impact is confined to the footprint of former Building 104 and a small area to the east. The impact diminishes quickly with depth: the highest Zone S1 total chlorinated ethenes concentration (of approximately 287 ppb) is significantly reduced to 14 ppb of total chlorinated VOCs in a recently-installed Zone S2 well (completed after the April 2014 GW RIR submittal), and only 6 ppb of total chlorinated VOCs in a Zone S3 well (at the same location).

For example, Building 106 did not contribute chlorinated VOCs to ground water. The PCE impacts in this area clearly migrated from the high PCE plume on the adjacent Deluxe property, through both ground water migration and transported via the stormwater system that drains water from the Building 106 area to the east. The extent to which PCE impacts from Deluxe have migrated eastward through IA-10, contributed to the impacts in the vicinity of former Building 104, and the area north of Building 70, is still under investigation as part of the ongoing IA-10 PDI and other delineation work.

NJDEP Comment:

IA-10 (continued)

- *The maximum concentrations in soil for PCE and TCE in IA-10 have been reported at 3.71 ppm and 1.42 ppm, respectively.*

Roche Response:

These concentrations are not considered a source that would account for plumes in the 10s and 100s of ppb.

NJDEP Comment:

IA-10 (continued)

- *Due to the historic operations, shallow depth of ground water and site wide soil excavation and reworking the lack of a residue source in the soil is not the deciding factor whether the dry well and solvent drain has impacted the surrounding ground water.*

Roche Response:

We are not clear on what the NJDEP is requesting in this comment.

NJDEP Comment:

IA-10 (continued)

- *Unknown UST together with the undocumented historic site operation or material handling / storage are one of many unknown potential sources across the site that may have contributed to site related impacts.*

Roche Response:

We are not sure about the location of the “unknown UST” in IA-10 to which the NJDEP is referring. NJDEP, please clarify.

NJDEP Comment:

IA-10 (continued)

- *The 2013 resampling of the 2004 collected VOC contaminated soil samples in Area J, which represent nine year duration, indicates that the Area J original source area(s). However, the VOCs (PCE and TCE) have been documented as historic releases.*

Roche Response:

Based on the results of the soil sampling conducted to assess previous exceedances in the IA-8 Area J subgrade piping SI borings, no contamination attributable to the piping has been identified. The lead and PAH exceedances detected in soil along the northern side of Building 103 are likely attributable to the former landfill (AOC 66). The previous PCE and benzo(a)pyrene exceedances in 2004 SI Boring J-121 from 4 to 4.5 bgs were not duplicated during the recent RI (see Figures 11, 12, and 17A of the IA-10 RIR). Ground water sampled from monitoring well 176RI-MW-1 was reported with total SVOCs of 2,810.8 ppb in the area of the soil re-sampling.

NJDEP Comment:

IA-11

- *PCE was detected above the RDCSRS and DIGWSSL (L-35, L-35-2, PSSB-03, PSSB-04), along with one exceedance of benzo(a)pyrene (L-142) requires full RI discussion as potential source area as a result of the 30-inch Process Sewer line.*

Roche Response:

In the area of the soil samples cited above, there is a concentration of wastewater pipelines, some of which are Roche process lines and some are current and former municipal sewers. All of the soil samples cited by the NJDEP were collected deeper than 11 feet bgs (Figure 7, Inset 1). The identified areas of ground water impact with PCE and other chlorinated solvents in IA-11 and IA-15 are in immediate proximity to Clifton and Nutley municipal sewer lines. Videotapes of the municipal sewers indicate the presence of numerous cracks and breaches occurring in IA-11 and IA-15, similar to the condition of the sewers further north and west (i.e., IA-12). As such, while the impacts in IA-11 and IA-15 may have received some contribution from Roche process lines and other operational activities, a significant portion of the VOC mass detected in ground water in these areas is likely attributable to releases from the municipal sewers. Recent PDI work and examination of the soil data in greater detail indicate that the impacts in IA-11 probably are mostly attributable to the municipal sewers. The PDI work in IA-11 will completely delineate the extent of soil and ground water impacts, and remediation of the chlorinated VOCs in ground water is underway, regardless of the source.

NJDEP Comment:

IA-11 (continued)

- *The area of the 30-inch Process Drain leak as defined by samples PSSB-03, L-35, L-35-2, and PSSB-04 should be shown between cross section sample locations L903-8 and L903-10, which depicts the shallow depth to top of weathered bedrock and a PCE concentration of 11.7 mg/kg at ten feet, bg (equal to or below the water table) in 2003.*

Roche Response:

Roche has evaluated these borings and samples and is not clear on what the NJDEP is requesting. Roche looks forward to getting clarification in our next working session with the NJDEP case team.

NJDEP Comment:

IA-11 (continued)

- 1.54 mg/kg of PCE at sample L-28-14 adjacent to MHP-pr-1.

Roche Response:

This concentration is not considered a source that would account for plumes in the 10s and 100s of ppb.

NJDEP Comment:

IA-11 (continued)

- *The general area of samples L-28, L-35, L-35-2, PSSB-03, PSSB-04 and 903-21, have defined CVOC releases and due to contaminant concentrations, DNAPL may have been present and not fully delineated vertically prior to the beginning of the 2006 through 2013 IRMs.*

Roche Response:

None of the referenced soil samples indicate the possible presence of DNAPL in soil. The USEPA has indicated that concentrations of DNAPL chemicals in soil greater than one percent by mass or 10,000 mg/kg may indicate the presence of DNAPL [USEPA, 1994. DNAPL Site Characterization. OSWER Publication 9355.4-16FS]. The highest PCE concentration is about 11 ppm, which is three orders of magnitude below the USEPA's guidance concentration of 10,000 ppm.

