UNITED STATES DISTRICT COURT
WESTERN DISTRICT OF NEW YORK

THE STATE OF NEW YORK,

Plaintiff,

-vs-

SOLVENT CHEMICAL COMPANY, INC., and
ICC INDUSTRIES, INC.,

83-CV-1401-JTC

Defendants/Third-Party Plaintiffs,

-vs-

OLIN CORPORATION and
E.I. du PONT de NEMOURS & COMPANY,

Third-Party Defendants.

APPEARANCES: JAECKLE, FLEISCHMANN & MUGEL, LLP (DENNIS P. HARKAWIK, ESQ.; CHARLES D. GREICO, ESQ.; and BRENDA J. JOYCE, ESQ., of Counsel), Buffalo, New York, for Solvent Chemical Company, Inc.

IRWIN F. ROTH, ESQ., New York, New York, for ICC Industries, Inc.

HUSCH BLACKWELL SANDERS LLP (MICHAEL H. WETMORE, ESQ., and JOEL B. SAMSON, ESQ., of Counsel), St. Louis, Missouri, for Olin Corporation.

COHEN & GRIGSBY, P.C. (DANIEL M. DARRAGH, ESQ., of Counsel), Pittsburgh, Pennsylvania, for E.I. du Pont de Nemours & Company.

MEMORANDUM OF DECISION

In this action, originally brought in 1983 by the State of New York against the Solvent Chemical Company, Inc. ("Solvent"), and its parent company, ICC Industries, Inc. ("ICC"), pursuant to the Comprehensive Environmental Response, Compensation and

Liability Act ("CERCLA"), 42 U.S.C. § 9601, *et seq*., the court conducted a non-jury trial on issues pertaining to the liability and equitable allocation of responsibility for costs incurred in remediating environmental contamination at Solvent's property located at 3163 Buffalo Avenue in Niagara Falls, New York; adjacent property owned by the Olin Corporation (referred to as the "Olin Hot Spot" or simply, the "Hot Spot"); and Gill Creek, which flows through both Olin's property and neighboring property owned by the E.I. du Pont de Nemours & Company ("DuPont"). The following constitutes the court's findings of fact and conclusions of law with regard to these issues, in accordance with Rule 52 of the Federal Rules of Civil Procedure,[1] based on the trial testimony and exhibits (including designated deposition testimony of 24 witnesses not appearing at the trial), the parties' post-trial submissions and arguments, and the court's prior rulings.

I. FACTUAL AND PROCEDURAL SUMMARY

A. The Three Neighboring Facilities

The geographical area of concern in this case involves relatively contiguous parcels of property comprising three chemical manufacturing plant sites located in the midst of a sprawling heavy industrial area along the northern shore of the Niagara River in the City

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[1] Rule 52 states in relevant part:

> In an action tried on the facts without a jury . . . , the court must find the facts specially and state its conclusions separately. The findings and conclusions may be stated on the record after the close of evidence or may appear in an opinion or memorandum of decision filed by the court. Judgment must be entered under Rule 58.

Fed. R. Civ. P. 52(a). While "punctilious detail" is not required, *In re Mazzeo*, 167 F.3d 139, 142 (2d Cir.1999), the court must set forth its findings and conclusions sufficiently to permit meaningful appellate review. *See, e.g., United States v. Sasso*, 215 F.3d 283, 292 (2d Cir. 2000).

of Niagara Falls. The court's analysis begins with a brief description of the three sites and the historical operations conducted there.

1. The Solvent Site

Solvent's property at 3163 Buffalo Avenue comprises 5.7 acres situated generally between the Olin chemical manufacturing plant site on the west, and the DuPont chemical manufacturing plant site on the east and south. It is bordered directly by Buffalo Avenue to the north, Adams Avenue to the south, DuPont Drive to the west, and a vacant parcel owned by DuPont to the east. Gill Creek, which flows from north to south through the Olin and DuPont plant sites, is located about 400 feet west of the 3163 Buffalo Avenue property (*see* December 1996 Record of Decision ("ROD"), Solvent Exhibit ("S-") 1012).

The manufacturing facility at the 3163 Buffalo Avenue address was originally built and operated by DuPont during World War II under a contract with the United States government to make "impregnite," a chemical compound developed to treat Army uniforms for protection against exposure to poison gas. The plant was reactivated between 1951 and 1953 by the Hooker Electrochemical Company for impregnite production during the Korean conflict. The City of Niagara Falls purchased the site in 1972 and sold it to Solvent (*id.*).

Solvent operated the chemical manufacturing plant at 3163 Buffalo Avenue from approximately 1974 to 1978. Its primary business function was to purchase lower grades of mixed chlorinated benzene material from other manufacturers or suppliers and refine this material into commercial grade products, such as various technical and refined grades of chlorinated benzenes and zinc chloride solutions. *See State of New York v. Solvent*

Chemical Co., Inc., 218 F. Supp. 2d 319, 323-24 (W.D.N.Y. 2002); *see also* S-6040. This process involved the handling, storage, production, and use of several chemicals including benzene, chlorobenzene (also referred to as "monochlorobenzene"), 1,2-dichlorobenzene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, 1,2,4-trichlorobenzene, 1,2,3-trichlorobenzene, petroleum products containing toluene, xylenes, ethylbenzene, and benzene, and zinc (DuPont Exhibit ("D-") 14, 213; Trial Transcript ("Tr.") 9/26/07, Item 1423[2] at 109). Solid residues from the refining process were accumulated in steel drums and disposed of off-site by approved waste disposal contractors (*see* Item 1328 (3/24/06 Decision and Order) at 43-44; *see also* S-6052; Tr. 1423 at 24-26).

The Record Chemical Co., later known as Recochem, Inc., and its president, Joseph Kuchar, also operated the plant at the Solvent Site for a short period during the first three months of 1978 in order to ascertain the plant's chlorinated benzene production capacity in anticipation of Recochem's purchase of Solvent's assets, which never materialized (*see* Item 1328 at pp. 68-69).[3] Between approximately 1980 and 1983, two separate entities named Frontenac Environmental Services, Inc., leased a portion of the Site and used it as an unlicensed hazardous and industrial waste storage and transfer facility (D-14, p. 1-6). During that period of time, approximately 610,000 gallons of liquid chemical wastes, including chlorinated aliphatic solvents perchloroethene ("PCE") (29,920

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[2] For consistency of reference, and because the trial transcript pages are not consecutively numbered, the court will cite to the transcripts by their docket number, preceded by "Tr." (*e.g.*, Tr. 1423).

[3] Following a separate trial and ruling from the court on issues pertaining to the CERCLA liability of Recochem and Kuchar as either operators of the Solvent facility or as arrangers for the disposal of hazardous wastes at the Site, those parties entered (and the court approved) a settlement agreement with Solvent and ICC resolving all claims between them with respect to contribution or indemnification for response costs incurred at the Site. *See* Item 1424.

gals.), trichloroethene ("TCE") (114,565 gals.), 1,1,1-trichloroethane (495 gals.), methylene chloride (1,100 gals.), chloroform, and carbon tetrachloride, as well as unspecified quantities of chlorinated and non-chlorinated waste products such as "halogenated solvents, electroplating sludge, spent pickle liquor, acid and caustic wastes, paint sludge, cyanides, etc." (S-1012, p. 3), were managed or stored at the Site (D-91, 213; S-6053, 6054; Tr. 1423 at 26-27; Tr. 1425 at 61-63).

2. The Olin Site

Olin's Niagara Falls facility, located directly west of the 3163 Buffalo Avenue property, consists of two plants: Plant 1, which comprises six acres located west of Chemical Road; and Plant 2, which comprises sixteen acres located between Chemical Road to the west and Gill Creek to the east (S-4113). The area of Plant 2 between Alundum Road to the west, Buffalo Avenue to the north, Adams Avenue to the south, and Gill Creek to the east, is known as the "ARGC Area." Olin also owns the property between Gill Creek and DuPont Drive directly adjacent to the 3163 Buffalo Avenue Property (S-4121; Tr. 1430 at 51, 62; Tr. 1433 at 81). Gill Creek runs from north to south through the Olin property and the DuPont property directly to the south, and empties into the Niagara River (Olin Exhibit ("O-") 431) .

Olin or its predecessors have engaged in the production of various chemical products at the Niagara Falls facility continuously since 1897, with principal emphasis on electrolytic production of chlorine and caustic soda from sodium chloride (rock salt) using various modifications of the mercury cell/chlor-alkali process (O-223; S-4113; Tr. 1420 at 114, 121-22). Mercury cell operations historically took place at both Plants 1 and 2, but were confined to Plant 2 for the last 30 years of chlor-alkali production, which ceased entirely in 1991 (O-223).

Olin also manufactured the pesticide benzene hexachloride ("BHC"), also known as hexachlorocyclohexane, in the southern portion of the ARGC Area of Plant 2 from 1950 to 1956 (S-4121; Tr. 1413 at 30-31; Tr. 1430 at 52, 62-63). By-products of Olin's BHC production included trichlorobenzene, pentachlorobenzene, and hexachlorobenzene (Tr. 1413 at 31-35, 39-41; Tr. 1430 at 119-123, 136). During this six-year period of operation, Olin generated approximately 4.5 million pounds of BHC and 5.5 million pounds of trichlorobenzene annually (Tr. 1413 at 38-41; S-6045). Olin's BHC production ended in 1956 when the manufacturing plant was destroyed in an explosion (S-4016; Tr. 1440 at 12-13).

3. The DuPont Site

From approximately 1896 to the present day, DuPont or its predecessors have owned and operated a chemical manufacturing facility situated on a 52-acre site located directly south of the Olin Site, and generally south and southwest of the Solvent Site (D-187; S-6014). During a 50-year period between 1925 and 1975, DuPont manufactured various chlorinated aliphatic compounds there (among other chemical products), including trichloroethene ("TCE"), tetrachloroethene (a/k/a perchloroethylene or "PCE"), cis-1,2-dichloroethane, chloroform, 1,1,2,2-tetrachloroethane ("1,1,2,2-TCA"), vinyl chloride, methylene chloride, and dichloroethene (Tr. 1413 at 16-17, 20-22; S-6039, 3024, 3025).

On November 28, 1989, DuPont entered into an Order on Consent with the New York State Department of Environmental Conservation ("DEC") requiring DuPont to perform certain remedial activities at its facility so as to “eliminate or mitigate, to the greatest extent practicable, the release and migration of contaminants into the environment” (D-106, p. 2). On January 3, 1990, the DEC issued a Record of Decision (“ROD”) outlining the remedial action for the DuPont facility. This remedy consists of a series of pumping wells in the shallow groundwater zone running along an east-west axis of the DuPont facility south and west of the Solvent Site, and a production well on Olin’s property for control in the deeper groundwater zones west of Gill Creek (*see* S-3021 at 15; *see also* Tr. 1432 at 118-19; Tr. 1442 at 66). There is no control of groundwater in the deeper zones on the DuPont East Plant, located east of Gill Creek and south and southeast of the Solvent Site and the Hot Spot (Tr. 1432 at 118-19; Tr. 1442 at 66-67, 69).

B. Remedial Investigations at the Solvent Site

In 1978, Solvent entered into a contract to sell the 3163 Buffalo Avenue property to Newco Chemical Waste Systems, Inc. (*see* D-4). In November 1978, RECRA Research, Inc. (“RECRA”), an environmental consulting firm, conducted an environmental survey on behalf of Newco, finding chemical contamination present on the site “to an appreciable extent,” and describing the conditions “to be quite serious and are expected to necessitate yet undefined abatement activities” (D-1). The RECRA report further stated that, “Gill Creek, immediately adjacent to the Solvent Chemical Plant, is also suspected of being highly contaminated with chlorobenzenes, as well as storm sewer lines leading from the Solvent Chemical property and discharging into Gill Creek” (*id.*).

In November 1979, Solvent and Newco retained environmental consultant Roy F. Weston to conduct an investigation of the conditions at the Site and to determine the need for any remedial measures (*see* D-4). In a report dated February 1980, Weston described benzene and chlorinated benzene groundwater contamination in the overburden and shallow bedrock in the southwest quadrant of the Site (S-1001, pp. 19, 22). Dichlorobenzenes had the highest groundwater concentrations, ranging from 8,000 to 24,975 ppb (parts per billion) (*id.* at Table 2-3).

Later in 1980, RECRA conducted a hydrogeological investigation of the Site on Solvent's behalf "to expand on the work undertaken by Roy F. Weston, Inc., and to provide recommendations for remedial work to be performed, if deemed necessary" (S-1002, p. 1). In a Remedial Action Investigation Report dated December 3, 1980, RECRA confirmed the presence of elevated concentrations of benzenes and chlorinated benzenes in the soil and groundwater, as well as in the sewer lines passing beneath the site (*see id*. at pp. 67-72). RECRA recommended a number of remedial measures "to collect contaminated ground waters and provide reasonable containment of such ground water to the site proper" (*id*. at p. 73-78).

Upon receipt and review of this information, the DEC requested further investigation to determine the extent of groundwater contamination and the scope of remedial work to be performed at the Site. As a result, a Phase I Study was conducted in the spring of 1983, and a Phase II Study was conducted in the summer of 1984, to gather additional data and evaluate remedial alternatives for the Site. Both studies were performed for the DEC by Engineering Science, in association with Dames & Moore (*see* D-11).

In 1985, the DEC listed the Solvent Site on the New York State Registry of Inactive Hazardous Waste Disposal Sites as Site No. 932096, designated as a class "2" site[4] (*see* D-103, p. 3). At about the same time, the State also listed the DuPont Site on the Inactive Waste Disposal Site Registry as Site No. 932013, and the two Olin plants as Site Nos. 932051A and 932051B (*see* D-103, p. 5).

Beginning in late 1989, the environmental consultant firm Ecology and Environment, Inc. ("E&E"), conducted a remedial investigation at the Solvent Site at the DEC's request, pursuant to a stipulated cost-sharing agreement entered between Solvent, ICC, and DuPont (along with other third-party defendants) subsequent to the commencement of this action. In November 1990, E&E submitted a Remedial Investigation ("RI") report to the DEC (S-1005). The DEC then requested additional investigation and, when the parties could not reach a cost-sharing agreement, engaged another environmental consultant firm, Malcolm Pirnie, to conduct a Supplemental Remedial Investigation ("SRI") and prepare a Feasibility Study ("FS"). The SRI report was completed and approved by the DEC in July 1995 (S-1009; *see also* D-14), and the FS report was completed and approved in February 1996 (S-1010; *see also* Tr. 1442 at 18-19, 22).

In December 1996, after several years of additional site investigation and evaluation of remedial alternatives, the DEC issued the Solvent ROD outlining a detailed plan for the remedial action to be taken at the Site (S-1012). As explained in the Solvent ROD's Declaration Statement, the DEC "selected an overburden containment remedy with a

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[4] The Registry of Inactive Hazardous Waste Disposal Sites was established pursuant to New York Environmental Conservation Law Article 27, Title 13. *See* N.Y.E.C.L. § 27-1305. A class "2" site presents a "[s]ignificant threat to public health or environment" and remedial action is required. N.Y.E.C.L. § 27-1305(2)(b)(2).

phased bedrock hydraulic control program for the Solvent Chemical site and associated groundwater" consisting of the following components:

1. Containment of highly contaminated soils on-site by placement of a permeable clean soil cover system.
2. Control and collection of contaminated overburden groundwater through construction and operation of an overburden ("A-zone") collection system.
3. Installation of a phased bedrock hydraulic control system, including pumping wells installed and operated within the upper fractured bedrock ("B-zone") to achieve hydraulic control over the highly contaminated groundwater found in the overburden and upper bedrock at both the 3163 Buffalo Avenue Property and in the vicinity of monitoring wells OBA-15A and OBA-3A located on Olin's property (referred to as the "Olin Hot Spot").
4. Treatment and disposal of pumped groundwater.
5. Implementation of a monitoring program to evaluate the effectiveness of the remedy.
6. Deed restrictions limiting future use of the Site.

See S-1012, at pp. *i-ii*.

Solvent began the construction of the ROD-specified remedy at the Site in the fall of 1999 with the installation of a trench and pumping well system designed to collect groundwater from the A-Zone overburden soils both on the 3163 Buffalo Avenue Property and at the Olin Hot Spot, followed by the installation of a series of pumping wells designed to collect groundwater from the fractured bedrock in the B-Zone both on the 3163 Buffalo Avenue Property and at the Hot Spot (Tr. 1422 at 31-36). All of the contaminated groundwater pumped by the system is pre-treated in the on-site pre-treatment system and then discharged to the Niagara Falls Publicly Owned Treatment Works ("POTW") pursuant to a permit (Tr. 1422 at 54; Tr. 1442 at 53-54).

B-Zone aquifer testing began in the early spring of 2000, and continuous B-Zone pumping operations commenced in the spring/summer of 2002 (*see* Tr. 1442 at 71-79; Tr. 1413 at 63-64). As of June 30, 2007, Solvent had incurred $9,624,328 in connection with implementing the remedy for the Site and Hot Spot (Tr. 1422 at 106-07).

C. The Lawsuit

Meanwhile, in December 1983, the State of New York brought this action (referred to by the parties as "*Solvent I*") against Solvent and ICC (among other settling defendants) pursuant to CERCLA and state statutory and common law seeking recovery of the costs incurred and expected to be incurred in responding to the release or threatened release of hazardous substances at or from the 3163 Buffalo Avenue Site (*see* Item 1; D-101). Beginning in June 1986, Solvent commenced a series of third-party contribution actions against more than 80 companies and individuals, including DuPont.

In April 1997, Solvent and ICC entered into separate consent decrees with the State, in which Solvent agreed to implement the remedial measures outlined in the ROD (*see* Item 655), and ICC agreed to guarantee Solvent's performance (*see* Item 652). Also in April 1997, DuPont entered into a separate consent decree with the State, in which DuPont agreed to pay $216,250 of the $865,000 reimbursement to the State for the costs incurred in investigating conditions at the Solvent Site (*see* Item 657). In an order dated October 8, 1997, this court approved entry of the Solvent, ICC, and DuPont consent decrees, effectively terminating the State's involvement in the litigation. *See State of New York v. Solvent Chemical Co.*, 984 F. Supp. 160 (W.D.N.Y. 1997).

In April 1998, Solvent filed a fifth amended third-party complaint (Item 746) seeking contribution pursuant to CERCLA from Olin and other third-party defendants for a share of the response costs Solvent has incurred and will continue to incur at the Site. Olin answered and asserted a counterclaim against Solvent, and filed a fourth-party complaint against ICC, seeking recovery of a portion of the response costs incurred in connection with the remediation of Gill Creek which Olin and DuPont conducted jointly in 1990-92 (*see* Item 809). DuPont has not sought recovery from Solvent or ICC for any of the response costs it incurred in connection with the Gill Creek remediation.

In June 2001, after encountering the presence of chlorinated aliphatic compounds (including TCE, PCE, DCE, 1,1,2,2-TCA, vinyl chloride, and chloroform) at much higher levels than expected in the groundwater extracted during aquifer testing of the B-Zone pumping wells at the Site, Solvent commenced a new lawsuit (referred to by the parties as "*Solvent II*") against DuPont for contribution pursuant to CERCLA § 113(f)(1) and the common law, seeking equitable allocation of response costs incurred as a result of the alleged migration of these substances from the DuPont facility. *Solvent II* was subsequently consolidated with this action for all purposes throughout trial and appeal.

II. THE TRIAL

Following extensive discovery, dispositive motion practice, resolution of Solvent's claims against all parties but Olin and DuPont, and referral of the remaining claims to a magistrate judge for one final, unsuccessful attempt at settlement, a non-jury trial was held over the course of 19 days in September, October, and November 2007. The trial was conducted primarily by electronic presentation of over 1200 exhibits consisting of drawings, photographs, charts, maps, correspondence, deposition transcripts, and other documents introduced during the live testimony of ten witnesses. The court received the parties' post-trial submissions and motions, and heard summations and argument on November 19, 20, and 21, 2008.

What follows next is the court's effort to summarize the parties' presentation of the facts in order to provide a relatively coherent groundwork for making the findings and conclusions required by the Federal Rules.

A. Solvent's Witnesses

1. Andrew H. Smyth

Mr. Smyth was retained by Solvent as its hydrogeological expert to determine the nature and possible sources of contamination at the Solvent Site and Gill Creek. As set forth in his curriculum vitae (S-6013), Mr. Smyth has an M.S. in Geology from New Mexico State University and a B.A. in Geology from Ohio Wesleyan University. He has over 17 years of experience as an environmental consultant encompassing geologic and hydrologic site assessments and has numerous professional registrations as a geologist and environmental professional. He is currently employed by TRC, an environmental engineering and consulting firm in Lowell, Massachusetts (Tr. 1413 at 10-11).

In preparing his expert report, Mr. Smyth reviewed historical documents, investigative reports, regional and localized hydrogeological studies, well-monitoring data, and several other sources of information about the Site. He defined the term "NAPL" as nonaqueous phase liquid, which can be either lighter or heavier than water. Light nonaqueous phase liquids (or LNAPL), such as benzene, are generally lighter than water and tend to float on the water's surface, while dense nonaqueous phase liquids (or DNAPL) are heavier than water and actually flow through the earth, often coming to rest on a low permeability medium like bedrock. NAPL contains higher concentrations of contamination than groundwater, in which the constituents tend to dissolve (Tr. 1413 at 12-16).

S-6023 is a diagram of the DuPont Site, showing the area where the chlorinated aliphatics PCE and TCE were manufactured. The diagram also indicates the location of a "tank heel cleanout" area where DuPont removed 4300 cubic yards of soil contaminated with chlorinated aliphatics at levels which were not present anywhere on the Solvent Site (*id*. at 16-18). Based on his analysis of pumping well data and historical information regarding contaminant levels in groundwater migrating from the DuPont Site, Mr. Smyth calculated that about 2 million pounds of chlorinated aliphatics have been removed from the DuPont Site. According to Smyth, this is a significant amount, but very small in comparison to the contamination still remaining in the DNAPL and soil at the DuPont Site (Tr. 1413 at 18-19).

S-6039 is a timeline Mr. Smyth created based on information obtained from a September 1989 report on an interim remediation program conducted at the DuPont Site which indicates various periods of operation during which chlorinated aliphatics were manufactured or used by DuPont (Tr. 1413 at 20-22).

S-6031 is a map of the Olin Site which depicts the location of mercury cell rooms, a BHC plant area where chlorinated benzenes were produced and used, and a bedrock injection well where hydrochloric acid was injected into the B-Zone bedrock. This map also depicts the Hot Spot area in the northeast corner of the Olin Site and process sewers that emptied into Gill Creek (Tr. 1413 at 22-28). S-4071 is a more detailed depiction of the network of sewers in the area of Gill Creek. The historical information available indicates discharges of various contaminants into Gill Creek through these sewers from Olin's production facilities, but there is no sediment sampling data or water quality information to confirm amounts or concentrations (Tr. 1413 at 28-30). S-6041 shows Olin's historical chemical production and use of chemicals at the Niagara Falls facility.

S-6033 is a process flow diagram created by Mr. Smyth depicting Olin's BHC production operations at a facility located in the Plant 2 area near Gill Creek. This process, which took place for a limited time between 1950 and 1956, generated various chlorinated benzene materials. S-6030 and 6045 are process flow diagrams produced by Olin which depict a slightly different BHC production process than the one depicted in Mr. Smyth's diagram (Tr. 1413 at 31-41).

S-6018 is a cross-section diagram entitled "Simplified Bedrock Geology and Fracture Zones," taken from the Record of Decision for the DuPont Site. Mr. Smyth used it to identify the water-bearing overburden and bedrock zones underlying the Solvent, Olin, and DuPont Sites, identified during various hydrogeological studies conducted in the area. As depicted on the cross-section, the uppermost layer of consists of approximately 12 feet of overburden aquifer, followed by approximately 150 feet of bedrock referred to generally as Lockport Dolomite. The bedrock is divided into fracture zones identified at various depths by the letters A, B, C, CD, D, E, F, and, finally, J. The J-Zone represents the base of the Lockport formation, below which is shale (referred to as the Rochester Shale) (Tr. 1413 at 48-50).

S-6026 is a document taken from a regional groundwater assessment dated October 1992, performed on behalf of Olin and DuPont by Woodward-Clyde and Conestoga-Rovers consultants. It depicts groundwater elevations in the area of the Solvent, Olin, and DuPont Sites, along with some of the regional hydrogeological features influencing groundwater flow. Mr. Smyth identified the Falls Street Tunnel and South Side Interceptor sewer lines, which carry approximately 9 million gallons of water a day each in an east-to-west direction under city streets, and the Power Authority of the State of New York ("PASNY") conduits, which carry water from the Niagara River north to the PASNY reservoir. He testified that this exhibit indicates a preferred groundwater flow path in the deeper bedrock zones (D-Zone and deeper) from the southwest to the northeast, with an arrow drawn directly from the DuPont Site, past the Olin BHC plant, under the Hot Spot, past the Solvent Site, and toward the exact location where the PASNY conduits intersect with the Falls Street Tunnel and South Side Interceptor sewer (Tr. 1413 at 50-54).

S-6022 depicts the same general flow path for groundwater in the Upper Lockport Dolomite (B-, C-, and CD-Zones). This drawing indicates that groundwater in the upper zones flows from a high elevation point at the DuPont and Olin Sites, through the Solvent Site and the Hot Spot, and directly toward the intersection of the Falls Street Tunnel and the PASNY conduits. According to Mr. Smyth, this intersection "is a major ground water discharge point for a huge section of the Lockport dolomite. A lot of the water is trying to get to that point as fast as it can" (Tr. 1413 at 55).

S-6015 is a composite of information obtained from several different hydrogeological investigations, showing groundwater elevations in the A-Zone, which is the groundwater flow zone closest to the surface. The A-Zone includes both "saturated overburden" and the uppermost level of fractured, or “weathered,” bedrock (*see* Tr. 1415 at 16-21). S-6015 depicts a high groundwater level near the center of Olin Plant 1, with a flow direction toward the low water level northeast of the Solvent Site. According to Mr. Smyth, the elevation readings on this exhibit indicate that Gill Creek does not have an impact on the flow of groundwater through the A-Zone (Tr. 1413 at 56-61).

On cross-examination by Olin’s counsel, Mr. Smith gave the opinion that chlorinated benzenes could travel in the A-Zone groundwater from the Olin Site to the Hot Spot through or under Gill Creek (Tr. 1415 at 26-29).

S-6017 shows the same northeasterly flow of groundwater in the B-Zone, from a high point south and west of the Olin BHC plant area toward the Hot Spot and the Solvent Site. This information was obtained from a Woodward-Clyde Phase I study at the Olin Site, conducted in 1993 (before Solvent began its pumping program in 2002). Mr. Smyth testified that the elevations depicted on this exhibit indicate that neither the Buffalo Avenue sewer, running from east to west along the northern boundaries of the Solvent and Olin Sites, nor the DuPont Sewer, running from south to north parallel to and just to the east of Gill Creek, have any impact on the flow of groundwater in the B-Zone (Tr. 1413 at 62-65).

S-6068 is a potentiometric surface map of the same area depicting B-Zone groundwater elevations and flow based on combined data from Solvent and DuPont investigations conducted in December 2006. According to Mr. Smyth, this exhibit shows that under pumping conditions, groundwater flows from the high point in the B-Zone aquifer, located on the DuPont Site in the area of the facility at which chlorinated aliphatics (PCE and TCE) were produced, and travels to the northeast across Gill Creek and on to the Solvent Site (Tr. 1413 at 65-67).

S-6069 shows potentiometric surface readings in the B-Zone prior to commencement of pumping operations, and S-6070 shows potentiometric readings after 69 hours of B-Zone pumping at well PW-1, located in the southwest corner of the Site. Mr. Smyth testified that a comparison of these two exhibits shows that this high rate of pumping did not have much influence on the overall groundwater flow in the B-Zone aquifer at the Site, beyond a limited draw-down effect in an area of approximately 50 feet surrounding the pumping well (Tr. 1413 at 67-70).

Based on these several groundwater elevation and flow path exhibits, Mr. Smyth gave the opinion that groundwater in the A-Zone flows from the Olin Site to the east and northeast toward the Hot Spot and the Solvent Site, and in the B-Zone the groundwater flows to the northeast throughout the areas of interest at the three sites. The B-Zone flow is not impacted by the Buffalo Avenue sewer, but there is not enough information on the exhibits discussed to determine the impact of the DuPont Sewer (Tr. 1413 at 70-72).

On cross-examination by Olin's counsel, Mr. Smyth testified that groundwater in the B-Zone flows primarily within the cracks and fissures in the bedrock between horizontal bedding planes, as well as in vertical fissures (Tr. 1415 at 18-21). He also testified that general hydrogeological principles regarding sewer lines as preferential pathways for groundwater flow would suggest that at least some of the groundwater from the Olin Site would travel north along the DuPont Sewer toward the Buffalo Avenue sewer and the wastewater treatment plant (*id*. at 30-40).

S-6075 shows the thickness of fill material and lacustrine (lake) sediments at the Solvent Site, indicating a fairly thick (six to ten feet) sequence of low permeability materials in the overburden which would impede the flow of spilled liquids into the bedrock and cause pooling of DNAPLs (Tr. 1413 at 73-74).

S-6019 is a bedrock elevation map of the entire three-site area, compiled from available well data with color-shaded areas indicating high-to-low elevation contours and computer-generated arrows indicating top of bedrock flow gradients. S-6071 is the same map without the elevation color shading but with the production facilities and buildings on the various sites highlighted. According to Mr. Smyth, the information on these exhibits shows that if NAPL was flowing along the top of bedrock, it would flow generally toward the Solvent Site (Tr. 1413 at 74-81). At the Olin Site, the arrows indicate that NAPL would flow from the location of the former BHC production plant south or southeast toward Gill Creek, and from the trichlorophenol and trichlorobenzene production areas north of the BHC plant toward the Hot Spot by traveling in fractures under Gill Creek (Tr. 1413 at 82-85).

On cross-examination, Olin's counsel pointed out that the arrows on these exhibits indicate a NAPL flow trend from northeast of the BHC plant to the south, in the opposite direction of the Hot Spot. Mr. Smyth testified that while there were several factors of influence in this particular area (such as a depression in the elevation of the bedrock under Gill Creek near the Adams Avenue bridge, and the nature of the media in the DuPont Sewer bedding), the general trend reflected by all of the parties' bedrock data remained consistent, showing the highest elevation on the Olin Site sloping toward the lowest elevation on the Solvent site (Tr. 1517 at 22-25).

S-6027 is a map showing the location of groundwater monitoring wells in the entire three-site area. The vast majority of wells are located on the Solvent Site in the areas of tank farm, rail, and other operations, and there is also a dense network of wells at the Hot

Spot. There are essentially no monitoring wells located in the areas of BHC and trichlorobenzene operations at the Olin Site, or in the areas of TCE and PCE operations at the DuPont Site. Mr. Smyth testified that if the object of well placement was to capture the highest potential sources of groundwater contamination without bias in the analytical data, the wells should be located directly in the area where the particular chemical production took place (Tr. 1413 at 85-88).

S-6036 shows soil sampling locations for the entire three-site area. The vast majority of soil samples have been taken from the Solvent Site, with a large number of dots indicating soil sampling in the areas of former site operations, as well as in the area of the Solvent 18-inch storm sewer which ran from north to south along the western boundary of the Solvent Site, then west through the lower portion of the Olin parking lot and emptied into Gill Creek. The map also shows sparse soil sampling in the areas of operations at both the Olin and DuPont Sites. In Mr. Smyth's opinion, this results in bias in the analytical data regarding contamination levels in the soil, as the placement of monitoring wells did with respect to groundwater contamination (Tr. 1413 at 89-94).

Mr. Smyth testified that the purpose of installing monitoring wells is to characterize ambient groundwater concentration in the aquifer, unaffected by pumping activity. The area of characterization is limited to the flow path line that travels through the well under ambient conditions, resulting in a zone of influence of just a few inches–essentially, the width of the sand pack around the well. A pumping well pulls in water from a greater diameter, giving a composite sample of flow paths in a much broader area of the aquifer. Because groundwater generally flows downward from the upper to lower water-bearing zones of the bedrock, a monitoring well screened in the B-Zone will have very little information about the C-Zone, whereas a pumping well in the B-Zone could conceivably pull water from the C-Zone through vertical fractures in the bedrock. In Mr. Smyth's opinion, pumping well data presents a better characterization of the overall quality of groundwater in the region than does monitoring well data (Tr. 1413 at 94-97).

On cross-examination, Mr. Smyth agreed with Olin's counsel that monitoring well data is of value because it represents the movement of contaminants through the aquifer at a specific location over time. A pumping well, which draws water from a much larger area than a monitoring well, can actually change the hydraulic regime of groundwater by pulling in contaminants from sources outside the normal flow path. In fact, the very purpose of a pumping well is to aid the cleanup objective by capturing the highest concentration of contaminants from as large an area of the site as possible. In Mr. Smyth's opinion, pumping well data presents a more representative picture of the contaminants in the aquifer of interest because monitor well data does not reflect the movement of groundwater through the fractured bedrock (Tr. 1415 at 60-64).

S-6021 is a graph prepared by Mr. Smyth as a summary of chlorinated aliphatics and chlorinated benzenes removed from the groundwater in the three-site area, beginning in 1940 when Olin began operation of its production wells, and continuing to approximately the time of trial. The graph shows a steady rise in the amount of chlorinated aliphatics being removed, with a noticeable upward turn beginning in 1991, when DuPont began operation of its shallow recovery well system; continuing in 1997 when Olin began operation of its shallow recovery well system; and a further spike in 2002, when Solvent began operation of its B-Zone pumping well system. The graph also shows chlorinated benzene removal at a very low rate throughout the entire period, with a slight increase in

2002 upon commencement of the Solvent pumping operations. According to Mr. Smyth, this exhibit represents the disparity between the large amounts of chlorinated aliphatics, as opposed to the much smaller amounts of chlorinated benzenes, being recovered by the pumping systems at the various sites (Tr. 1413 at 100-04).

S-6043 is a map of the three-site area taken from a regional groundwater assessment performed in 1992 by Woodward-Clyde and Conestoga Rovers Consultants, showing various levels of chlorinated aliphatic contamination. According to Mr. Smyth, this exhibit shows widespread groundwater contamination over the entire area of study as the result of DuPont's chlorinated aliphatic production (Tr. 1413 at 104–06).

S-6038 is a map of the entire study area, prepared by Mr. Smyth from monitoring well results, showing 1,1,2,2-tetrachloroethane concentrations in the B-Zone groundwater. The highest concentrations emanate from the area of DuPont's TCE and PCE manufacturing facilities, spreading to various locations in the Olin and Solvent Sites. TCE and PCE can be considered tracer chemicals for DuPont since, among the three companies, only DuPont manufactured these chemicals. According to Mr. Smyth, this exhibit shows that DuPont is the source of the chlorinated aliphatic contamination found at the Hot Spot and the Solvent Site (Tr. 1413 at 107-13).

On cross-examination, DuPont's counsel asked Mr. Smyth about D-240, which is a copy of a 1977 report by the International Trade Commission listing Hooker Chemicals & Plastics Corp. as the only manufacturer of 1,1,2,2-TCA in the United States at that time (Tr. 1420 at 16-17). He explained on redirect examination that the Hooker facility is located to the east of the Solvent Site, and there is no groundwater contour map or other evidence to suggest that materials from the Hooker facility could have migrated to the wells at the Solvent Site and Hot Spot (Tr. 1420 at 53-54).

S-6025 is a graph and associated pie chart prepared by Mr. Smyth based on combined data obtained from the pumping wells at the Solvent Site and Hot Spot, showing average concentrations of contaminants extracted from the groundwater, divided by USEPA maximum contaminant levels. As demonstrated by the graph and pie chart, chlorinated aliphatics (TCE, PCE and vinyl chloride) represent the overwhelming majority of contaminants found in the water pumped at the Site and Hot Spot (Tr. 1413 at 113-17).

