PART 4
SUMMARY OF RI ADDENDUM, ERA, AND HHRA CONCLUSIONS

Operable Unit 2, McIntosh, Alabama

Prepared for:

OLIN CORPORATION

Prepared by:

AMEC E&I, INC.
3200 Town Point Drive NW, Suite 100
Kennesaw, Georgia 30144

April 15, 2011
Revised November 14, 2011
Project 6107-11-0036

EPA Preface

The following document, entitled Part 4: Summary of RI Addendum, ERA and HHRA Conclusions (Revised November 14, 2011) was prepared for Olin by AMEC E&I to summarize the conclusions presented in Part 1: Revised RI Addendum, Part 2: Updated Ecological Risk Assessment, and Part 3: Updated Human Health Risk Assessment. EPA prepared prefaces to Parts 1, 2, and 3, and the information presented in the prefaces to those parts is also relevant to the conclusions summarized in Part 4.

As noted in the preface to Part 1, the OU-2 surface water data presented in the RI considers data collected through 2009. The surface water data summary in Part 4 summarizes data from 2009. The RI notes that concentrations of mercury in surface water decreased by an order of magnitude between 2008 and 2009. However, surface water samples collected subsequent to the RI sampling in 2010 showed mercury concentrations similar to 2008 levels. Although less than one-quarter of the filtered surface water samples in 2009 exceeded the AWQC of 0.012 ug/L, when data collected from 2008 to 2010 are considered as a whole, approximately two-thirds of the filtered surface water samples collected in OU-2 contained mercury concentrations in excess of the ambient water quality criterion (AWQC) of 0.012 μg/L.

Surface water samples were collected at the discharge gate to determine whether mercury was leaving OU-2 at levels of concern. All 19 samples collected in winter and early spring contained filtered mercury concentrations below AWQC, while 6 of 9 samples collected in late spring (early June) contained filtered mercury concentrations in excess of the AWQC. While the RI shows that the average across all Gate Overflow samples is less than the AWQC, a seasonal component to mercury concentrations in surface water leaving the site cannot be ruled out. Based on flow rates and mercury concentrations in the gate overflow samples, modeled mercury concentrations in the Tombigbee River are below the AWQC.

EPA concurs with the conclusions of the updated ecological risk assessment and updated human health risk assessment summarized in Part 4.

TABLE OF CONTENTS

11.0 SUMMARY OF RI ADDENDUM, ERA, AND HHRA CONCLUSIONS

Part 4 of the RI Addendum submittal summarizes the conclusions of each of the preceding parts of the document. The following sections address *Part I Updated Remedial Investigation Addendum* (AMEC, 2011a), *Part 2 Updated Ecological Risk Assessment* (AMEC, 2011b), and *Part 3 Updated Human Health Risk Assessment – Revision 2* (AMEC, 2011c).

11.1 UPDATED RI ADDENDUM CONCLUSIONS AND RECOMMENDATIONS

Supplemental data collected to support the ESPP monitoring program and to address data gaps are presented in this RI Addendum. This RI Addendum updates the RI prepared in the early 1990s (WCC, 1993). Average mercury concentrations in surficial sediment samples decreased from 41.4 to 32.8 mg/kg between 1991 and 2009. These averages represent three sampling events (1991, 2008, and 2009). The statistical significance is limited due to the limited number of sampling events and variability within the dataset. Decreased concentrations are most prevalent in the southern portion of the Basin north of the inlet channel, where sediment from incoming flood events deposits. Grain size distributions and TOC analyses for the southern portion of the Basin indicate a higher sand percentage and lower TOC percentage, indicative of incoming sediment, compared to northern and central portions of the Basin. This area is where heavier particles would settle when floodwaters enter the Basin from the inlet channel. Deposition is also evident from aerial photographs. The distribution of mercury in the surficial sediment changes slightly among years. The percentage of methylmercury in surficial sediments generally ranges from 0.01 to 0.07 percent, with some locations near the Basin edges having higher methylmercury percentages (0.09 to 0.14 percent). These percentages are lower than those seen at other similar sites.