NJDEP Comment:

IA-11 (continued)

- *Roche's production wastes largely consisted of wastewater, spent solvents, non-hazardous solid wastes and catalysts. Wastewaters were discharged through a combined sanitary and process waste sewer system to the municipal sanitary sewers. Documentation identifies that wastewater from Building 47 was discharged to the city sewer system until Roche's pretreatment facility was brought online in 1982.*

Roche Response:

The NJDEP is correct. Roche's wastewater was discharged to the PVSC system at Building 47 prior to 1980. As stated earlier in the response to comments on IA-3 above, PCE impacts to ground water have only been seen where Roche's process lines are co-located with the municipal sewer. In addition, PCE impacts have been identified in portions of the former alignment of the sewer where no Roche process lines are present.

NJDEP Comment:

IA-11 (continued)

- *AOC 59; Hazardous Waste/Raw Materials storage area; due to PCE impact to groundwater RIR states that the shallow ground water investigation for AOC 59 and existing well MW-138 would be addressed in the GW RIR.*

Roche Response:

With respect to AOC 59 (Figure 7, Inset 2), monitoring well MW-138 has shown no PCE exceedance. The storage area has had no impact on ground water quality.

NJDEP Comment:

IA-11 (continued)

- *The process line southwest of building No. 47 labeled as abandoned has not been investigated however, numerous treatment event has occurred and TRC stated that following additional 2013 IA-11 bioremediation treatment the area will be included in future sampling.*

Roche Response:

There are two abandoned process lines in this area – one southwest of Building 47, and another east and southeast of the same building. Both of these lines were investigated as part of the IA-11 Soil PDI. The results will be provided to the NJDEP in the Soil RAWP for IA-11. There were no exceedances of any NJDEP soil criteria for VOCs in any of the soil samples collected.

NJDEP Comment:

IA-12

- *PCE concentration of 3.12 ppm at sample MHS-1-15-13.5 at the removed 3 foot connection along the Clifton Sanitary Line.*



Roche Response:

The PCE concentration cited by the NJDEP (3.12 ppm of PCE at sample MHS-1-15-13.5) is associated with the release from the Clifton-Allwood Municipal Sewer (Figure 8 of Attachment 2), not the Valley Drain. Roche does not view this low PCE concentration of 3.12 ppm PCE in a soil sample collected directly under the sewer as the source of the high PCE concentrations in ground water. The cause of the very high ground water PCE concentrations is the DNAPL that migrated out of the sewer and into the fractures, penetrating to a depth of at least 41 feet bgs. The Clifton-Allwood Municipal Sewer is the only PCE source in IA-12; there is no identified source of PCE associated with Roche practices in IA-12.

NJDEP Comment:

IA-12 (continued)

- *PCE DNAPL identified in well MW-60E at 22 feet depth.*

Roche Response:

The evidence of DNAPL in ground water samples collected from well MW-60 and other wells installed in the central portion of IA-12 is clearly associated with the DNAPL directly observed in angle borings drilled under the municipal sewer. As stated above, the Clifton-Allwood Municipal Sewer is the only PCE source in IA-12; there is no identified source of PCE associated with Roche practices in IA-12.

NJDEP Comment:

IA-12 (continued)

- *PCE and TCE above the December 2013 DIGWSSLs detected in samples VD-SB-1, VD-SB-2 and VD-SB-3 at or near the water table, collected in May 2005 and removed during the fall of 2006.*

Roche Response:

Note Roche's Response to NJDEP Comment from IA-12 RIR (April 30 2014):

NJDEP Comment:

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Low concentrations of PCE and TCE (but above the December 2013 DIGWSSLs) were detected in samples VD-SB-1, VD-SB-2 and VD-SB-3, collected in 2005. The delineation samples were not collected as proposed because "these locations had previously been excavated when the Valley Drain was culverted south of IA-12." The sample depths and the discussion of the excavation (including timeframe, purpose and depth) must be provided to better explain why this area around the Valley Drain and Roche storm

sewers should not be considered to be a source of the VOC contamination in ground water.

Roche Response:

During the fall of 2006 a substantial reconstruction of the bottom and easterly wall of the culvert was performed. This included demolishing the existing culvert, re-forming and pouring concrete to create the current Concrete Valley Drain Culvert. The areas north, south and east of the culvert were excavated as part of this project, however based on existing information, precise depths and extents were not available. An evaluation of the data associated with this area, including data from the March 2014 ground water sampling event, indicates that there is no VOC contamination in shallow ground water. The low levels of PCE and TCE previously detected in samples VD-SB-1, VD-SB-2 and VD-SB-3 are not the source of the significantly elevated concentrations of VOCs in ground water. As discussed in the April 2, 2014 Site-Wide Ground Water Remedial Investigation Report, the source of the VOC contamination in ground water is the confirmed leakage of PCE previously discharged through the Clifton Sanitary Sewer as evidenced by the detection of DNAPL directly below the sanitary sewer line. Furthermore, the sample depths for VD-SB-1, VD-SB-2 and VD-SB-3 were 7.0 to 7.5, 8.5 to 9.0 and 6.0 to 6.5 feet below ground surface, respectively. All three samples are situated at or near the water table and do not need to be compared to the DIGWSSL. Therefore, no further investigation is necessary with respect to former samples VD-SB-1, VD-SB-2 and VD-SB-3.

NJDEP Comment:

IA-12 (continued)

- *Stone Yard; one soil sample (designated SYSF-N). Specifically, 1,1,1-trichloroethane (0.78 ppm), PCE (0.169 ppm), lead (126 ppm) and arsenic (19.8 ppm), were detected at concentrations above their respective Default Impact to Ground Water Soil Screening Levels (DIGWSSLs).*

Roche Response:

The 1,1,1-TCA concentration in one sample collected in the Stone Yard is the only 1,1,1-TCA concentration detected in all of IA-12. The fact that this low soil concentration (less than 1 ppm) is the only detection in the hundreds of soil borings sampled in IA-12 is evidence of the lack of Roche contribution to the 1,1,1-TCA (and its breakdown products) contamination in deeper ground water under IA-12 and IA-10. The Zone S1 ground water in the Stone Yard shows no VOC exceedances, which is additional evidence that the 1,1,1-TCA and other compounds found in deeper ground water in this area of IA-12 are migrating onto the property from the northwest. The Annual Ground Water Progress Report will provide a detailed discussion of evidence of the impacts migrating onto the Roche property from the west, northwest, and north.



