UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
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ATLANTA, GEORGIA 30303-8960

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Ref: 4WD-SRB

Via Delivery as Email-attachment to (Prashant.gupta@honeywell.com) and Certified Mail

Mr. Prashant K. Gupta
Honeywell, Inc.
4101 Bermuda Hundred Road
Chester, Virginia 23836

Re: Human Health Risk Assessment for the Estuary, Operable Unit One (OU 1):
LCP Chemicals Superfund Site, Brunswick, Glynn County, Georgia

Dear Mr. Gupta:

The purpose of this letter is to notify Honeywell International, Inc. (Honeywell) that the U.S. Environmental Protection Agency is approving its August 2011 draft of the Human Health Risk Assessment for the Estuary, Operable Unit One (OU 1), of the LCP Chemicals Site Superfund (Site). In addition, the EPA is now directing Honeywell to submit the draft remedial investigation report, described in detail in the Scope of Work (SOW) incorporated into the Administrative Order by Consent for Remedial Investigation/Feasibility Study, EPA Docket No. 95-17-C (AOC). Acknowledging Honeywell's November 3, 2011 proposal for the development of the feasibility study, the following are remedial goal option (RGO) ranges EPA has developed. In the meantime, EPA is discussing internally the process outlined by Honeywell.

In developing and screening the remedial action alternatives, Honeywell is directed to use the RGO ranges set out below, which have been selected as explained in detail in the enclosed paper. These RGO ranges for mercury, Aroclor 1268, lead and total polynuclear aromatic hydrocarbons (PAHs) integrate the RGOs developed in the April 2011 Baseline Ecological Risk Assessment for the LCP Estuary and the conclusions of the now-approved August 2011 Human Health Risk Assessment for the LCP Estuary. This integration is necessary in order to identify and evaluate potential cleanup alternatives which are protective of both human health and the environment. Based on information provided in the two tables in the enclosed paper, the EPA and the Georgia Environmental Protection Division have selected the following sediment RGOs for the LCP Estuary (OU 1) Feasibility Study:

- Aroclor 1268 - 2, 4 and 6 milligram per kilogram (mg/kg);
- Mercury - 1, 2, and 4 mg/kg;
- Lead- 40, 60 and 90 mg/kg; and
- Total PAHs- 1.5, 2.5 and 4.0 mg/kg

In addition to using the RGOs listed above, Honeywell may also utilize other RGO ranges for each of these hazardous substances, as long as it provides the justification for using such ranges in its development and screening of remedial action alternatives.

The EPA's instructions for evaluating the RGOs for protection of both human health and ecological receptors are contained at the end of the enclosed paper.

Please submit the draft remedial investigation report for OU1 to the EPA for review and approval within 15 calendar days of receipt of this letter.

If you have any questions regarding the approval of the Human Health Risk Assessment for OU1 of the LCP Chemicals Site or the instructions for next steps in this letter, please contact me at (404) 562-8937.

Sincerely,

Galo Jackson, P.G.
Remedial Project Manager
Superfund Remedial Branch

Enclosures

cc: J. McNamara, EPD

LCP Estuary Sediment Remedial Goal Options

The purpose of this paper is to determine the appropriate ranges of sediment remedial goal options (RGOs) to choose in order to adequately protect both human and ecological receptors. At this Site, human health is at risk due to consumption of contaminated fish from the LCP Estuary. Ecological receptors are also at risk. The selected RGO ranges can then be used in the Feasibility Study (FS) to evaluate cleanup alternatives.

Sediment RGOs for Protection of Human Health

The human health risk assessment (HHRA) for OU1 identified non-cancer hazards and cancer risks from consumption of clapper rail, shellfish (blue crabs and white shrimp) and a variety of finfish taken from the LCP Estuary. The development of RGOs for the LCP Estuary is based on the premise that the source of contamination in the Estuary is the contaminated sediments, regardless of how the fish, shellfish or clapper rail acquired the chemical through the local food web. This means that the tissue concentrations measured in the consumed food items are ultimately related to the levels of contamination in the sediment sources.

