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VIA EMAIL AND UPS

Mr. Christos Tsiamis
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Central New York Remediation Section
U.S. Environmental Protection Agency
290 Broadway, 20th Floor
New York, NY 10007-1866

Re: ***Superfund Proposed Plan***
Gowanus Canal Superfund Site
Kings County, New York

Dear Mr. Tsiamis:

These comments on the "*Superfund Proposed Plan*, Gowanus Canal Superfund Site, Kings County, New York" (SPP) issued by the U.S. Environmental Protection Agency (EPA) in December 2012 are submitted on behalf of Consolidated Edison Company of New York, Inc. (Con Edison).

Introduction and Summary of EPA's Preferred Remedy

The Gowanus Canal is a man-made canal located in Brooklyn, New York, that was added to the National Priorities List in early 2010.[1] EPA conducted a remedial investigation of the sediments in the canal, and a feasibility study of remedial alternatives, with the goal of developing a response action that would "reduce or eliminate unacceptable human health and ecological risks from exposure to the contaminated sediments and to prevent recontamination of the sediments after the remedy is implemented."[2] The SPP describes the remedial alternatives that were considered for the site, identifies EPA's preferred remedy, and provides EPA's rationale for that preference.[3]

The principal focus of EPA's preferred remedy is on the contamination of Gowanus Canal sediments by polycyclic aromatic hydrocarbons (PAHs) and by non-aqueous phase liquid

[1] 75 *Fed. Reg.* 9790 (Mar. 4, 2010).
[2] SPP (at 2).
[3] The administrative record in support of the SPP includes a draft Remedial Investigation Report (RI) dated January 2011; a draft Feasibility Study (FS) dated December 2011; and a Feasibility Study Report Addendum (FS Addendum) dated December 2012. Appendices to the RI include a Human Health Risk Assessment (HHRA) and an Ecological Risk Assessment (ERA).

(NAPL). EPA has established six Remedial Action Objectives (RAOs) to be achieved by the preferred remedy, and five of them address either PAHs or NAPL. Three risk-based RAOs for PAHs were developed based on EPA's conclusion that the PAH contamination presents unacceptable risks to human health and to ecological receptors. Two other RAOs were developed to address potential recontamination by NAPL, either from ongoing sources, or from the residual NAPL that will remain at the site because it is too deep to be practically removed.

To address the human health and ecological risks from PAH contamination identified by EPA, the preferred remedy requires the removal of all soft sediments along the entire length of the canal. EPA also determined that ongoing sources of PAH and NAPL contamination, primarily from the three former manufactured gas plants that were located along the Gowanus Canal, must be controlled in order for the proposed remedy to be effective. And to prevent the residual NAPL remaining in the canal after the remedy is implemented from releasing additional PAHs into the canal sediments, EPA determined that a three-layer cap with a treatment layer will be constructed, and that in-situ stabilization of native sediment will be required in some areas with high levels of NAPL contamination.

The SPP also includes proposed actions to reduce combined sewer overflows from the City of New York's sewer system; the excavation and restoration of a lateral extension of the canal that has been filled in; institutional controls to incorporate an existing fish consumption advisory and to protect the integrity of the cap; and a possible on-site disposal facility. EPA states that it will coordinate with State and local authorities to control ongoing discharges from upland contaminated areas and from unpermitted pipe outfalls.

Overview of Comments

The SPP suggests that, in addition to the PAH and NAPL contamination, concentrations of polychlorinated biphenyls (PCBs) in Gowanus Canal sediments are contributing to unacceptable human health and ecological risks. Consequently, PCBs are identified in two of the six RAOs. However, as discussed in detail in these comments, the underlying analyses used to support those risk-based conclusions are flawed. Thus, EPA's conclusions regarding the risks presented by PCBs in Gowanus Canal sediments, and regarding the need to address those purported risks in the preferred remedy, are not supported in the administrative record.

With respect to human health risks, EPA has not supported its assertion that PCB levels in fish taken from the Gowanus Canal are "about two times higher" than PCB levels in fish taken from the reference area. In addition, the HHRA uses overly conservative and unrealistic assumptions about fish consumption rates, and about the species that are consumed. Further, EPA has not demonstrated that PCBs in Gowanus Canal surface sediments actually contribute to PCBs in fish tissue, or that the proposed remedy will reduce fish tissue concentrations of PCBs.

Moreover, the RAO addressing human health risks is based on the assumption that concentrations of PCBs in Gowanus Canal surface sediments are significantly higher than in reference area surface sediments, when in fact there is no statistically significant difference

between them. And EPA acknowledges that even if the proposed remedy were to be implemented and the RAO were to be achieved, human health risks from fish consumption would not be reduced to acceptable levels, because PCB concentrations in fish and shellfish are and will remain a regional problem. Those risks are currently being addressed by institutional controls, and the same institutional controls would be required even if this remedy were to be implemented. In short, the administrative record does not support the assertion that PCB concentrations in Gowanus Canal surface sediments present human health risks that must be addressed by the preferred remedy.

With respect to ecological risks, EPA's assertion that PCB concentrations in Gowanus Canal surface sediments are statistically higher than in reference area surface sediments disregards the PCB congener data in the administrative record. The environmental consulting firm ENVIRON conducted an analysis using those congener data, and it shows that there is no statistically significant difference between PCB concentrations in Gowanus Canal surface sediments and in reference area surface sediments.

More importantly, EPA's conclusion that PCBs in Gowanus Canal surface sediments are contributing to benthic toxicity is based solely on a comparison of sediment concentrations to a screening value. But screening values are merely tools to determine whether more refined analyses are required; they cannot be used to determine toxicity, because they do not take into account site-specific conditions that affect bioavailability.

EPA apparently found it unnecessary to develop a site-specific risk-based value for PCBs, based on its reasoning that the remediation that is necessary to address benthic toxicity from PAHs in Gowanus Canal surface sediments will also remove the PCBs that "co-occur" with those PAHs. But that begs the question of whether the PCBs in Gowanus Canal surface sediments are, or are not, toxic to benthic organisms. In order to answer that question, ENVIRON relied on several lines of evidence derived from the scientific literature to develop a site-specific risk-based criterion for Gowanus Canal surface sediments based on cause-effect, concentration-response relationships. The PCB concentrations in Gowanus Canal surface sediments are all well below that site-specific risk-based criterion.

Moreover, EPA did not comply with the requirements of the National Contingency Plan (NCP) in its development of the two RAOs that are intended to address human health and ecological risks from PCB concentrations in Gowanus Canal sediments. The RI lacks sufficient data to adequately characterize risks attributable to PCBs, or to support the development of appropriate response actions based on those risks, both of which are required under the NCP. In addition, the FS does not contain remediation goals that "establish acceptable exposure levels that are protective of human health and the environment," also as required by the NCP.

For all of these reasons, Con Edison respectfully submits that the RAOs identified in the SPP should be modified in the Record of Decision (ROD). Specifically, the RAO addressing PCB levels in fish and shellfish should be eliminated in its entirety, and the RAO addressing toxicity to benthic organisms should be revised to eliminate any reference to PCBs.

Comments

I. Statements in the SPP that PCBs in Gowanus Canal Sediments Present Unacceptable Risks to Human Health are Not Supported by the Record, and the Proposed Remedial Action Would be Unnecessary and Ineffectual

The SPP states that human consumption of fish and crabs taken from the Gowanus Canal presents unacceptable health risks, due to the levels of PCBs in edible tissues.[4] EPA also implies, without further support, that PCBs in Gowanus Canal surface sediments have contributed to those tissue levels. EPA thus derived the following RAO:

> Reduce the contribution of polychlorinated biphenyls (PCBs) from the Gowanus Canal to fish and shellfish by reducing the concentrations of PCBs in Gowanus Canal sediments to levels that are within the range of Gowanus Bay and Upper New York Bay reference concentrations.[5]

EPA also established a PRG of 0.48 mg/kg total PCB congeners, which it described as the "maximum concentration in reference area surface sediment."[6]

EPA's analyses and conclusions regarding human health risks from PCBs in Gowanus Canal sediment are flawed. First, the administrative record does not support EPA's characterization of PCB levels in Gowanus Canal fish as "about two times higher" than PCB levels in reference area fish. Second, the HHRA uses overly conservative and unrealistic assumptions regarding fish consumption rates and the species that are consumed. Third, EPA fails to quantify the extent to which PCBs in Gowanus Canal surface sediments contribute – if at all – to PCB levels in fish tissue, and fails to quantify the reduction in PCBs in fish tissue – if any – that would result from achieving the RAO. Fourth, there is no statistically significant difference between total PCB congener concentrations in Gowanus Canal surface sediments and total PCB congener concentrations in reference area surface sediments.

The RAO and PRG are thus based on certain assumptions that are not supported in the administrative record. More importantly, the SPP notes that "game fish and blue crabs do not forage solely in the canal and the PCB concentrations in their tissues reflect cumulative uptake from all of the areas that they inhabit."[7] EPA further acknowledges that consumption of fish and crabs taken from the reference area also present unacceptable human health risks.[8] Consequently, "because of the anticipated unacceptable human health risk associated with the consumption of PCB-contaminated fish and shellfish *after the remedy is implemented*,"[9] the SPP incorporates the existing fish consumption advisory as an institutional control.

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[4] SPP (at 14).
[5] FS Addendum, *Supplemental Evaluation of Remediation Goals* (at 3).
[6] SPP (at 16). Surface sediments are those in the 0-to-6-inch depth interval. *Id*. (at 9).
[7] *Id*. (at 16).
[8] *Id*. (at 14).
[9] SPP (at 31, emphasis added).

In other words, according to EPA, even if the RAO is achieved, it will not reduce to acceptable levels the human health risks from consumption of fish and shellfish. Thus, any remedial action intended to achieve that RAO would not meet the effectiveness criterion of the NCP. Continuation of the existing institutional control is both necessary and sufficient to address the risk pathway from fish consumption, and nothing in the administrative record demonstrates that the proposed response action is required or would be effective. Accordingly, the RAO based on human health risks from PCBs in Gowanus Canal sediments should not be included in the ROD for this site.

A. EPA has not properly compared PCB levels in fish taken from the Gowanus Canal to PCB levels in fish taken from the reference area

The SPP states that the "average concentrations of PCBs in the canal fish and crab samples were about two times higher than the average PCB concentrations in the reference area samples collected from Gowanus Bay and Upper New York Bay."[10] Although the SPP does not provide a reference for that assertion, it appears to come from a statement in the HHRA that "[r]eference area average PCB fish concentrations are about one half the average concentrations identified in canal fish."[11] However, that comparison is neither accurate nor complete.

Table 2-5 of the RI provides a summary of the total number of samples collected for blue crabs and for larger fish species. In the Gowanus Canal, there were 12 blue crab samples (edible tissue), 2 blue crab samples (hepatopancreas), 6 American eel samples, 5 striped bass samples, and 2 white perch samples. In the reference area, there were 8 blue crab samples (edible tissue) and 1 blue crab sample (hepatopancreas), but only 1 American eel sample, and no striped bass or white perch samples. In other words, although blue crabs are represented by data from both the Gowanus Canal and the reference area, American eel is the only fish species represented by data from both the Gowanus Canal and the reference area, and the data used to characterize PCB concentrations in American eel in the reference area were based on a single sample.

The comparisons of average concentrations for PCBs in crab and fish tissue are found in Table 7-3 of the HHRA, for three groupings of PCB congeners used in the risk calculations (dioxin-like, non-dioxin-like, and total PCB congeners), and show the following:

- The comparisons for blue crabs show that the reference area averages range from 61 to 77 percent of the Gowanus Canal averages, which is considerably greater than one half.[12]

[10] SPP (at 14; at 15).
[11] HHRA (at 9-3).
[12] These percentages are based on the averages reported for the edible tissue and hepatopancreas samples, which were analyzed for PCB congeners. The data reported for "whole body" crabs were calculated from the edible and hepatopancreas data, and were not measured directly. RI (at 4-45).