NJDEP Comment:

IA-15

- *TRC statement that all PCE sample results are below the IA-specific IGWSRS developed for PCE of 3.16 ppm appears to be faulty as high concentrations within the saturated zone at other parts of the site indicate impact and site releases. Based on potential offsite impact to the Valley Drain in IA-12 (PCE at 3.12 ppm), the reported PCE concentration of 3.16 ppm in IA-15 soil sample SB-A15-57-1.5 indicates source material.*

Roche Response:

Roche has not cited the detection of 3.12 ppm in a soil sample collected directly under the collapsed municipal sewer in IA-12 as a “source” of ground water contamination. We have only cited this sample as the only detection of PCE-impacted soil above the water table in IA-12. The source of the very high (in excess of 10,000 ppb) PCE and breakdown products in the shallow ground water in IA-12 is the DNAPL which has been identified below the water table, directly under the collapsed section of the municipal sewer. Roche and TRC do not view 3 ppm of PCE in soil as a “source” that would create a ground water plume with 100s of ppb of PCE.

NJDEP Comment:

IA-15 (continued)

- *Potential source areas as shown at the PCE hot spots in “soil samples” collected below the water table (i.e., 5.2 and 1.7 ppm PCE at locations A-79 and A-89, respectively).*

Roche Response:

Some of the identified areas of ground water impact with PCE and other chlorinated solvents in IA-15 are in immediate proximity to Clifton and Nutley municipal sewer lines. Videotapes of the municipal sewers indicate the presence of numerous cracks and breaches occurring in IA-15, similar to the condition of the sewers further north and west (e.g., IA-12). As such, while the impacts in IA-15 may have received some contribution from Roche process lines and the operational activities of Roche’s predecessor, a significant portion of the VOC mass detected in ground water in these areas is likely attributable to releases from the municipal sewers. Additional PDI work in IA-15 is ongoing and will provide more data to assess the relative contribution of process lines (and practices of Roche’s predecessor on IA-15) and the municipal sewers that transect this area.

NJDEP Comment:

IA-15 (continued)

- *Based on review of the Appendix E referenced data set; 30 locations indicate PCE concentrations greater than the DIGWSSL.*

Roche Response:

See response to above NJDEP (Bullet # 2) comment regarding potential sources of ground water impact.

NJDEP Comment:

IA-15 (continued)

- *Numerous hot spot and release areas below the water table have been identified associated with the AOC 67, AOC 116, and former ECF operations.*

Roche Response:

See response to above NJDEP (Bullet # 2) comment regarding potential sources of ground water impact.

8. NJDEP Comment:

Due to high diffusive properties of PCE which are key to conceptual understand the historic movement of PCE, the reference paper by “Beth L. Parker, Robert W. Gillham, John A Cherry entitle Diffusion Disappearance of Immiscible-Phase Liquids in Fractured Geologic Media” was copied and given to TRC and Roche at the IA-2 RIR pre-meeting. It is unclear if information from this study was included in the GW RIR as the reference was not included in the reference list and the following items are important in the conceptual approach at the Roche Nutley campus:

- *Fractures are the main avenues for immiscible fluid flow and that no significant entry of the immiscible phase to the matrix occurs.*
- *DNAPL released in a fractured medium tends to spread farther laterally and penetrate deeper into the subsurface, thereby contaminated a much larger bulk volume of the geologic material than would be the case for the same volume released to a granular porous medium.*
- *The potential exists for the immiscible-phase liquid in the fracture to disappear by dissolution and subsequent diffusion.*
- *At an intermediate time, free-phase DNAPL in the pool diminished through the continued invasion of fractures, governed by fracture entry pressures and capillary pressure relationship, resulting in greater*

penetration of the organic liquid into the fracture system compared to the entry time conditions.

- *DNAPL would generally not enter smaller fractures due to capillary pressures/fracture entry pressure limitation and larger fractures may exist in some situations.*
- *Because of the lower solubilities, smaller amounts of PCE and TCB would disappear in the same length of time. Within 2.7 years, all the PCE in a 19 um fracture and all the TCB in a 2 um fracture would diffuse into the matrix.*

Roche Response:

Roche has reviewed the articles provided by the NJDEP and appreciates the insights that these articles offer. The 1994 article by Parker, et al. cited above presents a set of calculations and proposes a new conceptual model for viewing the behavior of DNAPL in fractured media. The authors describe processes whereby DNAPL can diffuse from fractures into the rock matrix, and develop several formulas to simulate these phenomena. The article is based entirely on theoretical calculations, and is not based on actual observations of the behavior of DNAPL at a field site. The authors caution in their section on limitations: “*..Furthermore, though parameters were evaluated on the basis of relationships and correlations from the literature, the applicability of these to natural geologic materials is, in some instances, uncertain.....The conditions are further idealized by assuming the fracture can be represented as smooth parallel plates...*”.

The large body of data collected at the Site demonstrates that the theoretical processes described in the cited 20-year old article have not governed the distribution of chlorinated VOCs at the Roche Site. In fact, the evidence at the Site suggests that DNAPL released many decades ago has not diffused into the rock matrix and persists in highly fractured zones directly below where the release occurred. This is evidenced by the data collected in the vicinity of the release from the Clifton-Allwood Municipal Sewer in IA-12. The persistence of PCE concentrations in excess of 10% of PCE’s solubility in well MW-60 over more than 15 years suggests that DNAPL has not completely partitioned to the dissolved form, and does not appear to have diffused into the rock matrix. During the recent PDI work, NAPL flutes installed in angle borings drilled directly below the municipal sewer demonstrated the presence of DNAPL in fractures extending downward to a depth of about 41 feet bgs.