For finfish, blue crab and white shrimp, the average area-weighted Estuary creek sediment concentrations were used to represent the exposure source. These sediments represent permanently inundated habitat areas for fish, shrimp, and blue crabs. Marsh sediments were not included because they are tidally influenced and subject to periodic wet-dry cycles. Based on numerous sediment samples collected in the LCP Estuary, the calculated area-weighted average Aroclor 1268 sediment concentration is 7.44 mg/kg. The area-weighted mercury concentration is calculated to be 2.74 mg/kg. Attachment A shows how the averages were calculated.

For the clapper rail exposed to tidal marsh sediment instead of creek sediment, the average marsh sediment concentrations were used to represent the exposure source. The average marsh sediment concentrations of Aroclor 1268 and mercury were calculated to be 3.41 mg/kg and 2.17 mg/kg, respectively (derived from Table 1 in the HHRA).

The LCP sediment concentrations were compared to the tissue concentrations at the levels that resulted in a non-cancer hazard index (HI) of ≥ 1 or in cancer risk of $\geq 10^{-6}$. This relationship was then used to predict sediment and/or tissue concentrations that would result a HI=1.0 or cancer risk $=10^{-4}$. The HHRA sediment RGO calculations are presented in Attachment A. The following table summarizes the sediment RGOs based on the various reasonable maximum exposure (RME) consumption scenarios.

Sediment RGOs for Human Health *			
RME Consumption Scenario	Adult	Child	Cancer
Arsenic			
Clapper rail	2.4	0.9-2.7[1]	2.3
Shellfish	8.5	3.6-10.8[1]	8.7
Finfish – Recreational	4.4	2.9-8.7[1]	4.6
Finfish – High Consumption	2.5	1.5-4.5[1]	2.7
Mercury			
Clapper rail	10.8	3.1	NA
Shellfish	3.9	1.7	NA
Finfish – Recreational	2.7	1.4	NA
Finfish – High Consumption	1.4	0.9	NA
* - All concentrations in mg/kg			

Sediment RGOs for Protection of Ecological Receptors

The Baseline Ecological Risk Assessment (BERA) developed a range of sediment RGOs that would be protective for various receptors, as summarized in the following table. This range is based on the no-observed-adverse-effect-level (NOAEL) and lowest-observed-adverse-effect-level (LOAEL).

Sediment RGOs for Ecological Receptors *	
Arsenic	
Mammals	5 – 10
Finfish	3 – 6
Benthic Invertebrates	3 – 13
Mercury	
Birds	1 – 3
Mammals	2 – 4
Finfish	1 – 3
Benthic Invertebrates	1.4 – 3.2
Lead	
Benthic Invertebrates	41 – 60[2]
Tributyltin	
Benthic Invertebrates	0.8 – 1.5
* - All concentrations in mg/kg	

[1] The ranges shown represent a HI range of 1 to 3.

[2] The grass shrimp sediment effect concentration (SEC) for lead was not used because a very low number of effect data were used to calculate it.

Selection of RGO Range for the Feasibility Study

An integration of the human health and ecological sediment RGOs is needed to address potential cleanup alternatives protective of human health and the environment. Based on the above two tables, the following sediment RGOs have been selected for the FS:

- Aroclor 1268 - 2, 4, and 6 mg/kg;
- Mercury - 1, 2 and 4 mg/kg;
- Lead- 40, 60 and 90 mg/kg; and
- Total PAHs- 1.5, 2.5 and 4.0 mg/kg

Methods for Evaluating RGOs for Ecological Receptors and Human Health

The following table summarizes the method that should be used for the evaluation of the RGOs.