S-6037 is a graph and associated pie chart, prepared from the same data as S-6025, showing straight concentrations of contaminants pumped from the wells at the Solvent Site and Hot Spot. As in the prior exhibits, the highest concentrations are chlorinated aliphatics. The pie chart suggests that chlorinated aliphatics represent about 65% of the contaminants extracted by the Solvent pumping wells (Tr. 1413 at 118-22).

S-6024 is a pie chart comparison of chlorinated aliphatic and chlorinated benzene groundwater contamination, based on pumped well data from various reports on the groundwater remediation systems being operated at each of the Sites. According to the pie charts, chlorinated aliphatics represent 100% of the contaminant load at DuPont. At Olin and at the Hot Spot, chlorinated benzenes represent only a very small percentage (approximately 3-4%) of the contaminant load. At 3163 Buffalo Avenue, chlorinated benzenes represent approximately 98% of the contaminant load in the shallow trench (A-Zone), and chlorinated aliphatics represent approximately 70% of the contaminants being pumped from the B-Zone wells. The combined B-Zone influent, including both the Hot Spot and the 3163 Buffalo Avenue property, is approximately 60% chlorinated aliphatics and 40% chlorinated benzenes. In Mr. Smyth's opinion, this information shows that the contaminants being pumped from the Olin Site are the same as the contaminants being pumped from the Hot Spot. The Solvent Site proper has a lot more chlorinated benzenes, but the overwhelming majority of contaminants being pumped from the B-Zone groundwater consists of chlorinated aliphatics (Tr. 1413 at 122-26).

S-6067 contains pie charts comparing the ratios of trichloroethene and tetrachloroethane (the two most prevalent chlorinated aliphatics) found in the pumped well data at each of the three sites. The comparison shows that the ratios are very similar, indicating that the chlorinated aliphatic contamination at all three sites is coming from the same source (Tr. 1413 at 126-27).

S-6042 is a pie chart comparison of the contaminants detected in the A-Zone shallow trench system at the 3163 Buffalo Avenue property. This system consists of three trenches installed down to the bedrock along the northern, western, and southern (including a portion of the southeastern) boundaries of the property to intercept the shallow groundwater in the overburden soils. The pie chart comparison shows that approximately 99% of the contaminants collected in the south and west trenches are chlorinated benzenes, while about 25% of the contaminants collected in the north trench are chlorinated aliphatics attributed to drum storage during the Frontenac periods of operation (Tr. 1413 at 127-30).

S-6028 is a summary of NAPL data for the three sites, compiled by Mr. Smyth from several site investigation and analytical data reports, showing the presence of NAPL associated with chlorinated aliphatics, chlorinated benzenes, and BHC throughout the study area on a widespread basis. Mr. Smyth testified that the NAPL associated with BHC is traceable to Olin, and the NAPL associated with chlorinated aliphatics is traceable to DuPont (Tr. 1413 at 130-139). He also testified on cross-examination by DuPont's counsel that, as stated in the SRI (*see* D-14 at p. 5-5), a quantitative assessment of contaminant loading based on NAPL migration would be difficult if not impossible due to several unknown factors, such as the unreported quantities of NAPL and the variable physical characteristics of the overburden and fractured bedrock (Tr. 1417 at 155-56).

S-6044 is a map of the study area showing total chlorobenzene and chlorotoluene concentrations in the B-, C- and D-Zone groundwater. According to Mr. Smyth, this exhibit shows two large plumes joining together, one caused by the Solvent facility and one caused by the Olin facility (Tr. 1413 at 139-40).

S-6032 shows monitor well results for perchlorate in the B-Zone groundwater. Mr. Smyth used perchlorate as a tracer to show that there is a flow path from Olin's hypochlorite production areas west of Gill Creek to the Hot Spot wells located east of Gill Creek, which indicated elevated concentrations of perchlorate (Tr. 1413 at 140-43). On cross-examination, Mr. Smyth explained that Olin did not manufacture perchlorate, but it was a "decomposition product" of hypochlorite (Tr. 1417 at 28). His opinion that there was a groundwater flow path from Olin's hypochlorite production facility to the Hot Spot, and that Olin was the source of not only perchlorate but all of the chlorinated benzenes detected at the Hot Spot, was based primarily on samples taken on one occasion in June 2007 from two of the six B-Zone monitoring wells showing concentrations of perchlorate above detection limits (Tr. 1417 at 30-34; *see also* O-608). He did not check to determine the groundwater impact of the long (over 60-year) history of perchlorate manufacturing operations at the nearby Occidental Chemical facility (Tr. 1417 at 37-43; *see also* O-404, 605, 607 and 623). He testified that Occidental would be an unlikely source of the perchlorate detected at the Hot Spot because of its location, which the existing documentation shows as downgradient in all of the groundwater flow zones (Tr. 1420 at 65-67).

S-6035 contains pie charts showing the relative proportion of cholorobenzene, dichlorobenzene, and trichlorobenzene materials detected in the groundwater influent from pumped wells at the Solvent and Olin Sites. According to Mr. Smyth, the pie charts show a close similarity in the proportions of materials being pumped at the Olin wells and the Hot Spot wells, indicating that the chlorobenzenes found at the Hot Spot came from the Olin facility (Tr. 1413 at 143-46).

On cross-examination, Mr. Smyth testified that the data represented on this exhibit was obtained by averaging the results from two pumping wells at the Hot Spot, one screened in the A-Zone and one screened in the B-Zone. Since each zone has different gradient and media characteristics, and each carries different concentrations of contaminants, a pie chart showing the average of sampling results taken from the two zones presents a completely different picture than a pie chart showing sampling results from each (Tr. 1415 at 49-56).

S-6046 is a map of Gill Creek and adjacent areas showing the location of downstream sediment samples taken during remediation activities in the late 1980s and early 1990s, along with a pie chart showing the makeup of the sampling results. Approximately 75% of the materials detected were PCBs associated with the DuPont facility, with approximately 5% attributed to chlorinated benzenes and the remaining 20% split between chlorinated aliphatics and BHC materials (Tr. 1413 at 146-47).

S-6048 contains pie charts comparing the results of sediment samples taken from Gill Creek near Adams Avenue, along with the results of soil samples taken from the Olin Site and from the Solvent Site during removal of the 18-inch storm sewer. According to Mr. Smyth, this comparison indicates that the sediment samples taken from the creek are composed of approximately 70% trichlorobenzenes, associated with the Olin Site (Tr. 1413 at 147-52). This comparison did not include available data based on sediment samples obtained from inside the sewer itself, which indicated the presence of very high levels of chlorinated benzenes, including trichlorobenzenes (Tr. 1417 at 59-63). Mr. Smyth explained that he did not use this information because of the different environmental media for samples taken from the soil and samples taken from inside a pipe, and there was no available data from the Olin Site to allow for a reasonable comparison (Tr. 1420 at 74-75).

During cross-examination, Olin's counsel showed Mr. Smyth three separate tables from the 1995 Malcolm Pirnie SRI indicating the presence of trichlorobenzenes at very high levels in both the soil and groundwater at the Solvent Site. Specifically, O-602 is a soil boring summary table showing concentrations of 1,2,3-trichlorobenzene at 640,000 ppb, and 1,2,4-trichlorobenzene at 290,000 ppb, detected at a depth of between six and eight feet in the southwest portion of the Site where a tank farm was located and chlorinated benzene processing operations took place (*see* O-613). Mr. Smyth agreed that these are high concentrations, and that the 18-inch storm sewer provided a potential pathway for contaminants released from this area to find their way into Gill Creek (Tr. 1415 at 65-70). Mr. Smyth also agreed that the high levels of NAPL concentrations detected in the soil at these operational areas of the Solvent Site are associated with several documented surface releases and spills (*see* O-449), and that these areas generally drained into the 18-inch sewer (Tr. 1417 at 45-48).

O-603 is a groundwater contaminant data summary based on samples taken from A-Zone monitoring wells showing a maximum level of 24,000 ppb 1,2,4-trichlorobenzenes detected at MW-4A, located in the northwest corner of the Solvent Site–just across DuPont Drive from the Hot Spot and monitoring well OBA-3A (Tr. 1415 at 70-71; *see also* O-615). O-601 is a groundwater contaminant data summary based on samples taken from B-Zone monitoring wells showing a maximum level of 47,000 ppb 1,2,4-trichlorobenzenes detected at MW-2B, located in the southwest corner of the Solvent Site where product was loaded and unloaded from railroad cars (Tr. 1415 at 71-76).

S-6047 is an allocation summary listing the contaminants found in the Gill Creek sediments. It was compiled by Mr. Smyth from the various studies performed in connection with the Olin/DuPont cleanup efforts in the late 1980s and early 1990s. The contaminants are given an allocation rating based on an assessment of "chemical harm" and "prevalence" under three separate DEC toxicity standards: 1985 Surface Water Criteria, 1999 Sediment Criteria–Human Exposure, and 1999 Sediment Criteria–Benthic Aquatic Toxicity. Under all three criteria, the overwhelming allocation percentages are attributed to PCB 1248, alpha-BHC, and beta-BHC, which are traceable to DuPont and Olin (Tr. 1413 at 152-55).

S-6020 is an allocation summary listing the contaminants found in the soil at the Solvent Site, compiled by Mr. Smyth from the various site investigation reports. He assessed a "weighted impact" for each contaminant based on its prevalence and average concentration as compared to DEC cleanup criteria, and then normalized the weighted impacts to add up to 100% as a means of rating each contaminant against the other. Zinc was rated first, with an assessed allocation of 22.54%, followed by mercury (21.93%), 1,2,4- trichlorobenzene (13.77%), benzene (9.06%), 1,2-dichlorobenzene (4.10%), and other chlorinated benzenes, metals, and chemicals. S-6020A is the full list of contaminants found in the soil for which Mr. Smyth performed this allocation calculation (Tr. 1413 at 155-59).

S-6066 is Mr. Smyth's allocation analysis for contaminants detected in the groundwater at the Solvent Site and Hot Spot, using pumped well (as opposed to monitoring well) data from the Solvent and Olin sites. As he did with soil contaminants, Mr. Smyth assessed a weighted impact for each groundwater contaminant, divided into two categories: aromatics, allocated at 44.5%, and aliphatics, allocated at 55.5%. According to Mr. Smyth, using a weighted risk factor as opposed to straight volumetric division of harm resulted in a 10% decrease in the allocation percentage for aliphatics (Tr. 1413 at 160-62).

On cross-examination by DuPont's counsel, Mr. Smyth testified that he used pumped well data for the years 2002-04 in calculating the allocation percentages reported on S-6066. He was then shown D-222, prepared by DuPont's expert, Dr. Faust, using B-Zone monitoring well data for the years 2004-06. This data reports concentrations and prevalence of chlorinated benzenes and other aromatic contaminants at 92.5%, and chlorinated aliphatics at 7.5%–significantly different than the allocation percentages reported on S-6066. Mr. Smyth explained that the monitoring well data used for this analysis represents a fraction of the contamination being intercepted by the pumping wells (Tr. 1420 at 40-46).

S-6016 is a table showing Mr. Smyth's assessment of contaminants detected in the shallow trench system at the Solvent Site. According to Mr. Smyth, this analysis shows that chlorinated aliphatics account for only a small amount of the contaminants being intercepted by the trench system (Tr. 1413 at 162-65).

S-6065 is a summary of groundwater flow readings showing the total gallons of water removed from the shallow overburden (approximately 2.9 million gals.), Solvent Site bedrock (42.4 million gals.), and Hot Spot (43.3 million gals.) wells between March 24, 2003 and December 23, 2005 (Tr. 1413 at 165-66).

S-6006 is a map of the three-site area showing mercury concentrations in the soil. The exhibit indicates a high level concentration of mercury in the southwest corner of the Solvent Site. In Mr. Smyth's opinion, this was most likely caused by an accumulation of surface materials at the Solvent storm sewer (Tr. 1413 at 166-68).

S-6072 contains two bar charts, one showing pumping data collected by TRC at the Hot Spot and the other showing pumping data from the Olin shallow groundwater remediation system located in the proximity of the BHC plant west of Gill Creek. According to Mr. Smyth, a comparison of the two charts shows very similar concentrations of contaminants being pumped at the two locations (Tr. 1413 at 168-71).

S-6074 is a compilation of the two previous charts with a third bar chart showing concentrations of contaminants detected in the DuPont groundwater remediation system influent. According to Mr. Smyth, a comparison of these charts shows the similarity of the chemicals being detected in the influents at all three sites. He testified that the general groundwater containment and control systems deployed at all three sites are very similar, and that the Solvent system can be expected to remain in operation for hundreds of years due to the high level of contamination at the site (Tr. 1413 at 172-76).

Mr. Smyth testified that, based on his review of the pumping data, 94% of the contaminants detected in the pumped wells at the Hot Spot are chlorinated aliphatics associated with DuPont. At the Solvent Site proper, as well as in the combined treatment system, chlorinated aliphatics make up the majority of the chemicals being pumped. According to Mr. Smyth, the presence of chlorinated aliphatics in the aquifer impacts the remediation of the site by lengthening the time for any natural bioremediation, leaching out of NAPLs, and eventual shutdown of the treatment system. He testified that if the system was treating chlorinated benzenes alone, it would be able to reduce contaminant levels to meet the standards for discharge to the Niagara Falls water treatment plant, and shutdown of the site treatment system, much sooner. In addition, the Solvent ROD requires Solvent to evaluate the impact of the treatment system on the concentrations of contaminants in the deeper bedrock zones. If the DEC finds the impact insufficient, it could require deeper wells and expanded pumping which, given the permeability of the deeper zones at the Site, would be likely to result in increased concentrations of chlorinated aliphatics in proportion to chlorinated benzenes (Tr. 1415 at 4-11).

2. Gary T. Hunt

Mr. Hunt is a Qualified Environmental Professional, currently employed by TRC. His area of expertise pertinent to this case is the impact on the environment of emissions of toxic air pollutants from stationary sources. He was retained by Solvent to investigate and report on the potential sources of mercury found in the soils at the Solvent Site (Tr. 1420 at 91-93).

He began his analysis by reviewing the available soil sampling data and documentation on the historical uses of the property since the inception of chemical production there in the early 1940s, finding no indication of activities that would account for the pervasive and widespread mercury contamination in the soils at the Site. His investigation of off-site sources revealed that Olin had operated a chlor-alkali production ("CAP") facility to the west and upwind of the Solvent Site, which the open literature confirmed was a potential major source of mercury emissions. Based upon his review of the available data, historical documents, peer-reviewed literature, deposition transcripts, results of air emissions dispersion modeling, and several other sources of information (*see* S-6080), Mr. Hunt reached the conclusion that the mercury found in the soils at the Solvent Site can be attributed to emissions from the Olin CAP (Tr. 1420 at 95-102).

S-6081 is a summary of the mercury detected in 21 soil samples collected at the Solvent Site in the 1990s. According to Mr. Hunt, this exhibit confirms the pervasive nature of the mercury contamination at the Site, at concentrations well above accepted background levels for urban soils in the United States (*see* S-6082). S-6006 is a contour map of the three-site area of study showing mercury soil concentrations as represented in the available soil data. Specifically, with respect to the Solvent Site, this exhibit shows the areas of concentrations of mercury as reported in the 21 soil samples represented on S-6081. According to Mr. Hunt, such pervasive contamination is unusual for a parcel of that size, particularly where there is no history of mercury use on the property. He identified Olin as the likely source, given the history of mercury use at its chlor-alkali production facility from 1897 through the early 1990s (*see* S-6041, 6083), the upwind location of the Olin facility as indicated by the "five year wind rose" represented on S-6006, and the lack of any information regarding mercury use at the DuPont Site (Tr. 1420 at 102-20).

Mr. Hunt explained his understanding of the chlor-alkali cell process, which involved the use of mercury to function essentially as an electrode in the electrolytic production of chlorine, caustic soda, and other products. The mercury was not consumed and would generally remain in the cell to be re-used in the process, but it commonly escaped into the environment as a vented gas, as a component of the "brine mud" waste product periodically removed from the cell, as the result of volatilization due to spills, or through other fugitive releases (*see, e.g.*, S-4086). Industry awareness of these problems eventually led to regulatory initiatives, resulting in the adoption in 1973 of national emission standards to specifically address mercury handling issues at chlor-alkali production facilities (Tr. 1420 at 122-32).

Mr. Hunt discussed several other documents which he relied upon in reaching his conclusions about the source of the mercury contamination at the Solvent Site. Figure 3 from the October 1988 Woodward-Clyde Olin Site Groundwater Assessment (O-243) shows the location of five mercury cell rooms at the Olin Site. Mr. Hunt testified that four cell rooms, containing a total of more than 2000 production cells, operated for a period of approximately 60 years, and a fifth cell room containing 58 cells operated for a period of approximately 30 years. According to Mr. Hunt, these operations resulted in the release of a significant amount of mercury into the atmosphere and environment in the area of the Olin Site. For example, Figure 31 from O-243 shows mercury concentrations detected at elevated levels in soil borings in the area of Olin Plant 2, where three of the five cell rooms were located (Tr. 1420 at 134-42).

S-4112 is an internal Olin memorandum dated August 14, 1991, entitled "Environmental Status of Niagara Falls Plantsite." The authorship is not indicated on the memorandum itself, but Mr. Hunt identified the author as a Mr. Brown. The memorandum discusses several issues related to the anticipated partial or complete shutdown of the Olin Niagara Falls facility, including the cost of corrective action to address contaminated soils resulting from the mercury cell chlor-alkali operations (Tr. 1420 at 142-43).

S-4113 is a February 1992 Woodward-Clyde RCRA Investigation Interim Report for the Olin Site, discussing at section 9.1.1 the evidence of widespread mercury contamination characteristic of emissions occurring over nearly 100 years of mercury cell operations at the Olin facility. S-4117 is the Woodward-Clyde Phase I Corrective Measures Study for the Olin Site, dated November 1993. Figure 4-1 depicts the soil management area, including the areas of both Plants 1 and 2 which contained the chlor-alkali cell rooms. According to Mr. Hunt, the remedial measures taken by Olin included some type of cover or cap of the soil management area (Tr. 1420 at 143-48).

Mr. Hunt described the steps taken by TRC to determine the potential impact of mercury emissions associated with Olin's chlor-alkali production activity on the soils at the 3163 Buffalo Avenue property. The principal analytic tool was an atmospheric dispersion modeling process using a computer program known as the Industrial Source Complex Model. The input parameters were based on available source identification information, mercury emission rates for cell room number five, meteorological data, representative ambient background levels for mercury in the air and soils in the study area, studies of environmental impacts at other chlor-alkali plants, and other pertinent data. The modeling program was run by TRC meteorologist John McCutcheon, and the results were plotted as predictive annual averages for mercury concentrations in both the atmosphere (*see* S-6011) and soils (*see* S-6009). Based on these results, Mr. Hunt concluded that Olin's chlor-alkali production was the most likely source of the mercury found in the soils at the 3163 Buffalo property (*see* Tr. 1420 at 148-56; Tr. 1421 at 2-43).

On cross-examination, Mr. Hunt agreed that the modeling results for soil deposition indicated that the highest concentrations of mercury would occur on the northwest portion of the Solvent Site, whereas the actual results of soil sampling showed the highest concentrations occurring in the southwestern portion of the Site. He explained that the purpose of the modeling was to determine if Olin's CAP could account for the overall presence of mercury at the Solvent Site, not to predict where the highest concentrations might be found (Tr. 1421 at 101-08).

Mr. Hunt testified that TRC also performed a dispersion modeling analysis to determine the possible impact on Solvent Site soils of chlor-alkali production at the Occidental plant, located to the east and upwind of the Solvent Site. Due to the limited availability of chlor-alkali production and sampling data from Occidental, TRC used the input parameters from the Olin model, essentially placing Olin's cell room five at the most likely location of Occidental's CAP. The results of the modeling, as depicted on S-6010, indicate that Occidental's mercury emissions had a limited ambient impact on the Solvent Site, estimated to be less than 10% of the impact of Olin's chlor-alkali production (Tr. 1421 at 43-51). Mr. Hunt also testified that there was no information available for his review to substantiate the theory that contaminated fill material might have been a significant source of the mercury concentrations detected at the Solvent Site (Tr. 1421 at 51-54).

3. Paul Hughes

Mr. Hughes is the Project Manager in charge of the design and implementation of the remediation activity at the Solvent Site, as required by the December 1996 Solvent ROD (*see* S-1012) and the October 1997 Solvent Consent Decree (*see* D-103). He was initially hired as a subcontractor by AIG Environmental Management, Inc., to provide design services for the remedy. He eventually became employed by TRC, which was the firm retained directly by Solvent to perform construction, operations, maintenance, and monitoring services at the Site (Tr. 1422 at 8-12).

S-1012 is the declaration statement from the Solvent ROD summarizing the seven major elements of the remedy being implemented at the Solvent Site and Hot Spot. The first element is described as containment of highly contaminated soils onsite with a clean cover system, which Mr. Hughes explained was implemented by installing a 12-inch-thick, generally clean soil cover across the entire site to prevent direct contact with contaminated soils, and to prevent migration due to wind or surface water erosion. The second element, control and collection of contaminated overburden groundwater, refers to construction and operation of a system to drain and collect the water from the overburden materials for treatment and disposition. The third element, phased bedrock hydraulic system for control of contaminated bedrock groundwater, refers to construction and operation of a series of pumping wells in the B-Zone, which is the upper transmissive zone of bedrock at the Site. The fourth element, monitoring and evaluation of B-Zone and lower bedrock groundwater, refers to ongoing monitoring of groundwater by elevation and quality measurements to evaluate the effectiveness of the pumping system. The fifth element refers to treatment and disposal of the pumped water, which involves pretreatment of the collected groundwater and discharge to the Niagara Falls POTW. The sixth element refers to the long-term monitoring program for the remedy. Mr. Hughes was not involved with the seventh and final element, which refers to deed restrictions to prevent future uses of the property incompatible with the remedy (Tr. 1422 at 12-16).

Mr. Hughes testified that AIG was responsible for the initial design of the remedial plan, negotiating access to the property, and other activities outlined on S-2023. The first site activity undertaken by TRC involved baseline groundwater monitoring at the 3163 Buffalo Avenue property in late 1997 to collect data and evaluate the status of the existing monitoring wells. TRC sought access to Olin's property at that time to perform baseline monitoring at the Hot Spot, but was denied (Tr. 1422 at 17-20; *see also* S-1081).

S-1022 is a letter from AIG to the DEC dated May 12, 1998, reporting the results of a pump test conducted by TRC in March 1998 at PW-2B, located in the northwest corner of the 3163 Buffalo Avenue property. The purpose of the test was to obtain preliminary site-specific information about how the B-Zone aquifer would respond to the stress of pumping activity. As indicated in the correspondence to the DEC, groundwater samples taken during test pumping showed decreasing levels of site-specific contaminants (benzenes and chlorobenzenes), as expected. However, the samples also showed unexpected increased levels of non-site-specific contaminants, including TCE, PCE, and BHC. According to the test report, sampling after one hour of pumping at a rate of 60 GPM (60 gallons per minute) indicated a ratio of 35% site-specific contaminants to 65% non-site-specific contaminants. After 20-plus hours of pumping, the ratio was 10% site-specific to 90% non-site-specific contaminants detected. As identified in the test report, the non-site-specific compounds were primarily chlorinated aliphatics (Tr. 1422 at 21-28).

Mr. Hughes testified that TRC also conducted a preliminary subsurface investigation of the 18-inch storm sewer running from the 3163 Buffalo Avenue property to Gill Creek to determine the scope of the sewer remediation project. According to Mr. Hughes, soil sampling at a variety of locations along the sewer line detected chlorinated benzenes and some inorganic compounds, but the soil contamination was deemed non-pervasive, and the remedial design was limited to the area of the sewer line and bedding (Tr. 1422 at 28-30).

To determine the placement of the pumping wells to be used in the groundwater remedy at the Solvent Site, Mr. Hughes reviewed the hydrogeological studies represented in the Solvent ROD, which indicated a general groundwater flow from south to north, influenced by man-made features to the north and northeast. Based on this information, Mr. Hughes determined that the hydraulic control required by the ROD would be most efficiently achieved by placing the wells along the northern property boundary. This remedial design was submitted to, and approved by, the DEC (Tr. 1422 at 30-32).

Construction of the remedy began in October 1999 with the installation of the overburden collection trench and pumping wells (also referred to as “production” or “extraction” wells). A plan view of the Site and the Hot Spot area (S-1057, JFM1070529)[5] shows the A-Zone collection trench and well system as built. The system was designed

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[5] For accuracy of reference, individual Bates numbers will be used where available to indicate excerpts from multi-page exhibits.

to manipulate the groundwater flow in order to eliminate offsite migration. Once the system was in place, additional aquifer testing was performed during the winter of 2000 to gather hydraulic control data at newly installed production wells along the collection trench in the Hot Spot area (PW-3B and 4B) and in the northern part of the 3163 Buffalo Street property (PW-5B and 6B) (Tr. 1422 at 32-36).

The next major construction event was the remediation of the 18-inch sewer, which took place in the summer of 2000. S-1057 (JFM1070534) is a drawing of the sewer remediation area, representing the different categories of remedial activity, including complete removal of the sewer and contaminated soils, where possible, and in-place closure and abandonment of the sewer in certain places where removal was not an option. The excavated soils were stockpiled on the Solvent Site, along with the soils excavated during construction of the A-Zone trench. Subsequent soil samples sent to the DEC confirmed satisfactory remediation of the predominant contaminants of concern (Tr. 1422 at 37-40).

The next step was construction of the soil cover by first establishing subcover grades for proper drainage, utilizing the soils stockpiled from the storm sewer remediation and A-Zone trench excavation. A geotextile vapor barrier was then installed, followed by 12 inches of clean fill over the entire site. Other surface elements included construction of a building housing the equipment to be used for pretreating the water for eventual discharge to the POTW and, finally, access roads and fencing (Tr. 1422 at 41-47; *see* S-1032). Mr. Hughes testified on cross-examination by DuPont's counsel that using the heavily contaminated excavated soils for subcover grading added chlorinated benzene materials to the property, to be flushed into the groundwater over time (Tr. 1422 at 193).

On cross-examination by Olin’s counsel, Mr. Hughes testified that he was unaware of any information suggesting that any entity other than Solvent was responsible for the chlorobenzenes found in the soils at the Site. He has worked on hundreds of environmental remediations and has never encountered higher concentrations of chlorobenzenes than those detected in the soils at the Solvent Site (Tr. 1422 at 121-22). However, he also testified that this was the first site he had ever worked on where the facility was in the business of manufacturing chlorinated benzenes (Tr. 1425 at 111-12). He was shown O-445, which is a map of the Site taken from the 1995 Malcolm Pirnie SRI representing the extent of NAPL either observed or suspected to be present in the soils along the 18-inch sewer line and other areas of the 3163 Buffalo Avenue property where historical chemical handling operations took place. He was also shown O-449, which depicts the location of reported chemical spills in relation to the detected or suspected presence of NAPL at the Site. He generally agreed that the NAPL found at several locations along the sewer line in both the soil and inside the sewer itself was associated with chlorinated benzene contamination, and that the sewer drained areas of the Solvent Site directly into Gill Creek (Tr. 1422 at 120-38).

O-319 is a letter from the DEC to Michael Plumb of TRC, dated January 16, 2003, in which the DEC acknowledges the completion of all major remedial construction activities at the Solvent Site. By letter dated May 16, 2003, TRC transmitted its Final Engineering Report and Engineer’s Certification (*see* S-1057, JFM1070541-42), which were approved by the DEC in July 2003 (*see* S-1059, 1060; Tr. 1422 at 47-50).

S-1065 is a transmittal letter and excerpts from the Performance Monitoring Plan for the Solvent Site, submitted to the DEC by TRC in June 2004. As outlined in a summary at Table 3-1 of this report, and as testified to by Mr. Hughes, these activities included monitoring the performance and integrity of the clean soil cover to ensure that it continued to contain contaminated soils; measuring the water levels in the collection trench and surrounding soil to determine whether the A-Zone groundwater was migrating to the trench; measuring water levels in the production and observation wells to determine the effectiveness of hydraulic control of contaminated groundwater in the B-Zone; water quality sampling of B-Zone and deeper monitoring wells; and water quality sampling of pumped and pretreated groundwater for discharge to the POTW, including submission of quarterly self-monitoring reports to the DEC, to ensure compliance with the discharge permit. The DEC approved the performance monitoring plan in July 2004, marking the completion of remedial construction and start-up activities and the beginning of operation, monitoring, and maintenance ("O, M & M") activities (Tr. 1422 at 50-56; *see* S-1083, JFM1076174-75).

Mr. Hughes testified that the remedy ultimately approved for the Site differed in a number of ways from the original design. The major modification involved a shift away from "formation grouting" or a "grout curtain," explained as a process for plugging up groundwater flow in the bedrock aquifer to reduce the amount of pumped water necessary to effect hydraulic control. Implementing this option would not have eliminated the need for pumping wells because the grout curtain would not address the horizontal flow of water entering the site from above. A grout curtain was also considered and rejected as an option for the Hot Spot, due to Olin's concerns about the need for further hydrogeological study. Ultimately, the decision not to utilize a grout curtain at the 3163 Buffalo Avenue property was based on the aquifer testing program data, which indicated that more than half of the water produced by the pumping wells would be coming from Hot Spot wells PW-

3B and PW-4B, located outside the grouted area (Tr. 1422 at 56-68; *see* S-1032, 2023,1040, 1048, 1081; O-312).

Mr. Hughes testified that the expected flow rate for groundwater pumping to attain the hydraulic control indicated in the Solvent ROD was estimated at a range from 175 to 225 GPM (*see* S-1012), and the conceptual design flow rate was estimated at 200 GPM. These estimates represented the combined total of the pumping rates of all B-Zone wells and A-Zone wells (*see* S-1045). However, a number of problems related to contaminant loading were encountered while operating the wells and pretreatment system during the "start up-prove out" period in late 2001 and early 2002, requiring the eventual modification of the flow rates to meet the limits of the POTW permit. As reported to the DEC in a letter dated March 29, 2002 (S-3038), sampling of groundwater influent at wells PW-2B and PW-4B revealed substantially elevated levels of chlorinated aliphatics, while site-specific indicator compounds (*i.e.*, chlorinated benzenes) were being detected within design criteria. TRC proposed a six-month study, during which the wells would be pumped at reduced rates in order to get a better understanding of how contaminant concentrations responded to different pumping rates over time. This proposal was approved by the DEC (*see* S-1083, JFM1069577-78), and the pumping wells began continuous operation in May 2002 (Tr. 1422 at 68-78).

S-1083 (JFM1069572-73) is a monthly progress report dated June 14, 2002, indicating that continuous operation of the groundwater extraction and pretreatment system began in May at a reduced pumping rate of 40 to 50 GPM. Individual well sampling and discharge sampling identified continued exceedences of discharge permit limits for chlorinated aliphatics, leading to discussions between representatives from Solvent and the POTW regarding temporary modification of the permit to allow the system to operate at pumping rates sufficient to demonstrate the hydraulic control required by the Solvent ROD. As testified to by Mr. Hughes, the monthly progress reports for June and July 2002 reflect that the predominant contaminants of concern associated with Solvent's historical activity at the Site did not impede operation of the extraction and pretreatment system within permit limits (Tr. 1422 at 79-83).

S-3039 is a letter from TRC to the DEC dated October 21, 2002, summarizing issues for discussion at a meeting scheduled for the end of the six-month study period. As discussed in this letter, the overall pumping well flow rate was gradually increased during this period from a low of 40-50 GPM to a high of 120 GPM, and high concentrations of chlorinated aliphatics continued to be detected in the groundwater extracted at PW-2B and PW-4B. Mr. Hughes testified that, at the urging of the POTW, TRC investigated possible sources of the chlorinated aliphatics causing the discharge permit violations. The investigation identified the lower zones of fractured bedrock beneath the East Plant area of the DuPont facility, where historic TCE and PCE operations were located, as one possible source. As reported in the October 21 letter, there was no active groundwater remediation system in place at the DuPont Site to address the documented presence of groundwater contamination and DNAPL containing chlorinated aliphatic compounds (Tr. 1422 at 83-91).

The meeting between TRC and the DEC took place on October 24, 2002. As indicated in TRC's monthly report for November 2002 (S-1083, JFM1069562), the DEC found the evidence regarding the source of the chlorinated aliphatic contamination to be compelling, and indicated its intent to encourage DuPont to engage in discussions with

Solvent to address the problem. However, Solvent was advised that it remained responsible for fulfilling its Consent Decree obligations. As Mr. Hughes testified, the Solvent ROD required Solvent to pump and treat whatever contaminants are found in the water in order to attain hydraulic control of the Site, and the system in place was incapable of extracting only the chlorinated benzene contamination due to the inseparability of the dissolved contaminants in the groundwater (Tr. 1422 at 91-93).

S-3040 is a letter dated November 25, 2002, from Michael Hinton of the DEC to Paul Mazerski at DuPont Environmental Remediation Services requesting that DuPont immediately undertake an evaluation of options to address the off-site migration of contaminants from DuPont's East Plant which the DEC had determined were adversely affecting the operation and performance of the remedial system in place at the adjacent Solvent Site. Mr. Hughes testified that he did not know whether DuPont ever responded to this letter (Tr. 1422 at 93-95).

O-317 is a letter from TRC to Albert Zaepfl, Industrial Monitoring Coordinator for the Niagara Falls POTW, requesting a permanent modification of the discharge permit. The POTW approved the modification in December 2002, allowing Solvent to operate its pump and treat system at 80 GPM without additional permit violations (*see* S-1083, JFM1069558). Mr. Hughes testified that this is the approximate overall rate at which the B-Zone system currently operates, and that the DEC approved the degree of hydraulic control achieved at this flow rate for the entire Site (Tr. 1422 at 95-101, 103-05; *see also* O-321; S-1083, JFM1075232-33).

In June 2003, the POTW made a further modification to the permit to allow for the discharge of T-cyanide and BHC, which had been detected in recent verification samples (*see* S-1065; Tr. 1422 at 102-03).

In March 2004, the DEC advised Solvent that it had reviewed the results of a continuous 24-hour B-Zone bedrock groundwater level monitoring event conducted in December 2003, which presented data from routine pumping as well as static conditions after a week-long shutdown for system maintenance. Based on this review, the DEC found sufficient hydraulic control of the bedrock groundwater at the Solvent property and the Olin Hot Spot to justify using the 24-hour monitoring event data as baseline hydraulic conditions for long-term performance monitoring (Tr. 1422 at 105-06; *see also* S-1062, 1064).

S-6064 is a summary of the costs incurred by Solvent as of June 30, 2007 for remediation of the 3163 Buffalo Avenue property and the Hot Spot, broken down on a chronological basis. S-6063 is a summary of the remediation costs incurred per task, along with future costs of operation, monitoring, and maintenance projected over a 30-year period. Mr. Hughes explained the general nature of the activities performed for each category of costs listed, and testified that in his opinion the operation, monitoring, and maintenance period is likely to last longer than 30 years (Tr. 1422 at 107-18).

4. James Kohanek

Mr. Kohanek is Vice President of Tech Law, Inc., located in Chantilly, VA. He has a Bachelor of Science degree from Saint John's University in Collegeville, MN, a Master's degree in chemistry from San Diego State University, and a Juris Doctor degree from Capital University Law School. His professional experience includes five years of working in the chemical industry, five years of working on Superfund cases as senior enforcement counsel for the USEPA in Washington, DC, and more than twenty years in the private sector performing a wide variety of roles as consultant, mediator, arbitrator, and court-appointed expert in cases involving the allocation of the costs of environmental remediation (Tr. 1423 at 2-5; *see* S-6049). He has no field experience in the areas of environmental engineering, geology, hydrology, hydrogeology, groundwater monitoring, or the movement of contaminants in the environment (Tr. 1423 at 98-100).

Mr. Kohanek was retained by Solvent to develop a methodology for the court to utilize in allocating the remediation costs at issue in this case. His methodology and proposal include all settling and non-settling potentially responsible parties, and all three areas of concern–the 3163 Buffalo Avenue property (including issues regarding soils, overburden groundwater, and bedrock groundwater), the Hot Spot (primarily involving bedrock groundwater), and Gill Creek (involving sediment issues) (Tr. 1423 at 5-8).