- The comparisons for fish show that for American eel, the concentrations in the sole reference area sample taken ranged from 54 to 83 percent of the Gowanus Canal averages, which is also considerably greater than one half. And even though concentrations are presented for striped bass and white perch in the Gowanus Canal, it is not possible to make comparisons to concentrations in reference area samples of those fish species, because such data do not exist in the administrative record.

The extremely limited sample size of comparable fish data (*i.e.*, one sample for one species), and the magnitude of the actual percentage comparisons for both fish and crabs, are insufficient support for the blanket statement in the SPP that average PCB concentrations measured in fish and crabs collected from the Gowanus Canal were "about two times higher" than average PCB concentrations in the reference area samples.

B. The HHRA uses inadequately supported assumptions about overall fish consumption rates and about species-specific consumption rates

The HHRA relies on a number of highly conservative upper-bound exposure assumptions to estimate potential risks for reasonable maximum exposure (RME) scenarios. Some of these exposure assumptions appear to be inconsistent with USEPA's definition of an RME scenario as "the highest exposure that is reasonably expected to occur at a site."[13] Such overly conservative assumptions may be appropriate for use in screening-level risk assessments; if the risks estimated in a screening-level assessment are below levels of concern, then further refinement is not warranted. However, when the screening-level risk estimates exceed levels of concern (as in the case of the Gowanus Canal HHRA), it is appropriate to examine the underlying assumptions to identify those that warrant further refinement.

In fact, the SPP acknowledges that the HHRA "assumed fishing/crabbing and ingestion of the fish/crab from the canal at typical recreational angler fish/crab consumption rates, *which is very conservative given the nature of the canal*."[14] But a thorough review of the HHRA suggests that little effort was made to refine the initial assessment in order to incorporate more reasonable assumptions.[15] Further, while the Uncertainty Assessment section of the HHRA acknowledges that "the resulting risks are likely overestimates,"[16] it does not appear that any effort was made to characterize the degree of overestimation. Thus, the HHRA presents an overly conservative RME scenario that is inappropriate for a CERCLA baseline risk assessment.

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[13] USEPA 1989, *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual, Part A, Interim Final*. Office of Solid Waste and Emergency Response. EPA/540/1-89/002

[14] SPP (at 14, emphasis added).

[15] The only significant modification to the exposure scenarios in the HHRA was the addition of a subsistence fisherman scenario in the *Supplemental Evaluation of Remediation Goals* section of the FS Addendum.

[16] HHRA (at 8-2)

1. The consumption rates for Gowanus Canal fish and crabs are unrealistic

The HHRA risk calculations are based on the assumption that all of the fish and crabs consumed by an individual angler are taken from the Gowanus Canal. Considering the frequency of CSO discharges to the Gowanus Canal, the poor water quality in the Gowanus Canal (characteristics unrelated to PCBs), and the current and anticipated future fish consumption advisory, this assumption is unrealistic and highly unlikely to occur.[17]

Section 2.5 of the RI Report indicates that it was necessary to set traps at multiple locations and to combine samples from multiple reaches in order to obtain adequate tissue mass for analysis, due to the paucity of fish and crabs in the Gowanus Canal. In light of the limited number of locations offering public access to the Gowanus Canal, and the proximity of other fishable water bodies that have a greater abundance of fish and crabs than the Gowanus Canal, it would be appropriate to use an adjustment factor – to reduce the anglers' assumed consumption of fish and crabs taken from the Gowanus Canal and to account for their consumption of fish and crabs taken from other surface water bodies in the area.

2. The species-specific consumption rates used in the HHRA are not properly supported

The HHRA is not consistent in its statements regarding the percentages of total fish consumption assigned to each species taken from the Gowanus Canal, nor are those percentages properly supported. At one point, the HHRA indicates that striped bass represent top-level predators, white perch represent mid-level predators, and that "[t]he midlevel predator represents species most frequently harvested and consumed by anglers."[18] Elsewhere, however, the HHRA states that "eel represent bottom feeders with 44 percent of the total fish consumption, striped bass represent the intermediate level with 47 percent consumption, and white perch represent the remaining 9 percent."[19]

These statements are inconsistent regarding the predator level represented by striped bass (top-level vs. intermediate level). More significantly, because the PCB exposure point concentrations in American eel samples from the Gowanus Canal are nearly three times higher than the corresponding concentrations in white perch samples, assignment of 44 percent of total consumption to that bottom-feeding species is inappropriate in light of the statement that mid-level predator species are most frequently harvested and consumed by anglers.

Further, the HHRA indicates that the percentages assigned to those three species are based on a publication that presents data collected by a survey of licensed anglers in New York State conducted more than 20 years ago.[20] These data are unlikely to represent the practices of

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[17] A report by the New York City Department of Environmental Protection (NYCDEP) states that the NYSDEC listed the Gowanus Canal as a high-priority water body in 1998, noting that the levels of dissolved oxygen in the Gowanus Canal were severe enough to prevent fish propagation. This listing is still in effect. NYCDEP. 2008. *Gowanus Canal Waterbody/Watershed Facility Plan Report* (at 1-6).

[18] HHRA (at 4-3).

[19] HHRA (at 5-6).

[20] *Id*., citing Connelly et al., 1992.

anglers who currently consume fish from the Gowanus Canal, because no license is required to collect fish and crabs from the Gowanus Canal.[21] Instead, the data most likely represent the practices of fresh-water fishermen, not those of Gowanus Canal anglers. Thus, the species-specific consumption rates and the angler practices assumed in the HHRA are unlikely to be representative of those actually occurring in the Gowanus Canal.

C. EPA has not demonstrated that PCBs in Gowanus Canal surface sediments contribute to PCBs in fish tissue or that the proposed remedy will reduce tissue concentrations of PCBs

It is well-established EPA policy that risks associated with background conditions must be properly assessed and taken into account in the development and selection of a proposed remedy, because "the CERCLA program, generally, does not clean up to concentrations below natural or anthropogenic background levels."[22] In the context of the HHRA for PCBs in Gowanus Canal sediments, this means two things: first, that EPA must consider whether, and to what extent, background conditions contribute to the PCB levels found in fish tissue; and second, that EPA must evaluate whether, and to what extent, PCBs in Gowanus Canal surface sediments contribute to the PCB levels found in fish tissue in excess of those background levels.

Although EPA implicitly assumes that PCBs in Gowanus Canal sediments contribute to the PCB levels in fish tissue, there are absolutely no data, analyses, studies or other information in the administrative record that support that key assumption. To the contrary, EPA acknowledges that it has not established any causal link between PCBs in Gowanus Canal sediments and PCBs in fish tissue:

> Additionally, the species targeted in the HHRA (striped bass, white perch, American eel and blue crab) inhabit areas that are larger than the Gowanus Canal, and the PCB concentrations in their tissue reflect contributions from all of the areas in which they forage. Therefore, *the PCB concentrations in fish and shellfish caught in the canal cannot be directly linked to PCB concentrations in the canal sediments alone.. . .PCB concentrations in [canal] sediment cannot be directly linked to the target species that were caught in the canal*.[23]

And even if such linkage could be established from studies or other information not in the administrative record, EPA acknowledges that the amount of any such contribution is uncertain at best:

> [T]he home ranges of the fish and shellfish species evaluated in the HHRA are not restricted to the Gowanus Canal, and the contaminant concentrations in tissue reflect contributions from all of the areas in which they forage. Additionally, the

[21] HHRA (at 2-1). New York State does not require a license for fishing from marine, coastal district, and tidal waters for "migratory fish from the sea." http://www.dec.ny.gov/permits/6091.html.
[22] USEPA 2002, *Role of Background in the CERCLA Cleanup Program.* OSWER 9285.6-07P.
[23] FS Addendum, *Supplemental Evaluation of Remediation Goals* (at 4, emphasis added).

> ingestion of some fish and shellfish species from the reference area in Upper New York Bay also poses an unacceptable risk. *Therefore, reductions in contaminant concentrations in canal sediments will not necessarily result in reductions in tissue concentrations to levels that do not pose a risk.*[24]

In short, EPA has assumed, but has not demonstrated in the administrative record, that PCBs in Gowanus Canal surface sediments actually contribute to PCB concentrations in fish tissue. And even if such a demonstration could be made, the fact remains – as discussed below – that, according to EPA, background concentrations of PCBs in fish tissue are already unacceptably high, and will not be reduced to acceptable levels by the proposed remedial action. Under these circumstances, any incremental risk reduction that could hypothetically be achieved by reducing PCB concentrations in Gowanus Canal surface sediments cannot be justified under EPA policy, or under the effectiveness criterion of the NCP.

D. The RAO and PRG have been set arbitrarily and will not reduce human health risks to acceptable levels

The RAO to address human health risks from consumption of PCBs in edible fish and shellfish tissues is as follows:

> Reduce the contribution of polychlorinated biphenyls (PCBs) from the Gowanus Canal to fish and shellfish by reducing the concentrations of PCBs in Gowanus Canal sediments to levels that are within the range of Gowanus Bay and Upper New York Bay reference concentrations. [25]

Implicit in this formulation are the assumptions (i) that PCBs from Gowanus Canal surface sediments are in fact contributing to PCB levels in fish and shellfish tissues, and (ii) that reducing PCB concentrations in Gowanus Canal surface sediments will reduce PCB levels in fish and shellfish tissues. But as discussed above, there is no support in the administrative record for either of those assumptions. The RAO has thus been set arbitrarily.

Moreover, there is another embedded assumption in the RAO – namely, that the concentrations of PCBs in Gowanus Canal surface sediments are statistically significantly higher than the reference area concentrations. But that is not the case. As discussed in detail below in Section II.A. of these comments, there is no statistically significant difference between total PCB congener concentrations in Gowanus Canal surface sediments and total PCB congener concentrations in reference area surface sediments, which renders the RAO essentially meaningless.

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[24] *Responses to National Remedy Review Board and Contaminated Sediments Technical Advisory Group Recommendations for the Gowanus Canal Superfund Site, Brooklyn, New York* (Responses to NRRB/CSTAG), Region 2, Dec. 28, 2012 (at 11, emphasis added).

[25] FS Addendum, *Supplemental Evaluation of Remediation Goals* (at 3).

More importantly, even if there were supporting documentation for this formulation of the RAO, EPA acknowledges that achieving the RAO – *i.e.*, reducing concentrations of PCBs in Gowanus Canal surface sediment to levels within the range of Gowanus Bay and Upper New York Bay reference concentrations – will not reduce human health risks from fish consumption to acceptable levels:

> [H]owever, *the PCB concentrations in the reference area samples also result in carcinogenic risks and non-carcinogenic hazards that exceed acceptable levels*. The New York State Department of Health (NYSDOH) has fish consumption advisories for Gowanus Bay and Upper New York Bay that identify PCBs as a COC in fish (NYSDOH, 2010). Because PCB contamination in fish is a regional problem, remediation of the sediments in the canal is unlikely to reduce PCB concentrations in fish tissue to acceptable levels.[26]

> Under current conditions, the PCB concentrations in reference area fish tissue pose a risk. *If the canal is cleaned up to similar concentrations as the reference area, the fish tissue will still pose a risk. While the concentration may not be protective*, it is the best that can be achieved.[27]

Under these circumstances, the RAO for human health risks from PCB contamination in Gowanus Canal sediments cannot be used as a criterion in support of, or to justify, the preferred remedy. Indeed, any RAO that has the sole purpose of reducing PCB concentrations in Gowanus Canal sediments, in the expectation of reducing fish tissue concentrations to acceptable levels of risk, would be futile and would result in remedial action for the sake of remedial action.

The PRG suffers from the same deficiencies, as it is nothing more than a numerical target for achieving the RAO, and it is not derived from any consideration of risk reduction:

> Site-specific risk-based PRGs were not developed for PCBs in sediment or tissue because it is unlikely that the canal remedy will reduce risk from ingesting PCB-contaminated fish and shellfish to acceptable levels. . ..[28]

Instead, the "maximum Gowanus Bay and Upper New York Bay reference area concentration for PCBs in sediment was selected as the PRG. This PRG is 0.48 mg/kg [total PCB congeners]."[29] However, as noted above, this PRG is essentially meaningless, because there is no statistically significant difference between total PCB congener concentrations in Gowanus Canal surface sediments and total PCB congener concentrations in reference area surface sediments.