The presence of DNAPL is also inferred north of Route 3, based on the sampling results of a well cluster adjacent to the Clifton-Allwood Municipal Sewer. The PCE concentrations in excess of 1 ppm (1,000 ppb) in the shallow and deep wells in this cluster may also suggest the likely presence of DNAPL in the immediate vicinity. The distribution of PCE in the ground water of this area suggests the DNAPL penetrated deeper at this location than it did in the vicinity of well MW-60 in IA-12. The detection of PCE (and breakdown products) at concentrations in excess of 1,000 ppb (1 ppm) in all wells in this cluster (MW-201 and DW-7) indicated that the releases from the Clifton–



Allwood Municipal Sewer north of Route 3 resulted in the vertical penetration of high VOC concentrations (and possibly DNAPL) to depths in excess of 300 feet bgs north of Roche property. In the deep wells in IA-12 (the DW-8 cluster) the chlorinated VOC concentrations are lower than the wells at the corresponding depths in the DW-7 cluster north of Route 3, indicating that no additional VOC mass has migrated vertically from the shallower bedrock (Zones S1 and S2) to the deeper bedrock on-Site.

The distribution of dissolved PCE and breakdown products in ground water at the Roche Site exhibits a typical pattern seen at virtually all DNAPL sites – the highest concentrations are found in the immediate vicinity of the locations where releases occurred, and those concentrations diminish with distance from the sources. In other words, despite the fact that the releases occurred decades ago, the persistence of DNAPL or VOC source material sorbed to soils and rock is evidenced by the typical “bulls-eye” pattern – concentrations above 1 ppm (1,000 ppb) in the immediate vicinity of the release, a zone with concentrations between 100 and 1,000 ppb extending 10s or 100s of feet downgradient, and lower concentrations extending further. This pattern is seen at the release from the Clifton-Allwood Municipal Sewer in IA-12, and the release from the former alignment of the same sewer in IA-7. At no location does a high concentration VOC plume separate from the source area and migrate (without a trailing plume behind it), even though the releases happened decades ago, and Roche’s supply wells were actively pumping for several decades.

9. NJDEP Comment:

Additional conceptual reference information “A Field Experiment To Study the Behavior of Tetrachloroethylene in Unsaturated Porous Media, by Mette M. Poulsen and Bernard H. Kueper published in Environmental Science & Technology (ES&T) Vol. 26, 1992” show that approximately 1 day following a PCE release of a set volume of PCE as a drip release in unsaturated porous media would move deeper than an instantaneous release of the same volume and reach a depth of three (3) meters.

Roche Response:

Roche agrees with the principle described in the article cited above; the deeper penetration of a “drip” release when compared to an instantaneous release is also described in one of the most cited, and most comprehensive DNAPL references: *Dense Chlorinated Solvents and other DNAPLs in Groundwater, James F. Pankow and John A. Cherry, Waterloo Press, 1996*. The repeated release of DNAPL in the same location (as would occur where a sewer pipeline collapsed), even in small quantities, results in deeper penetration because the consistent loading of new DNAPL on top of previously released DNAPL provides enough driving pressure to overcome the resistance to penetration when the DNAPL encounters the capillary fringe and the saturated zone.

This phenomenon confirms Roche's conceptual model, that the largest volume of PCE release, and the most persistent and frequent releases, were associated with a likely breach in the Clifton-Allwood Municipal Sewer north of Route 3. The sampling of the well cluster on the north side of Route 3 (MW-201 and DW-7B) indicates that this location experienced the deepest vertical penetration of DNAPL and high concentrations of dissolved VOCs; the highest chlorinated ethane concentrations in Zones D1 and D2 have consistently been detected at this location. This suggests that the releases from the apparent breach north of Route 3 allowed the escape of more VOC mass, and at a higher frequency, than breaches further downstream (south) on the Roche property. The significantly lower extent of vertical penetration in IA-12 is evidenced by the fact that there is no increase in VOC concentration in Zones D1 and D2 relative to the concentrations in the same zones north of Route 3.

10. NJDEP Comment:

Pg 35 of RIR; Boreholes within the central portion of the Site display high pumping yields during drilling (increased availability of water, >100 gpm), especially boreholes DW-7, DW-9, DW-21D, and DW-22D. This area of the bedrock fracture and high well yield is located in the area of IA-9 where the recent site historic releases of DNAPL detection in soil and ground water at AOC 49 has been reported. This high yield zone along with the RI conclusion that there is a significant downward vertical flow component from Zone S1 to the deeper intervals (Zones S2 and S3) throughout much of the Site where there is significant vertical fracturing and historic operation of production wells PW-20, PW-33 and PW-37, would result in the present day plume configuration commingle with offsite release from the north central area of the site.

Roche Response:

See response to Comment No. 7. There are separate lines of evidence that the DNAPL contained within the pipe trench in AOC 49 never migrated beyond the bottom or sides of the trench, and had no impact on ground water quality in the bedrock adjacent to or beneath the trench. As such, there is no indication that the releases in AOC 49 contributed to the VOC plumes in Zones D1 and D2.

11. NJDEP Comment:

The PCE mass of dissolved phase PCE and breakdown product remaining in the overall bedrock aquifer has not been calculated. This estimated value would be helpful to understand the amount that remains in the aquifer for remedial action selection and calculation, in addition to approximate the residue volume of source(s) material release both historically and recently.

Roche Response:

Roche can estimate the volume of dissolved PCE and other ethenes in ground water, and will provide these estimates in the Annual Ground Water Progress Report. However, it should be noted that the persistence of high VOC concentrations in the areas of releases from the Clifton-Allwood Municipal Sewer (IA-12, IA-3, IA-7) indicates that there is considerable VOC mass sorbed to soil and rock materials and is currently present (in the case of IA-12) as DNAPL. The mass in the sorbed and DNAPL phase is probably much greater than the VOC mass in the dissolved phase, and as such, any calculation of the mass in the dissolved plumes will be an underrepresentation of the PCE mass still in the subsurface.

