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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: International Woolen Co. Inc.
Facility Address: 100 Dale St. Sanford, ME 04073
Facility EPA ID #: MED057977092

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

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

 _____ If no - re-evaluate existing data, or

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

BACKGROUND

Definition of Environmental Indicators (for the RCRA Corrective Action)

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

Definition of "Migration of Contaminated Groundwater Under Control" EI

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

Relationship of EI to Final Remedies

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

Duration / Applicability of EI Determinations

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

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

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

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

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

Rationale and Reference(s):
Ref., Campbell Environmental Group Inc (CEG)., March 2002, Preliminary closure report, International Woolen Company, 100 Dale Street, Sanford, ME. See Tables 23 through 27B, and Figure 16 for groundwater contaminant concentrations above MEGs (**VOCs:** TCE, PCE, 1,1 DCA, 1,1,1 TCA, MTBE, benzene, vinyl chloride; **SVOCs:** naphthalene, 3+4 methylphenol; **METALS**: antimony, arsenic, cadmium, chromium, lead, nickel, thallium). See Table 1 for detailed data.

Table 1 Groundwater Contaminants Exceeding MEGs

Analyte	MEG	Concentration	Location	Date
METALS	**(ppm)**	**(ppm)**		
antimony	0.003	0.003J	CEG7	11/14/01
arsenic	0.01	0.015	CEG9	11/20/01
cadmium	0.0035	0.005	CEG2	11/12/01
chromium	0.04	0.041	CEG1	11/12/01
lead	0.01	0.017	CEG11	01/10/02
nickel	0.14	0.25	CEG13	01/11/02
thallium	0.0005	0.004J	CEG21	01/11/02
VOCs	**(ppb)**	**(ppb)**		
trichloroethene (TCE)	32	3930	CEG7	11/14/01
		3140	CEG11	01/10/02
		523	CEG12	01/11/02
		360	CEG16	01/14/02
		338	CEG19	01/10/02
tetrachloroethene (PCE)	7	255	CEG7	11/14/01
		311	CEG11	01/10/02
1,1-dichloroethane (DCA)	1	63	CEG11	01/10/02
1,1,1-trichloroethane (TCA)	200	562	CEG17	01/10/02
MTBE	35	45	CEG9	11/20/01
		45	CEG11	01/10/02
benzene	5	9	CEG11	01/10/02
vinyl chloride	0.2	36	CEG11	01/10/02
		79	CEG14	01/11/02
SVOCs	**(ppb)**	**(ppb)**		
naphthalene	14	48	CEG20	01/10/02
3+4 methylphenol	3.5	3J	CEG20	01/10/02

Footnotes:

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

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

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

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

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

Rationale and Reference(s):

Ref: Campbell Environmental Group Inc (CEG)., March 2002, Preliminary closure report, International Woolen Company, 100 Dale Street, Sanford, ME., See page 43, Figure 13 (geologic cross section), Figure 14 (groundwater contours), Figure 15 (contaminant concentrations above MEGs).

Available data suggest that contaminated groundwater is horizontally bounded by the limits of the former Batley Pond, and the Mousam River in the eastern portion of the site, and vertically by underlying bedrock. Batley Pond was reportedly filled with available fill, possibly including construction debris. Groundwater in this area is subjected to a relatively low hydraulic gradient (approximately 0.008) that lessens eastward from a steeper gradient located under Building 103. Thus contaminated groundwater appears to be localized in the original Bately Pond depression ("existing area of groundwater contamination"), discharging to the Mousam River. Since the hydraulic gradient near the river is so small (approximately 0, or "flat"), it may be possible that the Mousam River recharges (and dilutes) the contaminated groundwater aquifer, especially during floods.

Footnotes:

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

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

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

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

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

Rationale and Reference(s):

Ref: Ref: Campbell Environmental Group Inc (CEG)., March 2002, Preliminary closure report, International Woolen Company, 100 Dale Street, Sanford, ME.