Mr. Kohanek testified that when he performs an allocation, there are three primary considerations: first, to determine the harm caused by the contaminants of concern; second, to determine the sources of the contamination causing the harm; and third, to determine the relative contribution of each source. To assist in this task, he relies on Tech Law staff for assistance in organizing the testimonial and documentary information, and often looks to outside organizations for technical expertise. In this case, he also relied heavily on the technical information provided by Andrew Smyth and Gary Hunt from TRC, essentially adopting their findings with respect to the sources of the contaminants causing the harm at the areas of concern (Tr. 1423 at 8-11).

S-6051 is a color-coded map representing Mr. Kohanek's attempt to identify the general locations of the 3163 Buffalo Avenue property where Solvent handled materials containing contaminants of concern. He explained his understanding that Solvent's operations included manufacturing chlorinated benzenes from the reaction of benzene and chlorine, as well as bringing in waste chlorinated benzene materials for reprocessing into useable product. As indicated by this map, chlorinated benzenes were handled in several areas of the property. Mr. Kohanek's review of the historical information, remedial investigation reports, and prior testimony revealed that Solvent was not a highly sophisticated chemical company, at least during the early days of its operation, and many spills and other releases of these materials occurred at the Site (Tr. 1423 at 11-14).

S-6054 depicts the general location of Frontenac's material handling operations at the Site. Mr. Kohanek testified that Frontenac was basically a storage company which handled a wide variety of chemical wastes, including TCE and PCE. Most of the material was transported to the facility in drums, which were stored for short periods in buildings, parking lots, and other areas of the Site and transported back out again. There was little available information regarding Frontenac's raw material handling, spills, ruptures of containers, or other releases indicating any major cause for concern (Tr. 1423 at 14-17).

As part of his work identifying potential sources of the contamination at the Solvent Site, Mr. Kohanek also reviewed the available historical documents, remedial investigation reports, and testimony pertaining to operations at the adjoining Olin and DuPont facilities, which indicated the occurrence of events resulting in major releases of contaminants. These events included the 1956 explosion at Olin's BHC facility, Olin's mercury cell operations, and DuPont's TCE and PCE production (Tr. 1423 at 17-19).

S-6050 is a chart Mr. Kohanek prepared entitled "Allocation Parties," listing the entities identified as owners or operators of the facility at 3163 Buffalo Avenue and the "Adjoining Migrating Facilities." The chart also indicates which of these entities might be responsible for the chlorinated benzenes, chlorinated aliphatics, metals, and other contaminants of concern detected at the Solvent Site (Tr. 1423 at 19-24).

S-6052 lists the "Arrangers" who transported chlorinated benzene waste material to Solvent during the years of its operation. The chart indicates the volume of chlorinated benzene waste assigned to each arranger, measured against the total volume of chlorinated benzene waste brought into the facility during Solvent's operation, to determine individual arranger shares by percentage. S-6053 presents the same type of volumetric waste-in information for arranger parties during the Frontenac period of operation of the Site, based on shipping records, manifests, deposition testimony, and other available data. This list does not indicate arranger shares by percentage (Tr. 1423 at 24-27).

S-6055 is a chart summarizing the first two steps of the allocation framework employed by Mr. Kohanek to assign relative contribution percentage shares for the contamination of the on-site soils at the 3163 Buffalo Avenue property. The first step involved assigning a contribution share for each of the contaminants of concern (representing the percentage of the total harm to the soils caused by each contaminant), based on the quantitative information and risk-weighted allocation calculations provided by Mr. Smyth (*see* S-6020A). Mr. Kohanek added up the percentages assigned to the individual contaminants detected in the soils and arrived at contribution shares of 38.72% for chlorinated benzenes, 0.01% for chlorinated aliphatics, 22.54% for zinc, 21.93% for mercury, and 16.80% for other mixed wastes not directly attributable to any specific source (Tr. 1423 at 27-32).

The second step involved Mr. Kohanek's attempt to ascribe weighted percentage shares to the identified sources of these contaminants. The sources are listed as follows: Solvent Chemical; Recochem, Inc.; FES I (referring to Frontenac's operation of the Site between 1/80- 3/81, under ownership of Laidlaw Transportation Co.); FES II (Frontenac's operation of the Site between 4/81-8/83, under ownership of George Lodick); Conrail (operator of railroad services at the Site); Bema (Canadian company related to Frontenac); and Corigan Sanoian (owner of 3163 Buffalo Ave. from 1983-1999). Based on the percentages of harm to the soil ascribed to the specific contaminants of concern reported in step one, as weighted against the extent of related site operations by each owner/operator, Mr. Kohanek assigned relative contribution shares of 59.07% to Solvent, 19.74% to Olin, and the remainder (totaling 21.19%) to the other identified sources. DuPont was assessed no contribution share for harm to the soils (Tr. 1423 at 32-39).

S-6055.2 illustrates Mr. Kohanek's calculations at step three, involving assignment of shares between owner-operators (responsible for the handling of materials at the Site) and arrangers (responsible for shipping wastes to the Site). S-6055.3 illustrates Mr. Kohanek's calculations at step four involving assignment of adjusted shares for individual arrangers during the FES I and FES II periods of operation. S-6055.4 shows the assignment of adjusted shares for individual arrangers during the Solvent/Recochem period of operation. According to Mr. Kohanek, these calculations represent classic allocation work dealing with distribution of contribution shares among parties based on volumetric data (Tr. 1423 at 40-45).

S-6056 illustrates Mr. Kohanek's calculations for assignment of contribution shares for contamination of the overburden (A-Zone) groundwater at the 3163 Buffalo Avenue property. Following the same step-by-step framework as he did for soils, he first ascribed relative shares to the contaminants of concern, assigning chlorinated benzenes a 97.3% contaminant contribution share, and chlorinated aliphatics a 2.87% share. The chlorinated aliphatic shares were broken down further as 2.17% ascribed to the north trench, and 0.70% ascribed to the south and west trenches. At step two, he assigned the relative contribution shares to the identified sources of the contaminants based upon their operations, resulting in the following total contribution share percentages for A-Zone groundwater contamination: Solvent = 89.36%; Recochem = 5.83%; FES II = 2.17%; Conrail = 1.94%; and DuPont = 0.70%. At steps three and four, Mr. Kohanek assigned percentage shares among owner/operators and arrangers based on the degree of their involvement with the contaminants detected in the A-Zone groundwater (*see* S-6056.2). S-6061 is an allocation summary listing the results of these calculations (Tr. 1423 at 47-64).

Mr. Kohanek testified that the same framework was used to develop contribution shares for the B-Zone bedrock groundwater contamination at 3163 Buffalo Avenue and the Hot Spot. S-6057.1 illustrates Mr. Kohanek's calculations for 3163 Buffalo Avenue. At step one, he assigned contaminant contribution shares of 31.61% for chlorinated benzenes, and 68.39% for chlorinated aliphatics. At step two, based on the sampling data and hydrogeological information provided by Mr. Smyth, Mr. Kohanek assigned Solvent a 92% contribution share for the chlorinated benzene contamination, and DuPont a 98% share for the chlorinated aliphatic contamination. He then distributed the relative contaminant shares among the identified sources, including owner/operators and arrangers, based on the degree of their involvement with the contaminants detected in the B-Zone groundwater. As a result of these calculations, Mr. Kohanek assigned contribution shares of 67.02% to DuPont and 0.63% to Olin, with the remaining 32.35% assigned to Solvent and its related owner/operators and arrangers (*see* S-6057, 6061, 6078; Tr. 1423 at 64-79).

Using the same framework to determine contribution share percentages for bedrock groundwater contamination at the Hot Spot, Mr. Kohanek assigned chlorinated benzenes a relative contaminant share of 6.48%, and chlorinated aliphatics a relative contaminant share of 93.52%, distributed among the sources as follows: DuPont, 93.52%; Olin, 6.35%; Solvent and its related owner/operators and arrangers, 0.13% (*see* S-6059, 6061, 6078; Tr. 1423 at 79-86).

S-6060 illustrates steps one and two of Mr. Kohanek's framework for allocating the costs of the Gill Creek remediation. Step one involved assigning relative contribution shares to the various contaminants found in the creek sediment samples, based on the data summary provided by Mr. Smyth (*see* S-6047), which resulted in average contribution shares of 0.44% for chlorinated benzenes and 99.56% for all other contaminants. Step two involved comparing the chemical composition of the chlorinated benzenes found in the creek sediment samples, storm sewer samples, and Olin plant soil samples, and assigning contribution shares as between Solvent (40%) and Olin (60%), the two identified sources of the chlorinated benzene contamination. When redistributed based on the average contaminant share of 0.44% for chlorinated benzenes, the result was an assignment of a 0.18% contribution share to Solvent and a 0.26% contribution share to Olin for the costs associated with cleanup of the chlorinated benzenes detected in the Gill Creek sediments (S-6060; Tr. 1423 at 90-97).

On cross-examination by DuPont's counsel, Mr. Kohanek testified that this overall allocation methodology did not take into account the variations in contaminant loadings that might occur over time as the result of remedial activity (Tr. 1425 at 60-61).

B. Olin's Witnesses

1. Kelly McIntosh[6]

Mr. McIntosh is an environmental engineer, currently employed by Geomatrix Consultants. He has a Bachelor of Science degree in biology from Penn State University, a Master's degree in hydrology from the University of New Hampshire, and a Ph.D. from the University of Delaware. He was hired by Woodward-Clyde in 1984, and gained knowledge of the soil and groundwater in the areas of concern in this case through his work on several projects for both DuPont and Olin involving operations at their Niagara Falls facilities. He was transferred to Western New York in 1989 to work as project manager for the groundwater investigations, corrective measure studies, and remediation activities that took place at Olin's Niagara Falls plant. He was directly involved with the remedial activities at Gill Creek in the 1990s, and was Olin's on-site representative during the remediation of Solvent's 18-inch storm sewer in 2000. He also served as project

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[6] Mr. McIntosh was originally designated by Olin to testify as an expert witness at trial, and submitted an expert report entitled "Solvent Chemical Site Groundwater Treatment System Influent Chemical Loading Allocation" (S-7003, for identification only), which set forth his opinion regarding Olin's responsibility for the chlorinated aliphatics detected in the water pumped from the Hot Spot wells. He was withdrawn as an expert prior to trial, and was called by Olin to testify as a fact witness regarding his first-hand knowledge of the remedial activities at the Olin and Solvent Sites.

manager for both DuPont and Olin in connection with the development of the 1992 Woodward-Clyde/Conestoga Rovers regional groundwater assessment (Tr. 1430 at 3-13).

Mr. McIntosh testified that he was aware of a prior remediation effort at Gill Creek in 1980 which addressed only certain portions of the creek and was ineffective in removing the contaminated sediments in the area of the Adams Street Bridge. S-4519 is the March 1991 Consent Decree between the State, Olin, and DuPont dealing with the further remediation of Gill Creek, and S-4527 is the March 1992 Gill Creek ROD which outlined the procedures for implementing the selected remedy. As indicated in the ROD, the creek was divided into three primary areas of concern–Area 1, the farthest downstream section of the creek extending from the Staub Road overpass to the Niagara River; Area 2D, the downstream area from just south of Adams Avenue to Staub Road; and Area 3, encompassing the area in the general location of the Adams Avenue Bridge. The remedial plan for Area 3 involved the construction of dams to dewater the sediments before excavation, with seepages of groundwater into the excavation zone to be controlled by collection, on-site pretreatment, and discharge to the POTW (*see* S-4527, Fig. 2; Tr. 1430 at 15-20).

O-469A is a 1990 aerial photograph depicting Gill Creek between Buffalo Avenue and the Adams Avenue Bridge, along with the Olin plant parking lot and the Solvent Chemical Site. Also depicted on this exhibit is the Solvent 18-inch storm sewer, which extended from the northwest corner of the Solvent Site southward along the entire western boundary, and then from the southwest corner westward along the southern boundary of the Olin parking lot, finally emptying into Gill Creek at the diversion dam located to the north of the Adams Avenue Bridge (Tr. 1430 at 21-23).

Mr. McIntosh testified that his investigatory work involved collecting sediment samples in Area 3, revealing levels of chlorinated benzenes which exceeded State cleanup goals by orders of magnitude, meaning hundreds or thousands of times higher than recommended levels. As he walked through the creek bed, he observed NAPL being transmitted up through the water column to form an oily sheath on the surface. His recommendation was removal of the sediments from the creek bed in Area 3. This recommendation was ultimately adopted by the DEC in the Gill Creek ROD (Tr. 1430 at 23-28).

The design and engineering of the Gill Creek remedy was an extensive process involving hydrogeologic analysis, a complex treatment program, and a multi-phase diversion dam construction procedure–as well as deconstruction of the dams and restoration of the normal flow of the creek. Diversion dams were built on the north side of Buffalo Avenue to divert the creek waters into the City of Niagara Falls diversion sewer, and on the southern end of the creek at the Niagara River. Additional dams were built to the north and south of Adams Avenue to divert and collect groundwater seepage for treatment (Tr. 1430 at 28-34).

Mr. McIntosh was involved in oversight, inspection, and certification of the excavation work performed in Area 3. He testified that the bulk of the sediments were removed, using a small “Bobcat” excavator, followed by hand removal, and then high-pressure spraying of the top of bedrock sediments. The spray water was collected and sent to the treatment facility, along with fluid that was found seeping from the creek bank on the southwest side of the Adams Avenue Bridge abutment. A sample of the seep fluid sent for analysis revealed NAPL containing chlorinated benzenes, which triggered further excavation of creek bank soils, installation of monitoring wells, and other measures to determine whether the seeps were traceable to soil or groundwater contamination at the Olin Site. O-604 is the December 1993 Gill Creek Remediation Project Final Report, prepared by Mr. McIntosh. He reported that no additional seeps were observed during this investigation of the dewatered western creek bank, which led him to conclude that the likely source of the NAPL was not the Olin Site soils but rather the outfall of the Solvent 18-inch storm sewer located on the east bank of the creek, north of the Adams Avenue Bridge (Tr. 1430 at 34-43).

On cross-examination by Solvent's counsel, Mr. McIntosh was shown S-4530, which is an Olin interoffice memorandum dated October 7, 1992 discussing the sampling results for the NAPL seep taken from the west bank of the creek in Area 3. He agreed with Solvent's counsel that the highest concentration reported in this sample was alpha BHC, indicating that the NAPL contained a lot of solid BHC which could not be diluted to liquid form in the environment. He also agreed that the high concentration of BHC, combined with reported high levels of trichlorobenzenes, indicated that the NAPL could have come from the Olin facility (Tr. 1432 at 20-23).

Mr. McIntosh testified that he was also the project manager for the remediation of the Olin Site, which took place between 1989 and 1995. He was responsible for the design of the site investigation and remedy, including development of several work plans, writing the RCRA Facility Investigation ("RFI") Report and Corrective Measures Study ("CMS"), and certifying the results to the DEC. His investigatory work included soil and groundwater sampling in the area located between Allundum Road and Gill Creek (the "ARGC" area), which revealed contamination related to Olin's production of BHC from chlorinated benzenes (Tr. 1430 at 45-53).

O-234 is a segment of the Phase II Corrective Measures Study for the Olin Site, dated March 1995. Mr. McIntosh testified that the purpose of the study was to evaluate the results of the RFI and to propose a remedy for cleaning up the site. He reported that the groundwater flow patterns at the site are strongly influenced by man-made passageways and the Olin production wells. In the A-Zone, the groundwater flows radially from a bedrock high point beneath Plant 2. There is some minor discharge to Gill Creek from the A-Zone, with the remainder of the flow being intercepted by the DuPont Sewer, which is a deep sanitary sewer running south to north along the east bank of the creek. Mr. McIntosh concluded that if any A-Zone groundwater somehow flowed from the ARGC area to the east or northeast under Gill Creek, it would be intercepted by the DuPont Sewer and sewer bedding and would flow north to the Buffalo Avenue sewer. In the B-Zone, monitoring well results indicate that the groundwater flows north towards Buffalo Avenue, or to the Olin production wells via leakage to the C-Zone. The Buffalo Avenue sewer sits in a trench blasted into the bedrock, fully penetrating the A- and B-Zones, and acts as a conduit carrying groundwater toward the POTW. Based on his review of all available information regarding hydrogeologic conditions at the Olin Site, Mr. McIntosh concluded that the groundwater in the B-Zone beneath the ARGC area west of Gill Creek generally flows north toward the Buffalo Avenue sewer and is discharged to the sewer or sewer bedding toward the POTW (Tr. 1430 at 57-68).

Mr. McIntosh testified that the groundwater remedy he proposed for the Olin Site consisted of two components–a soil management plan and a groundwater treatment system. The soil management component involved paving certain areas of exposed soil to prevent direct human contact. The groundwater component of the remedy involved the installation of a series of passive relief and extraction wells to recover contaminated groundwater for treatment and to prevent offsite migration. The passive relief wells were designed by Mr. McIntosh to create a connection between the A- and B-Zones in order to increase the influence of the extraction wells, which did the actual pumping of B-Zone groundwater. Mr. McIntosh testified that based on his review of the extraction well data for the initial three or four years of operation, the system was maintaining satisfactory hydraulic control, meaning that it was successful in intercepting the groundwater in the ARGC area for collection and treatment (Tr. 1430 at 68-73).

On cross-examination by Solvent's counsel, Mr. McIntosh was shown a series of communications which took place between Olin and the DEC in 1994-95, commenting on Woodward-Clyde's proposed RFI and CMS and chronicling the DEC's ongoing disagreement with Olin's characterization of the extent of groundwater contamination attributable to Olin's historical operations in the ARGC area (*see* S-4118, 4119, 4124A, 4125). In a letter dated June 5, 1995, the DEC indicated that while the contamination detected in the monitoring wells in the area of the Hot Spot may be associated with the Solvent Site, it remained convinced that some of the contamination is attributable to Olin, and that the presence of substantial concentrations of BHC is difficult to attribute to a source other than Olin (*see* S-4126; Tr. 1432 at 92-109).

Mr. McIntosh also testified on cross-examination that, based on his experience as project manager for remedial activities at the Olin Site and his prior experience with conditions at the DuPont Site, he became aware of the extensive chlorinated aliphatic contamination at the DuPont facility and the migration of chlorinated aliphatics from the DuPont Site to the Olin Site. He stated in his expert report (*see* note 6 *infra*) that a plume of chlorinated aliphatics extended from the DuPont Site to encompass areas of both the Olin and Solvent Sites, and that there is no containment or recovery system in place to prevent migration of contaminated groundwater from DuPont to the Olin Site and the Hot Spot in the B-Zone and deeper. As a result, he ruled out Olin as a source of the chlorinated aliphatics being captured by Solvent's groundwater recovery and treatment system, and expressed the opinion that all of those chlorinated aliphatics were migrating from the DuPont Site (Tr. 1432 at 117-22).

On cross-examination by DuPont's counsel, Mr. McIntosh was shown D-213, which is a list of some of the chemicals and chemical waste products handled at the Solvent facility during the period of Solvent's processing operations and Frontenac's waste storage and management operations. This list was prepared by DuPont based on the historical records, and as reflected in Mr. Kohanek's expert report. The list contains a number of chlorinated aliphatics, including PCE, TCE, 1,1,1-trichloroethane, methylene chloride, and chloroform. Mr. McIntosh was also shown D-91, which is an exhibit from Mr. Kohanek's report identifying the locations where Frontenac conducted its TCE and PCE handling operations. Mr. McIntosh testified that when he prepared his report on the source of the chlorinated aliphatics detected in Solvent's pump and treat system, he was not aware that Frontenac had handled these materials in these locations during the period of its waste management operations at the Site (Tr. 1450 at 136-44).

D-259 is a map prepared by Mr. McIntosh showing the location of monitoring wells at Olin Plant 2 and the Solvent Site. Samples taken from OBA-24B, -25B, and -26B located in the southwest quadrant of the Olin parking lot, as reported in a draft Supplemental Groundwater Investigation Report dated September 1999, indicated low or non-detect levels of chlorinated aliphatics (*see* D-260). D-192 shows the location of additional B-Zone pumping wells OBA-30B, -25B, and -29B installed by DuPont along Adams Avenue, which also reported low or non-detect levels of chlorinated aliphatics (*see* D-261). D-238 is a figure taken from Solvent's monitoring report for the first quarter of 2007, showing the location of the A- and B-Zone wells and sampling results. D-257 is a reproduction of S-4156, which is a compilation of data obtained by subpoena from Olin's consultant, MACTEC, reporting the results of a pump test conducted in July 2001 at wells SRW-1 and SRW-2, located in the ARGC area of the Olin Site where historical BHC production and trichlorophenol operations took place. Mr. McIntosh agreed that none of these sampling results supports his theory of a chlorinated aliphatic plume in the B-Zone migrating from the DuPont Site toward the Hot Spot (Tr. 1450 at 144-62).

Mr. McIntosh was also Olin's on-site representative during TRC's remediation of the Solvent 18-inch Sewer in the summer of 2000. The project manager for TRC was Todd Majer. Representatives of the DEC were also present during certain portions of the remedial activity. The work involved removal of the sewer line everywhere it could be accessed, but there were sections of the sewer line that could not be removed because of surface impediments, electrical grids, or gas lines. These sections were flushed out with a high pressure wash and filled with grout or cement. Mr. McIntosh testified that he observed NAPL in the flushed water, as well as in the pipe itself, in the wells, and along the entire length of the sewer line excavation (Tr. 1430 at 73-81).

O-302 is Todd Majer’s log book for the 18-inch Sewer removal project. At 10:45 a.m. on July 20, 2000, as TRC was in the process of flushing out the sewer pipe, Mr. Majer noted the presence of “free product,” or NAPL, floating on top of the water in the excavated area. Several other log entries note the presence of NAPL observed in the excavation area, in test pits, and flowing from concrete encasements around the sewer pipe. At some locations, TRC used a foam spray to suppress the odors caused by vaporization of the volatile organics exposed during the excavation (Tr. 1430 at 83-86).

O-631 is a drawing depicting TRC’s 18-inch storm sewer remediation activity in the southern portion of Olin’s east property, and showing the location of confirmatory soil samples. Samples SS-09 and SS-10 were taken along the wall of the excavation just to the west of the electrical substation, one of the areas where the sewer line was cleaned and left in place rather than removed. O-247 reports the soil sample results showing detections of barium, copper, lead, mercury, and zinc. O-477 is a map of the Olin and Solvent Sites showing the location and results of soil samples taken in the area of the sewer excavation. Sample number SD-KRM71400-1 was taken by Mr. McIntosh from inside the sewer pipe at a point approximately 30 feet from the end of the pipe outfall at Gill Creek, showing a total chlorinated benzene concentration of 22,300,000 ppb. SD-0612-AK-01 was taken from inside the pipe about five feet in from the end at the Gill Creek outfall, showing a total chlorinated benzene concentration of 26,000,000 ppb (Tr. 1430 at 87-97).

Mr. McIntosh testified that he conducted a video survey of the Solvent 18-inch sewer in the area of monitoring well OBA-10A, near the intersection of the Solvent and DuPont sewers. The video showed that the 18-inch sewer pipe had been breached at that location.

As noted by Mr. Majer in his log book, Mr. Hinton from the DEC suggested that the DNAPL detected at OBA-10A might be due to the breach in the 18-inch pipe. Mr. McIntosh did not observe NAPL in the area of the breach, but he did observe it coming out of the pipe when it was being cleaned (Tr. 1430 at 97-101).

Mr. McIntosh agreed with the statement in TRC's April 2003 final engineering report (*see* O-625) that much of the overburden surrounding the 18-inch storm sewer consisted of urban fill material, and that the elevated concentrations of inorganic compounds were related to the fill as opposed to releases originating from the sewer (Tr. 1430 at 102-04).

On cross-examination by Solvent's counsel, Mr. McIntosh was shown S-4071, which is a drawing of abandoned and existing sewer lines at Olin Niagara Plant 2, dated October 1982. The drawing depicts three plugged sewer lines, along with several connecting sewer lines, leading to Gill Creek from various buildings in the ARCG area. He was also shown S-4001, documenting spillages of benzene and other product loss during Olin's BHC production operations; O-419, which is an aerial photograph of the ARGC area shortly after the 1956 explosion at the BHC plant; and S-4500, which is an Olin internal memorandum discussing groundwater seepage from the BHC plant. Mr. McIntosh agreed with Solvent's counsel that all of these circumstances could have contributed to the chlorinated benzene contamination found in the Gill Creek sediments. He also agreed that Olin and DuPont were primarily responsible for the elevated concentrations of BHC, PCBs, chlorinated aliphatics, mercury, and other materials detected in the Gill Creek sediments and identified in the Gill Creek ROD as the contaminants of concern necessitating the remedy (Tr. 1430 at 110-38).

S-4507 is Woodward-Clyde's Gill Creek Sediment Study Report, completed in April 1989. Mr. McIntosh was the Project Scientist on this study. As noted in this report, the primary area of concern for the sediment study was the mouth of Gill Creek, designated as Area 1, where PCBs, chlorobenzene compounds, hexachlorobutadiene, and mercury were detected in the sediments. Figure 3-1 from the sediment study (Bates No. DUP15469) indicates that the vast majority of sediment sampling undertaken during this study was performed in Area 1, with only one set of samples taken in Area 3, at the Adams Street bridge. According to Mr. McIntosh, the sediment study focused on the mouth area of the creek because he assumed that the previous remediation of Gill Creek in 1981 took care of the upstream sediments, and the NAPL problems that later arose in Area 3 took him by surprise (Tr. 1430 at 138-48).

Table 5-1 from the sediment study (Bates No. DUP15387) is a list of indicator chemicals, representing the contaminants detected in the Gill Creek sediments with the greatest potential for environmental impact. The list contains several volatile compounds and PCBs associated with DuPont's operations, as well as hexachlorobenzene, hexachlorobutadiene, pentachlorobenzene, and mercury, all associated with Olin's BHC production. There are no chlorinated benzenes associated with Solvent's operations on the list. Mr. McIntosh testified that hexachlorobenzene is the most toxic of the chlorobenzene compounds (Tr. 1430 at 148-55).

S-6085 is a listing of the results of Gill Creek Area 3 sediment samples taken in connection with the sediment studies performed in April 1989 and December 1990. Mr. McIntosh agreed with Solvent's counsel that this listing shows that BHC in pure concentration accounted for 79.45% of the contamination in the Area 3 sediments (Tr. 1432 at 12-16).

S-4534 is the Gill Creek Remediation Final Report, dated December 1993, which describes the components of the remedy performed by Woodward-Clyde. The Report states that the majority of the excavated sediments were transported to permitted landfills for disposal, with the exception of a small volume of sediment from Area 3 which had to be incinerated due to elevated levels of gamma-BHC (Tr. 1432 at 25-28).

Table 6-1 of S-4534 is a listing of the estimated volumes of sediments to be removed, as compared to the volumes of the sediments that were actually removed, from the various areas of Gill Creek. Mr. McIntosh agreed with Solvent's counsel that the volume of Area 3 sediments removed and disposed of (230 cubic yards) represents approximately 2.9% of the total volume of sediments removed and disposed of (8,020 cubic yards) (Tr. 1432 at 36-37).

2. William Hall

Mr. Hall is the Chief Executive Officer of NewFields Companies, an environmental engineering and consulting firm. He has been an environmental engineer and consultant for 33 years. He received a Bachelor of Science degree in civil engineering from Georgia Tech in 1974 and worked for over 20 years for Dames & Moore on environmental projects internationally and domestically. He has worked on over 100 CERCLA sites and was the principal engineer on 7 Superfund sites from the initiation of remedial investigation to closure. A critical component of his work involves determination of the "fate and transport" of contaminants, described by Mr. Hall as addressing what happens to a contaminant once it is released into the environment. He also defined the term "preferred pathway" as a feature in the environment that will alter the direction of the transport of a contaminant–*e.g.*, as when groundwater finds its way to a creek or a sewer (Tr. 1433 at 2-10; *see also* O-630).

Mr. Hall testified that his general strategy in determining fate and transport as an allocation approach involves a very heavy focus on the data collected at the site which can be measured, quantified, and verified. He assembles a searchable electronic database containing all of the hard data that can be extracted from the field reports, site investigations, design reports, engineering data on surface and subsurface features, aerial photography, and other sources of quantifiable information obtained at the site over an extended period of time.[7] The data is accessed by using standardized computer software programs, such as Access and Art Map. He also considers the nature of the remedial activity and how it affects the fate and transport of the contaminants (Tr. 1433 at 10-14).

O-403 is a summary of the environmental data accumulated for the Solvent and Olin Site database, identified by type of matrix (or environmental media), number of locations, number of samples, and number of results. For example, for the matrix identified as "total groundwater," there are listed 293 well locations, 1586 samples, and 52,535 results. According to Mr. Hall, this summary points out the need for an electronic database to effectively manage the large amount of accumulated information, and to prevent "cherry-picking" only the data supporting a particular hypothesis or conclusion. By way of illustration, Mr. Hall explained how he accessed the soil boring analysis data reported on

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[7] The database was submitted in CD form as O-647.

Table 4-2 of the Malcolm Pirnie Supplemental Remedial Investigation Report for the Solvent Site (O-602) to create O-614, which is an aerial photograph of the Solvent Site depicting various locations where concentrations of 1,2,4-trichlorobenzene have been detected in the soil (Tr. 1433 at 21-45).

O-444 is a 1978 aerial photograph of the Solvent Site, the Olin East Property, and a portion of Gill Creek. Also depicted on this exhibit are the DuPont sewer, the Buffalo Avenue sewer, and the Solvent 18-inch sewer. O-432 is a 2002 aerial photograph depicting the areas where the remedial activities at issue in this action took place: the Hot Spot, the Solvent Site, the Solvent 18-inch sewer, and Gill Creek at the Adams Avenue Bridge. Mr. Hall testified that he was engaged by Olin to formulate an opinion regarding the fate and transport of the contaminants found at each of these remedial areas (Tr. 1433 at 45-48).

O-439 depicts the elements of the groundwater recovery system installed by TRC at the Solvent Site and the Hot Spot, including the extraction wells, interceptor trenches, piping, and onsite treatment facility. In the Hot Spot area there are two extraction wells completed into the B-Zone, along with an A-Zone interceptor trench and piping that carries the recovered water to the pre-treatment plant. Extraction wells, piping, and recovery trenches were also installed around the northern, western, and southern perimeters of the Solvent Site. According to Mr. Hall, this system was installed to maintain hydraulic control by preventing further migration of contaminated groundwater from the Solvent property and Hot Spot areas. His fate and transport analysis included examination of the sampling data obtained from this pump and treat system, as well from monitoring wells previously installed by Olin, to determine both the spatial distribution and the temporal characteristics of the contaminants–where they came from and where they went, and how they changed over time relative to the different features at the sites (Tr. 1433 at 48-52).

O-452 is a pie chart comparison of chlorinated benzene concentrations detected in groundwater samples from wells screened in the A-Zone on either side of Gill Creek. Each pie represents the total chlorinated benzene concentration detected at a particular location, divided into relative percentages of mono-, di-, and trichlorobenzenes, to demonstrate how the various contaminants have been distributed between the two areas. For example, the samples obtained from the A-Zone at monitoring well MW-4A, located in the northwest corner of the Solvent Site, contained approximately 55% trichlorobenzenes and 45% dichlorobenzenes. According to Mr. Hall, the ratios reported on this exhibit reveal a pattern of contamination indicating that the materials found in the A-Zone at the Hot Spot look more like the materials detected in the A-Zone at the Solvent Site than those detected at the Olin Site (Tr. 1433 at 52-56).

O-407 is a pie chart comparison of comparison of the average chlorinated benzene concentrations detected in all of the samples from all of the wells screened in the A- and B-Zones during the year 1998. Mr. Hall testified that this exhibit is an example of one of the various ways he looked at the data accumulated over many years in order to determine whether his conceptual model presents an accurate picture of the pattern of contamination at the Site. The averages from 1998 are important because they represent the middle of three significant time periods: before groundwater pumping took place, after pumping began at Olin in 1997, and after pumping began at Solvent in 2002. The pie charts on O-407 represent that during 1998, the wells in the Hot Spot area were detecting predominantly mono- and dichlorobenzenes in the A- and B-Zone groundwater, which are the constituents associated with operations at the Solvent Site. The Hot Spot wells show very small concentrations of trichlorobenzenes, the constituents associated with operations at the Olin Site (Tr. 1433 at 57-60).

O-408 depicts the average chlorinated benzene concentrations detected in the A- and B-Zone wells during the year 2004. The presence of more pie charts indicates that there were more wells being sampled in 2004, after Solvent began operation of its pump and treat remediation system. The comparison of pie charts represented on this exhibit indicates that while more trichlorobenzenes were being detected at the Hot Spot in 2004, that area was still dominated by mono- and dichlorobenzenes (Tr. 1433 at 60-61).

O-445 is the figure taken from the 1995 Malcolm Pirnie SRI, presented during Mr. Hughes' testimony, which identifies the areas of the 3163 Buffalo Avenue property where NAPL was observed or suspected to be present in the soils. This includes virtually the entire border with Olin East, as well as most of the southern half of the Solvent property, in the areas where loading and unloading of chemicals from rail cars and trucks took place (*see* O-448). Mr. Hall testified that loading operations are the dominant mechanism for releasing large quantities of contaminated material into the environment. He also testified that when NAPL or DNAPL show up in a boring log, it indicates extensive concentrations of oily, sludge-like material in free phase, before dilution. As depicted in these exhibits, NAPL was detected in several areas in the northwest corner of the Solvent Site, approximately 130 feet from Hot Spot pumping well PW-4 (Tr. 1433 at 61-66).

O-449 shows the same image with numbers added to indicate the location of several reported chemical spills at the Solvent Site (*see* OX450), which correspond to the loading and tank farm areas where NAPL was present. Also depicted on this exhibit is the

18-inch sewer, which runs along the western boundary of the Site and drains into Gill Creek. According to Mr. Hall, his review of the available environmental reports indicates that the southwest quadrant of the Site–*i.e.*, the area with the greatest concentration of NAPL–drained into the 18-inch sewer (Tr. 1433 at 66-68).

O-613 depicts various locations at the Solvent Site where concentrations of 1,2,3-trichlorobenzene have been detected in the soil. O-614, presented earlier, shows detections of 1,2,4-trichlorobenzene. Mr. Hall testified that these exhibits indicate the presence of trichlorobenzenes at the Solvent Site sufficient to have an impact on groundwater. He explained the industry rule of reference that a detection of greater than 1% of the solubility limit concentration of any particular chemical indicates the potential for the presence of NAPL or DNAPL. As represented on O-617, NAPL was detected at several locations along the Solvent/Olin border, and in the chemical handling areas of the Solvent Site, at levels greater than 10% of the solubility limit for trichlorobenzene. According to Mr. Hall, this indicates an ample source of TCB across the entire Solvent Site and negates the use of TCB as a tracer chemical for Olin (Tr. 1433 at 70-75).

O-446 depicts monoclorobenzene detections in the A- and B-Zone groundwater at various sampling locations across the Solvent Site and the Olin East property. According to Mr. Hall, these detections show levels of greater than 10% solubility at several areas of the Solvent Site, concentrated primarily in the southwest corner and along the 18-inch sewer, while there are no detections at these levels in the Hot Spot area (Tr. 1433 at 74-75).

Mr. Hall gave the opinion, based on the information in the environmental reports and the data that has been gathered at the Olin and Solvent Sites, that Gill Creek and the

DuPont sewer act in combination as a barrier to the flow of groundwater from the Olin plant site toward the Hot Spot. He agreed with the conclusions stated in the March 1995 Malcom Pirnie Corrective Measures Study with respect to the flow of groundwater from the ARGC area, and explained his understanding of those conclusions in greater detail. For example, he agreed that Gill Creek penetrates the upper portion of the A-Zone, meaning the bottom of the creek is essentially down to the bedrock, and the water moving along the top of bedrock is moving into the Creek. He also agreed with the conclusion that the DuPont sewer fully penetrates the A-Zone and potentially acts as a preferential conduit for groundwater flow. He explained his understanding that the DuPont sewer trench and the pipe itself are installed down into the rock, and water flowing across the bedrock from the A-Zone that is not picked up by Gill Creek would be likely to travel along the cut-out trench or leak into the deteriorated sewer pipe. The CMS also concluded that the Buffalo Avenue sewer fully penetrates the A- and B-Zones on the west side of Gill Creek, meaning that this sewer line acts as an open conduit to transmit groundwater from the A-Zone down into the B-Zone, and into the sewer pipe and trench. Mr. Hall also agreed that the Buffalo Avenue sewer likely receives groundwater discharge west of Gill Creek due to the deteriorated condition of the sewer line, and field testing has confirmed that the hydraulic gradient of the B-Zone is toward the sewer except during periods of high flow (Tr. 1433 at 76-85; *see* O-234).