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[26] *Id*. (at 3-4, emphasis added).
[27] Responses to NRRB/CSTAG (at 14, emphasis added).
[28] FS Addendum, *Supplemental Evaluation of Remediation Goals* (at 4).
[29] *Id*.

E. Existing institutional controls are the best method to address any human health risks that may be presented by PCBs in Gowanus Canal surface sediments

As discussed above, the administrative record does not support the threshold assertion that PCBs in Gowanus Canal surface sediments contribute to unacceptable human health risks. As EPA has acknowledged, PCB contamination in fish is a regional problem and even fish in the reference area have unacceptably high levels of PCBs in their edible tissue.

This regional problem is currently being addressed by a NYSDOH fish consumption advisory. Not surprisingly, the SPP incorporates that institutional control as part of the preferred remedy. However, EPA's statement in support of that action is highly significant:

> The existing fish consumption advisory would be included because of the anticipated unacceptable human health risk associated with the consumption of PCB-contaminated fish and shellfish *after the remedy is implemented*.[30]

In other words, EPA acknowledges that the proposed remedial action will not be an effective means of addressing human health risks (if any) presented by PCBs in Gowanus Canal surface sediments. Continuation of the existing institutional controls (*i.e.*, the fish consumption advisory) will still be required, and nothing in the administrative record demonstrates that any additional response would be necessary, appropriate, or effective in addressing that exposure pathway.

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For all of the foregoing reasons, the RAO based on human health risks from PCBs in Gowanus Canal surface sediments should not be included in the ROD for this site.

II. <u>PCBs in Gowanus Canal Surface Sediments Do Not Present An Unacceptable Toxicity Risk to Benthic Organisms</u>

As part of the RI, EPA conducted an ERA to determine whether contaminant concentrations in Gowanus Canal surface sediments present a risk to ecological receptors. Risks to benthic macroinvertebrate communities were evaluated primarily through the use of laboratory-based sediment bioassays (i.e., toxicity tests), and through comparison of sediment chemical concentrations to literature-based screening benchmarks.[31]

The sediment bioassays indicated "a site-related potential for adverse effects to benthic communities from chemicals in sediment."[32] Because PAHs were "consistently detected in sediment at the highest concentrations relative to their ecological screening benchmarks,"[33] EPA

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[30] SPP (at 31, emphasis added).
[31] SPP (at 14).
[32] *Ibid*.
[33] *Ibid*.

concluded that PAHs "represent the greatest site-related risk to the benthic community"[34] and are "the most likely cause of the toxicity observed in laboratory tests."[35]

Other contaminants were also identified as potential contributors to the observed toxicity to benthic organisms, based on two criteria: they were present in Gowanus Canal surface sediments at concentrations that "exceeded both risk-based screening levels and were statistically higher than reference area concentrations."[36] Based on those two criteria, PCBs and seven metals were designated as COCs with respect to "*potential* site-related risk to the benthic community."[37] Based on the same two criteria, but without further analysis, EPA concluded that the ERA had found that PCBs and the seven metals "*are* toxic to benthic organisms."[38]

EPA thus developed the following RAO for benthic toxicity:

> Reduce the risks to benthic organisms in the canal from direct contact with PAHs, PCBs, and metals in sediment by reducing sediment toxicity to levels that are comparable to reference conditions in Gowanus Bay and Upper New York Bay.[39]

However, a site-specific risk-based PRG was "developed for PAHs only[,] because PAHs are most likely causing the toxicity in the sediments."[40] With respect to PCBs, EPA specifically noted that although concentrations exceeded sediment quality screening values, "the magnitude of exceedances was low. Therefore, the potential contribution of PCBs to observed toxicity relative to PAHs is considered to be low. PCBs co-occur with PAHs and therefore will be addressed through the remediation of the PAHs."[41]

EPA's conclusion that PCBs are contributing to benthic toxicity of Gowanus Canal surface sediment is unsupported. EPA based that conclusion on a simple comparison of sediment concentrations to a screening value. But screening values are merely tools to decide whether more refined analyses are required; they cannot be used to make determinations about cause-effect, concentration-response relationships, because they do not take into account site-specific conditions that affect bioavailability, nor other confounding factors. The mere circumstance that PCB concentrations in Gowanus Canal surface sediments exceed a screening value does not establish that those PCBs are toxic to benthic invertebrate organisms.

In order to make a determination regarding benthic toxicity, it would first be necessary to develop a site-specific risk-based criterion for Gowanus Canal surface sediments, and then to compare the PCB concentrations in Gowanus Canal surface sediments to that site-specific risk-

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[34] *Ibid*.
[35] FS Addendum, *Supplemental Evaluation of Remediation Goals* (at 5).
[36] *Ibid*.
[37] SPP (at 14, emphasis added).
[38] *Id*. (at 15, emphasis added).
[39] FS Addendum, *Supplemental Evaluation of Remediation Goals* (at 4).
[40] Responses to NRRB/CSTAG (at 13).
[41] FS Addendum, *Supplemental Evaluation of Remediation Goals* (at 5). A PRG was not established for either of the two metals of concern (copper and lead) because they "are not likely to be bioavailable." *Ibid*.

based criterion. EPA did not develop such a site-specific risk-based criterion, and therefore cannot properly conclude that PCB concentrations in Gowanus Canal surface sediments are toxic to benthic organisms.

EPA found it unnecessary to reach a definitive conclusion about the benthic toxicity of PCBs in Gowanus Canal surface sediments, as reflected in its statement that the remediation it selected to address benthic toxicity from PAHs in Gowanus Canal surface sediments will also remove the PCBs that "co-occur" with those PAHs. Under EPA's reasoning, the issue of whether those PCBs are toxic to benthic organisms is moot, because they will be "along for the ride" during the remediation that EPA has determined is necessary to address the PAH contamination.

Whether or not this issue is moot, the assertion in the SPP that those PCBs "are toxic to benthic organisms" is wholly unfounded, and finds no support in the ERA or elsewhere in the administrative record. Nor does the administrative record contain a site-specific risk-based criterion for determining the benthic toxicity of PCBs in Gowanus Canal surface sediments.

In order to make a definitive determination as to the matter of benthic toxicity of PCBs in Gowanus Canal surface sediments, ENVIRON developed a site-specific risk-based criterion based on three lines of evidence from the scientific literature. As discussed in detail below in Section II.C. of these comments, ENVIRON derived a value of 41 mg/kg. Because PCB concentrations in all Gowanus Canal surface sediments sampled in the RI are well below that level, the RAO for benthic toxicity should be revised in the ROD to eliminate any reference to PCBs.

A. PCB concentrations in Gowanus Canal surface sediments are not statistically higher than in reference area surface sediments

As a threshold issue, not only is EPA's characterization of the PCB concentrations in Gowanus Canal surface sediments as "statistically higher than reference area concentrations"[42] incorrect, but it is also based on an inaccurate and inconsistent value for PCB concentrations in reference area surface sediments.

Specifically, Table 6-1 of the ERA is entitled "Comparison of Detected Constituents in Reference Sediment Samples to Criteria." Under the heading "Pesticides/PCBs (ug/kg)," the only entry is "*None detected*."

But "none detected" is inconsistent with the analytical results from the RI and with the statement in the FS Addendum that the "maximum Gowanus Bay and Upper New York Bay

[42] *Ibid*.

reference area concentration for PCBs in sediment" is 0.48 mg/kg.[43] That same value is also reflected in Table 1 of the SPP, "Average Contaminant Concentrations at Reference Stations."[44]

It is likely that the "none detected" entry in Table 6-1 of the ERA was based on analysis for PCB Aroclors, rather than PCB congeners, even though the ERA itself states that "congener-specific data offers a more comprehensive representation of the total PCB concentrations in a medium."[45] Indeed, there are congener data in the RI for three of the five reference area stations that are shown in Table 6-1; instead of "none detected," the total PCB values reported for those three stations are 0.341 mg/kg, 0.466 mg/kg, and 0.476 mg/kg.[46]

The last of those three congener values would be rounded to 0.48 mg/kg, which is the value used in the SPP and the FS Addendum as the maximum concentration in the reference area. The same congener value is established as the PRG for the RAO addressing human health risks, and EPA also used congener data to perform the risk calculations presented in the HHRA and the ERA. Accordingly, instead of the "none detected" value from Aroclor data, congener data should have been used to investigate the potential differences in total PCB concentrations between the Gowanus Canal surface sediments and the reference area surface sediments.

Appendix A to these comments, "Comparison of PCB Congener Concentrations in Surface Sediments in Gowanus Canal and in Reference Area," was prepared by ENVIRON and shows that there is no statistically significant difference between total PCB congener concentrations in the Gowanus Canal surface sediments and total PCB congener concentrations in reference area surface sediments. In support of that analysis, Appendix A also contains a detailed description of the available data sets, and discusses inconsistencies both in those data sets, and in certain analyses in the RI and the SPP.

B. Toxicity determinations cannot be based on comparisons to screening levels

EPA has used a screening value as the sole determinant of the benthic toxicity of PCBs in Gowanus Canal surface sediments. But screening levels are just that – thresholds below which no further analysis is warranted, and above which more refined assessments are required. By their very nature, screening values cannot be used to make determinations about cause-effect, concentration-response relationships, because they do not take into account site-specific conditions that affect bioavailability, nor other confounding factors.

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[43] *Id.* (at 4).

[44] Table 1 shows a "Reference Average" of 0.47 mg/kg, and a "Reference Range" of 0.47-0.48 mg/kg, for "Total PCBs."

[45] "There are 209 individual PCB congeners (compounds), but there are nine Aroclors (Aroclors 1016, 1221, 1232, 1242, 1248, 1254, 1260, 1262, and 1268). . . .Aroclors consist of a mixture of PCB congeners. Since not all congeners are represented in Aroclor mixtures, congener-specific data offers a more comprehensive representation of the total PCB concentrations in a medium." ERA (at 7-4).

[46] The PCB congener data are found in Table I-5A of the RI.

Indeed, EPA acknowledges in the SPP that screening criteria are not determinative of toxicity, and cannot be used to establish target cleanup levels. The SPP includes the following quotation, selected by EPA, from NYSDEC's *Technical Guidance for Screening Contaminated Sediments*:

> Sediments with contaminant concentrations that exceed the criteria listed in this document are considered to be contaminated and *potentially* causing harmful impacts to marine and aquatic ecosystems. *These criteria do not necessarily represent the final concentrations that must be achieved through sediment remediation.* Comprehensive sediment testing and risk management are necessary to establish when remediation is appropriate and what final contaminant concentrations the sediment remediation efforts should achieve.[47]

The screening value used to evaluate benthic toxicity was 0.0598 mg/kg,[48] which is found in the Screening-Level Ecological Risk Assessment (SLERA). As indicated in Table 3-5 of the ERA, "Medium-Specific SLERA Screening Values – Sediment and Surface Water," that value is for total PCB congeners, and the source is identified as MacDonald et al. (2000).[49] That table also references a screening value of 0.0227 mg/kg for individual PCB Aroclors, and total PCB Aroclors, and the source is identified as NYSDEC (1999),[50] although those screening values were based on an earlier publication by Long et al. (1995).[51]

It is widely accepted that empirical sediment quality guidelines (SQGs) such as those presented by Long et al. (1995) and by MacDonald et al. (2000) do not necessarily represent cause-effect, concentration-response relationships between chemical concentrations and biological effects.[52] Rather, their purpose is to provide an indication of whether more detailed analyses (for example, sediment toxicity tests) should be conducted to determine whether sediments are actually toxic. And in sediments contaminated by multiple chemicals, additional information would be needed to determine which chemicals are responsible for any observed toxicity.

