Attachment B

Evaluation of Dissolved PAH Fluxes for RTA-2

The in-situ sediment stabilization remedy in the Gowanus canal adjacent to the Citizens will limit the groundwater discharge to canal. Information was presented in the November 19, 2021 meeting that showed how the direction of groundwater flow would be altered. This attachment extends that analysis to estimate the resulting change in dissolved phase polyaromatic hydrocarbons (PAH) flux from baseline (no remedy) conditions to two in-situ sediment stabilization configurations evaluated for the canal remedial design (Scenarios 3 and 4).

To estimate the change in dissolved PAH flux, the total chemical flux for PAHs was calculated using the in-canal porewater/groundwater concentration data provided in Table 1 and the estimates groundwater specific discharge. This approach is the same as that used to design the treatment cap layers within the canal[1].

The assumptions and outputs of the analyses performed for the baseline scenario and the two remedy scenarios are illustrated in a set of three figures as follows:

- Figure 1 represents baseline pre-remedial conditions for RTA-2 (Baseline scenario).
- Figure 2 represents in-situ stabilization (ISS) applied to the EPA-selected areas[2] and capping. This scenario represents the minimum ISS areas to meet the ROD objectives of treating migrating NAPL within the canal (Scenario 3).
- Figure 3 represents ISS applied to all EPA-selected areas and supplemental areas selected by responding parties and capping (Scenario 4).

The assumptions and procedure associated with this analysis are as follows:

- The lateral extent of the analysis encompassed only the main channel of the canal from the upland Citizens site boundary on the upstream direction of the canal to the 9th Street Bridge. The extension past the Citizens downstream site boundary is based on groundwater flow direction.

- The PAH concentrations of the discharge is based on in-canal porewater data and upland groundwater monitoring well data (Table 1). These data were compiled from two studies[3]. The concentrations were assigned to areas of the canal using Thiessen polygons. The polygons

[1] Geosyntec Consultants, Inc. 2021. Gowanus RTA2 ISS Layout - Workshop Follow-up (model parameter outputs). Email from Dave Himmelheber. July 23.

[2] Jacobs Engineering Group Inc. (Jacobs). 2021a. RTA 2 ISS Target Area Identification Calculation Support, Gowanus Canal Superfund Site, Brooklyn, New York. Memorandum. April; Jacobs. 2021b. RTA 2 ISS Target Area Supplemental Evaluation - 7th Street Turning Basin, Gowanus Canal Superfund Site, Brooklyn, New York. Memorandum. August; Jacobs. 2021c. RTA 2 ISS Target Area Supplemental Evaluation - 4th Street Turning Basin, Gowanus Canal Superfund Site, Brooklyn, New York. Memorandum. September.

[3] Geosyntec. 2015b. Draft PD-8: NAPL Mobility Investigation Report; CH2M HILL. 2011a. Gowanus Canal Draft Remedial Investigation Report. January.

where then aligned to the grid cells of the groundwater model. The spatial application of the data provided in Table 1 across RTA-2 is illustrated in Figures 1 through 3.

- The groundwater model was used to calculate the groundwater specific discharge on a cell-by-cell basis for the three scenarios (Figures 1 through 3).
- The PAH flux was then estimated as the product of the concentration and the groundwater specific discharge for each model cell (Figures 1 through 3).
- The annual discharge of each cell was calculated by multiplying the area of each groundwater cell area by the cell's PAH flux. The sum of these values for each cell across this reach of the canal represents the total annual PAH loading.
- The total annual PAH loading for Scenarios 3 and 4 were then compared to the Baseline scenario to determine the reduction in total chemical flux associated with each.(Figure 4).