O-646 is a cross-section drawing showing Mr. Hall's rendition of the vertical relationships between the subsurface features in the area where the Buffalo Avenue sewer passes under Gill Creek and intersects with the DuPont sewer. The drawing also depicts three monitoring wells at that location: BH-1 and OBA-15A, completed in the A-Zone, and

OBA-15B, completed in the B-Zone. Data taken from the Conestoga Rovers CMS indicate groundwater elevations. According to Mr. Hall, this depiction shows that the A-Zone groundwater flowing west to east from the Olin plant site toward the Hot Spot would pass down Gill Creek, and any water passing through the creek would sink down toward the bottom of the DuPont sewer. He testified that, based on information obtained from his review of the available environmental studies and reports, Gill Creek discharges about 2 million gallons of water per day into the Niagara River, due largely to the decrease in the river's water level during operation of the power plant intakes. Contaminants dissolved in the groundwater flowing through the overburden into the creek on the west side would be flushed down the creek and into the river and would not flow across or through the creek and into the groundwater in the overburden on the east side (Tr. 1433 at 85-93).

Mr. Hall testified that there has only been one occasion during the course of the investigations at the Olin and Solvent Sites when synoptic, or simultaneous, groundwater elevation testing took place at both sites. This was in June 1994, when groundwater level data was collected synoptically at multiple wells in the vicinity of the Hot Spot. The event was coordinated through cooperation between Olin and the DEC, which was investigating the Solvent Site at the time. Water levels were obtained at monitoring wells by physical measurements of the distance from the ground surface to the top of the water in the well. According to Mr. Hall, synoptic testing provides a clearer understanding of groundwater flow because the elevations change depending on existing hydraulic conditions–*e.g.*, during a drought or after a very wet period–and actual field measurements provide better elevation information than computer-generated contour maps because the data points for the contours might not account for subsurface features, such as Gill Creek or the DuPont sewer (Tr. 1433 at 93-97).

S-6015, the A-Zone composite groundwater elevation contour map relied on by Mr. Smyth, was generated from data obtained from several different studies undertaken at widely varying times. According to Mr. Hall, this map is meaningless with regard to determining how groundwater actually flows subject to changing hydrological conditions in a particular area. O-635 was generated by Mr. Hall using S-6015 as a base, but adding data from the June 1994 testing to show that the groundwater elevations represented on the composite contour map do not match the actual synoptic measurements. For example, while Mr. Smyth's contour map depicts a groundwater flow direction from the high water level at the Olin Site toward the low water level northeast of the Solvent Site, with no impact at Gill Creek, the June 1994 data shows a groundwater surface elevation at Hot Spot monitoring well OBA-15A, which is nearly five feet lower than the elevation reported at MW-4A in the northwest corner of the Solvent Site. According to Mr. Hall, this data indicates that a contaminant dissolved in the A-Zone groundwater at the northwest corner of the Solvent Site would flow toward the Hot Spot and Gill Creek (Tr. 1433 at 97-102).

Mr. Hall gave his opinion that because the Buffalo Avenue sewer penetrates into the bedrock in both the A- and B-Zones, it acts as a large drain causing the groundwater in the area of the Olin facility west of Gill Creek to flow to the north. This opinion was based on data reported in the March 1995 CMS (O-234), which was generated by a pump test to obtain information about the hydraulic characteristics of the aquifer. O-412 is a drawing of a larger cross-section view showing the subsurface features beneath the ARGC area of the Olin Site, the Hot Spot, and the Solvent Site. The pump test was conducted in the

ARGC area at two wells–OBA-2B, located immediately adjacent to Buffalo Avenue, and OBA-16B, located to the southeast (*see* O-413). O-415 is a drawing of a cross-section view of the Olin Site subsurface down into the C-Zone, looking from west to east at Alundum Road. Depicted on the left (north) is the installation trench and the two sewers comprising the Buffalo Avenue sewer system. OBA-2B is depicted just to the right (south) of the sewers, and OBA-16B is depicted further to the right. Both wells show collecting screens completed through the B-Zone into the C-Zone. The wells were fitted with transducers to measure water pressure, which was converted to elevation levels and charted on a time line (Tr. 1433 at 103-13).

On January 19, 1995, OBA-2B had a groundwater elevation reading of 558.2 ft., and OBA-16B had a groundwater elevation reading of 558.4 ft., indicating a northward gradient toward the Buffalo Avenue sewer. Then, on the morning of January 20, heavy rainfall began which caused a steady rise of the pressure in the wells and in the sewers, measured as a rise in groundwater elevation to a maximum of 560.9 feet at OBA-2B, and 561.75 feet in OBA-16B (*see* O-416). The rain stopped at 10:00 a.m., and the measurements recorded an almost immediate drop in groundwater elevation levels (*see* O-417). Within 48 hours of the rainfall event, the levels had returned to normal (*see* O-418). According to Mr. Hall, this series of field measurements shows the Buffalo Avenue sewer to be a hydraulic control which drains the B-Zone northward in the vicinity of the Olin plant (Tr. 1433 at 113-18).

Mr. Hall testified that he also examined the available sampling data from three discrete periods of time: before any groundwater pumping took place, after Olin began its pumping operations, and after Solvent began its pumping operations. O-636 shows the

Hot Spot area and the location of five monitoring wells in the vicinity: OBA-17AB, located on the west bank of Gill Creek in the ARGC area of the Olin Site; OBA-15A, located on the western side of the Hot Spot area; OBA-3A and OBA-3B, located next to each other on the eastern side of the Hot Spot area; and MW-4A, located in the northwestern corner of the Solvent Site. O-637 reports the percentages of total chlorinated benzenes represented by trichlorobenzene (TCB) detected in the groundwater at these wells at various times prior to 1996, when Olin began to operate its pumping wells, as follows: OBA-17AB = 48% TCB; OBA-15A = 4% TCB; OBA-3B = 2%; OBA-5A = 5%; MW-4A = 54%. O-638 reports the combined total of monochlorobenzenes (MCB) and dichlorobenzenes (DCB) detected at these wells, as follows: OBA-17AB = 2,590 ppb; OBA-15A = 15,800 ppb; OBA-3B = 18,740 ppb; OBA-5A = 25,300 ppb; MW-4A = 20,340 ppb. According to Mr. Hall, these results show that before any pumping operations began at the Hot Spot, the concentrations of chlorinated benzenes in the groundwater were greater closer to the Solvent Site, indicating a downward gradient from Solvent to the Hot Spot, and that the smaller concentrations of chlorinated benzenes at OBA-17AB could not be the source of the higher concentrations of chlorinated benzenes detected at Hot Spot wells OBA-15A, OBA-3A, and OBA-3B, on the other side of Gill Creek and the DuPont Sewer (Tr. 1433 at 118-27).

O-639 depicts chlorinated benzene ratios in November 1998, after pumping began at the Olin Site. Passive relief wells PR-3 and PR-4, completed into the B-Zone in the ARGC area of the Olin Site near the west bank of Gill Creek, reported TCB concentrations at 1600 ppb and 300 ppb, respectively. Moving toward the east, Hot Spot monitoring wells OBA-15A and OBA-3A reported concentrations of MCBs and DCBs, but no TCBs. OBA-3B reported a TCB concentration of 220 ppb, represented on a pie chart as approximately

20% of the total chlorinated benzene detection. Then, at MW-4A in the northwest corner of the Solvent Site, a TCB concentration of 24,000 ppb was reported, represented on a pie chart as approximately 55% of the total chlorinated benzene detection. According to Mr. Hall, these results indicate that the highest concentrations of TCBs are at the Solvent Site, and that the TCBs detected at the Hot Spot are coming from Solvent, not from Olin (Tr. 1433 at 127-30).

O-640 shows the location of four pumping wells in operation at the Olin and Solvent Sites as of 2002. Olin well RW-3 is located in the ARGC area near the west bank of Gill Creek. Solvent wells PW-3B and PW-4B are located in the Hot Spot area, and Solvent well PW-2B is located in the northwest corner of the Solvent Site. O-641 shows total TCB concentrations detected in the A- and B-Zone groundwater at these wells during synoptic testing in May and June 2002, as follows: RW-3 = 61 ppb; PW-3B = 1,400 ppb; PW-4B = 1,400 ppb; and PW-2B = 12,900 ppb. Based on this data, Mr. Hall stated his opinion that pumping wells PW-3B and -4B are pulling the TCBs from the Solvent Site toward the Hot Spot, and that all three gradients–hydraulic, mass, and concentration–support his conceptual model which points to Solvent, not Olin, as the source of chlorinated benzenes in the groundwater being pumped from the Hot Spot (Tr. 1433 at 133-34; 145-49).

O-652 contains pie charts showing the ratios of chlorinated benzene concentrations detected at monitoring wells in the Hot Spot area during the June 1994 synoptic testing, along with groundwater elevation readings at certain wells. Also depicted are the DuPont and Buffalo Avenue sewer lines. According to Mr. Hall, this data shows that any contaminants traveling in the A-Zone groundwater from the Olin Site which might make their way through or under Gill Creek into the DuPont sewer bedding would be carried to the north, rather than to the east toward the Hot Spot. This is confirmed by the pie charts, which show that no TCBs were detected at wells OBA-13A and 13B, located to the north of Buffalo Avenue, with lower groundwater elevation readings than at OBA-15A, located to the south (Tr. 1433 at 150-54).

S-6072 is the bar chart comparison of pumping data collected at the Hot Spot and the Olin wells which, according to Mr. Smyth, showed that very similar concentrations of contaminants were being pumped at the two locations. Mr. Hall testified that, upon closer examination, it appeared that the concentration parameters on the two charts had been shuffled to create the similarity. O-634 is a bar chart comparison representing just the constituents associated with Olin and Solvent detected at these wells, without showing the chlorinated aliphatics associated with DuPont. According to Mr. Hall, this comparison shows that there is no correlation at all between the water being pumped at the two sites (Tr. 1433 at 155-61).

On cross-examination, Mr. Hall was shown S-4562, which is a bar chart representing a combination of the two sets of data represented on S-6072. Mr. Hall explained that while the chart appears to have a good visual correlation, the data represented primarily shows that aliphatics are being detected at high levels at both the Hot Spot and the Olin Site. These detections are not indicator parameters for any transport of contaminants from Olin to the Hot Spot (Tr. 1440 at 101-04).

Mr. Hall testified that Mr. Smyth's identification of perchlorate as a tracer to show a flow path from the Olin Site to the Hot Spot wells was unreliable because the information depicted on S-6032 with respect to the presence of perchlorate in the B-Zone groundwater was based on two minimal detections from one sampling event, and because historical documentation revealed that Occidental Chemical, and its precursors Oldbury Electrochemical and Hooker Chemical, manufactured perchlorate at a facility to the east of the Solvent Site for approximately 67 years (Tr. 1434 at 11-19; *see also* O-605, 606, 607, 608, 623).

O-493 shows the location of the groundwater treatment system at the Olin Site. There are six pumping (or extraction) wells completed in the B-Zone, and four passive relief wells which are drilled into the bedrock to passively allow contaminated water to drain into the B-Zone where the extraction wells are pumping. The primary purpose of the Olin system is to provide hydraulic containment within the boundaries of the site, and to treat the contaminated groundwater pumped. According to Mr. Hall, the environmental data and reports generated since the system began operating indicate that hydraulic control has been achieved, and groundwater is not crossing the boundary of the containment system (Tr. 1434 at 19-21).

Based on his review and analysis of all relevant data, Mr. Hall stated his conclusion that the chlorinated benzenes detected in the groundwater at the Hot Spot are coming from the Solvent Site, not from the Olin Site. Gill Creek and the DuPont sewer are acting as hydraulic barriers to the flow of groundwater in the A-Zone. In the B-Zone, the groundwater flow at the Olin Site is due north toward the Buffalo Avenue sewer. Finally, the sampling data confirms that the isomers of chlorinated benzenes detected at the Hot Spot are more closely associated with the contaminants found at the Solvent Site than those found at the Olin Site (Tr. 1434 at 21-23; *see* O-494).

Turning to Gill Creek, Mr. Hall was first shown O-469A, depicting the remedial area of Gill Creek at the Adams Avenue Bridge, referred to as Area 3. Also depicted is the

Solvent 18-inch storm sewer which is shown emptying into the creek just north of the bridge. He was also shown O-445, which is the figure taken from the 1995 Malcolm Pirnie SRI depicting the areas of the Solvent Site where NAPL was observed or suspected to be present in the soils, as well as O-449, identifying the reported chemical spills at the Site. Mr. Hall testified that these were the tank farm and loading dock areas, and that surface liquids in these operational areas would drain into the 18-inch storm sewer by means of rainfall events or other discharges and be carried toward Gill Creek (Tr. 1434 at 23-28).

O-613 and 614 depict the areas of the Solvent Site where high levels of trichlorobenzenes were detected in the soils, which correlate with the areas where NAPL was observed. Mr. Hall testified that these exhibits indicate a significant source of trichlorobenzenes at the Solvent Site, with the 18-inch sewer providing a pathway for discharge of chlorinated benzene materials to Gill Creek. These materials would be expected to accumulate in the sediments downstream of the Adams Avenue Bridge (Tr. 1434 at 23-32).

O-428 contains pie charts indicating the relative concentration of chlorinated benzene isomers detected in the soils, sewer pipe, and creek bed sediments during the remediation of Area 3 and the Solvent 18-inch storm sewer. O-651 depicts the sampling locations for the data utilized by Mr. Smyth in his analysis of the likely source of the contamination found in the Area 3 sediments, along with two samples that were taken from the sludge in the sewer pipe (*see* O-650). O-649 is a bar chart prepared by Mr. Hall indicating the relative percentages of the total chlorinated benzenes and trichlorobenzenes detected in the samples taken from the Olin Site, the 18-inch sewer pipe, and the creek bank at the sewer outfall and downstream. According to Mr. Hall, this data shows that the levels of chlorinated benzenes detected in the downstream creek sediments more closely match the levels detected in the sewer pipe than the levels detected in the Olin Site soils (Tr. 1434 at 32-40).

Mr. Hall testified that Mr. Smyth's pie charts depicted on S-6048 comparing the composition of chlorinated benzene materials detected in the Area 3 sediments and the soils at the Olin and Solvent Sites are based on a simple average of percentages, which fails to account for the actual mass of chlorobenzenes represented in the sampling data. By contrast, O-656 contains pie charts using the same data, but scaled to represent the relative mass of the contaminants detected at the various locations. The large pie chart representing the average mass of chlorinated benzenes detected in the in-pipe sewer samples, referred to by counsel as the "death star," is many times larger than the pie chart representing the average mass of contaminants detected in the soil samples taken from the Olin plant (Tr. 1434 at 40-45).

On cross-examination by Solvent's counsel, Mr. Hall explained that the purpose of O-656 was to show that the data relied on by Mr. Smyth to produce S-6048 did not establish a connection between Olin and Gill Creek Area 3, and that the process of averaging the percentages of chlorinated benzene concentrations detected at the various locations did not account for an apparent active source of contamination immediately adjacent to the Area 3 remediation. He agreed with Solvent's counsel that the BHC and chlorobenzene concentrations detected in the Gill Creek sediments are much higher than the BHC and chlorobenzene concentrations detected in the Olin soil borings (Tr. 1440 at 29-34).

Mr. Hall explained that he did not perform a risk assessment to determine the relative risk of the various chemicals found in the Area 3 sediments because each class of contaminants alone was sufficient to cause the sediments to be removed. He gave his opinion that the bulk of the chlorobenzene contamination detected in the Area 3 sediments originated from the Solvent 18-inch sewer. The concentration levels of chlorinated benzenes in the sediments were 150 times greater than the cleanup levels established by the DEC for the Solvent Site. Based on these findings, Mr. Hall stated that Solvent should be allocated 50% of the costs incurred by Olin for the remediation of Gill Creek at Area 3 (Tr. 1434 at 46-54).

On cross-examination by Solvent's counsel, Mr. Hall testified that he considered the historical evidence regarding Olin's BHC production (including the use and storage of trichlorobenzenes), the existence of sewers which drained into Gill Creek before they were plugged, and the explosion at the plant in 1956 which deposited a large amount of BHC material into the creek. He also reviewed the Gill Creek ROD, which identified BHC as the major contaminant of concern at Area 3 and identified chlorobenzenes at generally below detection limits. Mr. Hall explained his understanding that BHC entering the creek in solid form would have settled into the sediments, and any chlorinated benzenes that might have been deposited into the creek as a result of Olin's BHC operations, or the explosion, would have long since dissolved in the creek waters and washed downstream (*see* Tr. 1434 at 70-119; *see also* Tr. 1440 at 3-29).

With respect to the soil remedy at the Solvent Site, Mr. Hall testified that the permeable cap alternative was chosen to allow water to continue to infiltrate the soils and enhance the movement of contaminants out of the soils. The pump-and-treat component of the remedy was designed to treat chlorobenzenes, not mercury. O-467 is a bar graph comparison of the relative mass of organic contaminants versus mercury detected in shallow soil borings taken at a depth of less than five feet, indicating that mercury represents 0.5% of the contaminants detected in the Solvent soils, while organics–*i.e*, chlorinated benzenes–represent 99.5%. He testified that upon examination of the boring logs, aerial photography, environmental reports, and other information in the record, he determined that an extensive amount of fill material exists at the Solvent Site which would be expected to contain a component of background or anthropogenic mercury. He also identified Occidental Chemical's chlor-alkali facility to the east of the Solvent Site as another potential source of the mercury detected in the Solvent soils (Tr. 1434 at 54-60).

In his approach to allocating responsibility for the contaminated soils, Mr. Hall first determined the average concentration of each chemical found in the soils, then generated a ratio relative to either the cleanup standard or background value for that chemical, adjusted based on the area where the chemical was detected. O-464 contains the calculations Mr. Hall performed to determine a risk factor for each of the soil contaminants, arriving at an allocation percentage representing the relative contribution of mercury as 16.03% of the need for remediation of the Solvent Site soils. Mr. Smyth used a similar approach to arrive at an allocation percentage of 21.93% for mercury (Tr. 1434 at 60-63).

The next step was to determine how much of the permeable cap consisted of soils relocated from other areas. According to Mr. Hall, this step was necessary because much of the material used for the cap was attributable to other remedial activity, such as the 18-inch sewer remediation and the Hot Spot trenches, and had nothing to do with mercury contamination. O-463 contains Mr. Hall's calculations of relative volumes of waste material and engineered cover material, resulting in the estimate that 55.6% of the cap consists of waste material and 43.6% of the cap consists of cover material. He then multiplied the cover material percentage (.436) by the mercury risk factor percentage (.1603), resulting in the conclusion that 6.9% of the soil remediation costs are attributable to mercury contamination (Tr. 1434 at 63-67; *see* O-427).

The final step of Mr. Hall's soil allocation calculation was to divide this percentage among the three identified potential sources of the mercury contamination: Solvent, Olin, and Occidental. He determined that in the absence of any specific data or other information about where the mercury came from, it was appropriate to distribute the responsibility equally among these three sources. Dividing by three his calculated percentage (6.9%) of the soil remedy attributable to mercury contamination, Mr. Hall concluded that Olin should be allocated 2.3% of the cost of the soil remedy at the Solvent Site (Tr. 1434 at 68-69).

3. Kirk Winges

Mr. Winges is an air quality scientist employed by Geomatrix Inc., and environmental consulting firm located in Lynwood, Washington. He described his expertise as concerning the transport and dispersion of air pollutants in the atmosphere from release to deposition. He has been involved in air quality investigations for over 30 years, and has dealt with the emission and deposition of mercury on several occasions. His work involves a process known as air modeling, which he described as a computerized method for analyzing what happens to pollutants once they are released into the atmosphere (Tr. 1441 at 65-69).

Mr. Winges testified that he was retained by Olin to review the report of Solvent's air emissions expert, Gary Hunt, and to determine whether Mr. Hunt's opinion as to the source of the mercury contamination at the Solvent Site was based upon sound scientific principles. According to Mr. Winges, there were several problems with Mr. Hunt's conclusion that the only possible explanation for the mercury found in the Solvent soils was airborne deposition of emissions from the Olin facility. For one thing, the concentrations of mercury detected in the Solvent soils do not follow the typical pattern of airborne deposition of pollutants from a single source. O-484 depicts the location of the soil samples collected at the Solvent and Olin Sites. There are several incidences where high concentrations of mercury were detected in the same area as low concentrations, indicating a rapid gradient which cannot be explained by aerial deposition (Tr. 1441 at 74-86).

Mr. Winges testified that he performed a regression analysis to compare the actual soil sampling data with Mr. Hunt's air model predictions, and found no correlation between the mercury concentration values predicted and the actual concentrations detected. He then looked at other possible sources for the mercury, including the Occidental Chemical chlor-alkali facility located to the south and east of the Solvent and Olin Sites. He testified that while there was insufficient information regarding the exact location of Occidental's chlor-alkali plant and other factors pertinent to a precise modeling analysis of the impact of Occidental's mercury emissions, the available information–including the windrose suggesting a predominant wind direction from the southwest to the northeast (S-6003)–indicated that if there was airborne deposition of mercury at the Solvent Site traceable to Olin, there would be airborne deposition of mercury at Solvent traceable to Occidental as well (Tr. 1441 at 86-97).

Mr. Winges also reviewed the available information regarding the placement of fill material at the Solvent Site. He was shown the RECRA Remedial Action Investigation Report dated December 3, 1980 (O-241), which indicates that much of the Solvent Site was once marsh area which was subsequently filled with a heterogeneous mixture of silt, cinders, brick fragments, wood, and other miscellaneous materials. Mr. Winges testified that the co-location of mercury with barium, lead, zinc, and other inorganics not associated with chlor-alkali production suggests that these contaminants came to the Solvent Site via the same mechanism, more likely the placement of fill material than aerial deposition (Tr. 1441 at 97-110).

On cross-examination, Solvent's counsel showed Mr. Winges historical aerial photographs indicating various periods of building construction, addition of railroad tracks and facilities, and other activities likely to create soil disturbances at the Solvent Site (O-404, 405). Mr. Winges agreed that these disturbances might account for some of the differences in the levels of contaminants detected in the soils, but not to the degree reflected in the sampling data (Tr. 1441 at 135-43).

4. James Brown

Mr. Brown was employed by the Olin Corporation for almost 40 years. From approximately 1990 until his retirement in May 2007, his focus was in the area of environmental remediation. He was directly involved in the remediation of Gill Creek, undertaken jointly with DuPont in 1992. His primary role was as environmental representative for Olin, with responsibility for liaison with the DEC and DuPont in the negotiation, execution, and implementation of the consent order, work plans, cost-sharing agreement, and various other aspects of the Gill Creek project (Tr. 1450 at 2-9).

Mr. Brown testified that in 1981, Olin and DuPont had independently performed remediation work on those portions of Gill Creek that ran through their respective properties. Subsequently, DEC contacted DuPont to address PCB contamination detected in the sediments at the mouth of Gill Creek during continuing work in the Niagara River. Further remedial investigations revealed the presence of additional contaminants traceable to both DuPont and Olin, including mercury, BHC, chlorobenzenes, and chlorinated aliphatics. According to Mr. Brown, the concentration levels detected for any one of these contaminants would have necessitated the chosen remedy, which involved removal of all contaminated sediments in four designated areas of the creek: Area 1, encompassing the mouth of Gill Creek between the Robert Moses Parkway and the confluence of the Niagara River; Area 2, encompassing the predominant length of Gill Creek which was remediated in 1981; Area 3, which is the area in the vicinity of the Adams Avenue bridge; and Area 4, encompassing the near shore of the Niagara River (Tr. 1450 at 9-15).

O-669 is a copy of the cost-sharing agreement entered by Olin and DuPont in September 1991. Mr. Brown testified that the purpose of the agreement was to establish responsibility for the various tasks of the remediation and the percentages of costs to be paid by Olin and DuPont, and to set up an operating committee with voting rights to address any changes in the scope of the work or cost-sharing percentages necessitated by circumstances encountered in the field. The initial overall percentages were set at 40% for Olin and 60% DuPont, but the final adjusted percentages were approximately 44% for

Olin and 56% for DuPont. Mr. Brown explained that he did not adopt the proposal submitted by Blaine Butaud, a member of Olin's environmental staff, that Olin pay a maximum of only 2%, because Mr. Butaud's approach was based entirely on the relative toxicity of the constituents detected in the sediments without taking into account the need to maintain the business relationship between Olin and DuPont (Tr. 1450 at 17-20).

Mr. Brown testified that during the course of the remediation, he became aware of the 18-inch storm sewer connection with the Solvent Site. Samples taken from the sewer indicated elevated levels of chlorobenzenes of the same type found on the Olin Site. However, no effort was made to include Solvent in the cost-sharing agreement because there was no apparent viable financial entity operating the Solvent Site, and Olin and DuPont had a common interest in cooperating with the DEC to clean up the creek while maintaining their ongoing plant operations (Tr. 1450 at 26-28).

O-667 is a summary chart listing by task the common costs incurred by Olin to investigate and remediate Gill Creek. Mr. Brown explained that certain costs were considered to be "common" because they were expended to remediate the contaminated creek sediments regardless of the source of contamination. He testified at some length about each of the tasks listed and amounts spent by Olin: Design = $435,220; Creek Diversion = $1,236,770; Contract and Project Administration = $578,821; Water Treatment = $1,417,810; General Items = $404,996; Health and Safety = $6,381; Sales Taxes, Phase I = $184,680; Sales Taxes, Phase III = $24,332; Area 3 Seeps = $7,165; Sevenson Incentive = $152,924; Total = $4,467,099. According to Mr. Brown, these costs were reasonable and necessary to accomplish this complex project in a manner consistent with DEC oversight and the terms of the consent order. He also testified that Olin spent a total of just over $7 million for the Gill Creek remediation, leaving approximately $2.5 million not included as common costs. These additional amounts were spent on such tasks as conducting the remedial investigation and risk assessments; excavation, removal and disposal of creek sediments; and relocating two sewer outfalls (Tr. 1450 at 30-43).

C. DuPont's Witnesses

1. Jeffrey Konsella

Mr. Konsella is employed by the DEC as a project engineer with responsibility for overseeing the investigation and remediation of inactive hazardous waste sites in New York State. He described the State program as New York's version of the federal program under CERCLA, which gives the DEC authority to investigate and oversee remediation of sites identified as posing a significant threat to human health or the environment. He has been the project manager for the DEC at the Solvent Site since 1993 (Tr. 1442 at 6-10).

D-124 is a copy of the Solvent Site's listing page on the web-based version of the DEC's registry of inactive hazardous waste sites, containing information about the Solvent Site as of October 30, 2006. The wastes disposed of at the Site are identified on the registry page as zinc, lead, benzene, mono-, di-, and trichlorobenzenes, all in unknown quantities. D-199 is DEC's Technical and Administrative Guidance Memorandum ("TAGM") 4030, described by Mr. Konsella as a guidance document for the selection of remedies at hazardous waste disposal sites in New York. It was used for guidance in selecting the remedy at the Solvent Site. Mr. Konsella explained that under the State's program, the DEC acts as lead agency with ultimate responsibility for decision-making with regard to remediation of a hazardous waste site, with input from the State Department of

Health to safeguard the human health aspects of the remediation. Occasionally, the USEPA becomes involved on a case-by-case basis, but the EPA did not take an active role in the Solvent Site remediation (Tr. 1442 at 11-14).

Mr. Konsella testified that one of the early steps in the remedy selection process is to identify the applicable standards for determining the appropriate remedial work to be performed at the site. The federal standards are known as "ARARs" (Applicable or Relevant and Appropriate Requirements), and in New York State the standards are referred to as "SCGs" (Standards, Criteria and Guidance). D-24 is an EPA guidance document entitled "Guidance for Evaluating the Technical Impracticability of Ground-Water Restoration," which Mr. Konsella explained was relied upon in the remedy selection process after a determination was made to waive otherwise applicable SCGs (Tr. 1442 at 14-16).

D-12 is a copy of the table of contents for the November 1990 Remedial Investigation report for the Solvent Site, undertaken by a group of potentially responsible parties to characterize the nature and extent of the contamination. Mr. Konsella testified that the DEC considered this to be a good first step, but more work needed to be done to perform a full remedial investigation and feasibility study. When the PRP group declined to complete the work, the State engaged Malcom Pirnie to conduct a supplemental remedial investigation and full feasibility study. D-14 is Volume I of Malcom Pirnie's Supplemental Remedial Investigation Report, finalized in July 1995. Mr. Konsella was the project manager who oversaw the SRI, reviewed and modified the work plan, and reviewed and approved the SRI Report on behalf of DEC. As summarized by Mr. Konsella, the SRI Report concluded that the overburden soil and bedrock groundwater at the Solvent Site were contaminated by chlorinated benzenes and metals. D-16 is an excerpt from the report finalized in June 1995 of a study performed by Malcolm Pirnie, again under Mr. Konsella's oversight, to determine the technical feasibility and cost of the various remedial alternatives being considered for the Solvent Site, which concluded that the presence of organic contaminants required on-site groundwater treatment (Tr. 1442 at 16-22).

D-17 is the table of contents for the Feasibility Study performed by Malcolm Pirnie on behalf of the DEC, dated February 1996. Mr. Konsella testified that the purpose of a feasibility study is to screen the appropriate remedial technologies to develop a remedial plan to deal with site-wide contamination. Table 2-6 from this study reports the volume and areal extent of soil contamination at the Site, indicating that the overburden materials down to a depth of 7.5 feet contained widespread organic and inorganic contamination. According to Mr. Konsella, the primary objective of the inactive hazardous waste site program is to achieve a cleanup remedy whenever possible, but in this situation the high concentrations of both organic and inorganic contaminants in the overburden made a cleanup alternative technically impracticable (Tr. 1442 at 22-26).

D-23 is a feasibility study supplement dated July 1996, principally authored by Mr. Konsella, which discussed additional remedial alternatives to address the high levels of contamination in the Solvent soils in order to achieve SCGs for groundwater both on-site and off-site. One of the additional alternatives was a permeable soil cover combined with a collection system to allow infiltration as a method of enhancing capture and control of the contaminants in the overburden. The feasibility study supplement also discussed a phased approach to B-Zone groundwater control, which recognized that the majority of the contaminants at the site would be transmitted to the groundwater flowing within the fractured B-Zone bedrock. The phased approach was intended to achieve containment and control of the overburden and B-Zone groundwater, and to monitor the effect of the containment and control system on the lower bedrock zones. The supplement also discussed the DEC's rationale for not requiring further off-site groundwater remediation, based on the technical impracticability presented by the man-made utilities located north of Buffalo Avenue, as well as the likelihood that these utilities would collect and carry a significant part of the off-site groundwater plume toward the POTW (Tr. 1442 at 26-30).

Mr. Konsella testified that he was the principal author of the Solvent ROD (D-26). The ROD contains the DEC's findings and conclusions regarding the remedial actions necessary to address the harm caused by the contaminants of concern, defined by Mr. Konsella as the principal contaminants associated with the site which present a threat to human health or the environment. The specific organic compounds identified as contaminants of concern at the Solvent Site were benzenes, chlorobenzenes, dichlorobenzenes, and trichlorobenzenes. Inorganic contaminants of concern were zinc, lead, and mercury. The Solvent ROD also sets forth the DEC's impracticability determination with respect to the soil and groundwater cleanup remedies (Tr. 1442 at 30-33).

Mr. Konsella testified that the remedy selected for the Solvent Site includes long-term groundwater monitoring to assess the performance of the remedy. D-71 is the performance-monitoring plan for the Solvent Site, prepared by TRC in June 2004 and submitted to the DEC for approval. The plan calls for monitoring the quality of the groundwater in the A-, B-, and lower zones, with monthly and annual reporting of sampling results. The reports are reviewed by the DEC to determine whether the remedial goals of the Solvent ROD and the consent decree are being satisfied. Mr. Konsella explained that phase one of the groundwater remedy was implemented as a means of control, containment, and treatment of the groundwater in the B-Zone to minimize contaminant loading to the lower bedrock zones through vertical migration. At some point the phase one remedy will be evaluated by reviewing the monitoring reports and groundwater quality data to determine whether the system is effectively controlling migration of the B-Zone contamination, and whether additional remedial phases might be necessary. He testified that the evaluation will be based on sampling data pertaining to the contaminants of concern identified in the Solvent ROD, without regard to the presence of chlorinated aliphatics or other inorganic constituents (Tr. 1442 at 33-39). On cross-examination, Mr. Konsella testified that Solvent is required under the terms of its POTW waste water discharge permit to treat all contaminants in the groundwater that exceed permit levels, regardless of whether they are site-specific contaminants (Tr. 1442 at 53-54).

Mr. Konsella testified that although Solvent has sent DEC sampling results from pumped groundwater, the primary monitoring mechanism is the samples obtained from the monitoring wells across the site. In making the determination as to whether groundwater standards are being met at the Site, the DEC looks at the data obtained from both the monitoring wells and the pumping wells, but the concentrations reported in pumped water may not be representative of overall site contamination because of the dynamic nature of the pumping conditions (Tr. 1442 at 39-40).

D-108 is a letter dated November 25, 2002, from DEC Region 9 Environmental Engineer Michael Hinton to Paul Mazerski at DuPont Environmental Remediation Services, advising that DuPont-related contaminants were adversely affecting the operation and performance of the remedial system constructed at the Solvent Site and requesting immediate action by DuPont to evaluate options to eliminate or mitigate the off-site migration of contaminants. D-109 is Mr. Mazerski's response and proposal for an additional site study to determine the appropriate remedial approach, and D-110 is the Conceptual Site Model developed by DuPont suggesting additional groundwater investigation to determine how the three separate pumping and treatment systems at the DuPont, Olin, and Solvent Sites are impacting the groundwater. Mr. Konsella testified that this proposal was submitted to the DEC and, at the time of the trial, was still under review (Tr. 1442 at 40-43).

On cross-examination, Mr. Konsella testified that the remedy selected for the Solvent Site was determined by the DEC to be consistent with the National Contingency Plan ("NCP"), protective of human health and the environment, cost-effective, and in compliance with State and federal requirements that are legally applicable or relevant and appropriate to the extent practicable. According to Mr. Konsella, to the extent that the State program mirrors the federal program, the remedy is a CERCLA quality cleanup (Tr. 1442 at 47-49). He also testified that the remedy for the DuPont Site, as required by the January 3, 1990 DuPont ROD, involved a pump-and-treat system to contain contaminants in the overburden as well as joint long-term operation of the Olin production well to control bedrock groundwater contamination west of Gill Creek. There is no active control of groundwater in the B-Zone or below at the DuPont Site east of Gill Creek, and the DEC has recognized that the DuPont remedy has had minimal impact on the bedrock groundwater contamination at the DuPont Site east of Gill Creek (Tr. 1442 at 65-69).

2. Charles Russell Faust

Dr. Faust is a Certified Professional Geologist with a Ph.D. in geology from Penn State University. He has worked as a hydrogeologist for more than 30 years, engaged primarily in the study and characterization of how groundwater flows in the subsurface and the behavior of contaminants in the groundwater or in separate non-aqueous phases. He is familiar with the general hydrogeological conditions of the Niagara Falls area through his site investigation and oversight work for the EPA at several inactive hazardous waste sites and Superfund cleanups, including Love Canal, S-Area, Hyde Park and 102nd Street. He was employed by DuPont in this case initially to assess the relative impact of the aliphatic and aromatic compounds detected at the Solvent Site and Hot Spot and, later, to consider explicitly the harm to the Site caused by the presence of these contaminants in the soil and groundwater. He defined the term "harm to the site" as adverse impacts affecting the soil, bedrock, groundwater, surface water, or biota in some way so that the property either cannot be used for its intended purpose or requires remedial action to bring it back into compliance with appropriate state or federal environmental standards (Tr. 1442 at 89-94; *see* D-248, 249).

