Environmental Stewardship Concepts, LLC

March 16, 2015

Comments on:
LCP Chemicals Site Proposed Plan
prepared by
Environmental Stewardship Concepts, LLC
on behalf of
Glynn Environmental Coalition

Questions for EPA:

Based on comments and questions from the community and detailed review of the Proposed Plan, Human Health Risk Assessment and Baseline Ecological Risk Assessment, and in consultation with the Glynn Environmental Coalition, ESC, LLC has not been able to successfully determine the correct answer to a number of questions. Therefore, we submit the following questions to EPA:

1) What sampling will be undertaken to determine the full extent of contamination in the Turtle River estuary system as a result of the LCP facility activities? This question is based on the data showing Aroclor 1268 congener profiles on Sapelo Island sediments, human tissues and in dolphins from the Turtle River.

2) How will EPA incorporate new methods for cleaning up contaminated sediments that have not been considered in the FS?

3) What corrections will EPA make to the Human Health Risk Assessment to account for the errors and omissions in human exposures and toxicity of contaminants, considering that site use is greater than estimated, fish consumption is greater than the value used and that dioxin contribution has not been included in the toxicity of site contaminants?

4) How does the Proposed Plan address the contamination of dolphins and other marine life that are not now included in the BERA or in another aspect of the RI/FS?

5) What additional sampling or analysis will EPA conduct in order to account for the omission of fate and transport of PCBs and other contaminants by *Spartina* grasses?

6) Will EPA require ecological risk evaluation of dolphins, based on all mammalian data, such as mink and other marine mammals and evaluate the toxicity to mink and river otter on the effects (toxicity) of PCBs as congeners?

7) The toxicity evaluations of the sediment have not adequately captured the anticipated toxicity, thus, how will EPA re-evaluate the sediment toxicity to account for this information?

8) Will EPA require measurement and assessment of dioxin in the site contaminants, EPA having included reference to the cleanup at Lake Onandoga that has both PCBs and dioxins, and obviously admits the occurrence of dioxins in this type of site.

9) Will EPA require alteration of the assessment of damage to the marsh to account for the factual errors present in the statements of damage to the marsh based on out-dated methods that are not used in working in salt marshes?

10) What provisions in the Record of Decision will EPA make for the consequences of rising sea-level and climate change on the remedy and the site?

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Introduction

Environmental Stewardship Concepts, LLC is submitting comments on the LCP Chemicals Site Proposed Plan on behalf of Glynn Environmental Coalition. We cover specific comments on the Proposed Plan report, as well as several areas of concern including institutional controls, fish consumption, site boundaries, new technologies, and a literature review of PCB toxicity.

Specific LCP Chemical Site OU1 Proposed Plan Comments

Several items in the LCP OU1 Proposed Plan raise concerns that threaten the goal of a cleanup that will protect human and environmental health.

- There needs to be more sediment removal, compared to capping and thin-cover placement, because sediment removal is a more effective and permanent cleanup option.
- A re-planting program of *Spartina* post-remediation should be one of the first monitoring efforts to help speed up ecosystem recovery.
- The evaluation of the way the LCP site is used by community members is inaccurate, specifically seen in the fish consumption rates used in the risk assessment that set the basis for achieving specific cleanup goals.
- Atlantic bottlenose dolphins are an essential part of the local ecosystem and are not included in the ecological risk assessment for the site.

- Thin-cover placement, or enhanced natural recovery, is not a sustainable recovery method.
- The Human Health Risk Assessment does not accurately assess human health risks because fish consumption values are wrong, and because dioxins and furans are not included in the exposure toxicity assessment.
- *Spartina* accumulates PCBs, but this fact is not considered in the estimates of PCB contamination or fate and transport.

These specific issues are each discussed further below.

Sediment Removal vs. Capping

Capping and thin-cover placement have been proposed as cleanup methods for large sections of the site. However, both of these methods cover up, rather than clean up, the contaminants of concern. Sediment removal is a viable option for the LCP site and should be implemented on a larger scale.

While the Proposed Plan claims that thin-cover placement is a well-studied method for site cleanup, there are not enough documented success stories of using thin-layer caps at contaminated sites to say that this remediation method is well-studied. Many of the examples of thin-layer capping for sediment remediation found in the LCP Feasibility Study are not salt marshes but bays, harbors or other large waterways like rivers (USEPA 2014). These are all environments with greater water depths and different hydrology than a typical salt water marsh. Thus, the thin-layer capping sediment remediation examples in the Proposed Plan are not very relevant to the LCP site.

Furthermore, thin-cover placement is not a sustainable recovery method. By nature, the layer of sediment will be thin, six inches or less, and will not be adequate to contain any contaminants in the marsh bed. A thin-cover layer is easily disturbed. For example, a storm surge could easily move the sediment around, as could scour from a passing boat. In addition, animals living in the marsh like crabs and worms will burrow into sediment and disturb the layer, causing bioturbation of the cap.

As larger storms and hurricanes occur more often due to climate change, there will be an increased chance that the contaminated sediments at this site will be disturbed and that neither thin-cover placement nor capping will be protective. Armoring of a wetland cap is not affective as the tidal flow will simply redirect, carrying sediment with it.