	Methods for Evaluating RGOs for Ecological Receptors and Human Health		
Contaminant	Concentrations, mg/kg		
Aroclor 1268	2	4	6
Method of Evaluation	Area Average	Area Average	NTE[3]
Mercury	1	2	4
Method of Evaluation	Area Average	NTE	NTE
Lead	40	60	90
Method of Evaluation	NTE	NTE	NTE
PAHs	1.5	2.5	4.0
Method of Evaluation	NTE	NTE	NTE

To protect ecological receptors and human health, the feasibility study should evaluate the average concentrations of the above sediment contaminants. Those contaminant concentration RGOs designated as "NTE" are based on the sediment toxicity to benthic organisms. RGOs designated as "NTE" should be evaluated as the average measured or estimated concentrations within grids of creeks and marsh measuring 50 by 50 meters. Those contaminant concentrations

[3] Not to Exceed

designated as "Area Average" are based on risks to human health from consumption of waterfowl in the case of the 3.0 mg/kg of Aroclor 1268 or risk to humans and ecological receptors that consume fish in the case of the 3.0 mg/kg for Aroclor 1268 and the 1.0 mg/kg for mercury. Since the clapper rail is exposed to contamination in the marsh, the RGO of 3.0 mg/kg for Aroclor 1268 should be based on the area average of concentrations in the creeks and marsh. The contaminant concentration RGOs of 3.0 for Aroclor and 1.0 for mercury are based on consumption of fish. They should be evaluated as the average of the concentrations in all four creeks (Main Canal, Eastern Creek, Western Creek Complex, and Purvis Creek) combined.

Attachment A

Calculation of Human Health Sediment RGOs

If assume that the source of all mercury and A-1268 in finfish is from the LCP estuary creek sediment (regardless of how the fish acquired the chemical through the food web), then fish body burden is ultimately related to the sediment source.
For finfish, blue crab and white shrimp the average area-weighted estuary stream sediment concentrations are used to represent the exposure source.

Area	*% Total Area*	*Avg A-1268 Sed. Conc.*	*Sed. Aroclor-1268 Contribution*	*Average Hg Sed.Conc.*	*Sed. Mercury Contribution*
Main Canal	2	27.64	0.553	7.4	0.148
Eastern Creek	7	49.57	3.470	20.28	1.420
Western Creek Complex	4	3.18	0.127	2.75	0.110
Purvis Creek	87	3.78	3.289	1.22	1.061
Area Weighted Creeks Sediment Concentration			**7.44** mg/kg dw		**2.74** mg/kg dw

However, for Clapper rail exposure, the average marsh sediment concentrations are used and derived from Table 1 in the HHRA.

	Aroclor-1268	*Mercury*
Average Marsh Sediment Concentration	**3.408** mg/kg dw	**2.167** mg/kg dw

Four human health exposure scenarios resulted in RME and/or CTE risks and hazards.
Given the above assumptions, the risk or hazard index for each COC is related to the sediment source via the fish consumption pathway.
Therefore, the sediment remedial goal is the average sediment concentration divided by the hazard index of each COC.
To calculate the sediment RGO for cancer risk, the following relationship is used: (EPC/sediment concentration) = target tissue concentration / X

The following RGOs are based on the RME hazards and risks.

Clapper rail (data from Table 19).	*Aroclor 1268 HI*	***RGO Marsh Sed.***	mg/kg	*Mercury HI*	***Hg RGO Marsh Sed.***
Adult consumption	1.4	**2.4**		0.2	**10.8**
Child consumption	4.0	**0.9**		0.7	**3.1**
Cancer Risk	10-4	**2.3**			

Target tissue at 10-4 Risk: 19.42/1.5E-04 = x/1.0E-04 = 12.95
Sed RGO: 19.42/3.408 = 12.95/x = 2.3