12. **NJDEP Comment:**

The soil sample location (designated SYSF-N in the stone yard of IA-12), detected 1,1,1-trichloroethane (1,1,1-TCA) at 0.78 ppm and represent a potential source area just east of the 1,1,1-TCA detection in deep ground water (Zones D 1, D2 and D3) at the northern portion of IA-10.

Roche Response:

The NJDEP has reviewed the extensive soil database for more than 7,000 soil borings and found one detection of 1,1,1-TCA, and that detection is less than 1 ppm. There are five shallow (Zone S1) monitoring wells in close proximity to the Stone Yard, and none of these show any exceedance of the GWQS for 1,1,1-TCA or its most common breakdown product, 1,1-DCA. In fact, there are no Zone S1 exceedances for these two VOCs anywhere on the Roche Site. However, 1,1,1-TCA has consistently been detected in Zone S1 ground water on the Deluxe property.

The exceedances of 1,1,1-TCA and 1,1-DCA are widespread in the deep zones under IA-10, and their distribution is upgradient and side-gradient to the Stone Yard. The concentrations detected in these deep zones are too high to be attributed to a minor (less than 1 ppm) detection in a shallow soil sample. These VOCs clearly originate from an off-Site, upgradient source or multiple sources. The additional wells that Roche has installed around the perimeter will provide additional data to document the impacts migrating onto Roche property from upgradient sources. These data will be presented in the Annual Ground Water Progress Report (Fall 2014).

13. **NJDEP Comment:**

The CEA application in Appendix V of GW RIR, which states SVOC and metals constituents are related to historic fill and not part of the site-related VOC CEA is unsupported. In addition, due to the undocumented site remedial measure and present of PCE DNAPL concentration onsite the CEA duration of all aquifer zones are



indeterminate. The recorded pesticides exceedance are also required to be included in the site wide CEA.

Roche Response:

As stated in the response to Comments No. 2, 3 and 4 above, Roche understands the NJDEP's position that any constituents detected at concentrations above the GWQS must be listed in the Site-wide CEA. These constituents (i.e., metals, SVOCs, dieldrin) will be listed in the CEA that will be established for the Site. All of these constituents are fully delineated by the current monitoring well network, and thus their extent can be defined on maps.

14. NJDEP Comment:

Fluctuation in TCE and PCE ground water concentrations have been observed at well MW-80 from 1999 to 2005, but has not been evacuated [evaluated?] as part of the RIR. The DEP believe this sudden increase may be a result of long term seasonal or recent discharge of PCE solvent from the Clifton Sanitary Sewer (approximately 10 years ago) variations from off-site discharge, which has leaked out of the Clifton Sanitary Line at the northern portion of the Nutley Roche Campus.

Roche Response:

Roche has observed fluctuations in the VOC concentrations in wells MW-60 and MW-80, but we did not discuss them in detail in the GW RIR. We do not think these fluctuations are indicative of recent releases. We have positively identified the presence of DNAPL under the municipal sewer, and it is likely that that DNAPL has been present for several decades. If DNAPL is present, it is hard for us to understand how these two wells could be sampled and show very low, or even non-detect, VOCs.

We believe the variation is related to several factors, including seasonal fluctuations, sampling methodologies, and depth of sample collection. As we have previously communicated to the NJDEP, recent sampling of well MW-60 with PDBs showed significant stratification. For example, the results for a sample collected from a PDB placed at approximately 13 feet bgs in well MW-60 displayed about 130 ppb of PCE, while a sample from a PDB deployed 5 feet lower (at 18 feet bgs) showed more than 10,000 ppb of PCE. It appears that the constant leakage of sanitary wastewater from the sewer over the last 2 or 3 decades has flushed the DNAPL out of the shallow fractures directly below the pipe, but the DNAPL persists from 15 or 18 feet bgs to at least 41 feet bgs, where the DNAPL was directly observed during the recent IA-12 PDI.

While it is less likely, the possibility of a recent release from the sewer cannot be ruled out. Roche has recently replaced the severely compromised section of the Clifton-



Allwood Municipal Sewer in IA-12, which precludes the possibility of future releases, at least in this limited area.

15. NJDEP Comment:

All ground water analytical data from deep core holes installed in 2003, particularly locations CH-10 and CH-6 within IA-9 shall be provided.

Roche Response:

These data are provided in Attachment 3 (Tables 1A and 1B).

16. NJDEP Comment:

Historic production well analytical data, withdrawal rates, time of operation, installation construction details, sealing/abandonment. etc., shall be summarized. It is known the Roche Nutley production level was the highest from the 1960s to 1980s and all process water was obtained from these on-site production wells.

Roche Response:

Roche has no records of production well pumpage and the NJDEP-Bureau of Water Allocations (BWA) files (related to Roche's allocation permit) do not provide actual pumpage data. Roche will compile whatever information is available in the Annual Ground Water Progress Report that will be submitted to the NJDEP in the Fall of 2014.

COMMENTS FOLLOWING MAY 21, 2014 MEETING

1. NJDEP Comment:

As discussed during the Friday May 9, 2014 phone/internet meeting, the site CEA boundary limits and site related contaminants of concern (COCs) will continue to be evaluated as more ground water data is generated and collected for seasonal variations. However, the CEA boundary limits shall equal or exceed the "NE" boundary limit as shown by the solid or dashed red line on the RI CVOC concentration maps of each monitoring zone.

Roche Response:

Roche will prepare maps for the CEA that will show limits as indicated by the NJDEP above. We anticipate that this information will be provided in the Annual Ground Water Progress Report that will be submitted to the NJDEP in the Fall of 2014.