The SQGs for PCBs presented in Long et al. (1995) were derived using an empirical approach that relied upon a large database of paired sediment chemistry and biological data collected from sites contaminated by multiple chemicals. There are several limitations to this

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[47] SPP (at 15, fn. 21; emphasis added).
[48] SPP, Table 7 (referenced at 16).
[49] Section 9 of the ERA, "References and Bibliography," does not contain a citation to MacDonald et al. (2000). However, the proper citation is: MacDonald, D.D., C.G. Ingersoll, and T.A. Berger. 2000. Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems. *Arch. Environ. Contam. And Toxicol.* 39:20-31.
[50] NYSDEC, *Technical Guidance for Screening Contaminated Sediments*, 1999.
[51] Long ER, MacDonald DD, Smith SL, Calder FD. 1995. Incidence of adverse biological effects within ranges of chemical concentrations in marine and estuarine sediments. *Environ Manag* 19:81–97.
[52] Wenning, R.J., G.E. Batley, C.G. Ingersoll, and D.W. Moore (eds). 2005. *Use of Sediment Quality Guidelines and Related Tools for the Assessment of Contaminated Sediments*. Society of Environmental Toxicology and Chemistry (SETAC) Press, Pensacola, FL.

database. *First*, the specific chemicals that caused the toxicity observed in laboratory tests were not identified; multiple chemicals were present at most sites and may have contributed to the toxicity of the sediments. *Second*, the bioavailability of the chemicals detected in the sediment from each site was not determined; this matters, because site-to-site variation in bioavailability causes site-to-site variation in the levels of PCBs that are toxic to benthic organisms. *Third*, there was substantial variation in sediments from various sites in geochemical characteristics that are known to influence bioavailability (e.g., organic carbon content, and sulfide concentration); this suggests that there was substantial site-to-site variability in the levels of PCBs that would be toxic to benthic organisms.

In addition, a critical evaluation of the "consensus" screening values for PCBs developed by MacDonald et al. (2000) found that those screening values were unreliable in identifying PCB toxicity and suffered from the same limitations noted above.[53] Key deficiencies include: inability to isolate effects caused by PCBs due to the co-occurrence of multiple contaminants in underlying data; inability to distinguish non-causal correlations from cause-effect, concentration-response relationships between chemical concentrations and biological effects; and derivation methods that are influenced by the distribution of concentrations in the underlying data set (regardless of relationship to toxicity) and are thus biased toward background and low PCB concentrations.[54]

Furthermore, the reliability of SQGs for predicting the toxicity of PCBs in sediments has been repeatedly demonstrated to be less than 60%.[55,56,57,58] Because of these limitations, the critical evaluation states that any conclusion regarding the cause of observed toxicity in sediment contaminated by multiple chemicals should be based on site-specific assessments of bioavailability and concentration-response relationships, as well as laboratory determination of causality with spiked sediment studies.[59]

C. The PCB concentrations in Gowanus Canal surface sediments are not toxic to benthic organisms

Screening values are useful as the first step in identifying COCs, but they cannot be used as the sole criterion to conclude that PCBs in Gowanus Canal surface sediments are toxic to

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[53] Becker, D.S. and T.C. Ginn. 2008. Critical evaluation of the sediment effect concentrations for polychlorinated biphenyls. *Integr. Environ. Assess. Manage.* 4:156-170.
[54] *Ibid*.
[55] Long ER, MacDonald DD, Smith SL, Calder FD. 1995. Incidence of adverse biological effects within ranges of chemical concentrations in marine and estuarine sediments. *Environ Manag* 19:81–97.
[56] Long ER, Field LJ, MacDonald DD. 1998. Predicting toxicity in marine sediments with numerical sediment quality guidelines. *Environ Toxicol Chem* 17:714–727.
[57] Smith SL, MacDonald DD, Keenleyside KA, Ingersoll CG, Field J. 1996. A preliminary evaluation of sediment quality assessment values for freshwater ecosystems. *J Great Lakes Res* 22:624–638.
[58] MacDonald DD, Carr RS, Calder FD, Long ER, Ingersoll CG. 1996. Development and evaluation of sediment quality guidelines for Florida coastal waters. *Ecotoxicology* 5:253–278.
[59] Becker, D.S. and T.C. Ginn. 2008. Critical evaluation of the sediment effect concentrations for polychlorinated biphenyls. *Integr. Environ. Assess. Manage.* 4:156-170.

benthic organisms. Screening values do not represent proof of a causal relationship between sediment concentrations and benthic toxicity, primarily because they do not take into account site-specific conditions that affect bioavailability. However, using multiple lines of evidence derived from the scientific literature, it is possible to develop a site-specific criterion based on cause-effect, concentration-response relationships between PCB concentrations in Gowanus Canal surface sediments and their potential effects on benthic invertebrates.

Appendix B to these comments, "Development of a Site-Specific Risk-Based Criterion for PCBs in Gowanus Canal Surface Sediments," was prepared by ENVIRON and describes that approach. The site-specific risk-based criterion was derived from application of the equilibrium partitioning method, from review of spiked sediment toxicity test results, and from analysis of biological data from contaminated sediment sites where PCBs are the primary contaminant of concern. It also used site-specific data from the RI regarding PCB homologue distributions and total organic carbon (TOC) concentrations.

The value derived in Appendix B as the site-specific risk-based criterion for PCB toxicity to benthic invertebrates is 41 mg/kg total PCB concentration, regardless of whether the concentration is generated from congener analysis or from Aroclor analysis. A review of the RI data indicates that <u>all</u> concentrations of PCBs in Gowanus Canal surface sediments are well below 41 mg/kg – the highest reported surface sediment concentration of total PCB congeners was 8.13 mg/kg at location 313,[60] and the highest reported surface sediment concentration of total PCB Aroclors was 3.4 mg/kg at location 314.[61]

Based on the comparison of PCB concentrations in Gowanus Canal surface sediments to the site-specific risk-based criterion determined by ENVIRON, it is clear that PCB concentrations in the Gowanus Canal are not toxic to benthic organisms. The RAO for benthic toxicity should therefore be revised in the ROD to eliminate any reference to PCBs.

III. <u>EPA Did Not Comply with the Requirements of the NCP in its Development of the RAOs for PCBs</u>

The NCP[62] is the blueprint for remedial actions under CERCLA, providing both a framework and specific provisions for responding to releases of hazardous substances. It establishes procedures and standards for conducting the investigation, study, and remediation of such releases. The framework emphasizes a measured process of: characterizing the nature and extent of the hazardous substance releases; assessing the risks posed by such releases, and the

[60] RI, Table I-5A. Table 5-5 of the ERA erroneously indicates that the maximum concentration of total PCB congeners was 15.1 mg/kg, reported at location 314. However, Table I-5A of the RI shows that the concentration of total PCB congeners in duplicate samples at location 314 were 4.03 mg/kg and 6.8 mg/kg, respectively. In any event, the erroneously reported value of 15.1 mg/kg for location 314 is still well below the site-specific criterion of 41 mg/kg.

[61] RI, Table I-4A; ERA, Table 5-5.

[62] 40 CFR Part 300.

need for response; and developing and selecting a remedy to address those hazardous substances that pose an unacceptable risk to human health or the environment.

The NCP sets forth the requirements that govern the conduct of the remedial investigation, the conduct of the feasibility study, and the selection of the remedy. However, EPA did not follow those requirements in its development of the RAOs for PCBs at this site. Accordingly, those RAOs should not be included in the ROD.

A. EPA did not comply with the NCP requirements for remedial investigations

The NCP sets out the purpose and requirements for the conduct of the remedial investigation, and provides in pertinent part as follows:

> The purpose of the remedial investigation (RI) is to collect data necessary to adequately characterize the site for the purpose of developing and evaluating effective remedial alternatives.. . .The RI provides information to assess the risks to human health and the environment and to support the development, evaluation, and selection of appropriate response alternatives.. . .The lead agency shall. . .gather data necessary to assess the extent to which the release poses a threat to human health or the environment.[63]

The NCP also contemplates that "estimates of actual or potential exposures and associated impacts on human and environmental receptors may be refined throughout the phases of the RI."[64]

Neither the SPP nor any of the underlying documents in the administrative record – either individually or in the aggregate – appropriately completed this process in order to support the development of the two RAOs for PCBs. In particular, and as discussed in detail above, the deficiencies include the following:

- EPA failed to collect sufficient information regarding PCB concentrations in fish tissues.
- EPA failed to refine its exposure estimates to reflect more realistic assumptions regarding both overall, and species-specific, fish and shellfish consumption rates.
- EPA failed to properly assess the risks to human health posed by consumption of fish and crabs from the Gowanus Canal.
- EPA failed to demonstrate a nexus between PCB concentrations in Gowanus Canal surface sediments and PCB concentrations in fish tissue.
- EPA failed to show that reductions in PCB concentrations in Gowanus Canal surface sediments will result in reductions in fish tissue concentrations.
- EPA failed to show that PCB concentrations in Gowanus Canal surface sediments are statistically higher than in reference area surface sediments.

[63] 40 CFR § 300.430(d)(1) and (2).
[64] 40 CFR § 300.430(d)(1).

- EPA failed to refine its initial determination of potential impacts on benthic toxicity that were based only on a screening value for PCBs.
- EPA failed to determine whether PCB concentrations in Gowanus Canal surface sediments are, or are not, toxic to benthic organisms.

In short, it is clear that EPA did not "collect data necessary to adequately characterize the site" with respect to PCB concentrations in Gowanus Canal surface sediments, nor did it "gather data necessary to assess" the extent to which those PCB concentrations pose a threat to human health or the environment. Further, the information in the RI is clearly not sufficient "to support the development, evaluation, and selection of appropriate response alternatives" that are based on a proper assessment of risks posed by PCB concentrations in Gowanus Canal surface sediments. Because of these shortcomings, the two RAOs for PCBs should not be included in the ROD for this site.

B. EPA did not comply with the NCP requirements for feasibility studies

The NCP establishes requirements for the feasibility study, and states that its primary objective is "to ensure that appropriate remedial alternatives are developed and evaluated such that relevant information concerning the remedial action options can be presented to a decision-maker and an appropriate remedy selected."[65] In support of that effort, the NCP directs the lead agency to:

> Establish remedial action objectives specifying contaminants and media of concern, potential exposure pathways, and remediation goals. . . . Remediation goals shall establish acceptable exposure levels that are protective of human health and the environment.[66]

The NCP also provides that "preliminary remediation goals" (PRGs) should be developed based on readily available information and then "modified, as necessary, as more information becomes available during the RI/FS."[67] In addition, the development and screening of remedial alternatives are to be guided by three criteria: effectiveness, implementability, and cost.[68]

As with the RI, EPA did not follow the requirements of the NCP for a feasibility study in its development of the two RAOs for PCBs.

With respect to the RAO based on health risks from PCBs, EPA has not established a PRG with "acceptable exposure levels that are protective of human health." Indeed, EPA has admitted that it is impossible to do so, because PCB contamination in fish is a regional problem, reflecting cumulative uptake from a broad foraging area: "If the canal is cleaned up to similar concentrations as the reference area, the fish tissue will still pose a risk. While *the concentration*

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[65] 40 CFR § 300.430(e)(1).
[66] 40 CFR § 300.430(e)(2)(i).
[67] *Ibid*.
[68] 40 CFR § 300.430(e)(7).

may not be protective, it is the best that can be achieved."[69] This falls far short of meeting the effectiveness criterion of the NCP.

Because EPA anticipates that the preferred remedy will be ineffective and that there will continue to be "unacceptable human health risk associated with the consumption of PCB-contaminated fish and shellfish after the remedy is implemented,"[70] the SPP retains the current, long-standing fish advisory as an institutional control. Clearly, that is the only response action that will effectively address this exposure pathway, and nothing in the administrative record suggests that any other remedial alternative would meet the effectiveness criterion of the NCP.