Contaminated groundwater discharges into the Mousam River.

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)?

_____ If yes - skip to #7 (and enter "YE" status code in #8 if #7 = yes), after documenting: 1) the maximum known or reasonably suspected concentration[3] of key contaminants discharged above their groundwater "level," the value of the appropriate "level(s)," and if there is evidence that the concentrations are increasing; and 2) provide a statement of professional judgement/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.

__X__ If no - (the discharge of "contaminated" groundwater into surface water is potentially significant) - continue after documenting: 1) the maximum known or reasonably suspected concentration[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):

Ref., Campbell Environmental Group Inc (CEG)., March 2002, Preliminary closure report, International Woolen Company, 100 Dale Street, Sanford, ME. See Tables 23 through 27B, and Figure 16 for groundwater contaminant concentrations above MEGs.

Data in Table 1 below reflect results from one groundwater sampling round in 2001-2002 for contaminants that exceed ten times MEGs. No subsequent sampling has been performed, and thus it cannot be determined whether concentrations are increasing or decreasing.

Table 2 Groundwater Contaminant Concentrations Exceeding 10xMEG

Contaminant	MEG (ppb)	Highest Concentration (ppb)	Location	Date
trichloroethylene (TCE)	32	3930	CEG7	11/14/01
tetrachloroethene (PCE)	7	311	CEG11	01/10/02
1,1-dichloroethane	1	63	CEG17	01/10/02
vinyl chloride	0.20	79	CEG14	01/11/02

Ref., Campbell Environmental Group In (CEG)., Figure 1, PVD Sample Results, November 13, 2003 (a preliminary figure that does not appear to be part of a formal report)

In 2003, a limited study of pore water contamination was performed on Mousam River bottom sediments, and from bank sediment within approximately 50 ft. of the river. Detected contaminants, and their levels (ng/sample) are shown in Table 3.

Table 3 Pore Water Detections (ng/sample)*

Contaminant	VT1	VT2	VT3	VT4	VT5	VT6	VT7	VT8	VT9
cis-1,2-DCE **		150		NR	31	NR		52	
PCE		540		NR		NR			
1,1,1-TCA				NR		NR		36	
TCE				NR	8J	NR		180	9J
toluene	330	190		NR	160	NR		110	110

DCE - dichloroethene
PCE – tetrachloroethene
blank – below detection limits
* not quantifiable
** not tested in groundwater sampling

TCA – tetrachloroethane
TCE - trichloroethene
NR – no results
J - less than reporting limit, above detection level

The nature of the pore water sampling did not allow calculation of quantitative values. One contaminant in Table 3 was not included in the groundwater sampling program (cis-1,2,DCE). Three contaminants detected in pore water were also found at high levels in groundwater samples (PCE, TCE, 1,1,1-TCA). One pore water contaminant was not detected in groundwater samples (toluene). It is important to also note that the hydraulic gradient toward the river in the filled area (location for groundwater samples) is very low, possibly near or at zero. During high discharges, the river may flow into the filled area, locally reversing the hydraulic gradient direction. Also, the river has a history of contamination from a variety of sources.

In view of these site conditions, the pore water results can indicate one or a combination of the following: 1) some contaminants from the International Woolen site may be entering the river (e.g. PCE, TCE, 1,1,1-TCA), 2) undetected contaminant source(s) may exist on site (e.g. toluene, cis-1,2-DCE), 3) some pore water contaminants may be breakdown products from contaminants on the site (e.g. PCE to TCE), 4) contaminants may be introduced from the river onto the sites (e.g. toluene, cis-1,2-DCE).