Dr. Faust testified that he has worked at several sites impacted by chlorobenzenes and DNAPL, which he defined as basically pure chemicals that dissolve very sparingly in water so that they form a separate dense nonaqueous phase. D-163 is a demonstrative slide prepared by Dr. Faust depicting how DNAPL behaves once it is released on the surface and passes through overburden, water table, and bedrock. He testified that since DNAPL is denser than water, it will typically sink down through the overburden, past the water table, and penetrate into the cracks and crevices of the bedrock where it will act as a long-term source of contamination that is difficult to remediate. D-217 depicts the aqueous solubility of chlorobenzene, indicating that 2.5 teaspoons of pure phase chlorobenzenes equivalent to DNAPL material would contaminate an Olympic-size swimming pool containing 603,558 gallons of water, at the DEC limit of 5 ppb (Tr. 1442 at 94-97). On cross-examination, he testified that the same amount of chlorinated aliphatics would have the same effect (Tr. 1444 at 103-04).

Dr. Faust testified that DNAPL is usually first identified visually as a black substance dripping from a passive diffusion bag, connecting pipe, or pump at a sampling location. D-160 is the figure from the Malcolm Pirnie Supplemental Remedial Investigation, depicting the locations where DNAPL was observed or was deemed likely to be found at the Solvent Site. D-167 shows these locations superimposed on an aerial photograph of the Site, along with flags indicating DNAPL detections in the wells and soil borings. D-160.1 and D-161.1 are tables showing the different compounds detected in the DNAPL, which Dr. Faust testified indicates that virtually all of the DNAPL detected at the Solvent Site is composed of benzenes or chlorinated benzenes, with only extremely small amounts of chlorinated aliphatics (Tr. 1442 at 97-101).

D-255 is a modification of S-6028, which Mr. Smyth used to demonstrate the presence of DNAPL associated with chlorinated aliphatics and chlorinated benzenes on a widespread basis throughout the study area. Dr. Faust testified that while S-6028 indicates that both compounds were detected at monitoring wells MW-4A and MW-2B on the Solvent Site, it fails to account for the actual relative percentages of the chemical composition of the DNAPL detected at these wells. Dr. Faust added these percentage numbers to D-255, indicating that the DNAPL detected at MW-4A was composed of

99.96% chlorinated benzene material, and the DNAPL detected at MW-2B was composed of 98.6% chlorinated benzene material. He also questioned the validity of the analytical results for the detection of chlorinated aliphatics at PW-5B (Tr. 1442 at 102-04).

D-164-66 represents a comparison of the two different remedial approaches for dealing with the presence of DNAPL at a site: the ARAR remedy, involving aggressive removal of the DNAPL source to achieve restoration of the site to ARAR standards; and the Technical Impracticability ("TI") remedy, involving a containment remedy based on the determination that removal of the DNAPL is not feasible. According to Dr. Faust, this comparison shows that the removal of DNAPL results in a much faster improvement of both on-site and off-site conditions than a containment remedy (Tr. 1442 at 105-08).

D-171 depicts the three main elements of the partial containment remedy in place at the Solvent Site: the permeable vegetated soil cover, the A-Zone trench dealing with the groundwater in the overburden, and the B-Zone wells that pump water from the shallow bedrock. The fourth element–the on-site treatment plant which deals with the groundwater collected in the A-Zone trenches–is not depicted. There is no active groundwater remedy for the C-Zone and lower, but passive treatment occurs at the POTW by means of collection in the NYPA conduits and the Falls Street Tunnel (Tr. 1442 at 108-110; *see* D-168, 169).

D-214 and 215 illustrate the differences between the workings of monitoring wells and pumping wells. Dr. Faust testified that a monitoring well draws a groundwater sample from a limited area immediately adjacent to the well, providing a measurement of contaminants located at a specific point. A pumping well pulls water from a larger area, depressing the water level of the aquifer as it pumps (Tr. 1442 at 110-13).

D-134 depicts the A-Zone trench and the location of the pumping wells that penetrate the B-Zone. D-136, 137, and 138 show the monitoring well network used by Solvent to collect samples from the A-, B-, and deeper zones. D-76 is TRC's operations, maintenance and monitoring report for the third quarter of 2004, representative of the quarterly reports submitted to the DEC regarding the operation of the system and the concentrations of contaminants being detected at the Solvent Site and Hot Spot. Dr. Faust testified that he reviewed these reports through the year 2006 as a source of data for his analysis of how Solvent's remedial system has been operating and how it has affected the concentrations of contaminants of concern in the A-and B- Zones (Tr. 1442 at 113-16).

D-14.151 and 14.153 depict iso-concentration contours of chlorinated benzenes detected in the A- and B-Zones at the Solvent Site, showing the highest concentrations of groundwater contamination in the southern part of the Site where chemical processing took place and the tank farms were located, and in the western portion of the Site where the railroad spur was located. D-173 is a pie chart showing the relative percentages of contaminants detected in the A-Zone trenches and wells, divided into the northern and southern portions of the Site. The chart indicates that 80.9% of the total A-Zone contaminant loading consists of aromatics (benzenes and chlorinated benzenes) detected in the southern trenches, with 15.7% attributable to aromatics detected in the northern trenches. Of the remaining 3.4% of total contaminant loading in the A-Zone, 0.6% is attributable to aliphatics found in the southern portion of the Site, with 2.2% attributable to aliphatics found in the northern portion (Tr. 1442 at 116-20).

D-172 contains bar graphs depicting the relative percentages of contaminants detected in the B-Zone bedrock wells, also divided into the northern and southern areas of the Site. Approximately 80% of the B-Zone groundwater contamination was detected in the southern wells, consisting almost entirely of benzenes and chlorobenzenes, along with a very small percentage of aliphatics. The remaining 20% of B-Zone contamination was detected in the northern wells, consisting of approximately 60% aliphatics (Tr. 1442 at 120-22).

D-150 through 153 contain side-by-side bar graphs depicting the total concentrations of aromatic and aliphatic contaminants detected in both the A- and B-Zone groundwater, as reflected in the sampling data from Solvent's annual and quarterly reports from 2004-05. According to Dr. Faust, these graphs demonstrate that the contaminants detected in the A-Zone consist almost entirely of aromatics, while the B-Zone contaminants are predominantly aromatics with a significant amount of aliphatics. As reflected in D-152 and 153, Dr. Faust calculated the relative risk of harm to the environment posed by these contaminants using the State SCGs for groundwater. He confirmed these weighted risk calculations using additional sampling data from Solvent's quarterly reports through 2006, as reflected in D-218, 221, 222 and 225. D-219 is a summary of these calculations, which indicate that benzenes and chlorinated benzenes represent approximately 98.2% of the risk of harm to the groundwater in the A-Zone, and approximately 92.5% of the risk of harm to the groundwater in the B-Zone. Conversely, chlorinated aliphatics represent approximately 1.8% of the risk of harm to the groundwater in the A-Zone, and approximately 7.5% in the B-Zone (Tr. 1442 at 122-29).

D-156 is a table prepared by Dr. Faust showing the ratios of aromatics and aliphatics detected in influent samples from the groundwater pumping wells at the Solvent Site during the 2004-05 period, when the wells were operating at normal capacity. This table reflects a wide variation in the ratio of aliphatics detected, from less than 20% to more than 80%, depending on the pumping conditions at the time of sampling. According to Dr. Faust, since pumping wells draw water from different areas, the sampling data does not represent the same consistent point measurements represented in monitoring well data. In addition, the ratio of compounds detected at individual wells can be impacted by such variables as the location of the well and the volume of water being pumped (Tr. 1442 at 129-31).

Dr. Faust also assessed the risk of harm to the Solvent Site as represented by contaminants detected in the soil. Figure ES-2 from the 1995 Malcolm Pirnie feasibility study (D-14) identifies the soil contaminant areas covered by the study, focusing on the railroad spur along the western and southern borders and the two tank farm areas in the southwest and southeast portions of the Site. Tables 4-8, 4-9, and 4-10 (*id.*) present summaries of the soil data collected from the unsaturated zone (from zero to four feet) in the southeast, southwest, and railroad spur areas, respectively. According to Dr. Faust, these summaries show the presence of benzene and chlorobenzene compounds in all three areas at levels significantly exceeding State soil standards (Tr. 1442 at 132-35).

Figure 2-1 from the Malcolm Pirnie feasibility study (D-17) represents a somewhat different areal delineation of the Site to assess remedial options in terms of soil and contaminant volume. Area 1 corresponds to the railroad spur and tank farm areas, accounting for 31,120 cubic yards of soil, 233,500 pounds of organic contaminants, and 1,693,000 pounds of inorganic contaminants. According to Dr. Faust, these amounts represent a significant source of soil contamination to deal with from a remedial perspective (Tr. 1442 at 135-37).

Dr. Faust was asked several questions about S-6038, which is the contour map of 1,1,2,2-tetrachloroethane concentrations detected in the B-Zone groundwater used by Mr. Smyth to support his opinion that DuPont is the source of the chlorinated aliphatic contamination at the Hot Spot and the Solvent Site. According to Dr. Faust, there were several discrepancies with Mr. Smyth's analysis of the sampling data which rendered this opinion misleading. For example, Mr. Smyth testified that he used only monitoring well data to construct the contour map, but Dr. Faust's review of the overall sampling results indicated that Mr. Smyth used pumping data as well. Dr. Faust also pointed out that Mr. Smyth used the highest reported concentrations for some of his contour points, whereas the overall sampling results showed much lower concentrations reported at those locations at various times, which would have altered the results of the computer-generated contour model (Tr. 1442 at 138-51).

Based on his analysis of the available information, Dr. Faust stated his opinion that virtually all of the harm to the Solvent Site caused by the contamination in the soils and groundwater is due to benzenes and chlorobenzenes, with only a very small amount of the harm due to chlorinated aliphatics (Tr. 1442 at 152-53). This conclusion was drawn from his calculations of the relative concentrations of aromatics and aliphatics detected at the Site using monitoring well data, adjusted to reflect risk of harm by using New York State cleanup criteria. He also considered the long-term impact of the DNAPL detected at the Site, which consists almost entirely of chlorinated benzenes (Tr. 1444 at 110-13).

Dr. Faust testified on cross-examination that while chlorinated aliphatics from the DuPont facility have had no impact on the overburden and A-Zone groundwater at the Solvent Site, there is some potential for impact in the B-Zone and deeper. The pattern of groundwater flow in the B-Zone beneath the DuPont and Solvent Sites is complex, but generally the flow direction is to the north and northeast, making it possible for contamination from the DuPont Site to flow toward the Solvent Site and Hot Spot. He agreed that elevated levels of chlorinated aliphatics, as well as chlorinated aliphatic DNAPL materials, have been detected at the DuPont Site on several occasions. He also testified that while the pump-and-treat groundwater containment remedies in place at the DuPont and Solvent Sites are similar, they differ in certain important respects. For one thing, there was no attempt to remove DNAPL material from the Solvent Site, while substantial amounts of DNAPL materials have been removed from the DuPont Site. For another, there are no wells on the DuPont Site controlling groundwater contamination in the B-Zone (Tr. 1444 at 6-44; *see* S-3006, 3015, 3048).

D. Solvent's Rebuttal

Solvent recalled Mr. Smyth to rebut the testimony of Olin's witness, Mr. Hall, and DuPont's witness, Dr. Faust. Mr. Smyth was shown S-4156, which is the compilation of data obtained by subpoena from Olin's consultant, MACTEC, reporting the results of a pump test conducted in July 2001 at wells SRW-1 and SRW-2, located in the ARGC area of the Olin Site where historical BHC production and trichlorophenol operations took place. S-6088 is a bar chart prepared by Mr. Smyth using the data reported in S-4156, showing the concentrations of 1,2,4-trichlorobenzene detected at SRW-1 during the pump test. Samples taken prior to pumping reported a range between 4100 and 4400 ug/L (micrograms/liter). After one day of pumping at 27 gallons per minute, the concentration had risen to 5000 ug/L, and after two days of pumping the concentration had risen to 7200 ug/L. According to Mr. Smyth, these results verify his conceptual model suggesting that the trichlorobenzenes detected in the pumped groundwater at the Hot Spot are coming from the BHC operations area of the Olin plant (Tr. 1449 at 2-10).

O-642 shows TCB concentrations detected in June 2002 at pumping wells RW-3 (in the northeast corner of the Olin Site), PW-3B and -4B (at the Hot Spot), and PW-2B (in the northwest corner of the Solvent Site), which Mr. Hall used to support his opinion that the Hot Spot pumping wells were pulling the TCBs from the Solvent Site. According to Mr. Smyth, this opinion does not negate his conceptual model because it implies an easterly groundwater flow, whereas his model is based on evidence showing a northeasterly flow, and because there have been much higher TCB concentrations detected at RW-3 than those reported on O-642. He prepared S-6094, which adds to O-642 the July 2001 results from SRW-1 showing the presence of TCBs at the Olin Site at levels well above the levels detected at the Hot Spot (Tr. 1449 at 10-12).

S-6093 is a bar chart comparison of chemical concentrations detected in extracted groundwater at the Hot Spot, the shallow Olin extraction wells, and the shallow Solvent extraction wells. Mr. Smyth testified that he performed a statistical “Pearson correlation” comparing the constituents detected at the three locations, which showed a 99.7% correlation between the Olin groundwater and the Hot Spot groundwater and a 3.5% correlation between the Solvent groundwater and the Hot Spot groundwater. Based on this analysis, Mr. Smyth concluded that the constituents found at the Hot Spot are coming from the Olin ARGC/BHC production area, not from the Solvent Site (Tr. 1449 at 12-16).

S-6091 is a bar chart prepared by Mr. Smyth depicting allocation percentages for the harm caused by the contaminants detected in the Gill Creek sediments, attributing

1.2% of the harm to chlorobenzenes associated with Solvent and Olin and 98.8% to the various other constituents associated with DuPont and Olin. S-6090 depicts a similar allocation calculation for just Area 3, showing 0.74% of the harm to the Area 3 sediments attributable to chlorobenzenes and 99.26% of the harm attributable to other constituents. According to Mr. Smyth, these charts show that chlorobenzenes played a *de minimis* role in the cleanup of Gill Creek (Tr. 1449 at 16-18).

Mr. Smyth testified that Mr. Hall's "death star" exhibit (O-656) is based on an improper comparison of the average mass of chlorinated benzenes detected in the NAPL found within the 18-inch sewer at the Gill Creek outfall with the average mass of contaminants detected in the soil samples taken from the Olin plant. According to Mr. Smyth, a more appropriate comparison could be made between the NAPL from the sewer and the DNAPL detected in recovery well RW-5, located on the Olin site near the west bank of Gill Creek, just north of Area 3. As reported in the October 29, 1999 quarterly report on the operation of the Olin pump-and-treat system (S-4132 at OLIN/SC 048291), the levels of chlorinated benzene compounds found in the DNAPL at RW-5 were approximately 28 times higher than the levels detected in the Solvent sewer (Tr. 1449 at 18-21).

Mr. Smyth also testified that Gill Creek and the DuPont sewer do not act as interceptors of the A-Zone groundwater flow, contrary to Mr. Hall's opinion. This conclusion is based on data showing the presence of contaminants on both sides of Gill Creek at both the DuPont and Olin Sites. In addition, DuPont's own study shows that the DuPont sewer is not a preferential pathway for contaminants; and if it is, its path runs along the western side of the Olin parking lot and would allow DNAPL or other contaminants crossing under the creek to travel to the Hot Spot (Tr. 1449 at 32-35).

Finally, Mr. Smyth testified that his opinion regarding Olin as a likely source of perchlorate was based on the general technical literature about hypochlorite production (*see, e.g.*, S-7009 (August 2005 Draft Report on Occurrence and Sources of Perchlorate in Massachusetts)), as well as historical information about the location of calcium hypochlorite operations on the Olin Site (*see* S-6096) (Tr. 1449 at 35-43).

Turning to Dr. Faust's testimony, Mr. Smyth was shown D-252.1, which Dr. Faust used to support his position that S-6038 (depicting the contours of 1,1,2,2-TCA concentrations detected in the B-Zone groundwater) was based on incomplete information overlooking several non-detect values reported at sampling locations in the area of the Solvent Site and Olin parking lot. S-6089 is Mr. Smyth's contour map of the study area generated after these non-detect values were added to the computer model. According to Mr. Smyth, the new model shows a slightly different pattern of widespread 1,1,2,2-TCA contamination throughout the study area, but it does not alter his opinion that this contaminant is a tracer for DuPont. Dr. Faust's risk of harm calculations were restricted to monitoring well data from the Solvent Site, which overlooked monitoring well data from other areas where the groundwater was actually coming from. In Mr. Smyth's view, pumped well data is more representative of the flow of contaminants through the groundwater than monitoring well data. This is because a monitoring well intercepts a narrow stream of water flowing through the area, whereas a pumped well draws in water from a wider region and is more likely to intercept higher flow fractures. In addition, Solvent’s groundwater treatment requirement is based on pumped well data (Tr. 1449 at 21-27).

III. TRIAL MOTIONS

During and subsequent to the trial, Solvent filed motions to strike the testimony of Olin's expert witnesses, William Hall and Kirk Winges, to the extent they offered opinions at trial different from those expressed in their pre-trial expert reports. Solvent also argues in its Reply Post-trial Memorandum of Law (Item 1475) that the trial testimony of James Brown should be stricken to the extent Mr. Brown offered expert testimony regarding Olin’s previously undisclosed theory of recovery for the Gill Creek remediation. The court heard argument of these motions prior to the parties’ summations on November 19, 2009.

Solvent and ICC have also filed a joint motion (Item 1482) to strike portions of Olin’s “Response to Solvent Chemical and ICC Corporation's Post-Trial Pleadings” (Item 1472), which the court has taken under advisement without further argument.

Each motion is now addressed in turn.

A. Solvent’s Motion to Strike William Hall’s Testimony

Solvent contends that in his expert report dated January 12, 2007, Mr. Hall identified three pathways by which chlorinated benzene materials could theoretically have been transported to the Hot Spot area from either the Solvent Site or the Olin Site: (1) groundwater transport; (2) movement of non-aqueous phase liquids (NAPL) along the bedrock surface; and (3) subsurface piping/drains and associated backfill. *See* Item 1462, Appendix B (Hall Report), at p. 5. With respect to groundwater transport, Mr. Hall stated in his expert report that it was not possible to draw any definitive conclusions concerning the source of contaminants detected at the Hot Spot based solely on groundwater elevation data due to the presence of several "fluctuating variables" such as rainfall, site surface conditions affecting infiltration, water surface elevations in Gill Creek and the Niagara River, and hydrostatic heads in the various sewers and drains in the area. *Id*. at p. 6. He also found the data inconclusive as to whether the underground utilities in the vicinity of the Solvent Site (*i.e.*, on-site piping and the DuPont and Buffalo Avenue sewers) might be a significant direct source of the contaminants detected in the groundwater at the Hot Spot. *See id*. at p. 11. In contrast, he found that “definitive” bedrock elevation data, along with the confirmed presence of DNAPL source material on the Solvent Site, supported his conclusion that chlorinated benzene contamination migrated from the Solvent Site to the Hot Spot along the top of bedrock. *See id.* at pp. 7-9.

Mr. Hall also expressed the opinion in his expert report that historic fill material provided one of the likely sources of the mercury contamination detected in the overburden at the Solvent Site. *See id*. at p. 13. The only identified basis for this opinion was the 1980 Remedial Action Investigation performed by RECRA Research. *Id*.

Solvent contends that after the exchange of all relevant data concerning bedrock elevations, Mr. Hall abandoned his theory of DNAPL migration and instead testified at trial that he believed chlorinated benzenes were migrating through the groundwater from the Solvent Site to the Hot Spot. He also offered at trial the opinion, not disclosed in his report, that chlorinated benzene contamination within the B-Zone at the Olin facility could not migrate to the Hot Spot because the groundwater west of Gill Creek flows to the north (rather than northeast) due to the influence of the Buffalo Avenue Sewer. Finally, Mr. Hall testified at trial that his opinion with regard to historic fill material as a source of the mercury contamination detected in the overburden at the Solvent Site was based on his review of aerial photographs and boring logs, without any mention of the 1980 RECRA Research Report.

According to Solvent, this testimony must be stricken from the record pursuant to Fed. R. Civ. P. 37(c)(1) as a sanction for violating the expert disclosure requirements of Rule 26(a)(2). In this regard, Rule 26(a)(2)(B)(i) requires that an expert's written report contain “a complete statement of all opinions the witness will express and the basis and reasons for them,” while Rule 26(a)(2)(C)(ii) allows the admission of expert testimony that is “intended solely to contradict or rebut evidence on the same subject matter identified by another party . . . .” *See Scientific Components Corp. v. Sirenza Microdevices, Inc.*, 2008 WL 4911440, at *2 (E.D.N.Y. November 13, 2008) ("[A]rchetypal rebuttal testimony . . . identifies a flawed premise in an expert report that casts doubt on both that report's conclusions and its author's expertise."); *TC Sys. Inc. v. Town of Colonie*, 213 F. Supp. 2d 171, 180 (N.D.N.Y. 2002) (interpreting phrase “same subject matter” in Rule 26(a)(2)(C)(ii) as allowing rebuttal experts to use a different methodology to analyze the same facts considered by the expert-in-chief). Rule 26(e) imposes the duty to supplement the expert disclosures in a timely manner.

In this case, it is clear that the opinions expressed by Mr. Hall in his expert report and at trial were offered to rebut the opinions of Solvent's expert, Andrew Smyth, on the fate and transport of contaminants (*see, e.g.*, Tr. 1433 at 139-40). The court certainly has the sanctioning authority under the discovery rules to exclude rebuttal testimony that goes beyond the scope of the other party's expert testimony and introduces new opinions not previously disclosed. *See, e.g., Jorgenson Forge Corp. v. Consarc Corp.*, 2002 WL

34363668, at *1 (W.D.Wash. January 9, 2002) (excluding rebuttal testimony that went "well beyond the scope of the Plaintiff's expert reports and introduces new opinions"). Specifically, under Rule 37(c)(1), “[i]f a party fails to provide information or identify a witness as required by Rule 26(a) or (e), the party is not allowed to use that information or witness to supply evidence . . . at a trial, unless the failure was substantially justified or is harmless.” The purpose of this rule is to prevent the practice of “sandbagging” an opposing party by presenting untested opinion evidence at trial. *See Ebewo v. Martinez*, 309 F. Supp. 2d 600, 607 (S.D.N.Y. 2004).

Despite the mandatory language of Rule 37(c)(1), “it is well-recognized that preclusion of expert testimony is a drastic remedy and should be exercised with discretion and caution.” *Disability Advocates, Inc. v. Paterson*, 2008 WL 5378365, at *12 (E.D.N.Y. December 22, 2008) (internal quotation marks and citation omitted). Indeed, the Second Circuit recognizes that the sanction of exclusion is discretionary, even if the trial court finds no substantial justification for the failure to disclose or supplement and that the failure is not harmless. *Design Strategy, Inc. v. Davis*, 469 F.3d 284, 296 (2d Cir. 2006). In deciding whether to exercise its discretion to exclude testimony, the court should consider (1) the party's explanation for its failure to comply with the disclosure requirement, (2) the importance of the testimony of the precluded witness, (3) the prejudice suffered by the opposing party as a result of having to prepare to meet the new testimony, and (4) the possibility of a continuance. *Patterson v. Balsamico*, 440 F.3d 104, 117 (2d Cir. 2006).

In this case, Olin offers the explanation that because the opinions expressed by Mr. Hall at trial did not represent an abandonment of his DNAPL migration theory, but instead represented rebuttal of Mr. Smyth’s opinions on the migration of contaminants in the groundwater, no supplementation of expert disclosures was anticipated by the parties or required by the rules. In this regard, the record reflects not only the parties' understanding that Mr. Hall would be called at trial to critique the expert report and opinions of Mr. Smyth, but also that the data relied upon by Mr. Hall for his rebuttal testimony was the same data relied upon by Mr. Smyth to formulate his theory that the chlorinated benzenes detected in the Hot Spot wells migrated from the area of Olin's BHC production facilities (*see, e.g.*, Tr. 1433 at 134-45). This data was incorporated into Mr. Hall's electronic database, which was referenced in his expert report, made available to the parties, and entered into evidence at trial as O-647. The record further reflects the parties' agreement that their pre-trial exchange of exhibits would not encompass the exhibits to be used for rebuttal or cross-examination (*see* Tr. 1433 at 139).

It is clear that Mr. Hall's testimony is important to Olin's defense of the contribution claims made by Solvent in this case. The question whether his testimony is important to the court's understanding of the hydrogeological issues presented is addressed below. If it serves no other purpose, it provides the court with a glimpse of the inability of knowledgeable scientific professionals who have spent many years studying the nature of environmental contamination at these sites to arrive at a consensus about how specific constituents associated with identified chemical production and handling operations might come to be detected in the groundwater or overburden at any given well or soil boring location.

With respect to the element of prejudice, Solvent contends that it suffered substantial harm because it was foreclosed from its right to know the substance and basis of Mr. Hall's opinions in advance of trial in order to adequately prepare for cross-examination. However, the court's review of the trial testimony indicates that the areas covered by Mr. Hall during both direct and cross-examination were the same topics covered by Mr. Smyth during his testimony, and Solvent had ample opportunity to explore the basis for Mr. Hall's rebuttal testimony during three days of cross-examination. Solvent also had the opportunity address the issues raised by Mr. Hall when it called Mr. Smyth as a rebuttal witness. Indeed, given the volume of information generated as a result of the hydrogeological studies, remedial investigations, monitoring and pumping well sampling, soil borings, and other on-site activity over the course of the long pendency of this litigation, as well as the number of depositions taken and exhibits produced during years of pre-trial discovery, the court has trouble with the notion that any party could claim unfair surprise or prejudice resulting from opinion testimony–rebuttal or otherwise–about the fate and transport of chemicals detected in the groundwater or overburden at the Solvent Site and Hot Spot.

Based on this review of the record, the court finds that to the extent any opinions expressed by Mr. Hall at trial were not fully disclosed in his expert report, such testimony was offered by Olin to rebut the opinions expressed by Mr. Smyth in his expert report and testimony, and was based upon the same information and data relied upon by Mr. Smyth to formulate those opinions. Solvent had a full and fair opportunity at trial to explore the basis for Mr. Hall's opinions, without the need for a continuance. Accordingly, any failure on the part of Olin to supplement Mr. Hall's expert report was harmless, and there is no other basis for finding that Solvent was prejudiced by Mr. Hall's trial testimony.

Solvent's motion to strike Mr. Hall's testimony (Item 1462) is therefore denied.

B. Solvent's Motion to Strike Kirk Winges' Testimony

At trial, while Mr. Winges was on the witness stand, Solvent's counsel submitted a motion seeking an order from the court pursuant to Fed. R. Civ. P. 37(c)(1) precluding Mr. Winges from offering any opinions beyond those expressed in his expert report regarding his critique of the atmospheric dispersion modeling analysis performed by Solvent's air emissions expert, Gary Hunt. The court briefly heard argument prior to Solvent's cross-examination of Mr. Winges (*see* Tr. 1441 at 113-22) and took the motion under advisement.

Upon review of both Mr. Winges' expert report[8] and trial testimony, the court denies Solvent's motion. Mr. Winges stated in his report and at trial that he was engaged by Olin as an air quality expert to determine whether there was a sound scientific basis for Mr. Hunt's opinion that Olin's chlor-alkali production was the most likely source of the mercury found in the soils at the Solvent Site. He gave his opinion, based on his review of Mr. Hunt's report and supporting documentation, that (1) the measured data at the Solvent Site were not consistent with Mr. Hunt's computer modeling analysis of how the airborne deposition of mercury might have occurred, and (2) there were other plausible explanations for the presence of mercury at the Site, including large quantities of fill material, the co-location of high concentrations of mercury with high concentrations of other inorganics and other chemicals handled at the Site, and the use of the Site as a storage facility for industrial waste.

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[8] Mr. Winges' expert report was attached as Appendix A to Solvent's written motion dated October 10, 2007, which was handed to the court during Mr. Winges' testimony on October 11, 2007. This report was not submitted as a trial exhibit and was not otherwise made part of the trial record.

As discussed at some length above, the opinions expressed by Mr. Winges during his trial testimony were, in sum and substance, consistent with the opinions stated in his expert report. Nonetheless, Solvent maintained its motion to preclude, shifting emphasis to argue that Mr. Winges' trial testimony was based on his review of documents which were not disclosed as source material in his expert report. More specifically, Solvent objected to Mr. Winges' reliance on the 1980 RECRA Remedial Action Investigation Report (O-241), which identified historic fill material at the Solvent Site, and the TRC soil sampling report dated August 8, 2000 (O-247), which showed the presence of mercury, along with other inorganics, at depth in the soils excavated during the 18-inch sewer remediation.

As discussed above, the 1980 RECRA Remedial Investigation Report has been widely referenced by the parties as a familiar source of information about historic operations at the Solvent Site. Indeed, it was one of the reports relied upon by the DEC in its determination to list the Site on the Inactive Hazardous Waste Site Registry. It was also listed by Mr. Hunt as a source document for his expert report, which was the focus of Mr. Winges' testimony. Although not specifically listed as a source document by Mr. Winges, there can be no serious argument that Solvent was somehow unfairly surprised by Mr. Winges' reference to the 1980 RECRA report during his testimony about historic fill material as a potential source of mercury contamination at the Site.

Similarly, the August 8, 2000 TRC soil sampling report was listed as a source document in the expert report of Mr. McIntosh, which Mr. Winges reviewed as a basis for his opinion about the co-location of mercury with other inorganics detected at depth in the overburden at the Solvent Site. Solvent availed itself of the opportunity during the trial to cross-examine Mr. Winges about his reliance on the data reported in that document (*see*

Tr. 1441 at 126-28). Based on this record, the court finds nothing to suggest that Solvent suffered any prejudice as a result of Mr. Winges' failure to specifically list the August 8, 2000 TRC report as a source document in his expert report.

Solvent also seeks an order striking Mr. Winges' previously undisclosed opinions concerning the concentrations of mercury predicted by Mr. Hunt's atmospheric dispersion model. However, as mentioned above, the court's review of Mr. Winges' trial testimony as compared with the matters discussed in his expert report[9] indicates very little inconsistency in this regard, and suggests no prejudice to Solvent that would warrant the drastic remedy of preclusion.

For these reasons, Solvent's motion to strike the testimony of Mr. Winges is denied.

C. Solvent's Motion to Strike James Brown's Testimony

Solvent also moves to strike Mr. Brown's testimony regarding Olin's claim that Solvent is responsible for a percentage of the $4.467 million spent by Olin in common

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[9] By way of example, Mr. Winges stated in his expert report that the aerial deposition patterns represented by Mr. Hunt's model, showing smooth contours and gradual changes in mercury concentrations:

> are significantly different from what is seen in the data at the Solvent Chemical Site. The data show soil concentrations that vary widely from location to location at the site. For example, the peak concentration of 443 mg/kg in the southwest portion of the Solvent site is within 80 feet from where a concentration of less than 1 mg/kg was observed.

Winges Expert Report, at p. 9. He testified on cross-examination as follows:

> If you take Mr. Hunt's model . . . and you look at his deposition rates that were predicted by his model, and you give him the benefit of the doubt and say there's nothing wrong with the model, . . . [i]t simply cannot account for the data that's observed there where you have . . . [an] average soil concentration [of] about twenty-five parts per million and the aerial deposition simply can't account for that. It can't make it go from four hundred down to point six . . . .

Tr. 1441 at 142-43.

costs associated with the remediation of the entire length of Gill Creek. According to Solvent, this claim is based not upon any verifiable facts or data, but entirely upon Mr. Brown's previously undisclosed expert opinion testimony offered in response to a hypothetical posed by Olin's counsel, and represents a last-minute change in Olin's contribution theory which previously sought recovery for a percentage of Olin's common costs associated with the remediation of Area 3 only.

As discussed above, Mr. Brown was identified by Olin as a fact witness to provide testimony concerning his first-hand knowledge of Olin's remedial activities at Gill Creek. He testified at trial about the various functions he performed as Olin's environmental representative for the project, including his involvement in the negotiation, execution, and implementation of the consent order with the DEC and the cost-sharing agreement with DuPont. During the course of his direct testimony, the following exchange with counsel took place:

> Q. Okay. Now, we've talked extensively about common costs and we have included the common costs–the four point four million or so for the remediation of all of Gill Creek, including the mouth of Gill Creek.
>
> A. Correct.
>
> Q. Why is it in your view that it's appropriate for Olin to receive a percentage of the common costs for the entire remediation of Gill Creek?
>
> A. Well, we attribute some portion of the chlorobenzenes to that eighteen inch sewer and to Solvent. There were chlorobenzenes present throughout the length of the creek, including down at the mouth. So to us it seems logical that it should be a percentage of the entire common costs.
>
> Q. Okay. Both at Area 3, the Adams Avenue Bridge and all the way down to the mouth as well; is that correct?

A. That is correct.

Q. From your review of the risk assessment and other documents that were prepared by the consultants, were the levels of chlorobenzenes at the mouth of Gill Creek such that had they been the only sediments there, all of the sediments would have had to be removed?

A. Yes, it was. As I said, the risk assessment was designed for the purpose of defining which areas needed to be remediated. But in looking at that, we compared all of the compounds to standards, clean-up standards. And the trichlorobenzenes in Area 1, the mouth, exceeded those standards.

Tr. 1450 at 43-44.

In the court's view, this line of inquiry straddles the boundary between elicitation of opinion testimony from a fact witness, as regulated by Rule 701 of the Federal Rules of Evidence,[10] and expert opinion testimony, as governed by the standards of Fed. R. Evid. 702[11] and the corresponding expert disclosure requirements of Fed. R. Civ. P. 26. As explained by the Second Circuit, Rule 701 was amended in 2000 to add the foundational requirement that opinion testimony cannot be received from a lay witness if it is based on

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[10] Rule 701 provides:

> If the witness is not testifying as an expert, the witness' testimony in the form of opinions or inferences is limited to those opinions or inferences which are (a) rationally based on the perception of the witness, (b) helpful to a clear understanding of the witness' testimony or the determination of a fact in issue, and (c) not based on scientific, technical, or other specialized knowledge within the scope of Rule 702.

Fed. R. Evid. 701 (2000).

[11] Rule 702 provides:

> If scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training, or education, may testify thereto in the form of an opinion or otherwise, if (1) the testimony is based upon sufficient facts or data, (2) the testimony is the product of reliable principles and methods, and (3) the witness has applied the principles and methods reliably to the facts of the case.

Fed. R. Evid. 702 (2000).

scientific, technical, or other specialized knowledge. *United States v. Garcia*, 413 F.3d 201, 215 (2d Cir. 2005) (citing Fed. R. Evid. 701(c)).

> Rather, a lay opinion must be the product of reasoning processes familiar to the average person in everyday life. . . .
>
> The purpose of this final foundation requirement is to prevent a party from conflating expert and lay opinion testimony thereby conferring an aura of expertise on a witness without satisfying the reliability standard for expert testimony set forth in Rule 702 . . . .

Id.; *see also* Fed. R. Evid. 701, Advisory Committee Notes on 2000 Amendments ("Rule 701 has been amended to eliminate the risk that the reliability requirements set forth in Rule 702 will be evaded through the simple expedient of proffering an expert in lay witness clothing.").

The treatises explain further:

> [T]he 2000 amendment to Rule 701 is intended to induce the courts to focus on the reasoning process by which witnesses reached their opinions; the courts are to determine whether the proffered testimony should be analyzed under Rule 701 or Rule 702 by ascertaining whether the witness used a reasoning process normal to the activities of everyday life. The express language of the amendment seems to suggest that, if the witness's opinion rests in any way upon scientific, technical, or other specialized knowledge, the court should analyze the admissibility of the testimony under the rules applicable to expert testimony rather than those applicable to lay opinion testimony.