Salt Marsh Grasses

The RI, FS and Proposed Plan make two substantial and fundamental omissions with regard to *Spartina* grasses in the estuary and on the LCP site. The first omission is failure to take into account the fact that *Spartina* does take up contaminants, and the site of accumulation may be any and all parts of the plant, including the rhizome, roots, stalk or stem, and leaf. The failure to account for these processes of uptake and accumulation means that contaminants contained in the living medium are not accounted in the estimate of total contamination on site. The second consequence is that the fate and transport of contaminants left on site under the Fs options and in the

Proposed Plan do not include the movement of contaminants via *Spartina* in the marsh. Both of these components of fate and transport of PCBs are potentially significant pathways and compartments for contaminants. The RI and FS really need to be redrafted to include *Spartina*.

The cleanup process for the marshes of the LCP site will involve the removal of native marsh vegetation, which is essential for the health of the ecosystem. The Proposed Plan relies heavily on the assumption that marsh plants will re-grow on their own within two years. However, the Plan must include a re-planting program in order to speed up recovery of the ecosystem post-remediation. Native *Spartina* will attract native wildlife, which will in turn help the ecosystem return to a pre-remediation state. Replanting Spartina has been conducted for many decades and there is substantial expertise on the practice, in both the private and public sectors (U.S. Fish and Wildlife, NOAA and US Army Corps of Engineers.

Estuary Use by People

The Proposed Plan states that the estuary is rarely used for recreation because it is too difficult to navigate with a small boat, and therefore the impacts of cleanup on that area do not need to be considered. However, there are no data outside the Purvis Creek area to show that the waterways of the estuary are used infrequently. Community surveys must be completed before the Plan can conclude that community members are not using this area for fishing or recreation. The lack of information is not data in support of the negative. Personal observation by ESC, by GEC and accounts from community members contradict the statement of lack of use, which must be considered anecdotal and of questionable value.

Dolphins

Atlantic bottlenose dolphins, which inhabit the Turtle/Brunswick estuary and coastal waters, are apex predators in the southeast. Because they are at the top of the food chain, dolphins bioaccumulate more toxins in their bodies than the animals lower in the food chain. Studies have shown that concentrations of PCBs in Brunswick dolphins are ten times higher than the PCB concentrations in dolphins found in the Savannah area, and the resident dolphins of Brunswick have the highest reported PCBs levels of any marine mammal in the world (Balmer et al. 2011). Dolphins across multiple generations have already been harmed by PCBs, suffering from anemia, reduced hormone levels, and increased susceptibility to disease (Schwacke et al. 2012). Dolphins play an important role in the Brunswick ecosystem and should be a central consideration in the Proposed Plan.

Human Health and Ecological Risk Assessments

The Human Health Risk Assessment in the Proposed Plan does not adequately account for the risks to human health posed by the contaminants at the estuary site. According to the risk assessment, the two chemicals causing the most harm are mercury and Aroclor 1268. There is no consideration of dioxin as a toxic chemical at the site, despite the fact that dioxin is a known contaminant of the industrial process at LCP (chlor-alkali). The reductions necessary to meet fish/shellfish goals to eventually end consumption advisories “are likely to be observed only after several years post remediation,” delaying the health-protective measures of this remediation.

The Proposed Plan defines a high quantity fish consumer as an adult who eats 40 fish meals per year for 30 years, and a recreational fish consumer as someone who eats 26 fish meals per year for 30 years. The difference between the two consumer categories is small and the fish consumption numbers should be increased based on detailed surveys of local fishermen. The data on local fish consumption in the Brunswick area could have been obtained via surveys, but was not. In fact, ATSDR has a better data set from a nearby community and ATSDR recommended using that data, which would have substantially increased the consumption rates used in the HHRA. The result would have been a conclusion to reduce site risks by more contaminant removal or treatment.

In the Ecological Risk Assessment, one of the sites used to compare the levels of chemicals in the sediment at LCP is only four miles from the LCP site at Troup Creek, and has shown to be contaminated with the same chemicals. Another reference site with a history of cleaner sediments should be used instead. Very little constructive comparison can be made when using an equally contaminated reference site.

Additionally, not all of the individual stations, domains, and creeks meet the acceptable PRG risk ranges; they are only protective of the local ecosystem when creeks and/or domains are considered collectively. This averaging across spatial data dilutes the exposure possible at each area of contamination. Further, the proposed cleanup levels were determined to be adequate, despite areas “Where CULs may not be achieved and residual risks in some areas may occur” because they existed “in combination with a robust monitoring program”; a monitoring program should not be considered “robust” when monitoring only occurs every five years with an undefined set of “triggers” for additional actions.