2. NJDEP Comment:

The site location map and topographic surface contours of the surrounding area indicate that the northern portion of the Roche campus is equal in surface topographic elevation with the areas north of Route 3 at approximately 110 feet msl. In addition, the main surface topography contour interval trends parallel to the underlying formation strike (SW to NE) and decrease in elevation in a NE-E direction towards the Passaic River.

Roche Response:

Route 3 currently straddles a local topographic divide, and in the lower area just north of the Roche guard shack, the ground surface elevation north of Route 3 drops off into a small valley oriented north-northeast. The land surface is characterized by a series of ridges and valleys that trend north-northeast, conforming to the general orientation of the bedrock bedding. The general topographic trend, however, is of decreasing elevation to the southeast. The ridges that parallel strike decrease in elevation in a direction perpendicular to strike from greater than 400 feet above mean sea level (amsl) at the top of the First Watchung Mountain, to a line of ridges at over 300 feet amsl in western Clifton and Montclair, to a ridge just west of the Site in Clifton and Bloomfield at about 220 feet amsl, to the ridge on the eastern edge of the Site at an elevation of about 150 feet amsl. The Roche plant sits in a valley between these last two ridges.

The water-level data collected from the monitoring well network indicate that the shallowest ground water flow is influenced by local topography and the streams act as flow boundaries, usually as locations of shallow ground water discharge. Below the shallowest (water table) zone, the ground water flows from northwest to southeast, in the direction of the regional decline in topography. This pattern is consistent from Zone S2 downward through Zone D3. The apparent ground water divide in the northern portion of IA-12 in Zones D1 and D2 is an artifact of the contouring water levels measured in screens that are as much as 50 feet apart vertically, most particularly the screen depth in DW-7B when compared with the water level in well DW-8B. Examination of the vertical flow net prepared along the line of section E-E', shows that ground water flow is consistently from north of Route 3 to south of Route 3.

It is interesting to note that while current topographic maps indicate the local topographic divide is coincident with Route 3, in the past a stream flowed southward from the vicinity of the cemetery north of Allwood Road onto Roche property. This stream was later culverted to create the Valley Drain, and the grade under Route 3 was likely raised to construct the road, altering the local topography.

Roche recently provided the NJDEP with sets of maps created from the water level and ground water quality data collected in the December 2013 and March 2014 quarterly sampling events. These maps depicted water levels and VOC concentrations in



horizontal and vertical planes. The Annual Ground Water Progress Report, due for submission to the NJDEP in the Fall of 2014, will include a discussion of these data, and more recent data, including the June 2014 quarterly sampling event.

The NJDEP has made reference to the past impact of Roche's production wells on ground water flow dynamics and plume migration. The pumpage of these production wells would have induced even more flow from north of Route 3 onto Roche property; in other words, the capture zones of these wells would have extended to the area north of Route 3.

3. NJDEP Comment:

The overall topographic decrease towards the NE echoes the regional ground water flow component as shown by site ground water contour elevation measurements. Based on this northern flow component, the northern portion of the site along Route 3 in the S-3, D-1, D-2 and D-3 aquifer monitoring zones may potentially impact the down gradient receptor Ridgelawn Cemetery irrigation and non-public active wells (G4 and NP1 on the well search map) which requires evaluation and sampling.

Roche Response:

See response to Comment No. 2 above. Based on our interpretation of ground water flow conditions in this area, there is no primary component of flow to the northeast from the Site.

4. NJDEP Comment:

Figure 18: Vertical ground water flow along Cross Section E-E' indicated a near vertical flat downward gradient to approximately 200 feet msl beneath IA-12 and Route 3. The direction of vertical flow is upward below 250 feet msl, and both upper and lower vertical flow directions indicate both south and north flow directional changes which parallel the cross section within primarily the D-2 aquifer zone. Cross Section D-D' indicated a large flat near vertical downward flow across all of IA-10 and Route 3 with less defined cross section oriented flow direction, excluding a small area of flow to the north in the S-1 and S-2 zones at the intersection with Cross Section B-B'.

Roche Response:

See response to Comment No. 2 above. There is no indication of a primary ground water flow component that trends north in the cited vertical flow nets.

5. NJDEP Comment:

Figures 21 and 27: Zone 2 ground water flow direction arrows are missing in the general area across IA-12 and Roche's North Gate, which indicate flow direction offsite to the northeast across Route 3. In addition, the flow divide appears to be based on transmissivity (T) zones which are defined as higher T-values along the valley drain and bedrock structural fault line compared to the lower T-values on the eastern half of IA-3 and off-site residential neighborhood. The northern portion of the Zone D2 CVOC plume has a strong northeast flow component offsite.

Roche Response:

See response to Comment No. 2 above.

6. NJDEP Comment:

Figure 22: Zone 3 Potentiometric map indicates a strong northern component of ground water flow from well cluster DW-8 to offsite DW-7. The "N/A" at half of the Zone 3 wells (DW-12C, DW-16C, DW-21D, DW-13D and DW-19D) result in missing data point and large degree of interpretation of the overall contouring. However, the northern portion of the site indicates a flat hydraulic gradient from IA-10 across Route 3 to the east, indicating a divide in the ground water flow direction that would change or be influenced under surrounding pumping conditions. This pattern is similar in the shallower D1 and D2 bedrock aquifer zones. The reported elevations in the three bedrock zones at the Roche north gate from on-site to off-site wells are as follows:

<u>Zone/Depth (feet msl)</u>	<u>DW-8 on-site</u>	<u>DW-7 off-site</u>
D1 / 0 to 100	103.11	101.23
D2 / 100 to 250	98.26	97.98
D3 / 250 to 400	101.46	99.31

Roche Response:

The Zone D-1 and Zone D-2 well screens in the DW-7 cluster are about 50 feet lower in elevation than the corresponding wells in the DW-8 cluster, and therefore the comparison of water levels cited above is not an accurate depiction of ground water flow conditions. In the sets of maps recently provided to the NJDEP, the vertical flow net drawn on cross-section E-E' with the March 2014 water-level data clearly shows that ground water flows from north of Route 3 southward. The Annual Ground Water Progress Report will include a discussion of ground water flow conditions based on four comprehensive rounds of ground water flow measurements. The June 2014 data will provide a more comprehensive depiction than previous rounds, due to the recent installation of additional wells around the perimeter of the Roche Site.