With respect to the RAO based on ecological risks of PCBs at this site, the deficiency is even more glaring. EPA did not establish any PRG that would "establish acceptable exposure levels that are protective" of benthic organisms. EPA essentially takes the position that it doesn't have to do so, because all of the soft sediment will be removed to address the benthic toxicity of PAHs – and since the PCBs "co-occur" in the soft sediment with PAHs, they will be removed as well. While this "along for the ride" rationale may be appealing, it is an insufficient basis for establishing an RAO under the NCP, particularly where EPA has failed to address the threshold issue of whether PCB concentrations in Gowanus Canal sediments are, or are not, toxic to benthic organisms. PCBs therefore must not be included in the RAO that addresses benthic toxicity.

* * *

In summary, EPA has failed to comply with the requirements of the NCP for remedial investigations, and for feasibility studies, in its development of the RAOs for PCBs at the Gowanus Canal site. Consequently, the RAOs for PCBs should not be included in the ROD.

Conclusion

Nothing in the administrative record supports the assertion that the low levels of PCBs in Gowanus Canal surface sediments are in any way risk drivers for the preferred remedy, which addresses PAH and NAPL contamination. There is no statistically significant difference between total PCB congener concentrations in Gowanus Canal surface sediments and total PCB congener concentrations in reference area surface sediments, and the PCB concentrations in Gowanus Canal surface sediments have not been shown to be toxic to benthic organisms.

Nevertheless, EPA proposes two remedial action objectives based on PCB concentrations in Gowanus Canal surface sediments. The first RAO addresses the potential contribution of PCBs to fish and shellfish that may forage in the Gowanus Canal, and states that the goal is to reduce PCB concentrations in Gowanus Canal sediments to levels "within the range" of reference area concentrations. There are several problems with this approach. EPA has not demonstrated that PCBs in Gowanus Canal surface sediments actually contribute to PCBs in fish tissue, or that reducing surface sediment concentrations of PCBs will reduce tissue

[69] Responses to NRRB/CSTAG (at 14, emphasis added).
[70] SPP (at 31).

concentrations of PCBs. Moreover, even if those assumptions were correct, no action would be required to achieve EPA's stated goal, because there is no statistically significant difference between the PCB concentrations in Gowanus Canal surface sediments and in reference area surface sediments.

More importantly, EPA indicates that even if the preferred remedy achieves the RAO, it will not reduce to acceptable levels the risks from consumption of PCB-contaminated fish and shellfish. Indeed, because concentrations of PCBs in fish tissue reflect cumulative uptake from a broad foraging area, no remedy addressing Gowanus Canal surface sediments would be effective at doing so; reference area fish and shellfish would continue to have unacceptably high levels of PCBs in their edible tissues following any such action. The only measure that would effectively address the exposure pathway from fish consumption, and the only measure that is needed, is continuation of the existing institutional control.

In these circumstances, the RAO based on this exposure pathway is not well conceived. Many of its underlying assumptions are not supported in the administrative record, and the RAO was not developed in compliance with the requirements of the NCP. For all of these reasons, that RAO should not be included in the ROD for this site.

The second RAO addresses the potential benthic toxicity of PCBs. EPA's development of that RAO began with an incorrect assumption, and ended prematurely without proper analysis. At the outset, EPA used two criteria to identify contaminants as potential contributors to benthic toxicity. The first criterion was whether concentrations of a contaminant in Gowanus Canal surface sediments "were statistically higher than reference area concentrations." EPA concluded that PCBs met that criterion, when in fact there is no statistically significant difference between total PCB congener concentrations in Gowanus Canal surface sediments and total PCB congener concentrations in reference area surface sediments.

The second criterion used to identify PCBs as a COC for benthic toxicity was the fact that the PCB concentrations in Gowanus Canal surface sediments slightly exceeded a risk-based screening level. However, instead of taking the scientifically-required next step – namely, conducting more refined analyses to determine, on a site-specific basis, whether the PCB concentrations in Gowanus Canal surface sediments were in fact toxic to the benthic community found there – EPA stopped the process. Without any further support, EPA simply concluded that benthic toxicity due to PCBs had already been established, when in fact it had not been. Indeed, had EPA evaluated the scientific literature and the available site-specific data regarding PCB homologues and TOC concentrations, it would have reached the opposite conclusion.

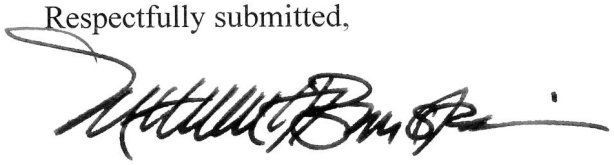
EPA glosses over these shortcomings by saying, in effect, that it doesn't really matter – all of the soft sediments will be removed to address EPA's concerns about the benthic toxicity of PAHs, and since the PCBs "co-occur" with the PAHs, they will be removed as well. But under that reasoning, where the PCBs are merely "along for the ride," they cannot be fairly characterized as a risk driver for the remedial element that will address benthic toxicity. EPA cannot have it both ways: either it must make an affirmative determination about the site-

specific benthic toxicity of the low levels of PCBs in Gowanus Canal surface sediments, or it must delete any reference to PCBs in the RAO. Because there is nothing in the administrative record that would support a finding of site-specific benthic toxicity, the RAO should therefore be revised to eliminate the reference to PCBs.

* * *

For all of the reasons set out in these comments, Con Edison respectfully submits that the RAOs identified in the SPP should be modified in the ROD. Specifically, the RAO addressing PCB levels in fish and shellfish should be eliminated in its entirety, and the RAO addressing toxicity to benthic organisms should be revised to eliminate any reference to PCBs.

Respectfully submitted,



Mitchell H. Bernstein

Attachments:

Appendix A, "Comparison of PCB Congener Concentrations in Surface Sediments in Gowanus Canal and in Reference Area"

Appendix B, "Development of a Site-Specific Risk-Based Criterion for PCBs in Gowanus Canal Surface Sediments"

cc: Brian E. Carr, Esq.

Appendix A

Comparison of PCB Congener Concentrations in Surface Sediments in Gowanus Canal and in Reference Area

ENVIRON

Appendix A – Comparison of PCB Congener Concentrations in Surface Sediments in Gowanus Canal and in Reference Area

Description of the available data sets

The RI Report provides concentration data for PCBs in surface sediments within the Gowanus Canal and in the reference area; PCB data from both areas were generated by two different laboratory methods.[1] All of the surface sediment samples collected by USEPA in 2010 (31 samples collected at 27 locations in the Gowanus Canal and 10 samples collected at 10 locations in the reference area) were analyzed for PCB Aroclors. In addition, 23 of the Gowanus Canal surface sediment samples (collected at 19 of the 27 locations) and 3 of the reference area surface sediment samples (collected at 3 of the 10 locations) were analyzed for PCB congeners. The RI report does not identify any earlier investigations of conditions in the Gowanus Canal and reference area that involved analysis of surface sediment samples for PCB Aroclors and congeners.

PCB Aroclors were detected in only 13 surface sediment samples collected at Gowanus Canal locations (at 10 of the 27 locations), and PCB Aroclors were not detected in any of the surface sediment samples collected at the 10 reference area locations. Thus, the available data set for PCB Aroclors in surface sediments in the Gowanus Canal and the reference area is composed primarily of non-detects (i.e., heavily censored[2]); actual measurements of the levels of PCBs in surface sediments are available for only 13 of the total of 41 samples, taken from only 10 of the total of 37 sampling locations. The results of the Aroclor analysis for the other 28 samples collected at the remaining 27 locations were all non-detects. The reported detection limits (which vary from sample to sample) should be interpreted as upper limits on the actual PCB

[1] Table I-4A of the RI Report lists data obtained by analyzing surface sediment samples for PCB Aroclors, and Table I-5A of the RI Report lists data obtained by analyzing surface sediment samples for PCB congeners.

[2] Page 130 of the USEPA guidance document titled *Data Quality Assessment: Statistical Methods for Practitioners* (EPA/240/B-06/003, USEPA 2006) says "Data that includes both detected and non-detected results are called censored data in the statistical literature."

concentrations in these samples, which were too low to be measured accurately by the method used to analyze these samples for PCB Aroclors.

By contrast, PCB congeners were detected in all 26 of the surface sediment samples that were analyzed for PCB congeners (23 from the Gowanus Canal and 3 from the reference area), although not all congeners were detected in each sample. The 26 samples analyzed for congeners were collected at 19 of the 27 Gowanus Canal surface sediment sampling locations and at 3 of the 10 reference area surface sediment sampling locations. Thus, compared to the Aroclor analysis, the PCB congener analysis provides measured values for a larger number of sampling locations both in the Gowanus Canal and in the reference area.

The RI Report does not explain why only 3 of the 10 reference area surface sediment samples were analyzed for PCB congeners. Although the field documentation provided in Appendix D-02 of the RI Report indicates that samples for PCB congener analysis were collected at 1 additional location in the Gowanus Canal and 5 additional locations in the reference area, the RI Report does not provide congener data for those samples or explain why they were not analyzed for PCB congeners.

A review of the quality of the PCB congener data is provided in Appendix H of the RI Report. This review says 22 results (of a total of 4,394 results[3]) were rejected by the data validator due to serious QA/QC problems and are not usable as detects or non-detects for any purpose. These 22 rejected results are identified by an "R" flag in the table that presents the complete results of the PCB congener analysis (i.e., Table I-5A in Appendix I of the RI Report). The 22 R-flagged results occur in a total of 7 surface sediment samples, all collected from the Gowanus Canal.[4] Table I-5A provides 169 results for each sample,[5] including results for each of nine homologue parameters and a parameter identified as "Total PCB (Lab)". None of the 22 R-flags in Table I-5A are applied to results reported for the homologue parameters or the Total PCB (Lab) parameter; this indicates that all of the results reported for these parameters are usable.

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[3] The total number of results reported by the laboratory (4,394) is equal to 26 (the number of samples analyzed for PCB congeners) times 169 (the number of parameters addressed by the PCB congener analysis).

[4] The 7 samples qualified with R-flags for one or more PCB congeners are identified in Table 1.

[5] Although there are 209 PCB congeners, some results were reported for groups of congeners that co-elute in the laboratory procedure (e.g., PCB 12/13, PCB 40/41/71, etc.) rather than for individual congeners. All 209 PCB congeners are represented in the 169 results reported for each sample.

Inconsistencies in the data sets and analyses in the RI Report and the SPP

1. Although the results reported for the Total PCB (Lab) parameter in Table I-5A are usable, USEPA apparently calculated and used different values to represent total PCB congeners in some of the surface sediment samples. This is indicated on a page titled "Notes for Statistical Summary Tables" that follows RI Table 4-3. A note at the bottom of that page concerning calculation of total concentrations says, "Total PCB was calculated by summing either detected concentrations of PCB Aroclors, or detected concentrations of PCB congeners. If any constituent had a rejected, or "R"-flagged, result, a total value was not calculated for the sample."

As noted above, 7 of the 23 Gowanus Canal surface sediment samples had at least one R-flagged concentration; this suggests that USEPA calculated total PCB concentrations for the other 19 surface sediment samples (16 from the Gowanus Canal and 3 from the reference area) by "summing. . .detected concentrations of PCB congeners". Table 2.12 Supplement a (which is presented in an attachment to the HHRA) lists congener data and provides sums of the detected congeners for each of the 26 surface sediment samples analyzed for PCB congeners, but that table shows 43 R-flagged results affecting 8 samples; this is not consistent with Table I-5A or the information in Appendix H of the RI Report, which identify only 22 R-flagged results affecting 7 samples. Section 5.3.1 of the HHRA indicates that non-detected congeners and B-flagged congeners[6] were not included in the sums shown in Table 2.12 Supplement a, but no B-flagged results were listed in that table or in RI Table I-5A. In addition, the highest sum shown in Table 2.12 Supplement a (which is equivalent to 10.1 mg/kg[7]) does not match the maximum value of 15.1 mg/kg shown in some of the other tables in the RI Report (e.g., Table H-3.1 and H-3.12 of the attachment to the HHRA, and Table 3-2 and Table 5-5 of the ERA).