Total Acreage of Cleanup

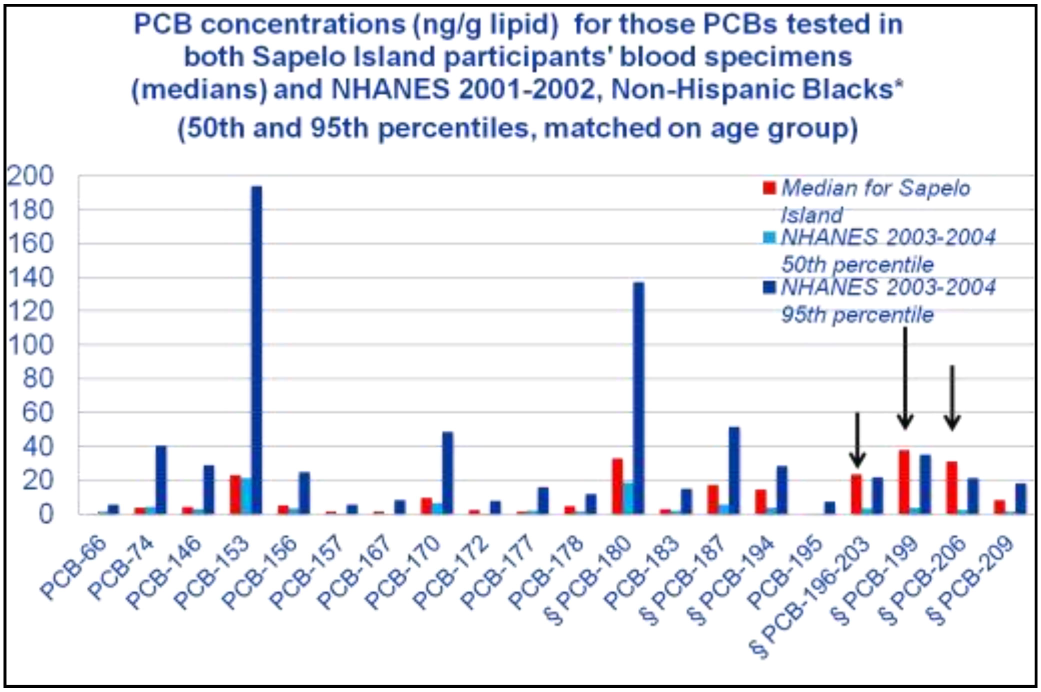
To clean up the marsh to a level protective of human and environmental health, 81 acres of marsh would need to be cleaned up. However, the chosen cleanup plan will only clean up 24 acres of marsh, leaving behind 57 acres with high levels of mercury and PCBs.

Sapelo Island

Sapelo Island is a state-protected barrier island north of Brunswick. The Agency for Toxic Substances and Disease Registry (ATSDR) recently conducted a study that showed that residents of Sapelo Island have dangerously high levels of PCBs in their bodies, based on their blood samples. Scientists conducting the study sampled nine residents, ages 21-74. All the residents stated that they ate two to three meals of locally-caught seafood per week, and had eaten locally-caught seafood for over five years.

When the results of the blood tests were compared to samples from non-Hispanic African Americans throughout the country, some of the PCB levels in blood of the

Sapelo Island residents were above the 95th percentile. In addition, when the Sapelo residents' samples were compared to the samples from local Atlantic bottlenose dolphins, scientists found that the human and dolphin samples contained similar environmental contaminants. This shows that contaminants from the LCP Chemicals Site have migrated into the waters and sediment surrounding Sapelo Island, into the local seafood, and finally, into the bodies of local residents who eat the local seafood.



The red bars are the median sample for the Sapelo Island residents. The three samples with the arrows above them point to Sapelo Island blood samples that were above the 95th percentile for PCB levels in blood (Backer and Mellard 2014).

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Institutional Controls at the Site

Institutional controls are a group of actions that seek to limit human activity to decrease exposure to a contaminated ecosystem. The EPA defines institutional controls as "…administrative and legal controls, that help minimize the potential for human exposure to contamination and/or protect the integrity of the remedy" (USEPA 2014a). Common examples of institutional controls (ICs) include fish consumption advisories, land use designations, and zoning restrictions. The EPA's Proposed Plan for the LCP Chemicals Superfund Site relies heavily on ICs in the form of fish consumption advisories and permit requirements. Currently, fish consumption advisories are in effect for Purvis Creek and the Turtle River, and a commercial fishing ban was issued for Purvis Creek. Permits are required for any in-water construction activities for Operable Unit 1 of the site (USEPA 2014b).

To estimate risk at the LCP Chemicals Superfund site, the EPA used Baseline Risk Assessments (BRAs) found in the Remedial Investigation/Feasibility Study. A Baseline Human Health Risk Assessment (BHHRA) and a Baseline Ecological Risk Assessment (BERA) were conducted for the site. The BHHRA provided the cancer and non-cancer risks associated with consuming fish and shellfish from the site, and the BERA provided the estimated likelihood of adverse ecological effects at the site. While the EPA clearly outlined how risk reduction was estimated in the BRAs, any risk reductions that result directly from the use of ICs are not made clear. Thus, based on the information given in the Proposed Plan and Feasibility Study, it is not possible to determine the actual risk reduction resulting from the use of ICs.

Issues with Institutional Controls

While ICs are meant to protect human health, they are simply a means of removing an exposure pathway by restricting human activity. The Proposed Plan for the LCP Chemicals site states that ICs will address residual risks posed by any un-remediated contaminants, and that ICs "help ensure the remedy's long-term structural integrity and effectiveness in reducing COC concentrations in fish/shellfish…" (USEPA 2014c 40). Yet ICs do nothing to reduce contamination; they simply keep people away from contaminated media at a site. Studies and government reports have found significant flaws in the philosophy and implementation of institutional controls, specifically with fish consumption advisories.

In 2005, the U.S. Government Accountability Office published a report titled "Improved Effectiveness of Controls at Sites Could Better Protect the Public." The study analyzed the implementation and effectiveness of institutional controls at Superfund and RCRA sites throughout the U.S. The researchers found that while the use of ICs has increased over time, there are numerous problems with both the implementation and the organization of ICs. One of the most obvious issues is one of timing and accountability. The GAO found that often documentation did not adequately address when the ICs should be implemented, how long implementation should last, or who would be responsible for enforcement. This led to ICs not being implemented until after cleanup processes were finished, posing significant risks to local residents. The GAO also found issues with the process for implementation of ICs. Language in the IC documentation was often vague, and the EPA sometimes failed to identify the specific mechanism for each IC. The GAO pointed out that in creating ICs, the EPA needs to identify the parties responsible for enforcing the ICs, such as state governments or site owners (2005). Because of the faulty implementation and enforcement of ICs, ICs come across as recommendations, and are thus taken much less seriously.