WEINSTEIN'S FEDERAL EVIDENCE § 701.03[1] (footnotes omitted).

> It is sometimes difficult to distinguish between a lay witness providing Rule 701 testimony and an expert providing testimony under Rule 702, particularly if the witness might otherwise qualify as an expert in his or her field . . . . An essential difference is that Rule 701 requires direct personal knowledge of a factual matter at issue. Only then does it allow introduction of a limited degree of opinion testimony to help convey that information and only if the court finds that it would be helpful to the jury.

6 MOORE'S FEDERAL PRACTICE § 26.23[2][a][i].

Also instructive is *Bank of China v. NBM LLC*, 359 F.3d 171 (2d Cir. 2004), in which the circuit court held that the lay opinion testimony of a bank employee assigned to investigate an allegedly fraudulent loan transaction scheme was admissible to the extent it was based on the employee's observations and reflected his investigatory findings and conclusions, and was not rooted exclusively in his expertise in international banking. "Such opinion testimony is admitted not because of experience, training or specialized knowledge within the realm of an expert, but because of the particularized knowledge that the witness has by virtue of his [ ] position in the business." *Id.* at 181 (quoting Fed. R. Evid. 701, Advisory Committee Notes on 2000 Amendments). However, the employee's testimony was excluded to the extent it "was not a product of his investigation, but rather reflected specialized knowledge he has because of his extensive experience in international banking, and his knowledge of business custom and the business community's understanding of certain kinds of transactions and business concepts . . . ." *Id.* at 182.

Analogous to the employee's lay opinion testimony in *Bank of China*, in this case Mr. Brown provided testimony about his direct involvement in the remediation of Gill Creek which was rationally based on his first-hand perception and helpful to the court in gaining a clearer understanding of the negotiation and implementation of the consent order and the cost-sharing agreement with DuPont, as well as various other aspects of the project. However, as reflected in the trial transcript excerpt set forth above, at the conclusion of his direct testimony Mr. Brown testified that Solvent should be required to contribute a percentage of the common costs for the entire Gill Creek remediation, not just the remediation of Area 3. He testified that this was due to the presence of chlorobenzenes throughout the length of the creek which were traceable to materials detected in Solvent's

18-inch storm sewer and which exceeded cleanup standards to the degree that, had this been the only contaminant detected in the sediments, it would have been necessary to remove all of the sediments.

This testimony regarding Solvent's liability for a share of the common costs associated with the entire Gill Creek remediation project represents Mr. Brown's opinion on allocation based not on his experience as a percipient witness, but rather on his specialized knowledge gained as a result of his extensive experience as a chemical and environmental engineer with overall responsibility for Olin's environmental remediation affairs, as well as his particularized knowledge of the Gill Creek remediation project gained by virtue of his role as team leader/liaison with DuPont and the DEC. It also represents a departure from the opinion of Mr. Hall, Olin's designated allocation expert, that Solvent's liability for the Gill Creek remediation should be based on the common costs incurred by Olin for the remediation of Area 3 (*see* Tr. 1434 at 46-54; *see also* Item 1462, Appendix B (Hall Report), at p. 16 ("The allocation of the common costs for the Gill Creek cleanup under the Adams Avenue Bridge are Olin 50% and Solvent Chemical 50%.")). To reach the determination that the high levels of chlorobenzene contamination detected in the creek sediments were traceable to Solvent, and would alone have required the removal remedy contemplated by the consent order with the DEC and DuPont, Mr. Brown necessarily relied upon a reasoning process utilizing technical knowledge beyond that normal to the activities of everyday life, triggering the application of the expert disclosure rules.

Accordingly, Solvent's motion to strike is granted to the extent it seeks to exclude Mr. Brown's opinion that Solvent's liability for the cost of remediating Gill Creek should be based on a share of the common costs associated with the removal of contaminated sediments from the entire length of the creek, and denied to the extent it seeks to exclude Mr. Brown's testimony grounded in the activities he undertook in his role as Olin's environmental representative for the Gill Creek project.

D. Solvent/ICC's Motion to Strike Olin's Response

Solvent and ICC have also filed a joint motion (Item 1482) seeking to strike Olin's post-trial responding brief to the extent it addresses the argument that ICC is responsible under CERCLA for a share of the Gill Creek remediation costs by virtue of its role as an operator of the Solvent Chemical facility. According to Solvent/ICC, this argument should be rejected because it was improperly raised for the first time in Olin's responding papers filed on March 14, 2008, and because the argument is based on Olin's "Synopsis of Solvent Chemical Site Operations," which was submitted to the court as an attachment to Olin's Pre-trial Statement in both hard copy and CD form (Item 1403, Att. 2), and which Olin subsequently agreed to withdraw from the record by stipulation entered at trial.

Upon review of the post-trial submissions, this motion is denied. First of all, Solvent and ICC have been on notice of Olin's claim that ICC is a responsible party under CERCLA since at least May 26, 1998, when Olin asserted its fourth-party cost recovery claim against ICC under CERCLA § 107(a)(2) (*see* Item 809, pp. 13-16).[12] In addition, the issue of ICC's

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[12] Olin also asserted a fourth-party claim against Solvent and ICC for contribution under CERCLA § 113(f)(1). The court dismissed this claim prior to trial based on the prevailing status of the law in the Second Circuit which required a finding that, "because Olin ha[d] not itself been made subject to a civil action under either section 106 or 107(a) by any party at any time relating to the Gill Creek site, it [wa]s not entitled to the contribution rights available under section 113(f)(1) for equitable apportionment of the remediation costs associated with that site." *State of New York v. Solvent Chemical Co., Inc.*, 2007 WL 1672910, at *3 (W.D.N.Y. June 6, 2007).

liability based on its status as an operator of the Solvent facility was addressed by Olin in several written submissions made prior to the filing of the responding brief (*see, e.g.*, Item 1458, p. 59; Item 1459, pp. 65-67).

It is true that in its initial post-trial submissions, Olin did not specifically refer to any trial testimony or exhibits of record to support this claim, as to which it bears the burden of proof. However, these submissions were accomplished in accordance with a scheduling order, adopted by the court upon consent of the parties, which contemplated simultaneous filing of initial briefs and proposals followed by simultaneous responses (*see* Item 1451). Solvent asserted in its initial post-trial brief that "Olin adduced no evidence whatsoever, either at trial or through its designated trial exhibits and deposition designations, that indicates that ICC was either an owner or an operator of the 3163 Buffalo Avenue Property within the meaning of Section 107(a)(2) of CERCLA" (Item 1460, p. 31). In its response, Olin cited to trial exhibits and designated deposition testimony which it contends set forth the facts supporting the argument that ICC, as Solvent's corporate parent, managed or directed activities at the Solvent Site connected with the release of contaminants which found their way to Gill Creek through the 18-inch sewer (*see* Item 1472, pp. 93-104). The question whether these facts are sufficient as a matter of record to satisfy Olin's burden of proof on its fourth-party claim against ICC is addressed by the court below. It is not appropriate for resolution on a motion to strike a responding post-trial memorandum of law.

Secondly, the court's review of the trial record makes it clear that Olin is not relying on the narrative substance of the withdrawn "Synopsis" exhibit to establish ICC's operator liability. Rather, Olin has directed the court's attention to the Synopsis CD as a convenient device for locating the trial exhibits and designated deposition testimony cited as source material for the facts supporting its operator liability theory. All of these exhibits and designations have been submitted to the record in hard copy form and are available for the court's review.

Accordingly, Solvent/ICC's motion to strike Olin's responding brief is denied.

Having resolved Solvent's post-trial challenges to the evidentiary record, the court now turns to an examination of the underlying legal principles to be applied to the findings of fact and conclusions of law required by Fed. R. Civ. P. 52.

IV. <u>APPLICABLE LAW</u>

A. **Cleanup Cost Liability Under CERCLA**

"CERCLA is a comprehensive federal law governing the remediation of sites contaminated with pollutants." *Consolidated Edison Co. of New York, Inc. v. UGI Utilities, Inc.*, 423 F.3d 90, 94 (2d Cir. 2005). Its primary purposes are (1) to encourage the timely cleanup of hazardous waste sites, and (2) to place the cost of that cleanup on those responsible for creating or maintaining the hazardous condition. *W.R. Grace & Co.-Conn. v. Zotos Intern., Inc.*, 559 F.3d 85, 88-89 (2d Cir. 2009); *see also Key Tronic Corp. v. United States*, 511 U.S. 809, 819 n.13 (1994) (CERCLA was designed to encourage private parties to assume financial responsibility of environmental cleanup by allowing them to seek recovery from others).

Unfortunately, implementation of the broad remedial regime contemplated by the CERCLA statute was hampered from the outset by its hasty enactment on the eve of the lame-duck session of the 96th Congress, and the statute has repeatedly been criticized by the courts for its circuitous language, inartful drafting, redundant provisions, and "numerous ambiguities attributable to its precipitous passage." *W.R. Grace*, 559 F.3d at 88 (quoting *Artesian Water Co. v. New Castle County*, 851 F.2d 643, 648 (3d Cir.1988)). As a result, and notwithstanding nearly 30 years of interpretive court rulings, many of the statute's key provisions remain "perplexing." *Id.*; *see also Cadlerock Properties Joint Venture, L.P. v. Schilberg*, 2005 WL 1683494, at *5 (D.Conn. July 19, 2005) ("The Court recognizes full-well that wading through CERCLA's morass of statutory provisions can often seem as daunting as cleaning up one of the sites the statute is designed to cover.").

Perhaps most perplexing is the interplay between the two cost recovery provisions which this court must apply in resolving the difficult factual and legal issues presented in this case–section 107(a), which permits the general recovery of cleanup costs from potentially responsible parties ("PRPs"), and section 113(f)(1), which creates a contribution right for parties liable or potentially liable for those costs. Section 107(a) defines the following four categories of PRPs:

> (1) the owner and operator of a vessel or a facility,
>
> (2) any person who at the time of disposal of any hazardous substance owned or operated any facility at which such hazardous substances were disposed of,
>
> (3) any person who by contract, agreement, or otherwise arranged for disposal or treatment, or arranged with a transporter for transport for disposal or treatment, of hazardous substances owned or possessed by such person, by any other party or entity, at any facility or incineration vessel owned or operated by another party or entity and containing such hazardous substances, and
>
> (4) any person who accepts or accepted any hazardous substances for transport to disposal or treatment facilities, incineration vessels or sites selected by such person,
>
> from which there is a release, or a threatened release which causes the incurrence of response costs, of a hazardous substance . . . ,

42 U.S.C. §§ 9607(a)(1)-(4), and makes them liable for, among other things:

> (A) all costs of removal or remedial action incurred by the United States Government or a State or an Indian tribe not inconsistent with the national contingency plan; [and]
>
> (B) any other necessary costs of response incurred by any other person consistent with the national contingency plan . . . .

42 U.S.C. § 9607(a)(4)(A)-(B); *see United States v. Atlantic Research Corp.*, 551 U.S. 128, 131-32 (2007) (Thomas, J.). Section 113(f)(1) provides that:

> Any person may seek contribution from any other person who is liable or potentially liable under section 9607(a) of this title, during or following any civil action under section 9606 of this title or under section 9607(a) of this title. Such claims shall be brought in accordance with this section and the Federal Rules of Civil Procedure, and shall be governed by Federal law. In resolving contribution claims, the court may allocate response costs among liable parties using such equitable factors as the court determines are appropriate.

42 U.S.C. § 9613(f)(1).

As noted by the Second Circuit in *W.R. Grace*, 559 F.3d at 89, recently the Supreme Court in *Atlantic Research* and *Cooper Indus., Inc. v. Aviall Servs., Inc.*, 543 U.S. 157 (2004) (Thomas, J.), took on the task of determining which of these subsections provides a cause of action for parties seeking reimbursement of remediation costs in differing procedural and factual circumstances. Prior to *Cooper Industries*, most courts dealing with environmental cleanup litigation had operated under the assumption that CERCLA's broad remedial scheme allowed a PRP who had incurred cleanup costs to bring a contribution action under section 113(f) against other PRPs, even if the PRP seeking contribution had not itself been subject to a civil action under section 106 or 107(a). *See, e.g., Bedford Affiliates v. Sills*, 156 F.3d 416, 423-24 (2d Cir. 1998). *Cooper Industries* invalidated this assumption, holding that a party may pursue a contribution claim under section 113(f)(1) only if that party has been subject to a civil action as specified in that section. *See* 543 U.S. at 583. Most circuit courts had also come to view contribution under section 113(f) as the exclusive avenue for PRPs to seek response cost reimbursement from other PRPs, reserving the strict, joint, and several liability remedy of section 107(a) for innocent parties. *See Bedford Affiliates*, 156 F.3d at 423-24; *see also Metro. Water Reclamation Dist. of Greater Chicago v. N. Am. Galvanizing & Coatings, Inc.*, 473 F.3d 824, 828 (7th Cir. 2007), and cases cited at n.4 therein. However, the Supreme Court in *Atlantic Research* invalidated this approach as well, holding that "the plain terms of § 107(a)(4)(B) allow a PRP to recover costs from other PRPs . . . ." 551 U.S. at 141.

The Second Circuit in *W.R. Grace* determined that, after *Atlantic Research*, a PRP who had remediated a contaminated site pursuant to an administrative consent order, but was foreclosed by *Cooper Industries* from seeking contribution from another PRP under section 113(f), could nonetheless seek reimbursement of response costs from that PRP under section 107(a). The court reasoned that when a PRP enters into an agreement with the State to investigate and remediate a contaminated site, it not only saves the parties and the government litigation costs, but presumably also limits ongoing contamination by promptly remediating the site, both worthy goals well within the key legislative purposes of the CERCLA statute. *W.R. Grace*, 559 F.3d at 91-95.

Although it was not presented with the precise issue, the Second Circuit also noted that the Supreme Court in *Atlantic Research* suggested (without holding) that a PRP who incurs remediation costs pursuant to a consent decree following a suit under Section 107(a) may have a cause of action for reimbursement from other PRPs under either section 113(f), section 107(a), or both. *Id.* at 93 n.7 (citing *Atlantic Research*, 551 U.S. at

139 n.6). Any danger that the PRP seeking reimbursement under section 107(a) "will eschew equitable apportionment . . . in favor of joint and several liability" could be alleviated by a section 113(f) counterclaim, which "would necessitate the equitable apportionment of costs among the liable parties, including the PRP that filed the § 107(a) action." *Atlantic Research*, 551 U.S. at 138, 140.

More recently, in *Burlington Northern and Santa Fe Ry. Co. v. United States*, ___U.S.___, 129 S.Ct. 1870 (May 4, 2009) (Stevens, J.), the Supreme Court reviewed the principles governing apportionment in CERCLA cases stemming from the approach first taken in *United States v. Chem-Dyne Corp.*, 572 F. Supp. 802 (D.C.Ohio 1983), and subsequently "fully embraced by the Courts of Appeals." *Burlington Northern*, ___ U.S. at ___, 129 S.Ct. at 1881 (citing cases from the Fifth, Third, First, and Fourth Circuits). Following the *Chem-Dyne* approach, the scope of CERCLA apportionment liability is to be determined "from traditional and evolving principles of common law," using section 433A of the Restatement (Second) of Torts as the starting point. *Id.* (quoting *Chem-Dyne*, 572 F. Supp. at 808). Under the Restatement:

> [W]hen two or more persons acting independently caus[e] a distinct or single harm for which there is a reasonable basis for division according to the contribution of each, each is subject to liability only for the portion of the total harm that he has himself caused. . . . But where two or more persons cause a single and indivisible harm, each is subject to liability for the entire harm.
>
> In other words, apportionment is proper when there is a reasonable basis for determining the contribution of each cause to a single harm.
>
> Not all harms are capable of apportionment, however, and CERCLA defendants seeking to avoid joint and several liability bear the burden of proving that a reasonable basis for apportionment exists. When two or more causes produce a single, indivisible harm, "courts have refused to make an arbitrary apportionment for its own sake, and each of the causes is charged

> with responsibility for the entire harm." Restatement (Second) of Torts § 433A, Comment i, p. 440 (1963-1964).

Id. (quoting Restatement (Second) of Torts, §§ 433A, 875, 881; Prosser, Law of Torts, pp. 313-16; internal quotations omitted; citing *Chem-Dyne*, 572 F. Supp. at 810).

Notwithstanding the repeated references to "equitable apportionment" in the *Atlantic Research* decision, Justice Stevens noted that:

> Equitable considerations play no role in the apportionment analysis; rather, apportionment is proper only when the evidence supports the divisibility of the damages jointly caused by the PRPs. As the Court of Appeals explained, "[a]pportionment . . . looks to whether defendants may avoid joint and several liability by establishing a fixed amount of damage for which they are liable," while contribution actions allow jointly and severally liable PRPs to recover from each other on the basis of equitable considerations."

Id., ___U.S. at ___, 129 S.Ct. at 1882, n.9 (quoting *United States v. Burlington Northern & Santa Fe Ry. Co.*, 520 F.3d 918, 939-40 (9th Cir. 2008); citing 42 U.S.C. § 9613(f)(1) (providing that, "[i]n resolving contribution claims, the court may allocate response costs among liable parties using such equitable factors as the court determines are appropriate"); other citations omitted).

These recent rulings have done little to provide the lower courts with useful guidance in determining which subsection of CERCLA provides a cause of action for parties seeking reimbursement of response costs in differing situations. This much can be said: "[t]he one overarching principle that remains as clear today as before [these rulings] is that CERCLA should be interpreted in a way that will further one of CERCLA's main goals, encouraging private parties to assume the financial responsibility of cleanup by allowing them to seek recovery from others." *Seneca Meadows, Inc. v. ECI Liquidating, Inc.*, 427 F. Supp. 2d 279, 288 (W.D.N.Y. 2006) (Larimer, J.) (internal quotation marks and citations omitted).

In recognition of this principle, for the purposes of the determination to be made under the procedural and factual circumstances presented in this case, a PRP (such as Solvent) seeking partial reimbursement for costs incurred in responding to environmental contamination pursuant to a consent decree following a suit under section 107(a) may proceed against other PRPs (such as Olin and DuPont) under either section 107(a) or section 113(f)(1) by establishing that: (1) the party from whom reimbursement is sought falls within one of the four categories of PRPs set forth in section 107(a); (2) the facility is indeed a "facility" as defined by CERCLA § 101(9); (3) there has been a release or threatened release of hazardous substances at the facility; (4) the party seeking reimbursement incurred costs in responding to the release or threatened release; and (5) the response costs incurred conform to the National Contingency Plan ("NCP"). *See Solvent Chemical Co. v. E.I. DuPont De Nemours & Co.*, 242 F. Supp. 2d 196, 207 (W.D.N.Y. 2002).

When allocating cleanup costs among responsible parties, section 113(f)(1) directs courts to "us[e] such equitable factors as the court determines are appropriate," without limitation to any particular list of factors. *Seneca Meadows*, 427 F. Supp. 2d at 292. This approach affords the court broad discretion to deal with each situation by creative means, considering all of the equities and balancing them in the interests of justice. *New York v. Westwood-Squibb Pharmaceutical Co., Inc.*, 2004 WL 1570261, at *21 (W.D.N.Y. May 25, 2004); *see also Bedford Affiliates*, 156 F.3d at 429.

B. Summary of This Court's Prior Rulings

During the long pendency of this consolidated action, this court has been called upon on a number of occasions to make rulings on the parties' potential liability for the costs associated with the remediation of the Solvent Site and Olin Hot Spot, largely due to the ongoing evolution of jurisprudence reflected in the Supreme Court's holdings pertaining to the relationship between CERCLA cost recovery and contribution actions, as discussed briefly above. For example, in the early stages of *Solvent II*, both Solvent and DuPont filed dispositive motions with respect to the legal issues raised by Solvent's claim for contribution seeking equitable allocation of the response costs associated with implementing the remedy at the Solvent Site and Hot Spot. The court thoroughly examined the case law requirements for pleading a *prima facie* contribution claim under CERCLA § 113(f)(1) and found that Solvent had sufficiently met those requirements. *See State of New York v. Solvent Chemical Co., Inc.*, 242 F. Supp. 2d at 207-11 (W.D.N.Y. 2002). The court also denied as premature DuPont's motion for summary judgment dismissing the contribution claim, rejecting the argument that the response costs were incurred as the result of the release of chlorinated benzenes associated with Solvent's operation of the Site, not as the result of migration of chlorinated aliphatics from the DuPont facility. *Id.* at 210.

In 2004, DuPont again moved for summary judgment, this time seeking to narrow the legal issues in the case by obtaining specific rulings on its contribution liability under CERCLA and the scope of contribution protection afforded by the 1997 DuPont Consent Decree. The court once again denied the motion, finding genuine issues of material fact remaining with respect to DuPont's liability under CERCLA for an equitable share of the remediation costs attributable to the migration of hazardous substances from the DuPont facility to the Solvent Site and Hot Spot, and that neither the CERCLA statute nor the 1997 Consent Decree offered DuPont full protection from the contribution liability asserted by Solvent. *Solvent Chemical Co. v. E.I. DuPont De Nemours & Co.*, 2005 WL 1523570 (W.D.N.Y. June 28, 2005).

Shortly thereafter, DuPont filed another motion for summary judgment seeking dismissal of Solvent's contribution claim based on the intervening decision in *Cooper Industries*. According to DuPont, the Supreme Court's holding that a private party could not maintain a contribution claim under CERCLA § 113(f)(1) unless that party itself had been subject to a civil action under CERCLA § 106 or § 107–as applied by the Second Circuit in *Consolidated Edison* and by the district court in *W.R. Grace*–required dismissal of Solvent's claim for an equitable share of the costs associated with the Solvent Site/Hot Spot remedy because those costs resulted from the resolution of Solvent's liability to the State under New York's Environmental Conservation Law and the common law of public nuisance, not from the resolution of any CERCLA liability. This argument was rejected for the reason that the limited holding of *Cooper Industries* did not foreclose Solvent's contribution claim against DuPont in this case since it was undisputed that Solvent had in fact been sued by the State under CERCLA § 107(a) before bringing suit against DuPont under section 113(f)(1). *See State of New York v. Solvent Chemical Co., Inc.*, 2006 W L 1582383, at *4 (W.D.N.Y. June 5, 2006).

Solvent then moved to dismiss Olin's contribution counterclaim regarding the Gill Creek cleanup, arguing that the claim was precluded by the holding in *Cooper Industries* since Olin was never made subject to a section 106 or section 107(a) civil action. In an order dated June 6, 2007, the court found that although the holding in *Cooper Industries* did seem to eliminate Olin's claim against Solvent under section 113(f), the Second Circuit's holdings in *Consolidated Edison* and *Schaefer v. Town of Victor*, 457 F.3d 188 (2d Cir. 2006), as well as Judge Larimer's holding in *Seneca Meadows*, provided sufficient authority for Olin to seek the relief it needed under section 107(a)–*i.e.*, contribution from Solvent for its equitable share of the cost of the Gill Creek remediation. *State of New York v. Solvent Chemical Co., Inc.*, 2007 WL 1672910, at *4-*8 (W.D.N.Y. June 6, 2007).

Finally, subsequent to the close of proof at trial but before closing arguments, Solvent sought leave to amend its complaint against DuPont to assert a cause of action for cost recovery under CERCLA § 107(a). This motion was based on the Supreme Court's intervening holding in *Atlantic Research* that a PRP who had itself incurred cleanup costs could pursue a cause of action for direct cost recovery against other potentially responsible parties under section 107(a), though foreclosed by *Cooper Industries* from relief under section 113(f). Noting that the Supreme Court expressly did not decide the very issue raised by Solvent in its motion to amend in this case–*i.e.*, whether response costs sustained involuntarily pursuant to a consent decree following a suit under section 107(a) are recoverable under section 113(f), 107(a), or both–this court nonetheless granted Solvent's request for leave to amend, stating as follows:

> [T]here cannot be much ground for dispute at this late stage of the proceedings that the court views the relief sought by Solvent against DuPont as an equitable share of the cost of implementing the groundwater remedy at the Solvent Site, recoverable to the extent Solvent can demonstrate that the detected presence of chlorinated aliphatics in the pumped-out groundwater is associated with DuPont's operations at its adjacent facility. As reflected in those rulings, the court has presided over this protracted litigation and trial with the understanding that this relief would be available in the form of "contribution" under CERCLA.

> . . .
>
> [T]he court is sympathetic to Solvent's concern that the pleadings conform to the present state of the law, as well as DuPont's concern that the addition of a direct cost recovery claim could ultimately result in joint and several liability for all of the costs incurred by Solvent in implementing the Solvent Site remedy. However, the court has tried to make it clear in its rulings that, regardless of what section of CERCLA is involved, it will make every effort to fairly and equitably apportion liability for the costs of remediation of the environmental harm at the Site, based upon each party's proportionate share determined as a percentage of fault for the contamination of the Site. At no time has the court indicated the likelihood that it would shift the entire cost of the Solvent Site remedy to DuPont, or would allow Solvent a double recovery under both a direct cost recovery claim and a contribution claim.
>
> Even if the court should ultimately find that direct cost recovery under § 107(a) provides the basis for imposing liability for remediating the environmental harm caused by the migration of contaminants from the DuPont facility, DuPont's proposed amended answer contains a counterclaim for contribution under § 113(a) which would engage the court in an equitable apportionment inquiry in any event. Thus, the amendment sought by Solvent would not result in any substantive change to the analytical framework anticipated by the court's prior rulings.

State of New York v. Solvent Chemical Co., Inc., 2008 WL 3211273, at *2-*3 (W.D.N.Y. August 6, 2008).

By order dated September 5, 2008, the court also granted Olin’s motion for leave to amend its counterclaims against Solvent, and its fourth-party claims against ICC, to conform the pleadings to the current state of the law (*see* Item 1515).

As reflected by the amended pleadings now in place, and the court’s interpretation of the applicable legal principles as they now stand, the parties’ claims remaining for resolution can be summarized as follows.

Solvent seeks an equitable allocation of the costs incurred in responding to the release of hazardous substances detected at the Solvent Site and Hot Spot, based on causes of action against DuPont and Olin for contribution pursuant to section 113(f)(1), and common law contribution, as well as against DuPont for cost recovery pursuant to section 107(a) (*see* Item 1507). DuPont has asserted several affirmative defenses to these claims, as well as counterclaims for contribution/equitable allocation pursuant to section 113(f)(1) of any joint and several liability adjudged in favor of Solvent on its section 107(a) claim, as well as for declaratory judgment with respect to the right to contribution protection under the DuPont Consent Decree (*see* Item 1508). Olin seeks reimbursement from Solvent and ICC pursuant to sections 107(a) and 113(f)(1) for the share of response costs associated with the remediation of Gill Creek which are attributable to the release of hazardous substances at or from the Solvent Site (*see* Item 1516).

Against this backdrop, the court now turns to a discussion of the parties' legal arguments with respect to these claims, based on the record developed during the 19-day trial.

C. The Parties' Positions

1. Solvent Site/ Hot Spot

Solvent's primary argument in this case is that both DuPont and Olin should be held liable under CERCLA for their equitable shares of the costs incurred to implement the remedial actions outlined in the Solvent ROD necessary to address the contaminated soils and groundwater at the Solvent Site and Hot Spot. According to Solvent, DuPont and Olin can be found liable as the owners and operators of facilities from which hazardous substances have been released and as parties that "otherwise arranged" for the disposal of hazardous substances.

More specifically, Solvent contends that the facts presented at trial establish that DuPont disposed of or otherwise released significant quantities of chlorinated aliphatic compounds into the soil and groundwater at the DuPont facility which have migrated to both the Solvent Site and the Hot Spot. Based on the “relative toxicity risk assessment” methodology proposed by its allocation expert, James Kohanek, Solvent seeks from DuPont 0.70% of the costs necessary to address the contamination detected in the groundwater being pumped from the A-Zone at the Solvent Site; 67.02% of the costs necessary to address the contamination detected in the groundwater being pumped from the B-Zone at the Solvent Site; and 93.52% of the costs necessary to address the contamination detected in the groundwater being pumped from the B-Zone at the Hot Spot.

DuPont responds that the court should dismiss Solvent’s section 113(f)(1) contribution claim because DuPont is not a CERCLA liable party with respect to the Solvent Site. DuPont contends that Solvent's recently added section 107(a) claim should be dismissed as well because Solvent has failed to show that any release of chlorinated aliphatics at the DuPont plant caused Solvent to incur necessary response costs, and it has failed to show that the response actions taken at the Solvent Site were consistent with the NCP. To the extent the court permits Solvent to proceed on its section 107(a) claim, DuPont contends that under common law principles of divisibility, DuPont should be responsible for no more than the several shares attributable to the marginal increase in groundwater treatment costs due to the incidental presence of chlorinated aliphatics in the pumped groundwater, and only then to the extent that those chlorinated aliphatics can be attributed to a release at the DuPont plant. Finally, DuPont argues that should the court reach a section 113(f) allocation of response costs, it should be predicated on the contaminants of concern ("COCs") that precipitated the remedy for the Solvent Site and Hot Spot–*i.e.*, benzene and chlorinated benzene contamination attributable to Solvent's activities at the Site–which would result in an allocated share for DuPont of 1% or less.

With respect to its contribution claim against Olin, Solvent contends the record establishes that significant quantities of hazardous substances, including mercury, BHC, and chlorinated benzenes, have been disposed of or otherwise released into the environment at the Olin facility and have migrated to the Solvent Site and the Hot Spot. Based on Mr. Kohanek's allocation methodology, Solvent seeks from Olin 19.74% of the costs associated with remediating the contaminated soils at the Solvent Site, 0.63% of the costs necessary to address the contamination detected in the groundwater being pumped from the B-Zone at the Solvent Site, and 6.35% of the costs necessary to address the contamination detected in the groundwater being pumped from the B-Zone at the Hot Spot.

In response, Olin contends the proof at trial establishes that Solvent, not Olin, is responsible for the chlorinated benzene contamination detected in the groundwater at the Solvent Site and Hot Spot, resulting in an equitable allocation of 100% of the response costs to Solvent. With regard to the Solvent Site soils, Olin contends that Solvent's allocation methodology is based entirely on the assumption that aerial deposition from Olin's chlor-alkali facilities accounts for the vast majority of the mercury concentrations detected in the soil, without accounting for other potential sources such as Occidental's nearby chlor-alkali operations and the extensive fill materials placed at the Site. Olin contends that its equitable share of the costs for the Solvent Soil remediation should be allocated at no more than 2.3%, and should not include costs associated with remediation of the 18-inch sewer, the construction of roads, or other activities on the Site unrelated to mercury contamination.

2. Gill Creek

As mentioned, Olin seeks reimbursement from Solvent and ICC, pursuant to sections 107(a) and 113(f)(1), for the response costs incurred jointly with DuPont in connection with the 1992 remediation of Gill Creek which are attributable to the release of hazardous substances at or from the Solvent Site. According to Olin, the record clearly shows that both Solvent and Olin contributed chlorinated benzenes to the creek at levels which would have rendered all of the creek sediments “dead” and required their removal, and therefore each should be allocated a 50% share of Olin’s common costs associated with the entire Gill Creek remediation.

Solvent responds that the Gill Creek remediation allocation should be based on the same “relative toxicity” methodology proposed by Mr. Kohanek with respect to the Solvent Site and Hot Spot. According to Solvent, considering the relatively small contribution of chlorinated benzenes to the overall creek sediment contamination as compared to the wide variety of contaminants attributable to Olin and DuPont, Solvent’s equitable share of the costs incurred by Olin to remediate the Gill Creek sediments should be no more than 0.18%. Solvent also contends that Olin’s fourth-party claim against ICC should be dismissed because no proof was presented at trial to establish that ICC was either an owner or operator of the Solvent facility at the time any contaminants were released into Gill Creek.

V. FINDINGS OF FACT AND CONCLUSIONS OF LAW

A. Liability for Response Costs Incurred by Solvent to Remediate Contamination at the Solvent Site and Hot Spot

1. DuPont

This court has already held that DuPont can be found liable for its share of the response costs incurred by Solvent in implementing the remedy required by the Solvent ROD if the proof establishes that: (1) Dupont falls within one of the four categories of PRPs set forth in section 107(a); (2) the facility is indeed a "facility" as defined by CERCLA section 101(9); (3) there has been a release or threatened release of hazardous substances at the facility; (4) Solvent incurred costs in responding to the release or threatened release; and (5) the response costs incurred conform to the National Contingency Plan (“NCP”).

There can be no dispute that DuPont is a CERCLA responsible party with respect to the contamination detected at the Solvent Site and Hot Spot. The court has previously established as the law of the case “that DuPont can be held liable as a responsible party with respect to the Solvent Site [and Hot Spot] in the event it is established that hazardous substances disposed of at the DuPont facility have migrated to the Solvent Site [and Hot Spot] and have caused Solvent to incur response costs.” *Solvent Chemical Co. v. E.I. DuPont De Nemours & Co.*, 2005 WL 1523570, at *10 (W.D.N.Y. June 28, 2005). This holding finds ample support in the case law. *See, e.g., NutraSweet Co. v. X-L Engineering Co.*, 227 F.3d 776 (7th Cir. 2000) (landowner who dumped hazardous substances on its property liable under section 107(a) for cleanup of adjacent site at which those substances were detected in groundwater); *State of New York v. Westwood-Squibb Pharm. Co., Inc.*, 138 F. Supp. 2d 372, 381-83 (W.D.N.Y. 2000) (holding that "facility" included adjacent property to which hazardous substances had migrated); *City of Tulsa v. Tyson Foods, Inc.*, 258 F. Supp. 2d 1263, 1279 (N.D. Okla. 2003) ("The definition of 'facility' . . . is broad enough to include both the initial site where a hazardous substance is disposed of and additional sites to which the substances have migrated following their initial disposal."). As indicated by the discussion in sections IV(A) and IV(B) *infra*, there is nothing in any of the intervening Supreme Court decisions that would require the court to revisit this holding.

There is likewise no dispute that the three adjacent Sites owned and operated by Solvent, DuPont, and Olin are "facilities" as defined by CERCLA § 101(9),[13] or that Solvent has incurred response costs because of releases of hazardous substances that came to be located at the Solvent Site and Hot Spot.

In addition, the proof at trial clearly establishes that hazardous substances, specifically chlorinated aliphatic compounds such as TCE and PCE, were released into the environment as a result of DuPont's manufacturing and waste management processes over the course of many years of operation. The evidence also establishes that elevated levels of these chlorinated aliphatic compounds have been detected in the groundwater extracted from the B-Zone pumping wells at both the Solvent Site and Hot Spot, causing

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[13] The term "facility" is defined in the CERCLA statute as:

> (A) any building, structure, installation, equipment, pipe or pipeline (including any pipe into a sewer or publicly owned treatment works), well, pit, pond, lagoon, impoundment, ditch, landfill, storage container, motor vehicle, rolling stock, or aircraft, or (B) any site or area where a hazardous substance has been deposited, stored, disposed of, or placed, or otherwise come to be located; but does not include any consumer product in consumer use or any vessel.

42 U.S.C. § 9601(9).

Solvent to incur costs associated with delays in the startup/prove out phase of the groundwater recovery system and modification of POTW discharge permit levels. These circumstances ultimately led the DEC to conclude that DuPont is a likely source of the chlorinated aliphatic contamination which has adversely affected the operation of the remediation system at the Site.

DuPont contends that this conclusion ignores much of the available site-specific evidence, including chlorinated aliphatic contamination in the overburden and A-Zone groundwater attributable to Frontenac's three-year unlicensed operation of a hazardous waste storage and transfer facility at the Site, as well as contradictory expert testimony and evidence regarding the effect of natural and man-made factors on the directional flow of groundwater in and through the bedrock in the B-, C-, and CD-Zones beneath the overall area of concern. The court is indeed troubled by the failure of the parties' hydrogeological experts to provide a basis upon which a reasonably definitive conclusion can be drawn with respect to the fate and transport of contaminants in the bedrock groundwater zones as between the Solvent, Olin, and DuPont Sites. Given the nature of the extensive horizontal bedding plane fractures and vertical fissures which are present in varying degrees throughout the water-bearing zones in the area, as well as the influence of the powerful Niagara River and several large-scale subsurface engineering structures (including the Falls Street Tunnel, the twin intake conduits of the New York Power Authority, and the Buffalo Avenue and DuPont sewers), this lack of consensus is understandable. However, even a convincing showing that sources other than DuPont have contributed to the chlorinated aliphatic contamination at the Solvent Site and Hot Spot would not eliminate the possibility that at least some of the contamination is attributable to migration from the DuPont Site.