7. NJDEP Comment:

Figure 26; The ground water flow direction arrow at the Roche North Gate to the northeast shall be shown. The D1 zone indicate a wider CVOC plume as a result of historic pumping of production wells PW-20 (AOC 120), PW-33 (AOC 123) and PW-37 (AOC 121) and due to their large open holes (80 to 400/600) shall be shown on all site maps. Based on the limited amount of ground water sample data to the east of PW 37 (well DW-3C to the south of PW-37) indicates the inferred eastern plume boundary. The site production well (PW) AOC summary sheets indicate the following information:

- *AOC 120; PW-20 start date 1939, 1950 Building 58 information produced 200 gpm and sampled between 1983 to 1985 a maximum detected concentration of 674 ug/L PCE,*
- *AOC 121; PW-37 start date 1940s, Building 71, produced 400 gpm and sampled between 1983 and 1985 indicated maximum detected concentration of 521 ug/L PCE,*
- *AOC 122; PW-32 start date 1943 produced 300 gpm and sampled between 1983 to 1985 indicated chlorinated and aromatic hydrocarbons and various other hazardous constituents, and*
- *AOC 123; PW-33 start date 1943, 1950 Building 59 information, produced 200 gpm, well no longer in use and ground water quality issues to be addressed under the MOA.*

Roche Response:

The locations of the production wells will be shown on all maps in future submissions to the NJDEP. The eastern edges of the plumes have been defined in greater detail as a result of the newly installed perimeter wells, many of which were sampled for the first time in the June 2014 quarterly sampling event.

8. NJDEP Comment:

The RIR presented limited information on operational building sumps across the facility and potential impact on ground water flow and contaminant migration in the shallow S1 and S2 zones. The sump operations may be considered minimal; however, some high withdrawal rates were discussed at various meetings that would contribute to historic overall remediation of the S1 and S2 aquifers.

Roche Response:

The sumps were capable of pumping as much as 30 or 40 gpm for short durations, but sump pumps did not operate continuously. They only pump when the water level in the sump is sufficiently high to trigger pump operation, and the pumps shut off when the



sump is dewatered below a set level. Therefore, the sumps would have had a limited effect on ground water flow patterns. We acknowledge that the operation of the sumps locally removed some VOC mass from the shallowest (Zone S1) ground water, but we do not think the sump operation would have influenced Zone S2 ground water. The current concentrations and flow data will determine what ground water has actionable levels of contamination.

9. NJDEP Comment:

Figure 27, Zone D2 VOC data to the west of the valley drain (IA-9; AOC 49) is missing and needs to be established.

Roche Response:

See response to Comment No. 7 (IA-9) in the initial set of general comments, above. The impact from the release of PCE in the pipe trench in AOC 49 has been fully delineated. Soil sampling indicates the PCE did not migrate beyond the bottom of the trench, and monitoring wells installed in Zones S1 and S2 surrounding the impacted portions of the trench indicate that VOCs are at concentrations ranging between 5 to 10 ppb. Therefore, there is no impact from AOC 49 in Zone S2 to delineate vertically in Zones S3, D1 or D2.

10. NJDEP Comment:

Figure 28, Zone D3 VOC concentrations clearly indicates the residue contamination at depth beneath AOC 49 and general Roche process area in Well DW-21D. DW-21D has a higher concentration than the off-site DW-7 location is up gradient and west of any potential offsite impact. The contaminant distribution clearly indicate the highest concentration sample location DW-9D is located adjacent to former production well PW-33 location. Note: DW-8D ground water result of “NE” appears suspicious or does in fact define the bottom of the VOC plume with upward vertical flow; however, the upper D2 zone indicates increased contamination. The D-3 ground water flow direction (Figure 22) in the area of DW-21D is poorly defined, but does indicate an overall flat gradient across the northern half of the Roche Campus and potential flow direction switch between NE to SE.

Roche Response:

With one exception, every well in Zone D3 shows chlorinated VOC concentrations that are less than 100 ppb. The diminishing VOC concentrations in Zone D3, relative to Zones D2 and D1, are due in large part to the diminishing permeability of the bedrock in Zone D3. The one exception, well DW-9D, shows over 200 ppb of 1,2-DCE, with much lower (<10 ppb) PCE concentrations. This relatively high concentration in well DW-9D may be related to the past pumpage of Roche production well PW-33. The distribution of

VOCs in the deep zones will be discussed in greater detail in the future Annual Ground Water Progress Report.

11. NJDEP Comment:

Figure 30; Dieldrin and PAHs across the site, indicated the primary GWQS exceedance area at IA-6 and IA-2. It is unclear which well results are NE or if these plumes have been fully delineated.

Roche Response:

There is a note in the legend box stating that “Only compounds with concentrations detected above NJDEP GWQS are shown in boxes”. All the wells shown on each map were sampled. Therefore, any well that does not have a concentration box was sampled and had no exceedance of the GWQS for the parameters in question.

12. NJDEP Comment:

Figure 31; clarification on 1,4-Dioxane in IA-6 delineation to “NE” result shall be reported as delineation is unclear.

Roche Response:

See response to Comment No. 11 above.

13. NJDEP Comment:

Figure 36; Cross Section A-A’ wells DW-8 A, B, C, D indicate C-VOC concentration increases in zones A and C (top of D-1 and bottom of D-2) from the shallower S-2 zone which indicates potential influence source(s) from the west (IA-9) independent of the surficial release from the Clifton Sanitary Sewer (well MW-24). Note: Need to check or conceptually agree that the mid D-2 zone has lower VOC concentrations compared to the top D-1 and bottom D-2 due to greater ground water flow and higher T-value. The area below wells MW-184 and MW-180 have no data to depict the plume (AOC 49 source area) on the western boundary. On the eastern area boundary the main plume has a 300 foot data gap within the D-1 and D-2 zones (highest reported T values).