Results of a recent study of people living on Sapelo Island, a barrier island 25 miles northeast of Brunswick, showed that residents have dangerously high levels of PCBs in their bodies due to the consumption of locally-caught seafood (Backer and Mellard 2014). The study, which was conducted by the Agency for Toxic Substances and Disease Registry, examined blood levels from adults who had lived on Sapelo Island for at least five years, and who consumed at least two meals of locally-caught seafood each week. The researchers found that 44% of the sampled residents were unaware of Georgia’s fish consumption advisories. Out of the five residents who were asked if they changed their fish consumption habits after learning of the advisories, only two responded that they had. If this small sample size is representative of the population in and around Brunswick, then the majority of residents who practice subsistence fishing are continuing to consume the contaminated fish that the consumption advisories warn against. Many scientific studies on fish consumption advisories, such as the two studies mentioned below, provide similar results to the Sapelo Island study: fish consumption advisories are often ignored or simply interpreted as recommendations.

In a study on the effectiveness of fish consumption advisories, researchers found that fish consumption advisories are unlikely to be effective in reducing the exposure of infants and children to persistent organic pollutants that have long elimination rates in the human metabolic system (Binnington et al. 2014). Persistent organic pollutants like PCBs have long elimination half-lives, meaning that the human metabolic system takes longer to break down persistent pollutants like PCBs than non-persistent pollutants. For this study, scientists used a mechanistic model to estimate and compare prenatal, postnatal, and childhood exposure to PCB-153 under different scenarios of maternal guideline adherence to fish consumption advisories. The scientists assumed realistic time periods for advisory compliance for mothers (from one year to five years before birth), and found that temporarily eliminating or reducing maternal fish consumption for fish contaminated with persistent organic pollutants did very little to reduce the exposure of infants and children to PCBs (Binnington et al. 2014). This study shows that it is not just the contaminated fish that prove problematic; it is the environmental persistence of the contaminants inside the human body, which can take years to be eliminated.

In a 2008 study concerning public knowledge about fish consumption advisories, Burger and Gochfeld found that many subjects questioned in a general university population could not give any specific answers to questions regarding the existence of fish consumption advisories. Of the respondents, 62% could not give any specific information as to why fish consumption warnings exist. Over half of the respondents did not know which fish are high or low in contaminants, and 16% of the subjects could not provide an answer as to why eating fish can be healthy. The authors point out that government agencies are often concerned that the public will be confused by advisory details, and that information on the nature of risks and benefits of fish consumption can be too complicated to convey. The authors believe that operating based upon that assumption is a mistake. They state that the lack of such information is a major part of ineffective communication. The study concluded that public agencies must provide more directed messages regarding the basis for making risk decisions (Burger and Gochfeld 2008).

The results of the Burger and Gochfeld study on public knowledge of fish consumption advisories were echoed by the Sapelo Island study, where residents continue to consume locally caught seafood even after learning of the risks posed by eating contaminated fish. The problem with relying on fish consumption advisories and other ICs for the LCP Chemicals site is two-fold. Half of the problem is that ICs do nothing to reduce contamination; they are simply a means of controlling human activity. The other part of the problem is that fish consumption advisories are, and will continue to be, an ineffective way to protect human and ecological health. Many residents are unaware of the fish consumption advisories, and many of those that are aware of the advisories choose to ignore the regulations and continue eating contaminated seafood. The LCP Chemicals Proposed Plan needs to be amended to rely on a more comprehensive removal of contaminants, not on institutional controls that attempt to keep humans away from their local waterways.

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Fish Consumption Advisories at the Site

At the LCP Chemicals Superfund Site, fish consumption advisories are in effect for Purvis Creek and the Turtle River, and a commercial fishing ban was issued for Purvis Creek. Permits are required for any in-water construction activities for Operable Unit 1 of the site (USEPA 2014a). However, the fish consumption advisories described in the Proposed Plan are insufficient for the protection of human health. The Proposed Plan relies on fish consumption information that is outdated and fails to gather appropriate data on local African-American residents' fishing habits and fish consumption rates. The fish consumption information for the local community, as outlined in the health risk assessment and carried forward in the Proposed Plan, must be fully revised in order to protect human health.

The Problems

The issues with fish consumption advisories are not unique to this site; government reports and scientific studies have found numerous problems with implementation and community adherence to fish consumption advisories. For example, a 2011 survey by the EPA found that fish advisories are not legally enforced in all states. The survey reported that 49 U.S. states and Native American tribes do not legally enforce advisories or bans, and only seven do. This same survey documented 17 out of 18 states that include consumption information for sport and subsistence fishers in their commercial fishing ban information (USEPA 2011). Other inconsistencies at the state level include differences in the ways sampling is conducted and differences in the number of contaminated fish required to affect an advisory. For example, four states in the survey required only one individual fish sample exceeding human health criteria to issue an advisory while others, such as Virginia, required between 11 to 20 fish. Additionally, some states require multiple years of sampling before an advisory can be issued, even after contaminant levels in fish tissue have exceeded state criteria (USEPA 2011).

