DOCUMENTATION OF ENVIRONMENTAL INDICATOR DETERMINATION

Interim Final 2/5/99

RCRA Corrective Action
Environmental Indicator (EI) RCRIS Code (CA750)

Migration of Contaminated Groundwater Under Control

Facility Name: Flexsys America L.P. Facility *(Solutia Inc.)*
Facility Address: No. 1 Monsanto Rd., Nitro, WV 25143
Facility EPA ID#: WVD039990965

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

   __X__ If yes – check here and continue with #2 below.

   _____ If no – re-evaluate existing data, or

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

   This CA750 Groundwater Environmental Indicator Report (EIR) is based on information collected during completion of an investigation and evaluation of groundwater resources throughout the Flexsys America L.P. facility (Figure 1). Areas investigated and included in the EIR are the internal portions of the plant process area (PA) as well as the wastewater treatment area (WWTA). In addition, sediment and surface water sampling in the Kanawha River downgradient of the Flexsys facility was also conducted to provide the information needed to prepare this report.

   Summary of Groundwater Investigation

   For all environmental investigations, groundwater concentrations were screened against federal Maximum Contaminant Levels (MCLs) promulgated pursuant to Section 42 U.S.C. §§ 300f et seq. of the Safe Drinking Water Act and codified at 40 CFR Part 141, or EPA Region III Screening Levels (RSL) for tap water for chemicals for which there are no applicable MCL. Soil concentrations were screened against EPA RSLs for residential soil and industrial soil.

2. Is **groundwater** known or reasonably suspected to be "**contaminated**"[1] above appropriately protective "levels" (i.e., applicable promulgated standards, as well as other appropriate

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

standards, guidelines, guidance, or criteria) from releases subject to RCRA Corrective Action, anywhere at, or from, the facility?

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

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

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

Rationale and References(s)

For all environmental investigations, groundwater concentrations were screened against federal Maximum Contaminant Levels (MCLs) promulgated pursuant to Section 42 U.S.C. §§ 300f et seq. of the Safe Drinking Water Act and codified at 40 CFR Part 141, or EPA Region III Screening Levels (RSL) for tap water for chemicals for which there are no applicable MCL.

The sampling efforts which were completed during several studies served to systematically collect representative grab samples of groundwater to identify contaminants of potential concern (COPC). The following target analytes were part of the parameter list for each groundwater sample collected at the site:

- Target Compound List (TCL) VOCs
- TCL SVOCs, plus Aniline, Ethyl Parathion and N-Nitrosodiphenylamine
- Appendix IX Chlorinated Herbicides (2,4-D, 2,4,5-T and 2,4,5-TP {Silvex}
- TCL Chlorinated Dibenzo-p-dioxin/Dibenzofuran Congeners
- TAL Metals

The following summary presents maximum analytical results for groundwater samples collected during site investigations that were in excess of the benchmark AWQC screening levels and/or Maximum Contaminant Levels (MCLs).

Table 1

Class	Constituent	Maximum Conc. (ug/l)	Screening Value (10xAWQC) (ug/l)	MCL (ug/l)
Volatile Organics	1,1-Dichloroethane	210	32	
	Carbon Tetrachloride	830	44	5
	Halomethanes	130		15.7

	Vinyl Chloride	17,000		
5250			2	
	Trichloroethene	14,000		
810			5	
	Tetrachloroethene	12,000		
88.5			5	
Semivolatile Organics	Total PAHs	160		
0.031				
	Phthalate Esters	290		3
Dioxins/Furans	2,3,7,8-TCDD	42 pg/l		
0.14 pg/l	.00003			

There were no exceedances of any AWQC for any surface water constituent in the Kanawha River surface water samples.

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

   __X__ If yes – continue, after presenting or referencing the physical evidence (e.g., groundwater sampling/measurement/migration barrier data) and rationale why contaminated groundwater is expected to remain within the (horizontal or vertical) dimension of the "existing areas of groundwater contaminataion"[2]).

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

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

Rationale and Reference(s)

Major conclusions from the Expanded Remedial Facility Investigation study dated February 2007 are summarized as follows:

- Dioxin is migrating from the Former 2,4,5-T Manufacturing Area, the PDA, and the Closed Wastewater Impoundments via the groundwater and/or surface water pathways and discharging to the Kanawha River.

- Tetrachloroethene (also known as perchloroethene or PCE) or its breakdown products (trichloroethylene or TCE; dichloroethene or DCE; and vinyl chloride or VC) are migrating from the Former Rubber Chemicals Manufacturing Area (Source Area) via the groundwater pathway and discharging to the Kanawha River.

  The Corrective Action Objectives developed for Facility groundwater were to control exposure to the hazardous constituents remaining in the groundwater, prevent a discharge of dioxin contaminated groundwater into the site-adjacent Kanawha River that could cause the Kanawha River to exceed its Allowable Maximum Daily Load for that compound, and reduce concentrations of contaminants in impacted groundwater in areas outside of the containment areas to ultimately restore that groundwater to MCLs.