Mercury is detected at higher concentrations near the surface at some locations and at depth in other locations in the Basin. Sample intervals with mercury concentrations greater than 0.2 mg/kg form a wedge that narrows as one travels north and east throughout the Basin, except for the deeper portion of the Basin. HCB and DDTR were detected within the mercury depth footprint.

The average filtered mercury concentration was 0.00769 ug/L. Twenty-four out of 28 filtered mercury concentrations were less than the AWQC of 0.012 µg/L. The average unfiltered and filtered methylmercury concentrations were 0.000314 ug/L and 0.00029 ug/L, respectively. Overflow from the Basin as a result of gate operation does not cause an exceedance of the AWQC in the Tombigbee River.

Mercury and HCB concentrations in floodplain soils surrounding the Basin and Round Pond were less than floodplain soil concentrations measured in the 1990s. Mercury concentrations in surficial floodplain soils generally decreased with increasing distance from the water's edges. Fine sediment particles suspended in the water column tend to settle near the edge of the Basin. The vegetation near the edge of the Basin acts as an impediment to solids transport. HCB was detected in floodplain soils in the southern portion of OU-2, while DDTR was detected throughout the floodplain. DDTR concentrations decreased from north to south in surficial soils, with concentrations in the northwest floodplain two to three orders of magnitude higher than those in other floodplain areas.

Mercury concentrations in groundwater between the Basin and the river were not above the AWQC of 0.012 μg/L. Model results demonstrate that HCB concentrations at the isolated location where HCB was detected in groundwater would not result in an exceedance of the HCB AWQC in the Tombigbee River. DDTR was not detected above the reporting limit in the groundwater samples. DDTR in sediment is not a source to groundwater. Mercury in OU-2 is not a source of mercury to groundwater beneath the Basin. Groundwater beneath the Basin does not contain mercury at concentrations above the AWQC of 0.012 μg/L, thus OU-2 groundwater discharge to the river would not result in exceedances of AWQC to the river.

11.2 UPDATED ERA CONCLUSIONS

An ERA was performed to evaluate the potential for adverse effects associated with mercury, methylmercury, DDTR, and HCB concentrations from various environmental media at OU-2. Results from biological field investigations and extensive OU-2 sample data were used to develop risk estimates. Remedial activities including removal and capping occurred upgradient (north) of OU-2 for DDTR, which will minimize migration of DDTR into OU-2. Concentrations of DDTR in OU-2 sediment decreased an order of magnitude since the 1990s, thus reducing exposure for this COPC.

A qualitative analysis of risk was performed for the benthic macroinvertebrate, fish, and soil invertebrate communities by comparing site sediment, surface water, surface soil, and tissue concentrations to available literature-based TRVs. Based on the qualitative assessment of benthic macroinvertebrates and fish, potential risk is posed to these communities in OU-2. Mercury, methylmercury, HCB, and DDTR in environmental media in OU-2 are anticipated to potentially cause adverse effects to the benthic macroinvertebrate community in OU-2. Exceedances of mercury effects levels indicate a potential for risk to the fish community from exposure to mercury in OU-2 sediments. Surface water methylmercury, HCB, and DDTR concentrations indicate a potential for risk to the fish community from exposure to OU-2 surface water. Fish tissue residue concentrations also exceed effects levels for mercury, HCB, and DDTR. DDTR in environmental media at OU-2, except for DDTR in surface water, is not anticipated to cause adverse effects to the fish community in OU-2. DDTR surface water data used in this qualitative assessment were collected in 1994, and concentrations may be lower today based on two remedial efforts conducted by the adjacent landowner and reductions in DDTR sediment concentrations since the 1990s. Therefore, potential risk from exposure to DDTR in sediments and surface water may be overestimated. Potential risk to the benthic macroinvertebrate and fish communities must be concluded, but may be overestimated for exposure to DDTR. Based on the qualitative risk assessment for soil invertebrates, mercury, methylmercury, DDTR, and HCB do not pose a potential for risk to the soil invertebrate community in OU-2.