Two contaminants (TCE and vinyl chloride) were detected at more than 100 times the MEG standard (TCE=3,930 ppb, MEG_{TCE}=32 ppb: VC=79ppb, MEG_{VC}=0.20ppb). The TCE load to the Mousam river was calculated to range between 0.2 g/yr and 20 g/yr. The vinyl chloride load to the Mousam was calculated to range between 0.00473g/yr and 0.473g/yr. These ranges were calculated using assumed hydraulic conductivities of 10^{-3} cm/sec and 10^{-5} cm/sec, which are typical for glacial outwash sand and gravel fill reported in CEG well logs (Appendix 6). Load calculations are attached on a separate sheet.

Since only one round of groundwater sampling was performed, it cannot be conclusively determined whether any contaminant concentrations are increasing or decreasing. However, the very low levels of contaminants detected in pore water, that were extracted a year later, and over an extended time period, suggest that levels lower than those in the contaminated groundwater are entering the river (*i.e.* concentrations possibly decreasing). Also, the fact that six contaminants found in groundwater (1,1,-dichloroethane, MTBE, benzene, vinyl chloride, naphthalene, 3+4 methylphenol) were not detected in pore water introduces the possibility that some contaminant attenuation has occurred.

Footnotes:

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

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 any other factors, such as effects on ecological receptors (e.g., via bio-assays/benthic surveys or site-specific ecological Risk Assessments), that the overseeing regulatory agency would deem appropriate for making the EI determination.

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

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

Rationale and Reference(s): The Final Remedy decision is to impose a deed restriction concerning groundwater usage. Public water is available at the site. In addition to the loading calculations described in 5 above, dilution calculations were performed using Mousam river discharge (30 cfs or 0.849 $m^{3/s}$/sec) supplied by the Maine DEP, Bureau of Land and water. A range of dilution (Table 4) was calculated using the same hydraulic conductivity assumptions described in 5 above. River-diluted TCE and vinyl chloride concentrations shown in Table 4 are considerably less that MEG and NRWQC standards. Calculations are attached on a separate sheet.

Table 4 TCE and Vinyl Chloride Dilllution by Mousam River

Contaminant	MEG (ppb)	NRWQC* Human Health Water & Org. (ppb)	NRWQC* Human Health Org. Only (ppb)	Max. Concent (ppb)	Diluted Concentration Range (ppb)
TCE	32	2.5	30	3930	0.0088 to 0.87
vinyl chloride	0.20	0.025	2.4	79	0.000176 to 0.0176

* NRWQC – National Recommended Water Quality Criteria

Footnotes:

[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, sediments or eco-systems.

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): Maine DEP plans to monitor Mousam River water quality upstream and downstream from the site, two times per year (high flow and low flow), for three years, starting in 2007. Minimally, analytes will include those that exceeded MEGs. Data acquired to date indicate 1) the groundwater is contained by local hydrogeology and 2) the Mousam River. A deed restriction on groundwater use is presently being negotiated.

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" is "Under Control" at the International Woolen Company Inc. facility, EPA ID # MED057977092, located at 100 Dale St., Sanford, Maine, 04073. Specifically, this determination indicates that the migration of "contaminated" groundwater is under control, and that monitoring will be conducted to confirm that contaminated groundwater remains within the "existing area of contaminated groundwater" This determination will be re-evaluated when the Agency becomes aware of significant changes at the facility.

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

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

Completed by (signature) [signature] Date 9/28/06
(print) Harold D. Nilsson
(title) Environmental Specialist III

Supervisor (signature) Stacy A. Ladner Date 9/28/06
(print) Stacy A. Ladner
(title) ES III, Unit Manager
(EPA Region or State) State of Maine

Locations where References may be found:

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File Room, Ray Building
28 Tyson Dr.
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CALCULATIONS
IWC Contaminant Discharge to Mousam R.