At the LCP site, the fish consumption advisories proposed by the EPA do not protect human health, nor do they accurately reflect the demographic makeup of the local population. The advisories are based upon a 1999 study conducted by the Glynn County Health Department (GCHD), comparing 211 residents who may have been exposed to mercury through wild game and seafood consumption from the Turtle River (target group participants) to 105 residents who reported they had not consumed seafood or wild game from that area (comparison group participants). Overall, 101 target group participants identified themselves as either recreational, commercial, or subsistence fishers; 96% of these individuals reported themselves as recreational fishers, 3% identified themselves as commercial fishers, and only 1% identified themselves as subsistence fishers (USDHHS/ATSDR 2014). However, the African-American community is severely underrepresented in the target study group. African-Americans made up only 4% of the people surveyed, yet according the 2010 U.S. census, African-Americans make up 26% of the Glynn County population, and nearly 40% of the population within four miles of the LCP site (USDHHS/ATSDR 2014). Thus, the ATSDR confirms that the GCHD study is not an accurate representation of commercial or subsistence fishers living in the area (2014).

Other shortcomings of the GCHD study include the possibility that participants purposely restricted their intake of fish following the dietary recall survey, leading to inaccurate urine mercury results (USDHHS/ATSDR 2014). Furthermore, in a study of fishers living along the nearby Savannah River, Burger et al. found that, on average, African-Americans eat more fish meals per month than whites, eat slightly larger portions of fish than whites, and therefore eat higher amounts overall of fish per month than whites (1999). The ATSDR states that it is reasonable to assume that African-Americans living in Brunswick have similar eating habits to those living along the Savannah River, and so the report explicitly states, “The results of the Brunswick fish study should not be applied to African-Americans in the Brunswick area [. . .]” (2014, pp.8).

Lastly, sensitive groups including children, women of childbearing age, and the elderly reside within a one-mile radius of the site. The ATSDR reports that based on a 2010 U.S. census, approximately 4,202 people live within a one mile radius of the LCP site; among these, nearly 451 are children aged 6 or younger, 519 are adults who are at least 65 years of age, and 827 are women of childbearing age (2014). Although 37% of target group participants were 60 or older, only 6% of participants were under the age of 10 years old (GCHD 1999).

In light of the major problems with the fish consumption advisories at the LCP site and the data that the advisories are based upon, it is essential to enforce stricter and more accurate fish consumption advisories. It will be many years until local fish and shellfish are clean enough for human consumption, and as such all advisories should be maximally protective of human health. Below we describe the ways in which new fish consumption advisories should be implemented.

The Solution

The fish consumption advisories in the LCP Chemicals Proposed Plan need to be based on data from a more accurate source. The data collected from local residents should accurately represent the population. This means that the data should reflect that African-Americans make up 26% of the Glynn County population (USDHHS/ATSDR 2014). This type of data collection could be done through an environmental justice analysis. An environmental justice analysis recognizes that some populations experience higher levels of risk than others. According to Executive Order 12898, an environmental justice analysis “directs federal agencies to identify and address disproportionately high adverse human health or environmental effects on minority and low-income populations that may result from their programs, policies, or activities” (USEPA 2014b, pp.1). An environmental justice analysis would account for the higher levels of risk experienced by residents who practice subsistence fishing, and therefore help to create guidance for more protective fish consumption advisories.

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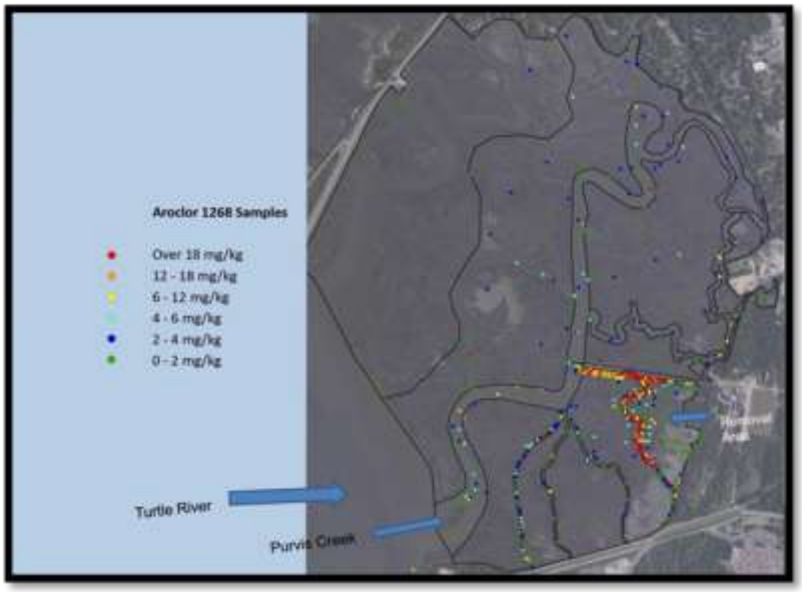
Site Boundaries at the Site

Site boundaries are established by the EPA as part of the Superfund process once the area of contamination has been determined. Boundaries delineate the area within which cleanup processes will occur and contamination will be contained. EPA further divides cleanup processes into operable units (OUs), which are “each of a number of separate activities undertaken as part of a Superfund site cleanup” (EPA 2013). The LCP Chemicals Superfund site is divided into three operable units (OUs) in order to address the differing types of contamination at the site. Following an EPA revision in 2005, Operable Unit 1 represents the marsh, Operable Unit 2 represents groundwater, and Operable Unit 3 represents dry-land soils (USDHHS/ATSDR 2014). The U.S. DHHS/ATSDR report (2014) states, “Other OUs may be examined when data are available for review” (pp.3). Sufficient data are available to question the currently designated site boundaries, conduct additional sampling, and add additional OUs.