Because of these discrepancies, ENVIRON re-calculated the sum of the detected congeners for each surface sediment sample. The R-flagged results identified in Table I-5A were excluded from these calculations; the sums produced by these calculations are provided in Table 1. In addition, the statement that a total value was not calculated for the samples with at least one R-flagged concentration suggests that USEPA used the results reported in Table I-5A for the Total

[6] Although B-flags are not discussed or applied to the PCB congener data in the Data Quality Evaluation presented in Appendix H of the RI Report, a B-flag is generally used to identify analytical results that are similar to the level of a chemical detected in related quality control blanks.

[7] The values reported in Table I-5A and some of the other tables discussed in this appendix are expressed in ng/kg. To simplify this appendix, all of these values are expressed in mg/kg in this discussion.

PCB (Lab) parameter to represent the total PCB concentrations in those 7 samples; those concentrations are also shown in Table 1.

2. The RI Report does not clearly identify the data that were used to represent total PCB congeners in each of the various analyses and tables presented in the body and appendices of that report. For example, the RI says "Data for PCB congeners that were used in support of the human health and ecological risk assessments are provided in Appendix I, Table I-5" (page 4-5). This statement suggests that USEPA used the results reported for the Total PCB (Lab) parameter in that table to represent the total PCB congener concentrations in surface sediments in the risk assessments. However, Table 5-5 of the ERA indicates that the maximum value for total PCB congeners is 15.1 mg/kg. This maximum value does not appear in Table I-5A; the highest concentration in that table is 8.13 mg/kg, reported for the Total PCB (Lab) parameter for the sample collected at station 313.

Although this discrepancy is not explained in the RI, ENVIRON has determined that the value of 15.1 mg/kg reported in ERA Table 5-5 is the sum of the detected congeners for one of the two samples collected at station 314. Rather than averaging the values for the two duplicate samples, USEPA apparently used only the maximum value in analyses of the total congener values. As a result, the maximum value reported for total PCB congeners in ERA Table 5-5 is nearly twice as high as the maximum concentration reported in Table I-5A, and is also associated with a different sampling location.[8]

3. For some of the surface sediment samples, the total PCB congener values calculated by summing the detected concentrations of congeners are considerably different from the values reported in Table I-5A for the Total PCB (Lab) parameter. Ratios that reflect this difference (calculated as the sum of congeners divided by the Total PCB (Lab) value) are nearly equal to 1 for 12 of the samples and less than 2 for all but 4 of the 26 samples; but the ratios for those 4 samples are much higher (9.8 for the sample collected at station 307A, 5.8 for the sample collected at station 319, 5.1 for the sample collected at station 326, and 3.7 for one of the two duplicate samples collected at station 314). Thus, the difference between the total PCB values calculated by summing the detected concentrations of congeners and the values reported for the Total PCB (Lab) parameter varies substantially from sample to sample.

[8] Station 313 is in the middle reach of the Gowanus Canal, while station 314 is at the eastern end of the Sixth Street turning basin.

In light of this variation, it is not appropriate to represent the total PCB concentrations in the sediments of interest by the sum of the detected congeners at some locations and by the Total PCB (Lab) values at other locations.

4. Table 1 of the SPP indicates that one station with a total PCB level of 1.7 mg/kg was excluded in determining the range of total PCB levels in the reference area. Although not explained in the RI or in the SPP, ENVIRON has determined that this value is the sum of the detected congeners in the surface sediment sample collected at station 326; the Total PCB (Lab) parameter value reported in Table I-5A for this sample is 0.34 mg/kg. The FS Addendum reports (page 4 in *Supplemental Evaluation of Remediation Goals, Gowanus Canal, Brooklyn, New York*) "The sample from station 326 was not included in the reference area data set because the total PCB congener concentration was more than three times higher than the concentrations in the other reference area samples." Exclusion of valid data merely because the value is substantially higher than other values considered representative of the same area is contrary to USEPA guidance documents (e.g., USEPA 2006, *Data Quality Assessment: Statistical Methods for Practitioners*, QA/G-9S, EPA/240/B-06/003). In this particular case, there are only three samples available to represent the reference area; exclusion of the value for station 326 suggests that conditions throughout the reference area can be adequately represented by the values at the two remaining locations. But the value of 1.7 mg/kg calculated for station 326 is valid, and should not have been excluded from the reference area data set.

Methods and data sets used to compare total PCB levels (Gowanus Canal to Reference Area)

The RI Report indicates that total PCB concentrations in surface sediment in the Gowanus Canal are significantly higher than in surface sediment in the reference area. This conclusion is based on statistical analysis of the data produced by the Aroclor analysis. Table 4-5 of the RI Report shows the results of comparisons of levels in the Gowanus Canal surface sediments to levels in the reference area surface sediments performed using data for three Aroclors and total PCBs (by Aroclor analysis). According to that table, the statistical method used for all four comparisons is Gehan's test, rather than the Wilcoxon Rank Sum (WRS) test; as explained in the RI Report, "The WRS test was used when the detection frequency in each data set was at least 60 percent; otherwise, Gehan's test was used" (page 4-6). Based on these tests, USEPA concludes that the levels of Aroclor 1260 and total PCBs in the Gowanus Canal surface sediment are significantly higher than in the reference area surface sediment (RI page 4-6).

The total PCB levels in surface sediments in the Gowanus Canal and reference area can also be compared using the PCB congener data, which USEPA has acknowledged are superior to Aroclor data. For example, USEPA describes congener data as "more sensitive and accurate" than Aroclor data in the FS Addendum *(Preliminary Estimate of Solids Reduction Needed to Achieve Remediation Goals,* page 3); elsewhere, EPA explains that "congener-specific data offers a more comprehensive representation of the total PCB concentrations in a medium" than do Aroclor data (ERA, page 7-4).

Nevertheless, the congener data are not used in the RI Report to compare the total PCB levels in the Gowanus Canal surface sediments to levels in the reference area surface sediments. Congener data are available for 19 Gowanus Canal locations and 3 reference area locations, which compares favorably to the number of locations represented by measured values (i.e., uncensored data) in the Aroclor data set (only 10 in the Gowanus Canal and <u>none</u> in the reference area). Moreover, USEPA's failure to use congener data for that purpose is inconsistent with its reliance on congener data for the risk calculations presented in the HHRA and the ERA. Accordingly, the congener data also should have been used to investigate the potential differences in total PCB concentrations between the Gowanus Canal and the reference area.

Because the total PCB congener data are not censored, the comparison between PCB levels in the Gowanus Canal and the reference area can be performed using the WRS test as described in the USEPA guidance document named above (EPA QA/G-9S), rather than using Gehan's version of this test method. The earlier sections of this appendix describe several data sets that could be used to compare the total PCB congener levels in the Gowanus Canal to the levels in the reference area, and another data set is suggested by Appendix C to these comments. The three data sets used in this appendix are:

1. The laboratory data set: This data set is based on the values reported in Table I-5A for the Total PCB (Lab) parameter. To provide the best estimate of the total PCB concentration at each location, the locations with duplicate samples are represented in the WRS tests by the averages of the two values reported for the Total PCB (Lab) parameter.
2. The combination data set: Even though ENVIRON does not believe that it is appropriate to use combined data sets in the statistical comparisons, this data set was developed to be consistent with the page titled "Notes for Statistical Summary

Tables" that follows RI Table 4-3. It includes the values reported for the Total PCB (Lab) parameter for the 7 samples with R-flagged congener data; for all other samples, it includes the values calculated as the sums of detected congeners. Because USEPA apparently used the higher of each pair of duplicate sample results in some analyses (e.g., RI Table 6-1 and ERA Table 5-5), the locations with duplicate samples are represented in the WRS tests by the higher of the two sample values.

3. The normalized data set: As explained in Appendix C to these comments, the toxicity of PCBs in sediments to benthic organisms is determined in part by their bioavailability, which is closely related to the level of TOC in the sediments. The normalized data set was developed to represent the level of total PCBs per gram of organic carbon in the sediments at each location. These normalized values were calculated by dividing the values in the laboratory data set (i.e., the values for the Total PCB (Lab) parameter) by the total organic carbon (TOC) values provided for each location in RI Table I-7. To provide the best estimate of the normalized PCB concentration at each location, the locations with duplicate samples are represented in the WRS tests by the averages of the two normalized values.

Only the values in the laboratory data set were found in the RI Report, so the remaining values used for the combination data set were calculated by ENVIRON by summing the results reported for the congeners and co-eluting groups in Table I-5A. The values used to prepare all three data sets are provided in Table 1.

This appendix presents the comparisons performed using the WRS test with all three data sets. As explained above, USEPA excluded the total PCB congener value for station 326 from the data used to represent conditions in the reference area without sufficient justification. Nevertheless, each of the three data sets (the laboratory data set, the combination data set, and the normalized data set) was analyzed both with and without station 326. Thus, six WRS tests are shown in Table 2. Each test was performed at a 5% level of significance with a one-sided region of rejection. The notation and nomenclature used in Table 2 are consistent with the USEPA guidance document cited previously (EPA QA/G-9S).

Results of the comparisons

All six of the WRS tests summarized in the attached table show that there is no statistically significant difference between the mean values of the populations represented by the data.

Contrary to the characterization presented in the RI Report, this shows that the average concentration of total PCBs in the Gowanus Canal surface sediments is not significantly higher than the average concentration of total PCBs in the reference area surface sediments. The RI conclusion was based on a heavily-censored Aroclor data set that does not include any actual measurements in the reference area sediment samples, whereas the conclusion drawn here is based on a congener data set that provides actual measurements for both the Gowanus Canal sediment samples and the reference area sediment samples.

In addition, the comparisons using the normalized data set demonstrate that much of the apparent difference in total PCB levels in surface sediments between the Gowanus Canal and the reference area is due to differences in the levels of organic carbon. Application of the WRS test to the TOC data in Table I-7 of the RI indicates that there is a statistically significant difference between the average TOC level in the Gowanus Canal surface sediments and the average TOC level in the reference area surface sediments. The normalized total PCB concentrations account for this difference in TOC, and the results of the WRS tests performed with the normalized data set indicate that the normalized concentrations of PCBs in the Gowanus Canal surface sediments are not significantly higher than the normalized concentrations in the reference area.

Finally, the same conclusion is supported by analyzing the normalized data set using rank as the metric. When the normalized total PCB concentrations in Table 1 are ranked from lowest to highest, the ranks assigned to the normalized PCB concentrations for the three reference area locations are 3, 10, and 13 (out of 22) when station 326 is included; without that station, the two reference area ranks are 9 and 12 (out of 21). These ranks are not distinctly different than the ranks assigned to the Gowanus Canal locations.