4. Does "contaminated" groundwater **discharge** into **surface water** bodies?

   __X__ If yes – continue after identifying potentially affected surface water bodies. (See Above)

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

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

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

Rationale and References(s)

Groundwater flow at the site is toward the west-northwest. Based on the observed flow direction to the west-northwest, the horizontal extent of plume migration in groundwater is limited by the Kanawha River, which is located adjacent to the western boundary of the site providing a physical limit to migration of impacted groundwater.

5. Is the **discharge** of "contaminated" groundwater into surface water likely to be "**insignificant**" (i.e., the maximum concentration[3] of each contaminant discharging into surface water is less than 10 times their appropriate groundwater "level," and there are no other conditions (e.g., the nature, and number, of discharging contaminants, or environmental setting), which significantly increase the potential for unacceptable impacts to surface water, sediments, or eco-systems at these concentrations)?

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

   ____ If no – (the discharge of "contaminated" groundwater into surface water is potentially significant" – continue after documenting: 1) the maximum known or reasonably suspected concentration[3] of each contaminant discharged above its groundwater "level," the value of the appropriate "level(s)," and if there is evidence that the concentrations are increasing; and 2) for any contaminants discharging into surface water in concentrations[3] greater than 100 times their appropriate groundwater "levels,: the estimated total amount (mass in kg/yr) of each of these contaminants that are being discharged (loaded) into the surface water body (at the time of the determination), and identify if there is evidence that the amount of discharging contaminants is increasing.

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

Rationale and Reference(s)

None of the results from the collected surface water samples exceeded the appropriate Ambient Water Quality Criteria. Therefore, the discharge of contaminated groundwater along the site boundary at the Kanawha River does not cause an exceedance of the standard (AWQC); therefore, is considered to be insignificant. The following table is provided to show the relationship between the concentrations of the various constituents of concern detected in the collected groundwater samples and those constituent concentrations resulting from the surface water samples collected from the Kanawha River. For reference, the appropriate screening criteria, AWQC is also included in the table for comparison.

Table 2

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

SURFACE WATER RESULTS VS. AWQC

Chemical Constituent	Surface Water Maximum Detected (ug/l)	AWQC (ug/l)
1,1-Dichloroethene	N/A	3.2
Carbon tetrachloride	1.2	4.4
Vinyl chloride	1.1	525
Trichloroethene	3.5	81
Tetrachloroethene	N/A	8.85
PAH	N/A	0.031
Halomethanes	N/A	15.7
Phthalate esters	N/A	3.0

N/A *These compounds were not analyzed for in the laboratory analyte listing approved as presented in the sampling and analysis work plan document.*

6. Can the **discharge** of "contaminated" groundwater into surface water be shown to be "**currently acceptable**" (i.e., not cause impacts to surface water, sediments or eco-systems that should not be allowed to continue until a final remedy decision can be made and implemented[4])?

   _X_ If yes – continue after either: 1) identifying the Final Remedy decision incorporating these conditions or other site-specific criteria (developed for the protection of the site's surface water, sediments, and eco-systems), and referencing supporting documentation demonstrating that these criteria are not exceeded by the discharging groundwater; OR 2) providing or referencing an interim-assessment,[5] appropriate to the potential for impact, that shows the discharge of groundwater contaminants into the surface water is (in the opinion of a trained specialists, including ecologist) adequately protective of receiving surface water, sediments, and eco-systems, until such time when a full assessment and final remedy decision can be made. Factors which should be considered in the interim-assessment (where appropriate to help identify the impact associated with discharging groundwater) include: surface water body size, flow, use/classification/habitats and contaminant loading limits, other sources of surface water/sediment contamination, surface water and sediment sample results and comparisons to available and appropriate surface water and sediment "levels," as well as only other factors, such as effects on ecological receptor (e.g., via bio-assays/benthic surveys or site-specific ecological Risk Assessments), that the overseeing regulatory agency would deem appropriate for making the EI determination.

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

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

Rationale and Reference(s)

The results of the surface water screening to the AWQC values (Table 2) shows that the discharge of groundwater into the surface water is adequately protective of receiving surface water because surface water sampling indicates that AWQC are not exceeded. The current designation for the Kanawha River prevents its use as a potable drinking water resource and the current fish consumption advisory discourages the consumption of bottom feeding fish.

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

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

In October 2003 Flexsys ceased operations at the Facility and began to dismantle all of its operational facilities. While Solutia continued to operate at the Facility, in 2004, EPA, WVDEP and Solutia conducted an extensive review of the Facility operational history and the historical environmental data. EPA concluded that an additional Facility environmental characterization would be required for groundwater, Facility soils and some SWMUs to address some remaining data gaps. In addition, EPA determined that groundwater flow within the Facility may be a transport mechanism for dioxin to offsite receptors (*i.e.*, the Kanawha River), and that additional information is needed to determine whether groundwater within the Facility was transporting dioxin to other offsite receptors.