The Problems

There are a number of problems with EPA’s currently designated LCP Chemical’s site boundaries. First, the boundaries are inaccurate. The EPA failed to include available data on the continued migration of Aroclor 1268 in its analysis of site boundaries. According to EPA’s *Clarifying the Definition of ‘Site’ Under the National Priorities List*, “a ‘site’ is best defined as that portion of a facility that includes the location of a release (or releases) of hazardous substances and wherever hazardous substances *have come to be located* [emphasis added].” The document also advises that “the extent of contamination (site extent) may not be precisely determined at the time a site is listed on the NPL. In fact, the extent of the site may change significantly as the cleanup process progresses” (EPA 1996, pp.1). Recent scientific studies have discovered the presence of Aroclor 1268 outside of EPA-defined site boundaries, making the current delineation erroneous (Wirth et al. 2014; Balmer et al. 2011; Backer and Mellard 2014).



Source: EPA, LCP Chemicals Proposed Plan Public Meeting 2014

Secondly, sampling at the Brunswick LCP site is insufficient given the documented migration of contaminated media to Sapelo Island. Sediment and tissue sampling in the Turtle River must be conducted to determine the extent of contamination as well as the potential migration pathways to populations, such as residents of Sapelo Island, in order to accurately assess impacts of the contamination. As displayed in the figure, previous sampling efforts for Aroclor 1268 and other contaminants have focused little on Turtle River as a potential migration pathway.

Additionally, Turtle River and Sapelo Island must be added as operable units. Backer and Mellard (2014) noted that there is evidence to suggest that Aroclor 1268 appears to be widespread around the Brunswick area and that residents of Sapelo Island have been exposed to the specific PCBs found at the LCP site; residents' median levels for highly chlorinated congeners of PCBs are equal to or greater than the 95th percentile NHANES study for Non-Hispanic Blacks. Another recent study documented similar PCB congener profiles for sediments and fish between the locations of Sapelo Island National Estuarine Research Reserve and Brunswick (Wirth et al. 2014). These congener profiles were also consistent with the Aroclor 1268 signature noted in residents of Sapelo Island in the former study.

Lastly, there are boundary discrepancies among various documents pertaining to the LCP site. Tables 1 and 2 include differing acreage estimates for the area of contamination. Table 1 refers to Operable Unit 1 acreage estimates only, while Table 2 refers to site-wide estimates. Once site boundaries have been updated to include additional areas of contamination, one consistent estimate is warranted.

Table 1: OU1 acreage estimates

Source	Acreage Marsh (OU1)	Acreage Land (OU1)	Acreage Tidal Creeks (OU1)	Link
EPA Brunswick LCP OU1 PP	670+			http://www.epa.gov/region04/foiapgs/readingroom/lcp_chemicals_site/superfund-proposed-plan-nov-2014.pdf
EPA Brunswick LCP OU1 Draft FS	≈662		98	http://www.epa.gov/region04/foiapgs/readingroom/lcp_chemicals_site/draft-feasibility-study-report-june-2-2014.pdf

Table 2: Site-wide acreage estimates

Source	Acreage Marsh (site-wide)	Acreage Land (site-wide)	Acreage Tidal Creeks (site-wide)	Link
Honeywell Fact Sheet	681	120		http://www.lcpbrunswickcleanup.com/documents/fact%20sheet.pdf
EPA LCP Chemicals Georgia webpage	"550-acre site"			http://www.epa.gov/region4/superfund/sites/npl/georgia/lcpchemga.html#location

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Modern Construction Methods for Salt Marsh Remediation

In the Proposed Plan, EPA states that the type of construction required for removal or treatment of contaminated sediments in the LCP salt marsh would cause “widespread physical damage to habitat and species” (USEPA 2014a, pp. 25). The EPA goes on to state that construction would also impact hydrology, “possibly in ways which are not readily anticipated or predictable” (USEPA 2014a, pp. 25). This line of thought leads the EPA to conclude that 48 acres is the largest possible removal action that would be sufficiently protective of the environment. These statements about salt marsh construction are not accurate. Construction in salt marshes is widely practiced and not nearly as environmentally detrimental as stated in the Proposed Plan. There are modern, accepted methods for construction in salt marshes that pose minimal disturbance risks to the surrounding ecosystems.

It is only later in the document (Section 7.6 Implementability) that EPA, by its own admission, states: “There are technologies and techniques available to meet the challenges associated with working in soft sediments in tidally influenced marsh areas. These include employing low-ground-pressure earthmoving equipment, telescoping conveyor belts for cap placement, shallow draft barges for water-based sediment removal and sediment capping, and hydraulic equipment to place thin-cover material.” It is obvious there are technologies to attain effective remediation without irreparable damage to the marsh. There are also new technologies that should be considered before moving into the remedial design.

Use of Alternative Technologies

The Proposed Plan relies on sediment removal, capping, and thin-cover placement for contaminant remediation at the site. Modern remediation methods exist that would work best to remediate a salt marsh without stressing the marsh beyond its ability to recover. EPA needs to consider using new remediation technologies that are more efficient and more environmentally sound than the ones recommended in the LCP Proposed Plan. Below we outline several alternative technologies that could be applied at the LCP site.

In Situ Technologies

PCB remediation is an expensive process and removal of the contaminated soil or sediment, whether by excavation or dredging, contributes a large part of that cost. These processes also risk disturbing and dispersing PCBs. In situ remediation technologies are designed to clean up PCBs without removal from the environment. Most in situ technologies remain difficult to implement on a large scale and are typically suited to low concentrations of contamination; however, several emerging technologies may be viable alternatives to traditional practices.