TABLE 1
Alternative values for total PCB congeners in 26 surface sediment samples

Sampling location	Area	Sample type[1]	Laboratory data set[3] (mg/kg)	Sum of detected congeners[4] (mg/kg)	Combination data set[5] (mg/kg)	Normalized data set[6] (µg/gOC)
301	canal	N	0.0995	0.099	0.099	3.96
303	canal	N	0.765	0.765	0.765	10.5
305	canal	N	0.625	0.639	0.639	9.65
307A	canal	N	0.0678	0.667	0.667	1.58
307B	canal	N	0.616	0.618	0.618	11.3
308A	canal	N[2]	1.75	2.81	1.75	46.4
308A	canal	FD[2]	2.29	2.96	2.29	60.7
308B	canal	N	0.465	0.465	0.465	8.94
309	canal	N[2]	0.696	0.696	0.696	15.5
310	canal	N	2.15	2.15	2.15	22.7
312	canal	N	1.10	1.10	1.10	18.1
313	canal	N[2]	8.13	8.13	8.13	59.3
314	canal	N	4.03	15.1	15.1	37.0
314	canal	FD	6.80	10.1	10.1	62.4
315	canal	N[2]	4.77	8.32	4.77	58.3
315	canal	FD	5.42	8.06	8.06	66.3
318	canal	N[2]	4.07	4.39	4.07	42.9
319	canal	N	0.473	2.74	2.74	9.59
320	canal	N	1.25	1.70	1.70	26.7
321	canal	N	0.623	1.06	1.06	12.2
324	canal	N	1.10	1.10	1.10	31.4
324	canal	FD	0.345	0.628	0.628	9.86
325	canal	N[2]	0.380	0.676	0.380	14.3
326	reference	N	0.341	1.74	1.74	7.86
330	reference	N	0.466	0.466	0.466	13.5
333	reference	N	0.476	0.477	0.477	18.0

[1] Sample type as provided in Table I-5A of the RI to identify duplicate samples

[2] Samples with R-flagged results

[3] Values reported for the Total PCB (Lab) parameter in Table I-5A of the RI

[4] Calculated by ENVIRON from results reported in Table I-5A of the RI; R-flagged results were excluded

[5] Samples with R-flagged results are represented by the Total PCB (Lab) value; all other samples are represented by the sum of detected congeners

[6] Ratio of Total PCB (Lab) to total organic carbon content from Table I-7 of the RI

TABLE 2
Comparison of total PCB concentrations in surface sediments in the Gowanus Canal and the reference area using Wilcoxon Rank Sum tests

Test number	**1**	**2**	**3**	**4**	**5**	**6**
data set	laboratory	laboratory	combination	combination	normalized	normalized
value used for duplicate sample locations	average	average	maximum	maximum	average	average
status of station 326	included	excluded	included	excluded	included	excluded
number of locations in the reference area (m)	3	2	3	2	3	2
number of locations in the Gowanus Canal (n)	19	19	19	19	19	19
ranks of reference area locations	3, 6, 8	5, 7	4, 5, 15	4, 5	3, 10, 13	9, 12
sum of the reference area ranks (R_1)	17	12	24	9	26	21
Step 1: null hypothesis	$H_{0:}\ \mu_{RA}-\mu_{GC}=0$	$H_{0:}\ \mu_{RA}-\mu_{GC}=0$	$H_{0:}\ \mu_{RA}-\mu_{GC}=0$	$H_{0:}\ \mu_{RA}-\mu_{GC}=0$	$H_{0:}\ \mu_{RA}-\mu_{GC}=0$	$H_{0:}\ \mu_{RA}-\mu_{GC}=0$
Step 2: alternative hypothesis	$H_{A:}\ \mu_{RA}-\mu_{GC}<0$	$H_{A:}\ \mu_{RA}-\mu_{GC}<0$	$H_{A:}\ \mu_{RA}-\mu_{GC}<0$	$H_{A:}\ \mu_{RA}-\mu_{GC}<0$	$H_{A:}\ \mu_{RA}-\mu_{GC}<0$	$H_{A:}\ \mu_{RA}-\mu_{GC}<0$
Step 3: value of the test statistic (W_0)	11	9	18	6	20	18
Step 4: critical value (W_α) for $\alpha = 0.05$	10	4	10	4	10	4
Step 5: compare W_0 to W_α	$W_0 > W_\alpha$	$W_0 > W_\alpha$	$W_0 > W_\alpha$	$W_0 > W_\alpha$	$W_0 > W_\alpha$	$W_0 > W_\alpha$
Conclusion	do not reject H_0	do not reject H_0	do not reject H_0	do not reject H_0	do not reject H_0	do not reject H_0

Appendix B

Development of a Site-Specific Risk-Based Criterion for PCBs in Gowanus Canal Surface Sediments

Appendix B – Development of a Site-Specific Risk-Based Criterion for PCBs in Gowanus Canal Surface Sediments

Introduction

The Superfund Proposed Plan (SPP) for the Gowanus Canal Superfund Site includes the following Remedial Action Objective (RAO) related to PCBs in sediments:

> "Reduce the risks to benthic organisms in the canal from direct contact with PAHs, PCBs and metals in the sediments by reducing sediment toxicity to levels that are comparable to reference conditions in Gowanus Bay and Upper New York Bay."

PCBs are included in this RAO because the Ecological Risk Assessment (ERA) suggests that PCBs in Gowanus Canal surface sediments may contribute to adverse effects on the benthic community. This suggestion is based on a comparison of the concentrations of PCBs in Gowanus Canal surface sediment samples to screening values reported in the scientific literature.

The ERA indicates that the levels of PCBs in the Gowanus Canal surface sediments were evaluated by comparing the total PCB concentrations measured in samples of those sediments to two sets of screening criteria. In the first (screening-level) comparison, total PCB concentrations determined by congener analysis (total PCB congeners) were compared to a criterion of 0.0598 mg/kg attributed to MacDonald et al. (2000).[1] The criteria provided in MacDonald et al. (2000) were developed for freshwater ecosystems, not for estuarine waterways such as the Gowanus Canal, and are not specific to either Aroclor or congener data. The concentrations of each of four individual Aroclors and total PCBs determined by Aroclor analysis were compared to a criterion of 0.0227 mg/kg established by the New York State

[1] The criterion applied to the total PCB congener data is listed in Table 3-5 of the ERA as 59800 ng/kg (which is equivalent to 0.0598 mg/kg) and that table lists "MacDonald et al. (2000)" as the source of this criterion. The ERA reference list does not include an entry that corresponds to MacDonald et al. (2000). The source publication for the 59800 ng/kg criterion is listed as MacDonald, Ingersoll, and Berger (2000) in the reference section of this appendix.

Department of Environmental Conservation (NYSDEC) for total PCBs.[2] Table 3-2 of the ERA indicates that these initial screening-level criteria for both congeners and Aroclors were exceeded by the total PCB concentrations in the Gowanus Canal surface sediment samples, and section 4.1.1 of the ERA (page 4-1) indicates that PCB congeners and three PCB Aroclors were identified as chemicals of potential concern (COPCs) on the basis of this screening-level comparison.

According to section 5.2.1 of the ERA (pages 5-6 and 5-7), the PCB concentrations in the Gowanus Canal surface sediments were evaluated further by a two-step process. The first step involved calculating and comparing the 95% upper confidence limits for the mean concentrations to the screening-level criteria (0.0598 mg/kg for total PCB congeners and 0.0227 mg/kg for total PCBs by Aroclor analysis). Chemicals that were identified as chemicals of concern (COCs) by this step are identified in ERA Table 5-5, which lists four PCB Aroclors, total PCBs, and total PCB congeners as COCs. These COCs were evaluated further by comparing the reported concentrations to less conservative baseline criteria, which are listed in Table 5-6 of the ERA (0.676 mg/kg for total PCB congeners and 0.180 mg/kg for total PCBs by Aroclor analysis). Based on this comparison, the ERA includes PCBs in the following statement (page 6-5) "Chemical analysis indicates the presence of organic chemicals (primarily PAHs and PCBs) and metals in sediment at concentrations that are likely to be causing the adverse effects observed in the sediment bioassays."[3]

Because none of the screening values for PCBs used in the ERA account for site-specific conditions, PCB concentrations that exceed those screening values do not establish that the levels of PCBs in the Gowanus Canal sediments are toxic to benthic invertebrates. The purpose of this paper is therefore to develop a site-specific risk-based criterion that can be used to make such a determination.

The site-specific risk-based criterion derived in this appendix is applicable to total PCB concentration data generated by either congener analysis or Aroclor analysis. Congener and Aroclor analyses are different ways of measuring the levels of the same chemical compounds (i.e., the 209 PCB congeners). Differences in total PCB concentrations determined by these

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[2] The criterion applied to the PCB Aroclor data and attributed to NYSDEC (1999) in Table 3-5 of the ERA corresponds to the ER-L ("Effects Range – Low") value for marine and estuarine sediments published in Long et al. (1995).

[3] Note, however, that Table 7 of the SPP indicates that USEPA considers the screening-level criterion of 0.0598 mg/kg for total PCB congeners to be the critical criterion for protection of the benthic community. As indicated earlier, this criterion was developed for protection of freshwater ecosystems.

methods reflect uncertainty (imprecision) in the analytical measurements. The site-specific risk-based criterion is based on the organic carbon content of the Gowanus Canal surface sediments and the PCB composition of those sediments as determined by the distribution of congener homologues, and it can therefore be used to evaluate data generated by either congener or Aroclor analysis.

Basis for the site-specific risk-based criterion for PCBs

The site-specific risk-based criterion for evaluating potential PCB risks to the benthic invertebrate community in the Gowanus Canal is based on analysis described by Fuchsman et al. (2006). These authors identified and reviewed the types of evidence that can be used to characterize cause-effect, concentration-response relationships between PCB concentrations in sediment and effects on benthic invertebrates. The three lines of evidence used to derive the site-specific risk-based criterion for the Gowanus Canal involve application of the equilibrium partitioning method, spiked sediment toxicity test results, and biological data from contaminated sediment sites where PCBs are the primary chemicals of interest.

Equilibrium partitioning

The equilibrium partitioning analysis described by Fuchsman et al. (2006) involved (1) characterizing aquatic (water-only) toxicity of PCBs based on data from extensive controlled experiments, (2) characterizing partitioning of PCBs between sediment particles and pore water, and (3) identifying sediment concentrations that would correspond to safe concentrations of PCBs in sediment pore water. A number of publications have demonstrated that pore water concentrations of hydrophobic organic compounds provide substantially better predictions of sediment toxicity than bulk sediment concentrations (USEPA 2003, Di Toro et al. 1991, Kraaij et al. 2003, McDonough et al. 2010). Fuchsman et al. (2006) proposed alternative sediment quality benchmarks based on this approach. These benchmarks range from 210 to 5,300 micrograms of PCBs per gram organic carbon (µg/gOC), depending on the composition of the PCB mixture, with more highly chlorinated mixtures being less bioavailable and having higher sediment benchmarks. The range of the benchmark values corresponds to PCB concentration ranges of 2.1 to 53 mg/kg dry weight for sediment containing 1% organic carbon, and 12.6 to 318 mg/kg dry weight for sediment containing 6% organic carbon. According to Table 3-1 of the draft Remedial Investigation (RI) Report, the average total organic carbon content of the Gowanus Canal surface sediments is 6.4%.

Spiked sediment toxicity tests

Spiked sediment toxicity tests are controlled experiments that provide direct measurements of chemical toxicity in sediment. Such studies provide valuable cause-effect data, although toxicity thresholds may be unrealistically low (overly conservative) due to slow sorption processes, especially if the study design does not incorporate a stabilization period to allow chemical partitioning to approach equilibrium. Of nine spiked sediment studies with PCBs, most showed no adverse effects at any test concentration, with no-effect concentrations ranging from 81 to 2,560 µg/gOC for PCB mixtures and up to 50,000 µg/gOC for individual PCB congeners. These concentrations correspond to PCB concentrations ranging from 0.81 to 25.6 mg/kg dry weight assuming 1% organic carbon, or from 4.9 to 154 mg/kg dry weight assuming 6% organic carbon. Toxicity was only observed in certain studies that did not incorporate a sediment equilibration period. The lowest PCB concentration associated with toxicity was from DiPinto et al. (1993), who observed reduced copepod reproduction at 100 µg/gOC; this result was not reproducible in a duplicate experiment, however, and the study did not incorporate an equilibration period. The available results of spiked sediment toxicity tests with PCBs are thus generally consistent with the equilibrium partitioning benchmarks described above.

Biological data from contaminated sediment sites

Fuchsman et al. (2006) also reviewed sediment toxicity test and benthic invertebrate community studies for eight contaminated sediment sites where PCBs were the major contaminants of concern. This review provided a “reality check” for the equilibrium partitioning evaluation developed in that paper, and for published sediment screening values. The results were generally consistent with the equilibrium partitioning benchmarks for PCBs and inconsistent with the various sediment screening values used in the Gowanus Canal ERA. Specifically, no-effect concentrations for benthic invertebrates at “PCB sites” generally ranged from 70 to 1,000 µg/gOC, with a lack of toxicity observed at even higher PCB concentrations at one site contaminated with unusually highly chlorinated PCBs. These concentrations correspond to PCB concentrations ranging from 0.70 to 10 mg/kg dry weight assuming 1% organic carbon. By comparison, Table 7 of the SPP indicates that the critical criterion for protection of the benthic community in the Gowanus Canal is 0.0598 mg/kg for total PCBs. Thus, even assuming an organic carbon content that is much lower than the average for surface sediments in the Gowanus Canal, the concentrations associated with no toxicity at PCB sites are more than an order of magnitude higher than the screening criterion considered critical by USEPA.