1. Cross sectional area (along 80 ft GW contour)
Width = 640 ft = 195 m
Sat. Thickness = 8 ft = 2.44 m

Area = A = 195 × 2.44 = 476 m^2

Ref: CEG Draft Fig 2, GW Contours, 9/22/03

2. Gradient 80 ft contour → 77' near river

$i = \frac{3 ft}{250 ft} = 0.012$ Ref: see above

3. Hydraulic Conductivity
Silty Sand → glacial outwash
$K = 10^{-5}$ to 10^{-3} cm/sec
K_1 K_2
Ref Fetter 2nd ed, p. 80

4. Average Linear Velocity

$v = \frac{Ki}{n_e}$ n_e = effective porosity
n_e assumed = 0.3

$V_1 = \frac{10^{-5} \times 0.012}{0.3} = 4 \times 10^{-7}$ cm/sec $= 4 \times 10^{-9}$ m/sec

$V_2 = \frac{10^{-3} \times 0.012}{0.3} = 4 \times 10^{-5}$ cm/sec $= 4 \times 10^{-7}$ m/sec

5. Discharge (Q) to River

$Q = vA$

$Q_1 = 4 \times 10^{-9}$ m/sec $\times$ 476 m² $= 1.9 \times 10^{-6}$ m³/sec
$= 59.92$ m³/yr

$Q_2 = 4 \times 10^{-7}$ m/sec $\times$ 476 m² $= 1.9 \times 10^{-4}$ m³/sec
$= 5{,}992$ m³/yr

6. TCE Load to River

TCE max concent. $= 3930$ ppb $= \frac{3930 \text{ kg}}{1 \times 10^9 \text{ kg}} = 3.93 \times 10^{-6} \frac{\text{kg}}{\text{m}^3}$

$Q_{TCE1} = 59.92 \text{ m}^3/\text{yr} \times 3.93 \times 10^{-6} \frac{\text{kg}}{\text{m}^3} = 0.0002$ kg/yr
$= 0.2$ g/yr

$Q_{TCE2} = 5992 \text{ m}^3/\text{yr} \times 3.93 \times 10^{-6} \frac{\text{kg}}{\text{m}^3} = 0.02$ kg/yr
$= 20$ g/yr

Estimated TCE load range = 0.2 g/yr to 20 g/yr

7. Vinyl Chloride Load to River

Vinyl Chlorid max concent = 79 ppb $= 79 \times 10^{-9}$ kg/m³

$Q_{VC1} = 59.92 \text{ m}^3/\text{yr} \times 79 \times 10^{-9} \text{ kg/m}^3 = 4.73 \times 10^{-6}$ kg/yr
$= 4.73 \times 10^{-3}$ g/yr

7. (continued)

$$Q_{VC2} = 5992\ m^3/yr \times 79 \times 10^{-9}\ kg/m^3 = 4.73 \times 10^{-4}\ kg/yr$$
$$= 0.473\ g/yr$$

Estimated Vinyl Chlorid Load to River =

0.00473 g/yr to 0.473 g/yr

8. DILUTION

$$\text{Dilution Factor} = DF = \frac{Q_R + Q_{gw}}{Q_{gw}}$$

Q_R = river discharge = 30 cfs = 0.849 m^3/sec
Ref. Greg Wood, BLW

Q_{gw} = groundwater discharge =
$1.9 \times 10^{-6}\ m^3/sec$ to $1.9 \times 10^{-4}\ m^3/sec$

(See 5 above)

$$DF_1 = \frac{Q_1 + Q_{gw}}{Q_{gw}} = \frac{0.849 + 1.9 \times 10^{-6}}{1.9 \times 10^{-6}} = 446{,}842$$

$$DF_2 = \frac{Q_2 + Q_{gw}}{Q_{gw}} = \frac{0.849 + 1.9 \times 10^{-4}}{1.9 \times 10^{-4}} = 4{,}468$$

TCE Dilution = $\frac{3930\text{ ppb}}{446842}$ to $\frac{3930\text{ ppb}}{4,468}$ =

0.0088 ppb to 0.87 ppb

Vinyl Chloride Dilution =

$\frac{79\text{ ppb}}{446842}$ to $\frac{79\text{ ppb}}{4468}$ = 0.000176 ppb to 0.0176 ppb