Bioremediation

Bioremediation is a process through which microbial degradation of PCBs is facilitated through creating a favorable environment for the process; this can be done through controlling the physical, chemical, and microbial aspects of the environment (EPA, 2012). This process generally begins with instigating anaerobic dechlorination, or the removing of chlorine atoms by anaerobic bacteria; this results in lightly chlorinated PCBs that are both less toxic and degrade more readily into inert molecules through the secondary process of aerobic biodegradation (Gomes, Dias-Ferreira, and Ribeiro 2013). Bioremediation may be of particular use in combination with active containment technologies such as reactive capping or phytoremediation.

There are many examples of bioremediation used in the remediation industry. One such example of note is the South Carolina company BioTech Restorations[1]. BioTech specializes in the bioremediation of chlorinated contaminants including PCBs through application of a proprietary protein "factor" which stimulates the indigenous microbial population and enhances its ability to degrade PCBs. While previously demonstrated in soils, dredged sediment could also be treated in this manner. Some of BioTech's successful remediation projects include the cleanup of the former New England Log Homes factory site in Great Barrington, Massachusetts and the Hercules Chemical Plant in Brunswick, Georgia.

Phytoremediation

Phytoremediation is an increasingly popular technology that employs specific plants to sequester, extract, and degrade contaminants in situ. Phytoremediation of PCBs works through three main pathways: i) uptake by the roots (sequestration), ii) degradation through plant enzymes, and iii) improving natural bioremediation through root activity in the soils (Gomes et al., 2013). While PCBs are partially retained in plant biomass, phytoremediation provides a noninvasive means of removing/degrading the contaminants. PCB contaminated plant matter may also be converted into biofuels during which the remaining concentrations would be destroyed. Phytoremediation can be implemented using a variety of plants; canarygrass and switchgrass were found to be particularly effective on soil (Chekol et al., 2004), while eelgrass was effective in aquatic sediment (Huesemann et al. 2009). Phytoremedation is also a good candidate for use in conjunction with bioremediation due to the root and rhizomatic boosts to biological activity.

There are several exampes of phytoremediation in the field. In 2015, the Iowa Superfund Research Program will finish a full scale study of employing phytoremediation to remove PCBs from soil and groundwater at a confined disposal facility in East Chicago. A similar test is being conducted on a PCB contamined wastewater pond in Altavista, Virginia. Several engineering and remediation firms use phytoremediationto remove PCBs including Edenspace, TRC Companies, and EADHA enterprises.

In Situ Sediment Ozonator

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[1] Disclaimer: Environmental Stewardship Concepts, LLC worked with BioTech Restorations on the first draft of the QAPP for the Housatonic River cleanup. ESC completed the project in May 2014 and is no longer under contract to BioTech Restorations.

In situ Sediment Ozonation (ISO) is a new technology developed by the University of Utah in cooperation with the National Oceanic and Atmospheric Administration (NOAA). ISO uses a floating rig equipped with ozone reactors and conveyors to remediate without dredging. Ozone has been shown to react with PCBs by forming more biodegradeable products, as well as boosting biological activity in sediment or soil (Gomes, Dias-Ferreira, and Ribeiro 2013). ISO enhances this process using pressure-assisted ozonation which injects sediment with ozone and rapidly cycled pressure changes to increase the efficacy of the ozone (Hong 2008). The final report on the technology suggests that the materials to build ISO rigs are readily available in current dredging technology, and that contaminated sediment could be treated for as little as fifty dollars a cubic yard. This technology also naturally enhances biological activity and would be a logical choice to increase remediation efficiency of more passive technologies, such as bioremediation or phytoremediation.

Ex Situ Technologies

In many cases, the most practical means to treat a contaminated area is to remove the target media with dredging or excavation. The materials can then be transported and treated ex situ, or off-site. Treating contaminations ex situ allows for the use of more intensive treatment technologies that would be unsafe or impractical in situ. While incineration remains the most common ex situ technology, several emerging technologies are showing promise.

BioGenesis℠

BioGenesis Enterprises’ proprietary BioGenesis℠ Soil/Sediment Washing Technology is one of the most well documented alternatives to incineration. BioGenesis℠ is a sequence of eight processing steps that treat contaminated sediment sufficiently to allow the post-treatment media to be used as high-end topsoil or construction grade products (BioGenesis 2009). BioGenesis℠ is designed to accommodate large volumes of contaminated sediment through the construction of a facility in a location where sediment can be directly delivered by barge or hydraulic pipe.

BioGenesis℠ has conducted several bench-scale studys and a recently completed full-scale demonstration of the technology in the New York/New Jersey Harbor which handled materials from the Raritan, Passaic, and Arthur Kill. According to the final report, the full-scale test facility was capable of remediating 250,000 cubic yards of sediment per year at a cost of $51-59 per cubic yard (2009). While initial costs of construction of these facilities is higher than other technologies, repeated demonstrations have provided enough data to conclude that BioGenesis℠ is an environmentally and economically sound alternative.

Mobile UV Decontamination

Researchers at the University of Calgary have developed a mobile PCB remediation unit that builds upon a study showing ultraviolet light’s capability of effectively degrading PCBs in transformer oil, as well as soils and sediment (Kong, Achari, and Langford 2013). The project, backed by SAIT Polytechnic and IPAC Services Corp., is a 15 meter long mobile unit that combines UV and visible light technologies to degrade PCBs as much as 94%, at a fraction of the cost of inicineration while remaining on site (Unviersity of Calgary 2013). This technology is well suited for operation in areas where soil or sediment could be removed and processed nearby. The unit is currently designed to handle smaller contaminations but the project group plans to expand the technology to address the needs of larger remediation projects.