Quantitative analysis indicated that there are a few receptors whose NOAEL-based HQs exceeded the threshold value of 1, but the LOAEL-based HQs did not exceed the threshold value of 1. This indicates that these receptors' risk lies between the NOAEL and the LOAEL. The receptors and the COPCs that have a potential for adverse health effects are: the mink for methylmercury, the pied-billed grebe for methylmercury and DDTR, the little blue heron for methylmercury, the great blue heron for DDTR, and the Carolina wren for methylmercury and DDTR.

Quantitative analysis also indicated that there are a few receptors whose individual HQs for the COPCs were below the threshold value of 1, but the HIs (sums of the HQs) exceeded 1. These receptors are the little brown bat, the short-tailed shrew, and the wood duck.

The Carolina wren has NOAEL-based HIs that exceed the threshold value of 1. Individual HQs for mercury and HCB were below the threshold value of 1; however, the individual HQs for methylmercury and DDTR (2.4 and 1.8, respectively) were above the threshold value of 1. LOAEL-based HIs also exceeded the threshold value of 1, with risk being driven from methylmercury (HQ = 2.4) and DDTR (HQ = 1.4). This assessment indicates that the potential for adverse risk for this receptor is present for methylmercury and DDTR. The flying insects collected in 2010 included in the risk characterization typically had higher concentrations of site COPCs than the 2010 crawling insects and spiders that would be typically consumed by the Carolina wren. Carolina wrens are primarily ground foragers and are not expected to ingest significant amounts of flying insects. The inclusion of flying insects for the Carolina wren increased the EPCs for the site COPCs and may have overestimated risk for this receptor. The flying insects collected in 2010 include a mixture of emergent aquatic insects and terrestrial insects. The previous study on prothonotary warblers nesting in OU-2 did not indicate adverse effects from mercury or DDTR on reproduction or long-term survival of this receptor (Institute of Environmental and Human Health [IEHH], 1999). The prothonotary warbler has a similar diet and forage range as the Carolina wren. This site-specific study indicated that the risk may be overestimated and population-level effects are not being observed to insectivorous terrestrial birds.

The most significant potential exposure pathway was determined to be ingestion of fish by avian receptors. The DDTR dataset used to evaluate this pathway was from 2001, which is historical and adds a notable level of uncertainty or overestimation of risk. When risks were estimated using the lowest effect values reported, three avian receptors (belted kingfisher, little blue heron, and great blue heron) were calculated to have potential to reach exposures exceeding these values (i.e., these receptors had LOAEL-based HIs that exceeded 1). Conservative assumptions in the maximum exposure scenario on the feeding frequency for the belted kingfisher may have overestimated risk. An additional scenario used a modified exposure scenario for the belted kingfisher. Both scenarios for the belted kingfisher (i.e., maximum exposure and central tendency) will be included in the RGO calculation for risk management purposes. Two additional potential exposure pathways based on the current datasets were the incidental ingestion of sediments (2008 and 2009 datasets) and ingestion of insects (2010 dataset).

Three of the ten assessment endpoints that were quantitatively assessed had NOAEL-based HIs that are less than the threshold value of 1.

- Assessment Endpoint 9: Protection of the Long-term Health and Reproductive Success of Carnivorous Aquatic Reptiles
- Assessment Endpoint 11: Protection of the Long-term Health and Reproductive Success of Omnivorous Terrestrial Mammals
- Assessment Endpoint 12: Protection of the Long-term Health and Reproductive Success of Herbivorous Terrestrial Mammals

Seven of the ten assessment endpoints quantitatively assessed had NOAEL-based HIs that are equal to or greater than the threshold value of 1, and these endpoints are as follows:

- Assessment Endpoint 4: Insectivorous Aquatic Mammals - Receptor Species: Little Brown Bat
- Assessment Endpoint 5: Carnivorous Aquatic Mammals - Receptor Species: Mink

- Assessment Endpoint 6: Insectivorous Aquatic Birds - Receptor Species : Pied-Billed Grebe
- Assessment Endpoint 7: Piscivorous Aquatic Birds - Receptor Species: Belted Kingfisher, Little Blue Heron, and Great Blue Heron
- Assessment Endpoint 8: Omnivorous Aquatic Birds – Receptor Species: Wood Duck
- Assessment Endpoint 10: Insectivorous Terrestrial Mammals – Receptor Species: Short-tailed Shrew
- Assessment Endpoint 13: Insectivorous Terrestrial Birds – Receptor Species: Carolina Wren

Because either NOAEL-based or LOAEL-based HIs were equal to or exceeded the threshold value of 1, potential risk must be concluded for these seven assessment endpoints and nine receptors.