Detailed work plans were developed and approved by the Agencies for an Expanded RCRA Facility Investigation (ERFI) for groundwater and an ERFI for soils in November 2004 and May 2006, respectively. Results from the ERFI investigations were documented in a February 2007 ERFI Report. Major groundwater conclusions from these investigations are detailed in the ERFI Report and summarized as follows:

- Dioxin is migrating from the Former 2,4,5-T Manufacturing Area, the PDA, and the Closed Wastewater Impoundments via the groundwater and/or surface water pathways and discharging to the Kanawha River. Although TCDD flux is less than 15% of the safe loading level (16.5 ug/l), migration from these source areas should be controlled because the WV Ambient Water Quality Criteria (WVAWQC) for 2,3,7,8 TCDD in the Kanawha River is .014 pg/l, a very low number established to protect human health.

- Tetrachloroethene (PCE) or its breakdown products, trichloroethylene (TCE); dichloroethene (DCE); and vinyl chloride (VC), are migrating from the Former Rubber Chemicals Manufacturing Area via the groundwater pathway and discharging to the Kanawha River. Even though TCE concentrations in the Kanawha River downgradient of the former process area are below the 81 ug/l WVAWQC, migration from this source area should be controlled to ensure that this criterion will continue to be achieved. Additional VOCs/SVOCs that exceeded their respective MCLs or Screening Levels were identified in on-site groundwater.

Because the presence of dioxin in Facility groundwater is at levels which render it impracticable to treat and discharge, soil-bentonite slurry walls were installed in order to isolate and contain groundwater source areas. Installation began in 2011 and was completed in 2016. Over 8000 linear feet (LF) of 3-foot thick soil-bentonite slurry walls were installed surrounding four areas totaling approximately 22 acres of the 118-acre Facility. The areas contained included parts of the PA, virtually all of the PDA (LNAPL migration control), and two areas in the WTA. The bottom of the soil-bentonite slurry walls were keyed into the bedrock, which is present at an average depth of approximately 60 feet below grade throughout the Facility. The installed slurry walls met the required permeability specification of $<1x10^{-7}$cm/sec.

Groundwater from inside of the four soil-bentonite slurry wall containment areas will be extracted to maintain inward gradient across the barrier walls via extraction wells. The extracted groundwater will be collected, treated and the discharged to surface water via an NPDES permitted outlet. Pumping and treatment of groundwater from within the groundwater containment areas will be continued until such time that Solutia can demonstrate that the concentrations of constituents in the groundwater outside of the groundwater containment areas

are below MCLs, or RSLs for tap water, as applicable, or until the Facility can demonstrate that pumping and treatment of groundwater for gradient control is not needed to achieve groundwater cleanup objectives.

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

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

   _____ If no – enter "NO" status code in #8.

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

Rationale and Reference(s)

The following is a list of the major elements of the proposed remedy for Source Area Containment and Treatment:

1. Groundwater source areas will be contained by barrier walls and impermeable caps.
   a. Contaminated groundwater source areas to be pumped at sufficient rates to maintain inward hydraulic gradients across the barrier walls.
   b. The extracted water to be treated prior to discharge to surface water via NPDES permitted outfall.
   c. An area-wide groundwater flow model to be developed to support the specific Site groundwater source area containment design and monitoring plan.

2. Facility soils to receive engineered covers to prevent contact with underlying contaminated soil. In addition, the Facility's riverbank along the Kanawha River will be stabilized and covered with riprap to mitigate potential COC exposure pathways and to prevent the potential transport of COCs off-site.

3. Periodic monitoring of groundwater and surface water will be conducted in accordance with an EPA- approved Monitoring Plan. EPA anticipates that the source control measures (containment-in place) provides the bulk of the controls for management of contaminants in the groundwater. The remaining contamination in groundwater outside of the containment areas will naturally attenuate, and will ultimately achieve groundwater cleanup levels (drinking water standards) without further treatment.

The Facility is required to maintain a groundwater monitoring program to demonstrate that the inward gradient across the barrier walls is
maintained as applicable and that the groundwater contamination outside of the containment area is being reduced through natural attenuation. EPA anticipates that, once the sources are contained the remaining contamination in groundwater outside the barrier walls will naturally attenuate, and will ultimately achieve our groundwater cleanup levels (below MCLs or WVDEP acceptable limits) without further treatment. Therefore, the proposed remedy for groundwater outside the barrier walls consists of monitored natural attenuation with continued monitoring

until groundwater cleanup levels are met, and compliance with and maintenance of groundwater use restrictions, to be implemented though institutional controls.

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

__X__ YE – Yes, "Migration of Contaminated Groundwater Under Control" has been verified. Based on a review of the information contained in this EI determination, it has been determined that the "Migration of Contaminated Groundwater." This determination will be re-evaluated when the Agency becomes aware of significant changes at the facility.

____ NO – Unacceptable migration of contaminated groundwater is observed or expected.

____ IN – More information is needed to make a determination.

Completed by (signature) William C Wentworth Date 9/29/16

(print) William C Wentworth

(title) Remedial Project Manager

Supervisor (signature) _____ Date 9/29/16

(print) Luis Pizarro

(title) _____

(EPA Region/State) Region III/West Virginia

Locations Where References May Be Found

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