		A-1268 HI	***RGO Creek Sed.***	*Mercury HI*	***Hg RGO Creek Sed.***
Shellfish (data from Table 16).					
	Adult consumption	0.88	**8.5**	0.7	**3.9**
	Child consumption	2.08	**3.6**	1.6	**1.7**
	Cancer Risk	10-4	**8.7**		
	Combined EPCs of crab and shrimp: (0.195*0.50)+(0.533*0.50) = 0.364				
	Combined target tissue at 10-4 Risk: 0.364/8.5E-05 = x/1.0E-04 = 0.428				
	Sed RGO: 0.364/7.44 = 0.428/x = 8.7				
Finfish - recreationally caught (data from Tables 12a and 12c).					
	Adult consumption	1.7	**4.4**	1.0	**2.7**
	Child consumption	2.6	**2.9**	2.0	**1.4**
	Cancer Risk	10-4	**4.6**		
	Combined EPCs for all finfish: see below = 0.525				
	Combined target tissue at 10-4 Risk: 0.525/1.6E-04 = x/1.0E-04 = 0.328				
	Sed RGO: 0.525/7.44 = 0.328/x = 4.6				
Finfish - high quantity consumers (data from Tables 14a and 14c).					
	Adult consumption	3.0	**2.5**	2.0	**1.4**
	Child consumption	5.0	**1.5**	3.0	**0.9**
	Cancer Risk	10-4	**2.7**		
	Combined EPCs for all finfish: see below = 0.525				
	Combined target tissue at 10-4 Risk: 0.525/2.8E-04 = x/1.0E-04 = 0.188				
	Sed RGO: 0.525/7.44 = 0.188/x = 2.7				

Finfish	*A-1268 EPC*	*FI*	*adjusted EPC*
Atlantic Croaker	1.427	0.011	0.016
Black Drum	0.343	0.039	0.013
Red Drum	0.148	0.207	0.031
Sheepshead	0.724	0.099	0.072
Southern Flounder	0.249	0.044	0.011
Southern Kingfish	0.716	0.197	0.141
Spot	1.785	0.0004	0.001
Spotted Seatrout	0.556	0.394	0.219
Striped Mullet	2.704	0.008	0.022
∑ EPC			**0.525**

This ∑EPC results in recreational risk of 1.6E-04 and high quantity consumer risk of 2.8E-04.

Another way to calculate the sediment RGOs (via the fish consumption pathway) is to use the area-weighted sediment concentration and the fish EPC to calculate the fish bioaccumulation factor (BAF). Then use the BAF for each fish and the target tissue concentration (that is normalized to the chemical HI) to calculate the sediment RGO.

BAF = EPC/sediment conc.

An example using the recreational fish consumer scenarios for adult and child:

	EPC		*EPC*		Adult recreational consumers *Target Tissue Conc.*		Child recreational consumers *Target Tissue Conc.*	
Finfish	*A-1268*	*A-1268 BAF*	*Mercury*	*Hg BAF*	*A-1268 (HI=1.7)*	*Mercury (HI=1)*	*A-1268 (HI=1.7)*	*Mercury (HI=1)*
Atlantic Croaker	1.427	**0.192**	0.302	**0.110**	0.839	0.302	0.5488	0.151
Black Drum	0.343	**0.046**	0.177	**0.065**	0.202	0.177	0.1319	0.089
Red Drum	0.148	**0.020**	0.343	**0.125**	0.087	0.343	0.0569	0.172
Sheepshead	0.724	**0.097**	0.372	**0.136**	0.426	0.372	0.2785	0.186
Southern Flounder	0.249	**0.033**	0.257	**0.094**	0.146	0.257	0.0958	0.129
Southern Kingfish	0.716	**0.096**	0.663	**0.242**	0.421	0.663	0.2754	0.332
Spot	1.785	**0.240**	0.124	**0.045**	1.050	0.124	0.6865	0.062
Spotted Seatrout	0.556	**0.075**	0.495	**0.181**	0.327	0.495	0.2138	0.248
Striped Mullet	2.704	**0.364**	0.042	**0.015**	1.591	0.042	1.0400	0.021
					1.7	**1.0**	**2.6**	**2.0**
					Sediment RGOs (these match RGOs calculated above)			
					4.4	2.7	2.9	1.4
					4.4	2.7	2.9	1.4
					4.4	2.7	2.9	1.4
					4.4	2.7	2.9	1.4
					4.4	2.7	2.9	1.4
					4.4	2.7	2.9	1.4
					4.4	2.7	2.9	1.4
					4.4	2.7	2.9	1.4
					4.4	2.7	2.9	1.4

To check the BAF, we notice that the striped mullet has the highest BAF for Aroclor 1268 and indeed has the highest target tissue concentration.