Derivation of the site-specific risk-based criterion for PCBs

The equilibrium partitioning approach (DiToro et al. 1991) uses the sediment-specific mass fraction of organic carbon content (f_{oc}) and the chemical-specific partitioning coefficient between water and organic carbon (K_{oc}) to calculate equilibrium-partitioning sediment-quality benchmarks (ESBs) from water quality values (WQVs) as follows:

$$\text{ESB (mg/kg)} = \text{WQV (mg/L)} \times K_{oc}\text{ (L/kgOC)} \times f_{oc}\text{ (kgOC/kg sediment)}$$

Dividing both sides of this equation by f_{oc} expresses the ESB in units of milligrams per kilogram organic carbon (mg/kgOC), which are equivalent to micrograms per gram organic carbon (µg/gOC):

$$\text{ESB (µg/gOC)} = \text{ESB (mg/kgOC)} = \text{WQV (mg/L)} \times K_{oc}\text{ (L/kgOC)}$$

Fuchsman et al. (2006) developed a water quality value for total PCBs of 0.54 µg/L (equal to 0.00054 mg/L) using USEPA methodology for developing chronic aquatic life water quality criteria. This water quality value is based on acute (i.e., short term) aquatic toxicity data for 21 invertebrate species and acute-to-chronic ratios (to estimate long-term toxicity thresholds) for 3 invertebrate species. These data represented a comprehensive literature review for Aroclor 1254 toxicity to aquatic and benthic invertebrates (Fuchsman et al. 2006). The invertebrate water quality value is higher than USEPA's ambient water quality criterion of 0.014 µg/L because the USEPA criterion is calculated from a fish tissue PCB concentration for the protection of wildlife, whereas the invertebrate water quality value is based on aquatic toxicity data (USEPA 1980).

The K_{oc} value for total PCBs in Gowanus Canal surface sediments depends on the site-specific composition of PCB mixtures in the sediments. Fuchsman et al. (2006) provide a methodology to estimate the total PCB K_{oc} value based on the distribution of PCB concentrations among different levels of chlorination (homologues). The K_{oc} value for each homologue is assumed to be approximately equal to the octanol-water partition coefficient (K_{ow}); for reasons explained by Fuchsman et al. (2006), this is generally a conservative assumption.[4] The K_{ow} value for the PCB mixture can be calculated based on the distribution of PCB concentrations among different levels of chlorination (homologues) as follows:

[4] A more conservative approach to estimating K_{oc} will result in a lower site-specific risk-based criterion.

$$K_{\text{ow}-\text{Total PCB}} = \frac{1}{\sum_{n=1}^{i} \frac{f_{\text{homologue i}}}{K_{\text{ow}-\text{homologue i}}}}$$

where $K_{\text{ow-Total PCB}}$ represents the overall K_{ow} for the PCB mixture, $f_{\text{homologue i}}$ represents the fraction of PCB mixture consisting of homologue *i*, and $K_{\text{ow-homologue i}}$ is the K_{ow} for homologue *i*.

The derivation of the site-specific risk-based criterion for PCBs from the relative proportion of the total PCB concentration represented by each PCB homologue in Gowanus Canal surface sediment (as identified in the RI Report, Table I-5A) is shown in Table 1. The PCB composition of Gowanus Canal surface sediments results in a site-specific sediment ESB of 641 µg/gOC. This site-specific benchmark lies near the high end of the range of default benchmarks developed by Fuchsman et al. (2006) because the PCBs in Gowanus Canal surface sediments are relatively highly chlorinated. Based on an average total organic carbon concentration of 6.4% in the Gowanus Canal surface sediments, the site-specific risk-based criterion for PCBs in those sediments is 41 mg/kg. Because this criterion was derived from the proportion of total PCBs found in each homologue group in the Gowanus Canal surface sediments, it is applicable to total PCB concentration data generated either by congener analysis or by Aroclor analysis.

TABLE 1

Calculation of a site-specific risk-based criterion for PCB toxicity to benthic organisms in surface sediments in the Gowanus Canal

PCB homologue	average percentage of total PCBs in sediments (100 x $f_{homologue}$)	homologue $\log_{(10)} K_{ow}$	homologue K_{ow}	ratio ($f_{homologue}$ / K_{ow})
Monochlorobiphenyl	0.15	4.64	43652	3.36E-08
Dichlorobiphenyl	2.49	5.12	131826	1.89E-07
Trichlorobiphenyl	15.18	5.62	416869	3.64E-07
Tetrachlorobiphenyl	15.40	6.04	1096478	1.40E-07
Pentachlorobiphenyl	22.44	6.49	3090295	7.26E-08
Hexachlorobiphenyl	20.57	6.84	6918310	2.97E-08
Heptachlorobiphenyl	11.42	6.98	9549926	1.20E-08
Octachlorobiphenyl	2.76	7.72	52480746	5.27E-10
Nonachlorobiphenyl	5.03	8.24	173780083	2.90E-10
Decachlorobiphenyl	4.57	8.26	181970086	2.51E-10
sum of percentages:	100.00		sum of ratios:	8.42E-07
			K_{ow} for total PCBs:	1187637
			common log of K_{ow} for total PCBs:	6.07
			Water Quality Value (mg/L):	0.00054
			Sediment Quality Benchmark (µg/gOC):	641
			Total Organic Carbon (g/kg):	64.385
			site-specific criterion for total PCBs (mg/kg):	**41**

notes:

1. Methodology, homologue log(10) Kow values, and Water Quality Value are from Fuchsman et al. (2006)
2. The average percentage of total PCBs for each homologue is calculated from the the homologue concentrations in Table I-5A of the Remedial Investigation report
3. Total organic carbon is the average for Gowanus Canal surface sediments as reported in Table 3-1 of the Remedial Investigation Report

Comparison of total PCB data for surface sediments to the site-specific criterion

The total PCB measurements generated by both Aroclor and congener analyses of surface sediment samples collected in the Gowanus Canal and the reference area are listed in Table 2. Values are provided for each sampling location for which a measured value is available; locations at which the only analytical results are non-detects are not shown. The values reported for locations with duplicate samples are averages of the results from each analysis. The values for total PCB congeners are the "Total PCB (Lab)" values in Table I-5A of the RI Report; for locations with duplicate samples, the "Total PCB (Lab)" values were averaged. The levels of total organic carbon (TOC) reported for each location are from Table I-7 of the RI Report.

The total PCB concentrations for each analysis are shown in mg/kg units; these values are all well below the site-specific risk-based criterion of 41 mg/kg. In fact, the maximum reported value (8.13 mg/kg total PCBs by congener analysis at station 313) is only 20% of the site-specific risk-based criterion.

A comparison can also be made to the site-specific sediment quality benchmark (ESB) of 641 µg/gOC that was used to derive the site-specific risk-based screening criterion, by normalizing the total PCB concentrations to account for the variation of TOC from one location to another. The normalized concentrations were calculated by dividing the total PCB concentrations determined by congener analysis by the TOC levels, then multiplying by 1,000 to convert to µg/gOC units, as shown in Table 2. The highest normalized concentration in the surface sediment samples collected in the Gowanus Canal and the reference area is 62.3 µg/gOC at station 315 (in the middle reach of the canal). This is an order of magnitude lower than the site-specific ESB of 641 µg/gOC.

TABLE 2

Total PCB levels and normalized levels for surface sediments at 24 locations in the Gowanus Canal and the reference area

sampling location	RTA number or reference area	total organic carbon[1] (gOC/kg)	total PCB Aroclors[2] (mg/kg)	total PCB congeners[3] (mg/kg)	normalized total PCB congeners[4] (µg/gOC)
301	1	25.1	ND	0.0995	3.96
303	1	73.1	ND	0.765	10.5
305	1	64.8	ND	0.625	9.65
307A	1	43.0	ND	0.0678	1.58
307B	1	54.4	ND	0.616	11.3
308A	1	37.7	0.55	2.02	53.6
308B	1	52.0	ND	0.465	8.94
309	2	45.0	ND	0.696	15.5
310	2	94.6	ND	2.15	22.7
312	2	60.7	0.31	1.10	18.1
313	2	137	ND	8.13	59.3
314	2	109	3.1	5.415	49.7
315	2	81.8	1.8	5.095	62.3
316	2	122	2.2	NA	NA
317	2	64.4	0.85	NA	NA
318	2	94.9	0.73	4.07	42.9
319	2	49.3	0.66	0.473	9.59
320	3	46.9	0.29	1.25	26.7
321	3	51.1	ND	0.623	12.2
324	3	35.0	ND	0.7225	20.6
325	3	26.5	0.23	0.380	14.3
326	reference	43.4	ND	0.341	7.86
330	reference	34.5	ND	0.466	13.5
333	reference	26.4	ND	0.476	18.0

[1] from Table I-7 of the RI Report
[2] from Table I-4A of the RI Report
[3] from Table I-5A of the RI Report
[4] ratio of total PCB congeners to total organic carbon
Concentrations for locations 308A, 314, 315, and 324 are averages of results obtained from duplicate samples
NA indicates that samples from this location were not analyzed for PCB congeners
ND indicates that PCB Aroclors were not detected at this location

References

Di Toro, D.M., C.S. Zarba, D.J. Hansen, W.J. Berry, R.C. Swartz, C.E. Cowan, S.P. Pavlou, H.E. Allen, N.A. Thomas, and P.A. Paquin. 1991. Technical basis for establishing sediment quality criteria for nonionic organic chemicals using equilibrium partitioning. *Environ. Toxicol. Chem.* 10:1541-1583.

DiPinto, L.M., B.C. Coull, and G.T. Chandler. 1993. Lethal and sublethal effects of the sediment-associated PCB Aroclor 1254 on a meiobenthic copepod*. Environ. Toxicol. Chem.* 12:1909-1918.

Fuchsman, P.C., T.R. Barber, J.C. Lawton, and K.B. Leigh. 2006. An evaluation of cause-effect relationships between polychlorinated biphenyl concentrations and sediment toxicity to benthic invertebrates. *Environ. Toxicol. Chem.* 25:2601-2612.

Kraaij, R., P. Mayer, F.J.M. Busser, M. van het Bolscher, W. Seinen, and J. Tolls. 2003. Measured pore-water concentrations make equilibrium partitioning work - A data analysis. *Environ. Sci. Technol.* 37:268-274.

Long, E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. 1995. Incidence of adverse biological effects within ranges of chemical concentrations in marine and estuarine sediments. *Enviro. Management* 19:81-97.

MacDonald, D.D., C.G. Ingersoll, and T.A. Berger. 2000. Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems. *Arch. Environ. Contam. Toxicol.* 39:20-31.

McDonough, K.M., N.A. Azzolina, S.B. Hawthorne, D.V. Nakles, and E.F. Neuhauser. 2010. An evaluation of the ability of chemical measurements to predict polycyclic aromatic hydrocarbon-contaminated sediment toxicity to *Hyalella azteca*. *Environ. Toxicol. Chem.* 29:1545-1550.

NYSDEC (New York State Department of Environmental Conservation). 1999. Technical Guidance for Screening Contaminated Sediments.

USEPA (United States Environmental Protection Agency). 2003. Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: PAH Mixtures. EPA-600-R-02-013. United States Environmental Protection Agency, Office of Research and Development, Washington, DC.

USEPA (United States Environmental Protection Agency). 1980. Ambient water quality criteria for polychlorinated biphenyls. EPA-440/5-80-068. U.S. Environmental Protection Agency, Washington, DC.