Roche Response:

See response to initial general Comment No. 7 above (IA-9). The data demonstrate that there has been no VOC contribution to the deep zones, or even the shallow zones, from the pipe trench in IA-9.

14. NJDEP Comment:

Figure 37: Cross Section B-B', shallow zone S-1 total VOC concentration of 15.6 ppb (well MW-193) infers a source originating from the area of the Valley Drain to Former Sanitary Sewer closer to the surface, whereas, the most likely sources are numerous Roche process waste line releases and historic operations of PW-20. The source for upper zone S-3 high total VOC concentration at 322.9 ppb is from site operational release beneath IA-7 or migration (PW-20 operations through 1987) into the higher fractured D-1 and D-2 zones.

Roche Response:

There are several independent lines of evidence that the chlorinated VOCs found in shallow ground water in IA-3 and IA-7 originate from releases from the current and former alignment of the Clifton-Allwood Municipal Sewer, and not the Roche process lines. Recent PDI work has enhanced the delineation of the horizontal and vertical extent of these plumes. Especially in the case of IA-7, the identified hot spot is directly on the former alignment of the Clifton-Allwood Municipal Sewer, in an area south of Building 123 where there were never any Roche process lines or operations. Roche believes that the IA-7 hot spot is solely attributable to releases from the abandoned municipal sewer. For the IA-3 hot spot detected at the southwest corner of Building 115, the similarity of the VOC constituents to the definite municipal sewer release to the north in IA-12 and the south in IA-7, and the absence of any VOCs used in large quantities by Roche (e.g., methylene chloride, toluene) indicates that this hot spot also derives from releases from the Clifton-Allwood Municipal Sewer, and not Roche process lines or operations. These shallow "hot spots" and their vertical extent will be discussed in detail in the Annual Ground Water Progress Report.

15. NJDEP Comment:

Figure 38: Cross Section C-C' well MW-207 C zone 3 (80 feet depth) indicate exceedance off-site that is not delineated, and suggest an off-site source in the western part of the site requires further discussion. Cross Section C-C' also shows the success of the 10-year IA-11 IRM operations reduction across the S-1 and S-2 source areas.

Roche Response:

Additional wells have been installed along the Site perimeter. Data collected from these new wells will better define the extent of the IA-10 plume, and will be discussed in the Annual Ground Water Progress Report.

16. NJDEP Comment:

Figure 39, Cross Section E-E' well MW-152 was used to depict IA-9 as a smaller release area, in comparison well MW-179 results indicated much higher DNAPL concentrations (Total VOC at 149,551 ug/L), which under pumping conditions during the 1950s through the 1980s contributed as one of the source areas the present day subsurface plume. In addition, based on the D-3 upward ground water flow component to D-2, the deep elevated concentration at DW-7C would have been pulled downward under historic pumping conditions from PW-33, located in the area of well cluster DW-9A, B, C. Based on ground water flow direction the CVOC concentration in off-site D-3 zone well DW-7C appears to be from a combination of historic Roche production wells operation and the natural migration split in ground water flow direction to the north-northeast and south-southeast.

Roche Response:

See response to comments above regarding IA-9.

17. NJDEP Comment:

Figure 39, Cross Section D-D' well DW-15A, B, C, and D (no D); indicate a separate historic release in the area of this well cluster possibly from the AOC 65 (fire safety training area), IA-12 material storage area or IA-1 operations and historic VOCs that were captured by production well PW-32. In addition, the D-D' Cross Section does not indicate the likeliness of an offsite source as discussed by TRC to the north or northwest of property. Based on recent information from Roche not in the GW RIR, additional information is being collected to support their conclusions for off-site source(s) and will be reviewed when available.

Roche Response:

Additional wells are being installed along the Site perimeter. Sampling results from these wells will provide a more complete understanding of background conditions. These results will be discussed in detail in the Annual Ground Water Progress Report.

18. NJDEP Comment:

Figures 41 through 46; The division of contamination groupings in the pie charts needs to reflect that 1,2-DCA and 1,1-DCE are daughter parameters of PCE. The use of the blue hue coloration under the dark blue color for 1,1,1-TCA incorrectly indicates 1,2-DCA and 1,1-DCE to be break down product of only 1,1,1-TCA. In addition, the 1,2-



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DCA is commonly associated with old lead gasoline releases and was added with the gasoline as a lead scavenger unrelated to 1,1,1-TCA.

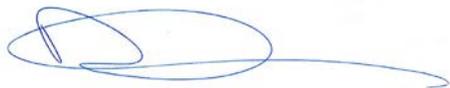
Roche Response:

1,2-DCA is not a breakdown product of PCE. The most prevalent DCA in deep ground water is 1,1-DCA, not 1,2-DCA. 1,1-DCA is a breakdown product of 1,1,1-TCA; therefore, it is accurate to depict the 1,1-DCA as being associated with 1,1,1-TCA.

If you have any questions or need additional information, please contact Daniel Nachman at (908) 988-1637 or dnachman@trcsolutions.com, and/or Arthur Goeller at (908) 988-1621 or agoeller@trcsolutions.com.

Very truly yours,

TRC Environmental Corporation



Daniel Nachman
Vice President



Arthur Goeller, LSRP
Senior Project Director

cc: Chandra Patel, Roche
Teresa O'Meara, Roche

Enclosures:

- Attachment 1 – Ground Water Metals Analytical Results (Figures 1 through 9)
- Attachment 2 – Soil & Ground Water Data Figures for IAs (Figures 1 through 9)
- Attachment 3 – Core Hole Data for CH-10 & CH-6 (Tables 1A and 1B)