nZVI Dechlorination

Zero-valent iron nanoparticles (nZVI) is primarily an ex situ treatment based on zero-valent iron (ZVI), a technology which has been used to clean up aquifers contaminated with a variety of chemicals. Where PCBs are concerned, ZVI works through dechlorination into less toxic and more biodegradeable constituents (Gomes, Dias-Ferreira, and Ribeiro 2013). ZVI has been tested in the sediment of both the Housatonic River and New Bedford Harbor in Massachusetts; however mixed results have prevented ZVI from mainstream implementation. nZVI improves upon ZVI through a reformulation using nanoparticles which exhibits superior reactivity and more consistent removal of PCBs in groundwater and soil (Mikszewski 2004). While nZVI can be used in situ, due to limited research on the effects of nanoparticles on the environment, most commercial and academic uses are conducted off-site. However, NASA currently licenses an associated technology, emulsified zero-valent iron (eZVI), and has demonstrated successfully removing a variety of contaminants both in situ and ex situ (Parrish 2013).

Removal Technologies

When in situ treatment is not possible, removal of the contamination, whether it be industrial waste, soils, or sediment is required before ex situ remediation is possible. Where PCBs are concerned, the most common, and often most concentrated contaminations are found in river sediment in and around industrial areas. Heavy dredging equipment is often required to remove and transport the sediment, the use of which can be expensive economically and environmentally. However, advances in removal technologies can reduce these costs through more precise and focused application.

Environmental Dredging

Environmental dredges are designed with the understanding that dredging can re-suspend and disperse contaminants beyond the original site. Most environmental dredging uses hydraulic cutter dredges, which break up and then pump sediment and water through pipes to a desired location. The Bean technical Excavation Corporation’s (Bean TEC) *Bonacavor* builds upon that standard using a hybrid model: mechanical excavation and hydraulic transport. This hybrid model allows more precise control of dredging which reduces unnecessary dredge area or depth and sediment disturbance. The *Bonacavor* also features an advanced onboard GPS and Crane Monitoring System (CMS) that provides precise control of the crane while dredging, as well as a Slurry Processing Unit (SLU) that increases solid concentration during dredging resulting in less water intake (Lally and Ikalainen). Smaller hydraulic cutter dredges have also been developed by companies such as Ellicott and Great Lakes Dredging (Randall, Drake, and Ii 2010). These dredges have smaller footprints and are able to facilitate removal at less cost and disturbance to the environment.

Activated Metal Treatment and Green PCB Removal

Technologies that allow PCBs to be removed without removing the contaminated media may offer alternatives to dredging in the future. NASA has also licensed two technologies that are designed to absorb PCBs from the environment for removal. The Activated Metal Treatment System (AMTS) is a solvent solution that can be applied to surfaces to remove PCBs from paints, caulk, or sealants (Parrish 2013). AMTS has been extremely successful during in situ remediation of industrial facilities where PCBs were used widely as paints and sealants on storage tanks, buildings, and other structures. The product allows extraction of PCBs without removal of the structures, whereupon the contaminants can be treated safely ex situ. While AMTS is primarily used for structure remediation, Bio Blend ® Technologies, a company currently licensing AMTS, is testing the technology in a variety of applications including in situ extraction of PCBs from soils and sediment (Parrish 2013).

Specific to sediment and soil contamination, NASA is also developing GPRSS, or Green PCB Removal From Sediment Systems, which is a system that uses a redeployable polymer blanket with “resevoir spikes.” The spikes are treated with AMTS, which removes PCBs from sediment (Parrish 2013). The blanket is inserted into the target area, wherein the AMTS breaks down and absorbs PCBs; the blanket system can then be removed and decontaminated before reuse. While still in preliminary testing, GPRSS appears to be a promising technology for removal of PCBs without dredging.

Containment Technologies

Monitored natural recovery (MNR), a process by which PCBs are monitored and left to degrade naturally in the environment, is a remediation method employed in areas where removal of a contaminant is impractical or impossible. As natural degradation of PCBs is a slow process, the contaminant is often contained or capped to keep it from dispersing in the wider environment (Gomes, Dias-Ferreira, and Ribeiro 2013). This method has highly variable success, in large part due to the slow rate of natural PCB biodegradation. Advances in containment technology are increasingly implementing in situ treatments, such as bioremediation, to increase the outcome of the treatment.

Reactive Capping

While traditional capping passively contains a pollutant, reactive capping is an emerging technology that caps the designated area with additives that can absorb and immobilize, increase degradation, or reduce the bioavailability of PCBs; additives used in this process include Activated carbon, biochar, and metals such as zero-valent iron coated palladium (Gomes, Dias-Ferreira, and Ribeiro 2013). CETCO®, a minerals technologies company, markets the *Reactive Core Mat (RCM)*, a cap which can be tailored to meet the specific needs of a remediation project by augmenting the additives included in the product.

Aquablok® and Aquagate® are two complimentary reactive containment technologies from Aquablok Ltd that can be used to form a “funnel and gate” system in sediment. Aquablock® acts as a low permeability barrier to contain wastes while Aquagate® allows specific treatment materials for bioremediation or phytoremediation to interact with contaminated sediment, thus improving the remediation outcome.

Conclusions

Advances in PCB remediation and removal technologies provide viable alternatives to sediment removal, capping, and thin-cover placement. General conclusions include:

- Many viable technologies exist for in situ and ex situ treatment.
- Dredging and removal technology has improved as well and can be more economically and envrionmentally sustainable.
- As circumstances differ dramatically from one project site to another, each option should be assessed independently when determing appropriate remediation technologies.

The EPA needs to institute an evaluation of possible alternative technologies. This could mean re-opening the Feasibility Study.

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