11.3 UPDATED HHRA CONCLUSIONS

Exposure media evaluated in the updated HHRA included floodplain soil, surface water, and ingested fish fillets. COPCs in floodplain soil included mercury and DDTR. COPCs in surface water included mercury and methylmercury, HCB, and DDTR. COPCs in fish tissue included mercury (assumed to be methylmercury), HCB, and DDTR. The HHRA was based on site-specific data collected from 1991 through 2010 and on recommendations from USEPA Region 4.

Exposure pathways considered in the HHRA included incidental ingestion of soil, dermal contact with soil, and inhalation of particulates while trespassing at OU-2. Additional exposure pathways included incidental ingestion of surface water during swimming, dermal contact with surface water during swimming, and ingestion of largemouth bass fillets. OU-2 is wholly contained within Olin property and has limited access for on-site employees. Because site access is limited by local topography, construction and operation of the berm and gate system, and Olin security, the frequency of exposure for trespassers is expected to be low.

Hazard estimates for current resident trespasser adults and adolescents exposed to floodplain soil, surface water, and through fish ingestion do not exceed an HI of 1. Hazard estimates for potential future resident trespasser adults and adolescents exposed to soil and surface water are less than 1.

USEPA required a potential future scenario that assumes unrestricted access to OU-2 or unlimited recreational exposures to surface soil, surface water, or fish from the Basin. HIs for future fish ingestion exceed the target HI of 1. This unrestricted potential future scenario has been incorporated into the HHRA; however, these potential future exposures are unlikely to occur because:

- Olin operates a multi-million dollar manufacturing facility on property next to OU-2, and is unlikely to relinquish control of the Basin and surrounding property.
- Olin will continue to operate the facility and maintain site security, which will limit access to the Basin and Round Pond; therefore, exposures to floodplain soil, surface water, and fish tissues will also remain of low frequency.

Cancer risks associated with resident trespasser adults and adolescent exposure scenarios did not exceed the acceptable risk range for site COPCs. Most of the risk observed is associated with HCB and DDTR in largemouth bass fillets. However, conservative exposure assumptions for the fish ingestion pathway were used, including the assumption that receptors would only ingest largemouth bass. In reality, fishermen would catch and ingest a variety of fish from multiple locations along the river. Therefore, the estimated risk associated with fish ingestion may be an overestimate. Risk resulting from DDTR may be overestimated because the DDTR surface water and fish tissue data were collected before the implementation of two remedial efforts by the adjacent landowner to mitigate DDTR migration to OU-2. Concentrations detected in sediment for DDTR and HCB have decreased over time, indicating that fish tissue concentrations may also decrease.

Currently there is no unacceptable risk to human health. Olin is committed to maintaining restricted access to OU-2 currently and in the future based on its current economic investment at the manufacturing facility. Future exposures for OU-2, where Olin maintains access restrictions, are expected to be very similar to current exposures in regards to exposure frequency.

12.0 REFERENCES

AMEC, 2011a. *Part 1 – Revised Remedial Investigation Addendum and Enhanced Sedimentation Pilot Project Annual Report, Year 2 Results.* Revision 2. Operable Unit 2, McIntosh, Alabama. November 14.

AMEC, 2011b. *Part 2 – Updated Ecological Risk Assessment.* Revision 2. Operable Unit 2, McIntosh, Alabama. November 14.

AMEC, 2011c. *Part 3 – Updated Human Health Risk Assessment.* Revision 2. Operable Unit 2, McIntosh, Alabama. November 14.

Institute of Environmental and Human Health (IEHH), 1999. *Exposure and Effects of DDT and Mercury in Prothonotary Warblers Nesting on the Ciby and Olin Floodplain in McIntosh, Alabama*. IEHH Reese Center, Texas Tech University, Lubbock, Texas. December 1999.