Based upon the preponderance of the proof presented at trial, as summarized in Section II *infra*, the court is left with little doubt that chlorinated aliphatic contamination has migrated from the DuPont facility to both the Hot Spot and the Solvent Site, causing Solvent to incur response costs which it would not otherwise have incurred.

The remaining issue for determination of DuPont's liability is whether those costs conform to the NCP. DuPont contends that because the DEC's remedy selection process was implemented pursuant to state law and not CERCLA, it did not adhere to the NCP's mandate that the EPA must be given the opportunity to participate in and comment on the process, particularly with respect to the determination to waive any requirement to achieve contaminant cleanup levels (SCGs or ARARs) in the on-site soils and groundwater.

The NCP was promulgated by the EPA in 1985 to provide "organizational structure and procedures for preparing for and responding to . . . releases of hazardous substances . . . ." 40 C.F.R. § 300.1; *see Nashua Corp. v. Norton Co.*, 116 F. Supp. 2d 330, 352 (N.D.N.Y. 2000). Before it was revised in 1990, many courts interpreted the NCP to require strict compliance with its provisions. *See, e.g., Amland Properties Corp. v. Aluminum Co. of America*, 711 F. Supp. 784, 796 (D.N.J. 1989); *Artesian Water Co. v. Government of New Castle County*, 659 F. Supp. 1269, 1295-96 (D.Del. 1987), *aff'd*, 851 F.2d 643 (3d Cir. 1988). In its 1990 amendments to the NCP, the EPA made it clear that it was abandoning ritualistic compliance "in favor of a case-by-case balancing approach that would evaluate the cleanup effort as a whole to ensure the quality of the cleanup while removing undue procedural obstacles to National Plan consistency." *Bedford Affiliates*, 156 F.3d at 428; *see* National Oil and Hazardous Substances Pollution Contingency Plan, 55 Fed. Reg. 8666-01, 8792-94 (March 8, 1990). As a result, “immaterial or insubstantial” deviations from NCP requirements are no longer viewed as inconsistent, so long as the remedial activities are “protective of health and the environment and . . . [are] cost-effective.” *AlliedSignal, Inc. v. Amcast Int'l Corp.*, 177 F. Supp. 2d 713, 738-43 (S.D.Ohio 2001); *see also Bedford Affiliates*, 156 F.3d at 428 (citing 40 C.F.R. § 300.700(c)(4)). In fact, “[c]ourts have held that where a CERCLA response action involves a state environmental agency charged with approving cleanup plans and monitoring the remediation process, the NCP consistency requirement is satisfied.” *Pfohl Brothers v. Browning-Ferris Industries of New York, Inc.*, 2004 WL 941816, at *22 (W.D.N.Y. January 30, 2004) (citing *NutraSweet*, 227 F.3d at 791 (plaintiff established NCP compliance by demonstrating that Illinois EPA approved cleanup plan and monitored progress of remediation); also citing *Bedford Affiliates*, 156 F.3d at 428 (NYSDEC’s substantial involvement in formulation and execution of preliminary remediation plan was effective substitute for NCP’s public comment requirement)); *see also Benderson Dev. Co., Inc. v. Neumade Products Corp.*, 2005 WL 1397013, *13-15 (W.D.N.Y. June 13, 2005) (involvement of NYSDEC in determining cleanup levels and monitoring remediation process sufficiently similar to circumstances in *Bedford Affiliates* to satisfy NCP requirements).

In this case, the record clearly reflects that the DEC–the agency charged with implementing the remedial programs for inactive hazardous waste sites in New York–oversaw a Phase I Study of the Solvent Site conducted in the spring of 1983, a Phase II Study conducted in the summer of 1984, a Remedial Investigation completed in

November 1990, a Supplemental RI completed in July 1995, and a Feasibility Study completed in February 1996. The Solvent ROD was issued in December 1996, selecting a remedy that "is protective of human health and the environment, complies with State and Federal requirements that are legally applicable or relevant and appropriate to the remedial action to the extent practicable, . . . is cost effective" and is "not inconsistent with the [NCP]" (S-1012, at pp. *i*, *ii*). Jeffrey Konsella, the DEC official who was the primary author of the ROD and is charged with overseeing the implementation of the remedy, testified at trial that the remedy being implemented by Solvent constitutes a "CERCLA quality cleanup" (Tr. 1442 at 49). In April 1997, Solvent entered into its Consent Decrees with the State, in which Solvent agreed to implement the remedial measures outlined in the ROD under the DEC's oversight.

Furthermore, the State regulations governing remedy selection which were in effect at the time the Solvent ROD was issued expressly provided that the selected remedy, "[a]t a minimum, . . . shall eliminate or mitigate all significant threats to the public health and to the environment," 6 N.Y.C.R.R. § 375-1.10(b), "must not be inconsistent with the [NCP]," *id.* at § 375-1.10(c), and must take into consideration SCGs which expressly incorporate federal standards contained in the NCP to the extent such standards are more stringent than the State standards. *Id.* at § 375-1.10(c)(1)(iii).[14]

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[14] These regulations were amended and reorganized in 2006, and now provide in pertinent part:

> The goal of the remedial program for a specific site is to restore that site to pre-disposal conditions, to the extent feasible. At a minimum, the remedy selected shall eliminate or mitigate all significant threats to the public health and to the environment presented by contaminants disposed at the site through the proper application of scientific and engineering principles and in a manner not inconsistent with the [NCP] . . ..

6 N.Y.C.R.R. § 375-2.8(a).

In support of its contention that the remedy selection process did not comply with the NCP because the State cannot waive an ARAR or SCG without first consulting with the EPA, DuPont cites several provisions of CERCLA and the NCP regulations (codified at 40 C.F.R. Part 300) discussing the interplay between the federal government and state governments in the context of federal Superfund-financed cleanups. However, the court's review of these provisions indicates nothing which would limit the authority of the states to act on their own to address contamination without federal funding and to seek to impose liability for the cost of the cleanup on responsible parties pursuant to CERCLA, as the DEC has done in this case. As stated by the Second Circuit nearly 25 years ago:

> Congress envisioned states' using their own resources for cleanup and recovering those costs from polluters under section 9607(a)(4)(A). We read section 9607(a)(4)(A)'s requirement of consistency with the NCP to mean that states cannot recover costs inconsistent with the response methods outlined in the NCP. Moreover, the NCP itself recognizes a role for states in compelling "potentially responsible parties" to undertake response actions independent of EPA and without seeking reimbursement from Superfund. Thus, the NCP's requirements concerning collaboration in a joint federal-state cleanup effort are inapplicable where the State is acting on its own.

State of New York v. Shore Realty Corp., 759 F.2d 1032, 1047-48 (2d Cir. 1985) (citations and footnotes omitted).

DuPont also relies on internal EPA documents, entitled "Guidance for Evaluating the Technical Impracticability of Ground-Water Restoration" (September 1993) (D-24), and "Questions and Answers About the State Role in Remedy Selection at Non-Fund Financed Enforcement Sites" (January 2000) (D-123). These documents expressly state that they are intended solely as guidance and cannot be relied upon to create any enforceable rights (*see* D-24 at p. ii; D-123 at p. 1, n.1).

Accordingly, the court concludes, based on the preponderance of the evidence in the trial record, that the DEC's substantial involvement in the investigation, design, selection, and implementation of the remedy at the Solvent Site and Hot Spot is in all respects sufficient to constitute substantial compliance with the requirement that the response costs incurred by Solvent are not inconsistent with the NCP. Solvent has therefore established that DuPont is liable for a share of the response costs incurred in implementing the remedy required by the Solvent ROD, with the amount of the share to be determined in accordance with the court's application of appropriate equitable factors in its allocation analysis.

2. Olin

For similar reasons, the court has little difficulty concluding that Olin is liable for its share of the response costs incurred by Solvent by virtue of the release of hazardous substances at the Olin facility which have come to be located at the Solvent Site and the Hot Spot. Specifically, Olin is clearly liable under section 107(a) as the current owner of the property on which the Hot Spot is located, and it is undisputed that mercury emissions from the Olin facility have impacted the soils at the Solvent Site to some degree. It is also undisputed that Solvent has incurred costs in responding to the contamination detected at the Hot Spot and in the soil, and that those response costs conform to the NCP.

Olin contends, however, that it cannot be held liable for a share of Solvent's response costs on two essential grounds:

(a) Olin is not a CERCLA responsible party with respect to the groundwater contamination detected at the Solvent Site and Hot Spot because the proof at trial shows that none of the chlorinated benzenes disposed of at the Olin facility has, in fact, migrated to the Hot Spot or any other portion of the Site;

(b) Based on the proof showing that aerial deposition from Olin is only one of three sources of the mercury detected in the Solvent Site soils, as well as the relative risks associated with the mercury, Olin should be assessed only a very small share of responsibility for the soil remediation portion of Solvent's response costs.

These contentions are addressed in turn.

a. Solvent Site/Hot Spot Groundwater

Olin asserts that it should not be found liable for the costs associated with remediation of groundwater contamination at the Solvent Site and Hot Spot because the proof presented at trial shows that none of the significant chlorinated benzene contamination detected in the A- and B-Zone groundwater at the Solvent Site and Hot Spot could have migrated from the Olin facility. According to Olin, application of sound scientific principles to the available data shows that:

- Gill Creek and the DuPont sewer are barriers to groundwater flow from the Olin Site to the Hot Spot in the A-Zone.
- In the B-Zone, groundwater at the Olin Site flows to the north, with the result that any contaminants in the B-Zone drain into the Buffalo Avenue sewer.
- While there is sufficient chlorobenzene contamination in the soil and groundwater at the Solvent Site to be considered the source of the chlorobenzene contamination in the groundwater at the Hot Spot, there is not sufficient chlorobenzene contamination on the

Olin Site to be considered the source of the chlorobenzene contamination in the groundwater at the Hot Spot.

The court's review of the testimony and evidence presented at trial raises several concerns about these conclusions. As a general matter, it is essentially undisputed that the overburden at both the Solvent Site and the adjacent Olin Site where the Hot Spot is located consists of a relatively thin layer of unconsolidated material, including fill and native deposits such as sand, gravel, silt, clay, and glacial till. The distribution of the overburden material is variable, ranging from 8 to 14.5 feet in thickness. The bedrock below the Solvent Site and Hot Spot, referred to as the Lockport Dolomite Formation, is approximately 160 feet thick.

Groundwater is present in both the overburden and bedrock. In the overburden, groundwater flows generally downward except where drains, sewers, building foundations, or other features create localized horizontal flow. The downward flow is slowed by the low permeability of the overburden materials.

Groundwater flow in the bedrock is dominated by extensive horizontal bedding plane fractures and vertical fissures which are present in varying degrees throughout all of the water-bearing zones in the area. The zones are labeled in order of depth as the A-, B-, C-, CD-, D-, F- and J-Zones, but they are defined and characterized somewhat differently in reference to the various sites. At the Solvent Site, the A-Zone is defined to include the overburden materials and the top of bedrock just below the overburden, and the B-Zone is defined to include the first water-bearing bedding plane fractures below the top of bedrock. At the Olin and DuPont Sites, the A-Zone is defined to include the overburden and the first three feet of bedrock, and the B-Zone is defined to include the first water-bearing bedding plane fractures below the A-Zone.

Groundwater flow in the bedrock is also influenced by the Niagara River, which acts as a source of recharge, and by Gill Creek, which flows from north to south and joins the Niagara River downstream past the Olin and DuPont plant sites. In addition, several large-scale subsurface engineering structures including the Falls Street Tunnel, the twin intake conduits of the New York Power Authority, and the Buffalo Avenue and DuPont sewers impact the flow of bedrock groundwater.

Largely due to these natural and man-made factors, the parties' hydrogeological experts disagreed on several aspects of the directional flow of groundwater in and through the bedrock in the various zones beneath the area of concern and offered widely differing views on how contaminants might come to be detected in the groundwater at any particular sampling location. Olin relies primarily on the analysis of its allocation expert, William Hall (who is an environmental engineer, not a specialist in hydrogeology), in support of its argument that none of the contaminants being detected in the groundwater pumped from Solvent's remediation system could have migrated from the Olin Site. As discussed above, Mr. Hall's opinion testimony was based on his interpretation of sampling results and other data assembled in electronic CD ROM format which, as Solvent points out, leaves open the possibility of selective use or omission of pertinent data which could affect the outcome of any computer analysis. Given the demonstrated manipulability of statistical data, and the inability of the parties' witnesses to provide the court with a workable consensus on key issues relating to site hydrogeology, the court is unable to ascribe much significance to Mr.

Hall’s conclusions with respect to the migration of contaminants in the A- and B-Zones as between the Solvent, Olin, and DuPont Sites.

Moreover, it is essentially undisputed that the vast majority of the groundwater extracted by Solvent's remediation system at both the Solvent Site and the Hot Spot–over 96%–is coming from the B-Zone. To the extent contaminants in the A-Zone groundwater have impacted the remediation system at the Hot Spot, the A-Zone groundwater gradient data presented at trial indicate a general northeast flow direction at the top of bedrock (where DNAPL migration is likely to occur) from the southern portion of the Olin ARGC Area towards the Hot Spot and the northwest corner of the Solvent Site.

Significantly, there is no evidence that chlorinated benzene materials were handled or disposed of directly on the Hot Spot property, indicating that any chlorinated benzene contamination detected at the Hot Spot has migrated there. The testimony and evidence presented at trial established that the continuous trench system installed in the overburden at the Solvent Site acts as an effective barrier to the lateral migration of contaminants in the A-Zone groundwater from the 3163 Buffalo Avenue Property toward the Hot Spot. Accordingly, a reasonable inference may be drawn that at least some of the chlorinated benzene contamination now being detected in the A-Zone groundwater at the Hot Spot has migrated there from the Olin ARGC Area.

In addition, there is evidence in the record contradicting Mr. Hall's conclusion that the groundwater in the B-Zone at the Olin Site flows due north toward the Buffalo Avenue sewer, and not to the east or northeast toward the Hot Spot. Merely by way of example, Olin's February 1992 Interim RCRA Facility Report concluded that the Buffalo Avenue sewer has "no discernable hydraulic impact" on the B-Zone groundwater at the Olin facility

(S-4113 at p. 8-6); and in a November 4, 1994 letter to Olin, the DEC reported that "none of the B-zone potentiometric maps indicates that sewers are acting as a hydraulic barrier or drain" (S-4124A at p.5).

Olin also contends that while there is sufficient chlorobenzene contamination in the soil and groundwater at the Solvent Site to be considered the source of the chlorobenzene contamination in the groundwater at the Hot Spot, there is not sufficient chlorobenzene contamination on the Olin Site to be considered the source of the chlorobenzene contamination in the groundwater at the Hot Spot. According to Olin, this is borne out by comparing the characteristics of the chlorobenzenes detected in the groundwater at the Hot Spot with the characteristics of the groundwater at the Solvent and Olin Sites.

For its part, Solvent does not dispute that the soil and groundwater at the Solvent Site is heavily contaminated with chlorinated benzene material, nor could it. Significant concentrations of chlorinated benzene materials, identified as benzene, chlorobenzene, 1,2-dichlorobenzene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, and 1,2,4-trichlorobenzene, have been detected in virtually all of the soil and groundwater samples collected during the long history of investigation and remediation activities at the Site. The heaviest chlorinated benzene contamination in the soils has been detected at a depth of approximately seven feet along the former railroad spur in the western and southwestern areas of the Site, and in the southern and southeastern portions of the property where Solvent's chemical manufacturing facilities and storage tank farms were located. Chlorinated benzene DNAPL, appearing as dark oily liquid and tar-like material, has also been detected in the soils in these areas as well as in the northwest corner of the Site adjacent to the Hot Spot. Based on the groundwater samples reported to the DEC, the principal organic contaminants of concern at the Solvent Site and Hot Spot, as identified in the Solvent ROD, were benzene, chlorobenzene, 1,2-dichlorobenzene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, and 1,2,4-trichlorobenzene.

However, Solvent does dispute Olin's claim that the chlorinated benzenes detected in the groundwater at the Hot Spot are more closely associated with the constituents found in the groundwater at the Solvent Site than those found in the groundwater at the Olin Site. In this regard, the proof at trial shows that Olin manufactured several millions of pounds of chlorobenzene material during the operation of its BHC facility in the southern portion of the ARGC Area, some of which leaked, spilled, or were otherwise released into the environment. Although the BHC operations ceased in the late 1950s, site investigations have confirmed the continuing presence of significant levels of BHC, trichlorobenzene, and other chlorinated benzenes in the soils and groundwater at the Olin facility.

As mentioned above, while the flow pattern variations within the different water-bearing zones lead to no definitive conclusions with respect to the fate and transport of any particular contaminants in the groundwater as between the three Sites, there is substantial evidence to support the conclusion that the overall flow pattern in the area of concern in both the A- and B-Zones is in a general southwest-to-northeast direction from the Olin ARGC Area to the Hot Spot and the Solvent Site. For example, the groundwater contours resulting from the June 1994 synoptic testing event measuring groundwater elevations at the Olin and Solvent Sites clearly indicate a groundwater flow pattern from the ARGC area towards the Hot Spot. These results were reviewed by both the DEC and EPA, as confirmed in a June 1995 letter (S-4126) indicating that the nature of the contamination detected in the Hot Spot monitoring wells suggested its association with both the Solvent and Olin Sites, and that the presence of substantial concentrations of BHC was difficult to attribute to a source other than Olin. This is because Olin is the only identified BHC manufacturer in the area of concern.

In addition, top of bedrock elevations underlying the area of concern indicate a pathway for chlorinated benzene DNAPL migration from the Olin ARGC Area to the Hot Spot, and sampling data confirms the detection of high levels of chlorinated benzene DNAPL at the Olin facility hydrogeologically upgradient of the Hot Spot. For example, DNAPL containing 737 million parts per billion chlorinated benzenes was recovered in 1999 at well RW-5, located just east of the former BHC operations area.

Finally, elevated levels of perchlorate–associated with Olin's hypochlorite production–have been detected at monitoring wells in the northeast corner of the Hot Spot, providing further evidence of groundwater migration from the Olin Site. Neither DuPont nor Solvent is known to have handled or manufactured perchlorate. Although evidence was presented regarding perchlorate production at the Occidental Chemical facility to the south and east of the Solvent Site, that facility is downgradient in all of the groundwater flow zones, and there was no plausible explanation given as to how perchlorate contamination could have migrated from there to the monitoring wells at the Hot Spot.

For these reasons, the court rejects Olin's argument that it is not a CERCLA-responsible party with respect to the groundwater contamination detected at the Solvent Site and Hot Spot because none of the chlorinated benzenes disposed of at the Olin facility could have migrated to the Solvent Site or Hot Spot.

b. Solvent Site Soils

As discussed above, Solvent seeks from Olin 19.74% of the costs associated with remediating the contaminated soils at the Solvent Site based on the conclusion that at least 90% of the mercury detected in the soils resulted from air emissions associated with Olin's 90-plus year history of chlor-alkali production. In response, Olin contends that Solvent's allocation methodology is flawed because it fails to properly account for other potential sources of mercury such as Occidental's nearby chlor-alkali operations and the extensive fill materials placed at the Site, and proposes that its equitable share of the costs for the Solvent Soil remediation should be allocated at no more than 2.3%.

Significantly, Olin does not dispute that the air emissions associated with its chlor-alkali production may be responsible for at least some of the mercury contamination addressed by the soil remedy at the Solvent Site. Rather, Olin’s presentation with respect to the soil remediation component of this case is focused on an alternative allocation method which will be addressed below.

Accordingly, based on the preponderance of the evidence in the record, the court finds that Solvent has established Olin’s liability under CERCLA for a share of the response costs incurred in implementing the remedy required by the Solvent ROD, to be determined in accordance with the court's application of appropriate equitable factors in its allocation analysis.

B. Solvent’s Liability for Response Costs Incurred by Olin to Remediate Contamination in the Gill Creek Sediments

Olin's Gill Creek counterclaim against Solvent and its fourth-party claim against ICC are governed by the same legal and equitable standards outlined above. That is, in order to recover an equitable share from Solvent or ICC of the response costs incurred by Olin at Gill Creek, Olin must demonstrate that (1) Solvent and ICC are liable parties with respect to Gill Creek, (2) the portions of Gill Creek running through the Olin and DuPont properties constitute a "facility," (3) there has been a release of hazardous substances at the facility, and (4) Olin has incurred necessary costs of response consistent with the NCP. *See Solvent Chemical Co.*, 242 F. Supp. 2d at 207 (citing *Prisco v. A&D Carting Corp.*, 168 F.3d 593, 602-03 (2d Cir. 1999)).

Solvent and ICC do not dispute that Gill Creek is a facility at which hazardous substances have been released, or that Olin has incurred costs in conducting certain joint cleanup activities with DuPont with respect to Gill Creek in the early 1990s. Furthermore, Solvent concedes that chlorinated benzene compounds released from the Solvent Site were likely discharged into Gill Creek during the period of time Solvent operated the facility at 3163 Buffalo Avenue. However, Solvent and ICC contend that Olin has failed to establish that ICC is a liable party with respect to Gill Creek.[15]

As outlined above, Olin seeks reimbursement from both Solvent and ICC for the share of response costs associated with the remediation of Gill Creek which are attributable to the release of hazardous substances at or from the Solvent Site. More specifically with respect to ICC, Olin alleges that:

> Solvent Chemical is a wholly owned subsidiary of ICC Industries. ICC Industries, on information and belief, has owned, operated, dominated and/or

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[15] In its initial post-trial submissions, Solvent also argued that Olin has failed to prove that the total amount of its Gill Creek cleanup costs were necessary and incurred consistent with the NCP. This argument is rejected for essentially the same reasons discussed in section V(A)(1) of the text, *supra*, with respect to the response costs incurred by Solvent at the Solvent Site/Hot Spot–*i.e.*, the Gill Creek remedy was performed under DEC oversight in accordance with the March 1991 Consent Decree and March 1992 Gill Creek ROD, so as to satisfy the NCP consistency requirement.

> controlled the business, policies and practices of Solvent Chemical from and after the time that ICC Industries acquired Solvent Chemical. As such, ICC Industries is responsible for the acts and/or omissions of Solvent Chemical.

(Item 1516, ¶¶ 7, 24).

The standards for determining whether a parent corporation can be held responsible under CERCLA for the environmental pollution caused by the activities of its wholly owned subsidiary were enunciated by the Supreme Court in *United States v. Bestfoods*, 524 U.S. 51 (1998). In that case, the United States sought to impose CERCLA liability on the parent corporation of a defunct subsidiary for the costs of cleaning up industrial waste generated by the subsidiary's chemical plant. Distinguishing between direct and indirect, or "derivative," liability, the Supreme Court began its analysis by reiterating the general principle, rooted in state corporation law, "that a parent corporation (so-called because of control through ownership of another corporation's stock) is not liable for the acts of its subsidiaries." *Id.* at 61 (citation and internal quotation marks omitted). While recognizing that the legal literature has severely criticized this respect for corporate distinctions when the subsidiary is a polluter, the Court observed that "nothing in CERCLA purports to reject this bedrock principle, and against this venerable common-law backdrop, the congressional silence is audible." *Id.* at 62. The Court therefore held that "when (but only when) the corporate veil may be pierced, may a parent corporation be charged with derivative CERCLA liability for its subsidiary's actions." *Id.* at 63-64 (quotation marks omitted).

The Supreme Court also recognized that a parent corporation could be held directly liable under CERCLA for its own actions as the "operator" of a facility owned by its subsidiary:

> Under the plain language of the statute, any person who operates a polluting facility is directly liable for the costs of cleaning up the pollution. This is so regardless of whether that person is the facility's owner, the owner's parent corporation or business partner, or even a saboteur who sneaks into the facility at night to discharge its poisons out of malice. If any such act of operating a corporate subsidiary's facility is done on behalf of a parent corporation, the existence of the parent-subsidiary relationship under state corporate law is simply irrelevant to the issue of direct liability.

Id. at 65 (citations omitted). The Court determined that in order to impose direct "operator" liability on the corporate parent for environmental contamination caused by the subsidiary, the parent "must manage, direct, or conduct operations specifically related to pollution, that is, operations having to do with the leakage or disposal of hazardous waste, or decisions about compliance with environmental regulations." *Id.* at 66-67.

> "The question is not whether the parent operates the subsidiary, but rather whether it operates the facility, and that operation is evidenced by participation in the activities of the facility, not the subsidiary. Control of the subsidiary, if extensive enough, gives rise to indirect liability under piercing doctrine, not direct liability under the statutory language."

Id. at 68 (quoting Oswald, *Bifurcation of the Owner and Operator Analysis under CERCLA*, 72 WASH. U.L.Q. 223, 269 (1994)).

While the Court did not attempt to fully delineate factors for courts to consider in determining this difficult question, it noted certain activities "that involve the facility but which are consistent with the parent's investor status, such as monitoring of the subsidiary's performance, supervision of the subsidiary's finance and capital budget decisions, and articulation of general policies and procedures," which should not give rise to direct liability. *Id.* at 72 (quoting Oswald at 282). "The critical question is whether, in degree and detail, actions directed to the facility by an agent of the parent alone are eccentric under accepted norms of parental oversight of a subsidiary's facility." *Id.*

Olin does not suggest that the court engage in a veil-piercing inquiry in this case in an effort to determine whether ICC should be held derivatively liable as the parent-owner of the polluting subsidiary. Instead, Olin argues that deposition testimony and exhibits identified in pre-trial filings establish that ICC, through its employees and employees of Dover Chemical (another one of its subsidiaries) managed and directed certain activities that led to the contamination of the Solvent Site, which in turn led to the contamination of the Gill Creek sediments through Solvent's 18-inch sewer.

Olin cites several internal memoranda documenting the involvement of Dover employees in activities at the Solvent facility which Olin contends were directed at minimizing the environmental impact of plant operations. For example, O-98 is an interoffice memorandum from Dover management employee Eric Beu to Sanford Schwartzman, one of Solvent's co-presidents, commenting on a report made by another Dover employee, David Rankin, after a visit to the Solvent plant in October 1975. Mr. Beu stated:

> While [Mr. Rankin] did not have a chance to inspect the whole plant in detail, he feels he inspected sufficiently to report general conditions concerning safety. One of the more serious problems is the presence of innumerable and citable OSHA violations. With production now increasing in importance, the Niagara Falls Plant is vulnerable to an OSHA inspection at any time. The difference between waiting for such an inspection to occur and beginning to take care of the safety program immediately, is that the latter course would be less disruptive to production and construction plans. OSHA violations must be corrected in 90 days or the violator will be heavily fined. The sooner a safety program is put into effect the less possibility that someone will get seriously injured at Niagara Falls.

O-179 is a copy of the above-referenced report to Mr. Beu, dated October 14, 1975, in which Mr. Rankin listed several perceived conditions at the plant which he described as "code violations," noting "the placement of fire extinguishers, inspection of fire hose, means of egress, proper stacking, sanitary conditions, cylinder storage, floor openings, and posting of the restricted areas to be of prime importance for immediate improvements with an all out effort on housekeeping." Mr. Rankin also reported:

> At the present time the effluent water goes to a public water way (small creek) and there is no means of determining the amount of contamination. The Buffalo water sewer system just started construction and it would seem to be a long way from completion. Meanwhile the water continues to flow to the small creek via 2 separate streams from the plant. I would suggest this could be a problem with the Federal EPA!

In January 1976, Dover Chemical's President Robert Cohen wrote an interoffice memorandum to Mr. Schwartzman regarding "Health Hazards and Spills at Niagara Falls," in which Mr. Cohen wrote:

> In filling tank trucks and drums, transferring materials from one tank to another and cleaning tanks and transportation equipment, CHLOROBENZENE materials apparently are discarded freely on the ground. It has been reported to me that as much as 20-30 gallons is flushed through pipelines or out of trucks onto the ground in order to be sure the lines are clear of the previous material, or to empty the dregs out of tank trucks.
>
> . . .
>
> Obviously, immediate measures should be taken in Niagara Falls to provide recovery tanks and recycle pipelines for all CHLOROBENZENE materials wherever samples are taken, lines are flushed, trucks or containers of any kind being drained. It is also obvious that such measures will pay for themselves.

(O-11). Apparently in response to this memorandum, Solvent's Plant Superintendent Harry Mazowiecki issued a notice to all personnel entitled, "Hazards and Spills of Chlorinated Benzenes," which stated:

> It has come to my attention that in filling tank cars, tank trucks, drums, and the transferring of materials that there has been excessive spillage and leakage due to improper connections and deliberate disregard of product waste.

> Due to EPA regulations and the installation of a new industrial sewer system we have to be extremely careful of contaminating run off waters from the plant.
>
> When loading or unloading tank cars, tank trucks, whenever connections are being made it should be a matter of policy that pails must be available and used to catch any leakage or spillage and these in turn empty into 55 gallon drums which in turn will be pumped back into the crude tanks, this also will apply especially if hoses are being used and then drained.
>
> Though this directive concerns Chlorination Benzene products, similar precautions should likewise be used in handling other materials.

(O-12).

While the matters discussed in these communications clearly indicate a level of awareness on the part of Dover employees as to the potential for environmental problems at the Solvent facility, the court cannot conclude that this evidence demonstrates sufficient involvement in the management, direction, or conduct of operations at the facility specifically related to pollution to impose direct CERCLA liability on ICC. Rather, these discussions reveal that the thrust of Dover's involvement with the Solvent facility was essentially consistent with Dover-ICC's status as the parent corporation monitoring Solvent's overall performance, as well as giving supervisory advice and direction regarding general operational policies and procedures, especially with respect to employee health and safety, which impacted financial and capital budget decisions. In the court’s view, this evidence demonstrates that the actions directed to the Solvent facility by Dover personnel are within accepted norms of parental oversight, not rising to the level of involvement necessary for the court to find ICC directly liable pursuant to CERCLA § 107(a) for the costs of cleaning up the pollution at the Solvent Site and Hot Spot, under the standards articulated in *Bestfoods*.

For these reasons, Olin’s fourth-party complaint against ICC is dismissed in its entirety.

C. Equitable Allocation

Having resolved the liability issues presented, the court turns its attention to an analysis of the parties’ respective claims for contribution, “allocat[ing] response costs among liable parties using such equitable factors as the court determines are appropriate.” 42 U.S.C. § 9613(f)(1). Section 113(f)(1) does not limit the court to any particular list of factors in allocating response costs, but “instead affords a district court broad discretion to balance the equities in the interests of justice.” *Bedford Affiliates*, 156 F.3d at 429. The court may consider “several factors or a few, depending on the totality of the circumstances and equitable considerations.” *New Jersey Turnpike Auth. v. P.G. Indus., Inc.*, 197 F.3d 96, 104 (3d Cir. 1999) (quoted in *Seneca Meadows*, 427 F. Supp. 2d at 292).

For example, many courts have applied the six so-called "Gore factors" (identified in an amendment to CERCLA proposed by former member of Congress Albert Gore, Jr.): (1) the ability of the parties to demonstrate that their contribution to the site can be distinguished; (2) the amount of hazardous waste involved; (3) the degree of toxicity of the hazardous waste involved; (4) the degree of involvement by the parties in the generation, transportation, treatment, storage, or disposal of the hazardous waste; (5) the degree of care exercised by the parties with respect to the hazardous waste concerned, taking into account the characteristic of such waste; and (6) the degree of cooperation by the parties with federal, state, or local officials to prevent any harm to the public health or the environment. *See Seneca Meadows*, 427 F. Supp. 2d at 292 (citing cases).

Other allocators have focused on the four "critical factors" identified by Judge Ernest C. Torres in *United States v. Davis*, 31 F. Supp. 2d 45, 63 (D.R.I. 1998), *aff'd*, 261 F.3d 1 (1st Cir. 2001): (1) the extent to which cleanup costs are attributable to wastes for which a party is responsible; (2) the party's level of culpability; (3) the degree to which the party benefitted from disposal of the waste; and (4) the party's ability to pay its share of the cost. *See* Robert P. Dahlquist, *Making Sense of Superfund Allocation Decisions: The Rough Justice of Negotiated and Litigated Allocations*, 31 ENVTL. L. REP. 11098, 11099 (2001) ("The Gore factors are most relevant in academic and theoretical analysis of the way Superfund liabilities should be allocated. But in the real world Judge Torres' list of four critical factors often provides the basis upon which Superfund allocations are made").

As this court observed in *State of New York v. Westwood-Squibb Pharmaceutical Co., Inc.*, 2004 WL 1570261 (W.D.N.Y. May 25, 2004), "'basic principles of equity' would suggest that the party that profited . . . from the creation and operation of a waste-producing enterprise 'should bear primary responsibility for the hazardous byproducts of its activity.'" *Id*. at *22 (quoting *Waste Mgmt. of Alameda County, Inc. v. East Bay Regional Park Dist.*, 135 F. Supp. 2d 1071, 1090 (N.D. Cal. 2001)). From this fundamental premise, courts often begin the CERCLA allocation process by attempting to quantify each party's relative contribution to the hazardous substances found at the site, "based on some physical measurement of pollution . . ., such as mass contributed . . . or volume contributed." *City of Wichita v. Trustees of the APCO OIL Corp. Liquidating Trust*, 306 F. Supp. 2d 1040, 1097 (D.Kan. 2003) (citing *Boeing Co. v. Cascade Corp.*, 920 F. Supp. 1121, 1136 (D.Or. 1996), *aff'd in part, remanded in part*, 207 F.3d 1177 (9th Cir. 2000); *Bancamerica Commercial Corp. v. Trinity Industries, Inc.*, 900 F. Supp. 1427, 1473-

74 (D.Kan. 1995), *rev'd in part on other grounds*, 100 F.3d 792 (10th Cir. 1996); *cf. United States v. Davis*, 31 F. Supp. 2d 45, 64 (D.R.I. 1998), *aff'd*, 261 F.3d 1 (1st Cir. 2001) ("[T]he fairest, and most practical, measure of relative responsibility is the quantity or volume of hazardous waste attributable to each party."). This approach not only recognizes the primary thrust of the equitable factors enumerated in the cases, but also advances "the overarching goal of CERCLA . . . to place the financial cost of the cleanup upon those parties responsible for creating the hazardous condition." *Amland Props. Corp. v. Aluminum Co. of America*, 711 F. Supp 784, 789 (D.N.J. 1989), *cited in Westwood*, 2004 WL 1570261, at *22.

In this case, the proof presented at trial addressing allocation issues focused in large part on the methodology proposed by Solvent's allocation expert, James Kohanek. Mr. Kohanek's proposal operates from the premise that Solvent is responsible for virtually all of the non-mercury contamination in the soils and A-Zone groundwater, as well as the vast majority of the chlorinated benzene contamination in the B-Zone groundwater at the Solvent Site; DuPont is responsible for substantially all of the chlorinated aliphatic contamination detected in the bedrock groundwater at the Hot Spot and the Solvent Site; and Olin is responsible for a share of the mercury contamination in the Solvent soils, as well as a share of the chlorinated benzene contamination in the Hot Spot groundwater. The proposal also recognizes Solvent's responsibility for a share of the cost of remediating the contaminated sediments in a portion of Gill Creek.

Neither DuPont nor Olin has mounted a convincing substantive challenge to Solvent's allocation methodology. Although DuPont criticizes Mr. Kohanek's approach on several levels, its principal argument is that the court's consideration of equitable factors should focus on the constituents identified by the DEC as the contaminants of concern that necessitated the remedy–namely, the extensive chlorinated benzenes and chlorinated benzene DNAPL in the overburden soil and the fractured bedrock. DuPont contends that since chlorinated aliphatics were not a factor in the DEC's remedy selection, and will not be a factor in future determinations regarding the Site, DuPont should not be assessed any share of the costs associated with the remedial activities at the Solvent Site and Hot Spot.

Olin, for its part, contends that it should not be assessed any share of the Solvent Site/Hot Spot remediation costs because the proof at trial shows that the characteristics of the chlorinated benzenes detected in the groundwater at the Hot Spot are more closely associated with the chlorinated benzenes in the groundwater at the Solvent Site than with the chlorinated benzenes in the groundwater at the Olin Site, and has advanced several reasons why it should be assessed only a small share of the soil remedy costs. With respect to Gill Creek, Olin contends that Solvent should be allocated 50% of the total response costs incurred by Olin to clean up the contaminated creek sediments because the proof shows that both Solvent and Olin are responsible for the chlorinated benzene contamination which required the remedial action.

Considering the parties' respective positions on allocation, and in the absence of any workable alternative proposal, the court finds Solvent's essential analysis to be consistent with the basic equitable principle that the parties responsible for creating the hazardous conditions should bear the costs of cleaning them up. Mr. Kohanek's considerable experience in the field of CERCLA liability allocation was established at trial, highlighting his work in both the private and public sectors as a consultant, mediator, arbitrator, court-appointed expert, and privately retained expert in Superfund cases and other matters involving the allocation of the costs of environmental remediation (*see* Tr. 1423 at 2-5; *see also* S-6049). Significantly, Mr. Kohanek was the only witness who presented a coherent methodology for the court to consider in approaching the considerable task of arriving at an equitable determination of responsibility for the costs incurred as a result of the remedial activities at issue in this case. His proposal separately addresses each component of the remediation by examining the sources of the contaminants detected within each particular media and assigning each party a share of the total costs incurred in proportion to the party's relative contribution to the overall contamination as well as the harm to the environment posed by the contamination. This is the essence of equitable allocation under CERCLA.

In addition, Mr. Kohanek's proposed allocation is based on the underlying assumption that Solvent bears responsibility for the cost of remediating all of the contamination resulting from the handling, disposal, or other activities resulting in the release of hazardous substances at the Solvent Site, including any activities on the part of settling, defunct, or "orphan" parties whose allocable share might somehow otherwise be attributed to DuPont or Olin. This approach provides an equitable means of assessing contribution shares to DuPont and Olin for the remediation costs incurred by Solvent to the extent the proof shows that contamination migrated to the Solvent Site and Hot Spot from the neighboring DuPont and Olin facilities, with the flexibility for adjustment as warranted by the application of other pertinent equitable factors.

As addressed in further detail below, Solvent's proposal assigns each party a share of responsibility for each of the following components of the remedial activities at issue:

(1) the clean soil cover system, addressing the contaminated soils at the Solvent Site;

(2) the Groundwater Remediation System ("GWRS"), addressing

   (a) the shallow overburden (A-Zone) groundwater contamination at the Solvent Site,

   (b) the bedrock (or B-Zone) groundwater contamination at the Solvent Site, and

   (c) the groundwater contamination at the Hot Spot; and

(3) the Gill Creek remediation.

Finding this to be a sensible framework, the court will address each of these components in turn.

1. The Clean Cover Soil System

The first remedial component analyzed by Mr. Kohanek in his allocation proposal is the clean cover soil system, or "cap," installed by Solvent to address the existence of widespread organic and inorganic contamination within the Solvent Site soils. In allocating responsibility for this component, Mr. Kohanek relied upon the analysis of Solvent's hydrogeological expert, Andrew Smyth, who calculated the weighted relative harm caused by each soil contaminant based on average concentration, prevalence, and toxicity of each contaminant. Mr. Kohanek allocated 100% of the responsibility for on-site soil contamination to Solvent–a result which, needless to say, neither Olin nor DuPont has contested.

With respect to off-site contaminants, Mr. Kohanek relied heavily on the analyses provided by Mr. Smyth and another of Solvent's testifying experts, air emissions specialist Gary Hunt. Mr. Hunt's analysis attributed 90% of the mercury found in the soils at the

Solvent Site to Olin and the remaining 10% to Occidental, based on his review of Olin's nearly 100-year history of mercury emissions from its former chlor-alkali production facility located adjacent to and predominately upwind of the Solvent Site as well as his modeling of the impacts from the mercury emissions on the Solvent soils and his assumptions regarding air emissions from the predominately downwind Occidental CAP facility. Mr. Smyth's analysis of risk of harm to the environment ascribed a weighted impact for each contaminant based on its average concentration, prevalence, and toxicity as compared to DEC cleanup criteria, calculating mercury's relative contribution rate at 21.93% of the overall harm to the soil. Multiplying these figures by the weighted percentage shares ascribed to the identified sources of the soil contaminants, Mr. Kohanek arrived at the assignment of 80.26%[16] of the costs associated with the soil remedy to Solvent and 19.74% to Olin.

Olin's challenge to Mr. Kohanek's soil allocation is focused primarily on Mr. Hunt's conclusions regarding aerial deposition as the only source of the mercury in the Solvent Site soils. According to Kirk Winges, Olin's air emissions expert, Mr. Hunt's analysis does not account for the presence of other inorganic metals in the Solvent Site soils, such as zinc, lead, copper, and barium, which can only be attributed to the historic placement of an extensive amount of fill materials in the area. From this premise, Olin argues that the relative contribution of mercury should be divided equally between the three sources: Olin's CAP facility, Occidental's CAP facility, and fill.

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[16] This percentage includes the share, assumed by Solvent, of 21.19% allocated to other identified sources of soil contaminants, including the Occidental CAP facility, settling PRPs, and orphans.

Olin also relies on the testimony of William Hall, who utilized a risk factor analysis approach similar to Mr. Smyth's to arrive at a relative contribution rate for mercury at 16.03% of the need for the soil remediation at the Solvent Site (compared to 21.93% as calculated by Mr. Smyth). Mr. Hall then calculated the percentage of the soil remedy attributable to mercury contamination, as compared to other remedial activity unrelated to mercury contamination (such as relocation of waste materials excavated from the A-Zone trench and the 18-inch sewer remediation), at 6.9% of the total soil remediation costs, which he then divided equally among the three potential mercury sources (*i.e.*, the Olin CAP, the Occidental CAP, and fill) to arrive at the soil allocation figure of 2.3% for Olin.

Although the amount Solvent seeks from Olin for reimbursement of soil remediation costs represents a relatively small percentage (approximately 4.3%) of the overall remedial costs incurred by Solvent through June 30, 2007, it represents a large share (approximately 65%) of the total reimbursement amount sought from Olin. Because of this, these parties have spent a considerable amount of time and resources litigating the soil issue, devoting much of their presentations to rebuttal of the scientific propositions, hypotheses, and assumptions put forth by the respective expert witnesses. As suggested by the discussion above, the court has struggled with the astonishing lack of consensus among these learned scientists, consultants, and legal counsel regarding the impact of the overwhelming data generated as a result of the remedial activities in the area of concern. Simply put, the testimony and evidence put forth at trial has failed to convince the court that either party's allocation analysis should be considered determinative.

Specifically with respect to allocation of the costs associated with the installation of the clean cover system, the only conclusions to be reached in the aftermath of the battle of the experts staged at trial are that reasonable scientific minds cannot agree about the source and impact of the mercury contamination detected in the Solvent Site soils, and that statistics can be interpreted in different ways to obtain different results. However, on a common sense level, some reasonable inferences can be drawn from the proof as a basis for determining the appropriate equitable considerations to be made in allocating response costs among the liable parties.

For example, it is reasonable to conclude that Olin's long history of air emissions from its CAP facility located upwind of the Solvent Site was responsible for a significant amount of the mercury contamination detected in the soils. However, a significant share of the mercury can also reasonably be attributed to the long history of emissions from the Occidental facility, as well as to the placement of fill material clearly indicated by the co-location of zinc and other inorganics unrelated to chlor-alkali production. Considered in conjunction with the underlying equitable principle that the party profiting from the operation of the site should bear the primary responsibility for the cleanup, the court finds that the proposed assignment to Olin of 90% of the responsibility for the mercury found in the Solvent Site soils, and the allocation to Olin of 19.74% of the soil remediation costs, is patently unreasonable. By the same token, the lack of direct proof to substantiate Olin's position regarding both the impact of the alternative sources of mercury as well as the discount attributed to the use of relocated excavation materials leads the court to conclude that Olin's share of soil-related costs should be assessed at a rate higher than 2.3%.

Based on these considerations, and in the absence of a convincing presentation of evidence from which a reasonable and rational approximation of each party's individual contribution to the contamination can be made, the court finds, upon balancing the equities under the circumstances, that Olin's share of responsibility for the Solvent Site soil remediation must be set somewhere between 19.74% and 2.3%. Utilizing Mr. Kohanek's framework in its essential form, the first step is to determine an intermediate rate of relative contribution to the environmental harm caused by mercury by splitting the difference between the risk analysis rates for mercury proposed by Mr. Smyth (21.93%) and Mr. Hall (16.03%). This results in an adjusted relative contribution rate of 18.98%.

The next step is to arrive at an intermediate percentage share for the identified sources of the mercury by splitting the difference between the rates ascribed to Olin by Mr. Hunt (90%) and Mr. Hall (33.3%). This results in an adjusted figure of 61.65%, representing Olin's percentage share of responsibility for the mercury in the Solvent Site.

Multiplying the adjusted relative contribution rate for mercury by the adjusted share of responsibility for the mercury ascribed to Olin (18.98% x 61.65%) results in an allocation of 11.7% the costs associated with the soil remedy to Olin, and the remaining 88.3% to Solvent.

2. The GWRS

a. Shallow Overburden (A-Zone) Groundwater Contamination at the Solvent Site

As explained at length above in the court's summary of the trial presentation, the GWRS installed by Solvent includes two major components: (a) a trench system to collect the shallow overburden (A-Zone) groundwater at the Solvent Site, and (b) a series of bedrock (B-Zone) pumping wells which draw water from both the Solvent Site and the Hot Spot. Mr. Kohanek provided a separate allocation analysis for each of these components, and further divided the B-Zone remedy allocation between the costs associated with the Solvent Site and the costs associated with the Hot Spot.

Unlike his soil allocation, Mr. Kohanek's groundwater allocations were based solely on the concentrations of the contaminants without considering toxicity, since the chlorinated benzene and chlorinated aliphatic toxicities varied by less than an order of magnitude. With respect to the A-Zone, Mr. Kohanek ultimately allocated 99.3% of the responsibility to Solvent, based on Mr. Smyth's hydrogeologic analysis indicating that the vast majority of the contamination detected in the A-Zone groundwater consists of chlorinated benzenes attributable to Solvent and other operators of the facility. The smaller concentration of chlorinated aliphatic contamination detected in the A-Zone groundwater was attributed both to on-site releases occurring during subsequent periods of operation, and to off-site releases at the downgradient DuPont facility, resulting in the assignment of the remaining 0.7% of the responsibility for the A-Zone contamination to DuPont. Olin was assigned a 0% share.

As mentioned above, rather than offering a viable allocation alternative, DuPont simply proposes that it should not be assessed a substantive share of the costs associated with any of the components of Solvent's groundwater remedy. According to DuPont, since the partial containment remedy chosen by the DEC for the Solvent Site was necessitated solely by the extensive chlorinated benzene contamination found in the soil and groundwater, it is fair and equitable to charge Solvent with sole responsibility for the costs of implementing the remedy, and to the extent it is determined that DuPont should be assessed a share for the incidental treatment of the chlorinated aliphatics detected in the pumped groundwater, that share should be 1% or less.

Once again, the *Seneca Meadows* case provides pertinent guidance. In *Seneca Meadows*, the owner of a landfill who incurred cleanup costs under DEC oversight sought contribution from numerous PRPs who had contributed to the contamination at the site. By the time the ten-day bench trial commenced, all but one of the PRPs had settled or had otherwise resolved their liability. The remaining party, Goulds Pumps, Inc., raised several of the same defenses to liability and legal arguments raised by DuPont in this action, including the defense of "divisibility," all of which were rejected by the court. As explained by Judge Larimer:

> Goulds Pumps argues that the proof establishes the complete affirmative defense of divisibility under § 107(b), that is, that the acts of another caused the release of hazardous waste and the resulting damages. Evidence and concepts relating to an affirmative defense on the one hand, and allocation of response costs in a contribution case, are sometimes discussed interchangeably. But, a defendant, in order to prevail on this affirmative defense, must establish that the harm was caused by a third party and that the defendant's pollution constituted no more than background contamination.
>
> The focus of this trial, though, has been about allocation of the response costs, and not on any affirmative defense. The factors advanced by Goulds Pumps to minimize its exposure are, of course, germane to the allocation inquiry. The focus, then, must be on the appropriate allocation of costs.

Seneca Meadows, 427 F. Supp. 2d at 291. Upon reaching the allocation issue, the court found the presence of TCE in the bedrock and groundwater as the "principal negative environmental impact" driving the remedy at the site, *id.* at 294, and ultimately allocated a 0% share to Goulds Pumps based on a lack of "credible evidence that it deposited liquid TCE, which the experts . . . seem to agree is the compound that has required the ground water remediation." *Id.* at 300.

Other allocators have taken a similar approach. For example, in *AlliedSignal, Inc. v. Amcast Int'l Corp.*, 177 F. Supp. 2d 713 (S.D. Ohio 2001), as "a logical basis for equitably and fairly allocating the response costs that the Plaintiff has and will incur," the court focused on the percentage of the contaminant driving the groundwater remedy–carcinogenic PAHs–that came from the waste each PRP had deposited at the site. *Id.* at 749. Similarly, in *The Ninth Avenue Remedial Group v. Allis-Chalmers Corp.*, 2001 WL 1823815 (N.D. Ind. August 30, 2001), the court stated:

> One key equitable factor in a CERCLA allocation analysis is whether or not a liable party is responsible for the hazardous substances that "drive" the remedy. Because such remedy drivers are the main reason for undertaking response action in the first place, and consequently for incurring response costs, determination of which liable parties have contributed to the remedy drivers is critical to a just and fair allocation of CERCLA response costs.

Id. at *10. *See also Boeing Co. v. Cascade Corp.*, 920 F. Supp. 1121, 1137 (D. Ore. 1996), *aff'd in relevant part*, 207 F.3d 1177 (9th Cir. 2000) (rejecting proposed allocation based on factors affecting cost of the remedy, such as complexity of the hydrogeologic setting and volume of water to be treated, "because liability is established by contribution to the harm, not the solution.").

In this case, there can be no dispute that DNAPL, in the soil and groundwater at the Solvent Site, is what necessitated the installation of the GWRS. Indeed, the proof at trial clearly established the presence of widespread chlorinated benzene contamination in both the saturated and unsaturated zones of the overburden soils at the Site, as well as throughout the fractured bedrock in the B-Zone and deeper.

As demonstrated by the testimony of DEC's Solvent Site project manager, Jeffrey Konsella, and as discussed in the Solvent ROD, the pervasive nature and extent of the chlorinated benzene contamination was the very reason for the DEC's determination that cleaning up the soil and groundwater to State standards was technically impracticable. This resulted in the selection of the partial containment remedy, designed to allow the chlorinated benzenes in the soil and DNAPL to dissolve and be flushed into the groundwater, with hydraulic control in the A- and B-Zones by pumping, treatment, and monitoring. It is not disputed that the continued presence of chlorinated benzene DNAPL in the soil constitutes a significant source of chlorinated benzenes that will continue to dissolve into the groundwater, and require hydraulic control of the A- and B-Zones, for many years. The remedy ultimately requires Solvent to demonstrate that hydraulic control of the A- and B-Zones has significantly reduced the downward migration of chlorinated benzenes into the C- and deeper zones as the benchmark for determining the effectiveness of the remedy. Chlorinated aliphatics were not a consideration in the DEC's remedy determination, and Mr. Konsella testified that the presence of chlorinated aliphatics in the pumped well data will not be a factor in the DEC's future determinations regarding the Site.

Solvent contends that, regardless of the reasons for the DEC's determinations with regard to the required remedial action at the Solvent Site, there can be no serious dispute that chlorinated aliphatic contamination has migrated from the DuPont facility to the Site and to the Hot Spot, or that Solvent has incurred response costs associated with pumping and treating groundwater contaminated with chlorinated aliphatics as part of its GWRS. Indeed, the court has already determined as much in its assessment of DuPont's *prima facie* response cost liability. However, as that discussion also suggests, while there is ample proof to attribute a portion of the chlorinated aliphatic contamination in the overburden and A-Zone groundwater to on-site operation of a hazardous waste storage and transfer facility, there is no such direct proof that the chlorinated aliphatics detected in the A-Zone monitoring wells and shallow overburden trench system at the Solvent Site migrated there from the DuPont facility.

In addition, it is undisputed that Solvent's essential business purpose was to purchase waste or low-grade chlorinated benzene material from other manufacturers or suppliers and reprocess it into a saleable grade of chlorinated benzene for profit. Accordingly, the basic equitable principle that the party seeking to profit from the operation of a waste-producing enterprise should bear primary responsibility for the hazardous byproducts of its activity is of overriding importance in this case.

For these reasons, the court finds that the presence of chlorinated benzenes in the soil and groundwater–none of which is attributable to DuPont–caused the principal negative environmental impact driving the A-Zone remedy at the Solvent Site. Considering this key equitable factor, along with the lack of credible evidence that 0.70% of the chlorinated aliphatics detected in the A-Zone groundwater at the Site migrated there from the DuPont facility, as well as the underlying recognition that Solvent should bear full responsibility for the cost of remediating the contamination caused by its release of hazardous substances into the environment, the court finds that the fair balancing of the equities requires Solvent to bear 100% of the responsibility for the response costs associated with the A-Zone remedy.

b. Bedrock (B-Zone) Groundwater Contamination at the Solvent Site

Solvent's proposed allocation for the B-Zone groundwater contamination at both the Solvent Site and Hot Spot is based on the same volumetric approach proposed for the A-Zone. Using contaminant concentrations derived from pumping well data, Mr. Kohanek determined with respect to the Solvent Site that, on average, 68.39% of the B-Zone groundwater contamination being remediated consists of chlorinated aliphatics, and 31.61% consists of chlorinated benzenes.

Mr. Kohanek allocated 98% of the Solvent Site B-Zone chlorinated benzene share to Solvent, based on evidence in the record showing significant releases of chlorinated benzenes related to operations at the Solvent facility. The remaining 2% of the chlorinated benzene share was attributed to Olin, based on Mr. Smyth's analysis indicating that a small portion of chlorinated benzene contamination located in the northwest corner of the Solvent Site likely migrated there from the former BHC production area at the Olin facility.

Mr. Kohanek allocated 98% of the chlorinated aliphatic share to DuPont based upon Mr. Smyth's conclusions related to a migration pathway from the DuPont facility and the presence of 1,1,2,2-TCA, considered as a "tracer" compound for DuPont, within the chlorinated aliphatic contamination detected in the B-Zone groundwater at the Solvent Site. Mr. Kohanek allocated the remaining 2% of the B-Zone chlorinated aliphatic contamination to Solvent based on the relatively small volume of chlorinated aliphatics handled or stored at the Solvent Site during periods subsequent to Solvent's operations but attributable to Solvent.

Applying his allocation methodology, Mr. Kohanek arrived at the following shares for the costs associated with remediation of B-Zone groundwater contamination at the Solvent Site:

Solvent: (68.39% x 2%) + (31.61% x 98%) = 32.35%
DuPont: (68.39% x 98%) = 67.02%
Olin: (31.61% x 2%) = 0.63%

The same key underlying equitable considerations made above regarding the nature of the contaminants driving the A-Zone remedy apply with equal force to the court's allocation of responsibility for response costs associated with the B-Zone remedy. Simply put, the presence of chlorinated benzenes in the soil and groundwater caused the principal negative environmental impact driving the B-Zone groundwater remedy at the Solvent Site, and those responsible for the release of chlorinated benzenes should bear primary responsibility for the cost of remediation.

There is, however, a significant additional factor to consider in determining a just allocation of B-Zone response costs–namely, undisputed proof that chlorinated aliphatics have migrated from the DuPont Site and have been detected in the B-Zone groundwater being pumped and treated at the Solvent Site. Mr. Kohanek has attributed 68.39% of the B-Zone groundwater contamination to chlorinated aliphatics and 98% of the responsibility for the remedial costs associated with these contaminants to DuPont.

There is substantial support for charging DuPont with the lion's share of responsibility for the B-Zone chlorinated aliphatic contamination. As discussed above, ample proof was presented at trial to establish that significant amounts of chlorinated aliphatics were deposited at the DuPont Site during the many years of its chemical manufacturing operations which have migrated through the groundwater in the fractured bedrock throughout the area of concern, including the Solvent Site and the Hot Spot. Indeed, based on the testimony of virtually every witness who testified at trial regarding this issue, it is beyond serious dispute that DuPont is the predominant source of the chlorinated aliphatic contamination within the B-Zone groundwater being pumped and treated at the Solvent Site. The essence of the dispute between Solvent and DuPont concerns the assessment of the relative risk of harm to the Site posed by the chlorinated aliphatics.

In this regard, several considerations lead the court to conclude that Mr. Kohanek's volumetric comparison of the relative amounts of chlorinated benzenes to the relative amount of chlorinated aliphatics detected in the pumped groundwater does not provide an equitable basis for fair allocation of the costs associated with the B-Zone remedy. Not only does this comparison fail to adequately account for the principal negative environmental impact of the chlorinated benzenes driving the groundwater remedy at the Solvent Site, it also fails to account for the significant concentrations of chlorinated benzene DNAPL found in the soil covering approximately 60% of the Site as well as in the bedrock fractures in the B-Zone and lower which, as indicated above, led to the DEC's determination that a groundwater and DNAPL cleanup remedy was technically impracticable.

In addition, the pumping wells from which the volumetric data were drawn are all located along the northern border of the Site, in the area where monitoring well data show the lowest chlorinated benzene concentrations and the highest chlorinated aliphatic concentrations in the B-Zone.[17] While the trial testimony revealed considerable room for

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[17] There are no pumping wells in the southern part of the Site, where monitoring well data show the highest chlorinated benzene concentrations with virtually no chlorinated aliphatics.

debate among hydrogeological and environmental experts regarding whether pumping well data or monitoring well data provided a more reliable indicator of the harm caused to the environment by the various types of contaminants detected in the groundwater, no evidence was presented to convince the court that one type of data should be included in the allocation analysis to the exclusion of the other.

In this regard, although DuPont has not advanced a useful overall allocation proposal, it has presented an alternative assessment of the relative risk of harm to the environment posed by chlorinated aliphatics and chlorinated benzenes. This alternative is based on Dr. Faust's comparison of the average total concentrations of these contaminants detected in the B-Zone monitoring wells, as reported to the DEC by Solvent as part of its performance monitoring program. The results were then divided by New York State groundwater cleanup standards to calculate a risk-weighted concentration factor indicating that benzenes and chlorinated benzenes represent approximately 92.5% of the risk of harm to the groundwater in the B-Zone, and chlorinated aliphatics represent approximately 7.5%.

Based on these considerations, and faced with the wide disparity in the parties' interpretation of the vast amounts of data generated over the course of decades of remedial investigations and clean-up activities at the Site, the court finds that splitting the difference between the risk analysis rates as calculated by Solvent and DuPont provides a rational basis for equitably allocating shares of responsibility for the costs associated with the B-Zone remedy. This results in adjusted relative contribution rates of 62.05% for chlorinated benzenes, and 37.95% for chlorinated aliphatics.

In addition, given the overwhelming evidence of the extensive chlorinated benzene contamination as the primary negative environmental impact driving the overall remedy at issue in this litigation, the court finds under all of the circumstances presented that a fair and equitable calculation of relative shares of responsibility for the B-Zone groundwater contamination should incorporate a further discount of 10% in favor of DuPont. This determination also takes into account any costs associated with delays in the startup/prove out phase of the GWRS and the modification of POTW discharge permit levels caused by the presence of chlorinated aliphatics in the pumped groundwater, as well as any incidental increases in Solvent's pretreatment plant operating costs, for which neither party has provided any useful quantification.

Applying these adjusted figures to Mr. Kohanek’s allocation framework, Solvent’s share of responsibility for the B-Zone contamination at the Solvent Site is recalculated at (62.05% x 98%) + (37.95% x 12%) = 65.36%. DuPont’s share is recalculated at (37.95% x 88%) = 33.39%. The remaining 1.25% is split between Olin (.63%)[18] and Solvent (.62%), resulting in an adjusted share for Solvent of 65.98%.

Accordingly, the court finds the following to be a fair allocation of the responsibility for the costs associated with the B-Zone remedy:

Solvent: 65.98%

DuPont: 33.39%

Olin: 0.63%

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[18] Olin has not challenged Solvent’s allocation proposal for the B-Zone groundwater remedy, and the court finds no basis for adjusting this rate.

c. Hot Spot Groundwater Contamination

Mr. Kohanek's proposal for allocation of the costs associated with the Hot Spot groundwater remedy is based on Mr. Smyth's volumetric analysis showing that, on average, 93.52% of the contamination in the groundwater pumped from the B-Zone at the Hot Spot is chlorinated aliphatics, and 6.48% is chlorinated benzenes. Relying on Mr. Smyth's analysis of groundwater flow directions, bedrock slopes, contaminant ratios, and the existence of the DuPont tracer 1,1,2,2-TCA, Mr. Kohanek allocated 100% of the chlorinated aliphatic contamination to DuPont and 98% of the chlorinated benzene contamination to Olin. The other 2% of chlorinated benzene contamination was allocated to Solvent. Mr. Kohanek arrived at the following shares for the costs associated with remediation of the groundwater contamination at the Hot Spot:

Solvent	0.13%
DuPont	93.52%
Olin	6.35%

Of course, the equitable considerations made above with respect to the allocation of the responsibility for the costs associated with the B-Zone remedy at the Solvent Site apply with equal force and effect to the allocation of responsibility for the costs associated with the remediation of groundwater contamination at the Hot Spot. Simply put, the undisputed proof at trial established that the DEC's integrated B-Zone remedy for the Solvent Site included the installation and operation of pumping wells on Olin's property to achieve hydraulic control at the Hot Spot, based on the determination that the contaminants found in that area were similar to the "predominant site indicator chemicals" driving the remedy–*i.e.*, chlorinated benzenes–which were "likely due in part to migration from the Solvent Site." (Solvent ROD, S-1012 at p. 20.) As discussed above, considering the overwhelming evidence in the record of the extensive chlorinated benzene and DNAPL contamination, the significant migration of chlorinated aliphatics through the fractured bedrock, and the parties' inability to reach any workable consensus as to the reasonable scientific conclusions to be drawn from the vast amounts of data generated at the Site, the court finds that a fair and equitable allocation requires DuPont to bear the discounted relative share of 33.39% of the responsibility for remedial costs incurred in implementing the B-Zone groundwater remedy, including the remedy at the Hot Spot.

With respect to the remaining 66.61%, Solvent's allocation proposal seeks 6.35% of the costs associated with the Hot Spot remedy from Olin. For its part, Olin maintains that it should not be responsible for any of those costs because the proof at trial establishes that none of the chlorinated benzenes disposed of at the Olin facility could have migrated to the Hot Spot. However, as discussed in Section IV(A)(2)(a) *infra*, the court has already rejected this argument. In any event, considering the totality of the circumstances presented, including the location of the Hot Spot on Olin's property in the predominate groundwater migration pathway downgradient from the ARGC Area where significant chlorinated benzene operations took place (as discussed at further length in section V(A)(2)(a) *infra*), Mr. Kohanek's assessment of Olin's allocable share of the Hot Spot remedy at 6.35% is eminently reasonable.

Accordingly, the court finds the following to be a fair allocation of the responsibility for the costs associated with the Hot Spot remedy:

Solvent:	60.26%
DuPont:	33.39%

Olin: 6.35%

3. Gill Creek

The final element in the court's allocation analysis relates to Solvent's equitable share of the $4,467,099 in "common costs"[19] incurred by Olin in removing the contaminated sediments from Gill Creek during the 1992 remediation performed jointly with DuPont. Olin has proposed that Solvent be allocated a 50% share of Olin's costs based on the proof at trial establishing that Solvent discharged significant amounts of chlorinated benzene material to Gill Creek through the 18-inch storm sewer. Solvent, on the other hand, proposes that it be assigned a share of no more than 0.18% for the Gill Creek remediation, based on Mr. Kohanek's assessment of the parties' relative contribution to the harm to the creek sediments posed by the chlorinated benzene contamination as compared to the contamination attributable to other sources.

In this regard, Mr. Kohanek utilized an approach similar to his soil allocation methodology to determine that non-chlorinated benzene contamination in the sediments vastly outweighed chlorinated benzene contamination in terms of concentration, volume, and toxicity. He assessed a relative contaminant share of 0.44% for chlorinated benzenes, and 99.56% for all other contaminants. He then assigned Olin 60% of the responsibility for this share, and Solvent 40%, based on Mr. Smyth's analysis indicating a predominance of the chlorinated benzenes more closely associated with Olin's operations than with Solvent's. This resulted in an allocable share for Solvent of approximately 0.18% (0.44 x

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[19] The term "common costs" has been used by the parties to describe the amounts spent by Olin "common" to the design and construction of diversion dams, dewatering the creek, contract and project administration, water treatment, and other costs deemed reasonable and necessary to remediate the contaminated Gill Creek sediments. *See* Item 1459, ¶ 194.

40% = 0.176%) of the costs associated with the remediation of the Gill Creek sediments, with the remaining share of 98.2% attributable to Olin.

Upon consideration of all of the circumstances, the court finds Solvent’s proposal to be a reasonable one. First of all, as suggested by the discussion in Section III(C) *infra*, the court’s consideration of the expert testimony pertaining to Solvent's liability for Olin’s Gill Creek expenditures is limited to Mr. Hall’s opinion that Solvent's share should be based on the costs incurred for the removal of contaminated sediments from Area 3 only, not from the entire length of the creek. This would include a share of the costs associated with the design and construction of the two diversion structures in the vicinity of the Adams Avenue Bridge, near the outfall of Solvent’s 18-inch storm sewer, rather than a share of the costs associated with all five diversion structures installed to divert the creek waters and keep the Niagara River from flowing into the creek during the sediment removal operations. As indicated by the proof at trial, the volume of sediments removed from Area 3 represents less than 3% of the total volume of the contaminated sediments removed during the 1992 Gill Creek remediation.

Significantly, it is not disputed that the Gill Creek ROD identifies PCBs, BHCs, chlorinated aliphatics, hexachlorobenzene, benzene, and mercury as the contaminants of concern driving the sediment remedy. Hexachlorobenzene–the only chlorinated benzene compound identified in the ROD as a contaminant of concern–was a byproduct of Olin's BHC manufacturing process, and there is no evidence to indicate that hexachlorobenzene was associated with chemical manufacturing or waste handling operations at the Solvent facility.

Solvent does not dispute that chlorinated benzenes which were spilled, leaked, or otherwise released into the environment at the 3163 Buffalo Avenue Property during the periods of manufacturing and waste handling operations likely were discharged into Gill Creek through the 18-inch storm sewer. However, it is likewise undisputed that chlorinated benzenes associated with Olin's BHC and trichlorobenzene manufacturing operations were spilled, leaked, or otherwise released into the environment at the Olin facility and found their way to Gill Creek through multiple pathways, including historical sewer discharges, groundwater flow, and the explosion at the BHC plant. Even with respect to just Area 3, there is substantial evidence to suggest that the chlorinated benzenes detected in the Area 3 creek sediments are more closely associated with the chlorinated benzene contamination at the Olin facility than with the DNAPL detected in the 18" storm sewer. In any event, it is beyond serious dispute that the chlorinated benzene contamination within the creek sediments, regardless of its source, was not a matter of significant environmental concern when compared to the PCBs, BHC, and other contaminants contributed by Olin and DuPont.

Based on these considerations, the court finds that a share of 0.18% represents a fair allocation of Solvent’s responsibility for the costs incurred by Olin in connection with the removal of the contaminated sediments from Area 3 during the 1992 Gill Creek remediation. This results in an allocable share in the amount of $8041 ($4,467,099 x 0.18%).

D. Allocation of Past and Future Costs for the Soil and Groundwater Remedies at the Solvent Site

Solvent's allocation proposal includes a breakdown of past costs incurred to implement the remedial activities required by the Solvent ROD, totaling $9,624,328 as of June 30, 2007 (*see* S-6063; *see also* Item 1461, Att. 2). Solvent has agreed to reduce this total by $500,000 to reflect the amount received in settlement payments related to another lawsuit, resulting in the total of $9,124,328 in past costs for which contribution is sought. Allocating this amount among the soil and groundwater remedies, using Mr. Kohanek's media-specific and location-specific factors discussed above, results in the following calculation of cost per remedial activity:

Soil:	$2,135,093	(23.4% of the total past costs)
Solvent Site A-Zone Groundwater:	$848,562	(9.3%)
Solvent Site B-Zone Groundwater:	$3,102,272	(34.0%)
Hot Spot:	$3,038,401	(33.3%)
Total:	$9,124,328	(100%)

Applying the allocable share percentages assigned above to DuPont and Olin for each remedial component, the court calculates the following amounts due as equitable shares of past response costs incurred at the Solvent Site and Hot Spot as of June 30, 2007:

	DuPont	Olin
Soil:	$0	$249,806 ($2,135,093 x 11.7%)
A- Zone:	$0	$0
B-Zone:	$1,035,849 ($3,102,272 x 33.39%)	$19,544 ($3,102,272 x 0.63%)
Hot Spot:	$1,014,522 ($3,038,401 x 33.39%)	$192,938 ($3,038,401 x 6.35%)
Totals:	$2,050,371	$462,288

Solvent also seeks declaratory judgment allocating DuPont and Olin equitable shares of future operation, monitoring, and maintenance costs for the GWRS, estimated at $16.5 million for a 30-year period. Solvent proposes annual payments based on pumped well test results taken twice a year and adjusted as necessary to account for variations in the results.

In determining whether to allocate future costs, the court has considered the key equitable factors discussed above regarding the principal negative environmental impact of the chlorinated benzene contamination resulting from Solvent's essential business operations, as well as the inability of testifying experts and other professionals, well trained and experienced in the environmental sciences and law, to provide the court with a reasonable basis for interpreting the vast amount of scientific data presented as evidence in the case. The court has also considered the unchallenged testimony of Mr. Konsella indicating that the DEC's future determinations with regard to the effectiveness of the groundwater remedy at the Site will be made based on data pertaining to hydraulic control of the contaminants of concern identified in the Solvent ROD–chlorinated benzenes–without regard to control of chlorinated aliphatics or other constituents. In addition, the proof is clear that the remedy requires Solvent to treat all organic constituents present in the pumped groundwater in order to meet the discharge limits of its POTW permit. The extent to which the continued presence of chlorinated aliphatics in the pumped groundwater might be deemed responsible for any incidental increase in treatment costs has already been taken into consideration by the court in discounting DuPont's allocable share of past costs associated with the B-Zone remedy. In any event, it was also made clear to the court that, at the time of trial, the DEC was still considering alternative remedial proposals to account for the presence of chlorinated aliphatics in the groundwater at the Site, further indicating that final judgment regarding the allocation of future costs to any party other than Solvent would be premature.

For these reasons, the court finds that Solvent has failed to demonstrate its entitlement to declaratory judgment allocating a share of responsibility for future costs to either DuPont or Olin.

VI. CONCLUSION

Based on the foregoing, the court grants judgment in favor of Solvent on its claim against DuPont in the amount of $2,050,371.00, and against Olin in the amount of $462,288.00, plus prejudgment interest, representing those parties' respective equitable shares of past response costs incurred by Solvent in implementing the remedial activities required by the Solvent ROD. Solvent's claim for declaratory judgment regarding future costs is dismissed.

The court also grants judgment in favor of Olin on its counterclaim against Solvent in the amount of $8041.00, plus prejudgment interest, representing Solvent's equitable share of the costs incurred by Olin for remediating the contaminated sediments in Gill Creek. Olin's fourth-party complaint against ICC is dismissed.

The foregoing constitutes the court's findings of fact and conclusions of law after trial, in accordance with Rule 52 of the Federal Rules of Civil Procedure. The Clerk of the Court is directed to enter judgment accordingly.

So ordered.

\s\ John T. Curtin
JOHN T. CURTIN
United States District Judge

Dated: 1/25/10
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