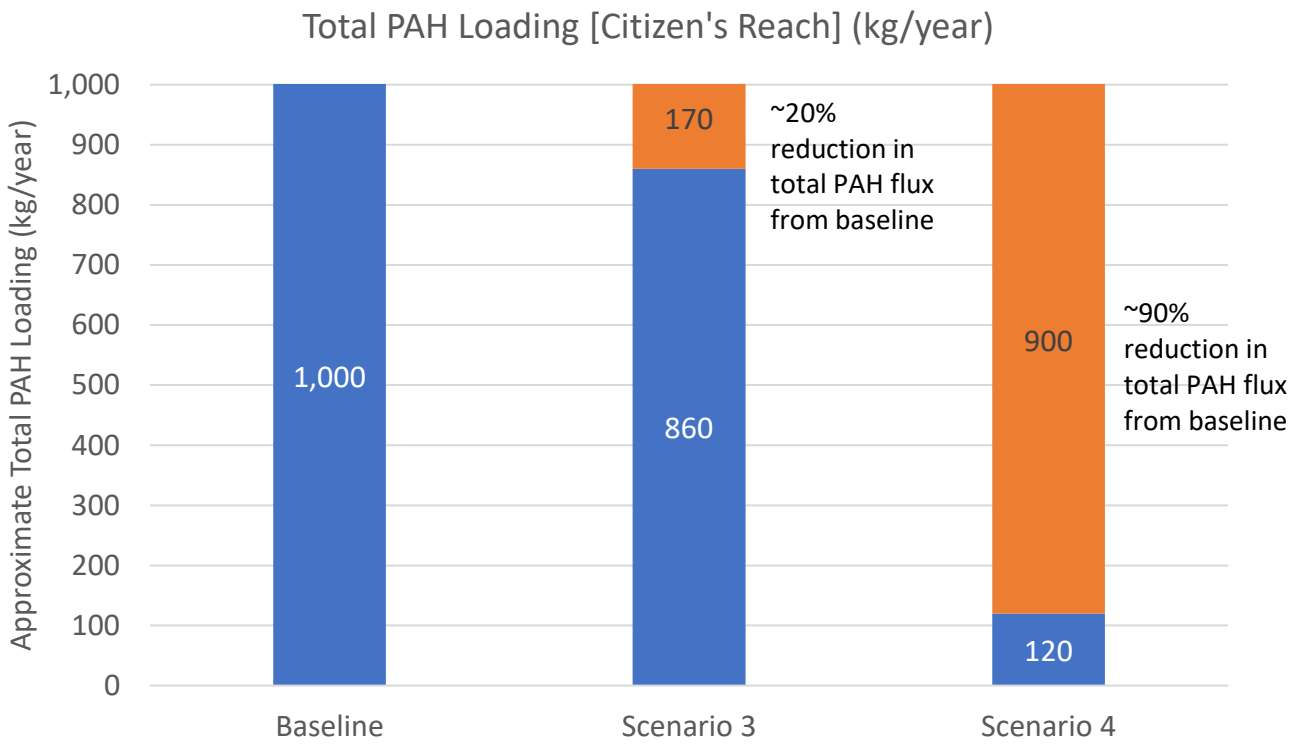

Figure 4. Approximate reduction in total PAH loading for the Citizen's reach from baseline

Table 1. Porewater Data near the Citizens Site

Study		RI	RI	RI	PD-8	PD-8	PD-8	PD-8	PD-8	PD-8	PD-8
Remediation Target Area		RTA-2	RTA-2	RTA-2	RTA2	RTA2	RTA2	RTA2	RTA2	TB6	RTA2
Sample ID		MW-09	MW-09	MW-20	MC3750-B1		MC4000-C	MC4200-A	MC3550-A1	6TB0100-B5	MC3350-A2
Location Group		Intermediate	Intermediate	Intermediate	NS-SEDMO-MC3750-B1-16-21-WG-150410	SEDMO-DUP-1-150410	NS-SEDMO-MC4000-C-13.50-18.50-WG-150408	NS-SED-MC4200-A-15.0-20.0-WG-180228	NS-SEDMO-MC3550-A1-10.7-15.7-WG-150416	NS-SEDMO-6TB0100-B5-18.7-23.7-WG-180306	NS-SEDMO-MC3350-A2-15.9-20.9-WG-180312
Analyte	**Units**										
Acenaphthene	µg/L	178	250	94	63 J	71	520	250	47	420	1200
Acenaphthylene	µg/L	2.3	21 U	81	270	300	1100	1500	440	1900	630
Anthracene	µg/L	2.3	21 U	8.5 J	77 J	72	600	620	150	800	720
Benzo(a)anthracene	µg/L	0.12 U	21 U	1 U	39 J	34	300	320	90	460	350
Benzo(a)pyrene	µg/L	0.095 U	21 U	1 U	27 J	24	190	250	66	310	210
Benzo(b)fluoranthene	µg/L	0.25 U	21 UJ	1 U	18 J	17	140	200	50	210	180
Benzo(g,h,i)perylene	µg/L	0.12 U	21 U	1.1 UJ	11	10	79	110	32	120	89
Benzo(k)fluoranthene	µg/L	0.38 U	21 U	1 U	8.4	6.6	51	70	15	91	53
Chrysene	µg/L	0.11 U	21 U	1 U	36 J	33	290	290	77	410	370
Dibenz(a,h)anthracene	µg/L	0.15 U	21 U	1 U	2.9	2.9	22	30	7.9	73 U	34
Fluoranthene	µg/L	0.46 J	21 U	3.1 J	70 J	63	510	670	200	850	630
Fluorene	µg/L	22.2	30 J	48 J	130	140	910	860	220	1200	980
Indeno(1,2,3-cd)pyrene	µg/L	0.13 U	21 U	1.1 UJ	8.7	7.7	60	87	24	92	68
Naphthalene	µg/L	2310	2800	3,100 J	1100	3100	11000	5400	3300	9300	7200
Phenanthrene	µg/L	15.7	21 J	50 J	270	260	2600	2100	610	2900	2400
Pyrene	µg/L	0.16 U	21 UJ	4.8 J	110	100	800	840	230	1200	910
Total PAHs[1]	µg/L	2679	3341	3989	2,241	4,241	19,172	13,597	5,559	20,336	16,024

Notes:
Geosyntec. 2015. Draft PD-8: NAPL Mobility Investigation Report.
CH2M HILL. 2011a. Gowanus Canal Draft Remedial Investigation Report. January, 2011.
[1]Total PAHs are used as reported in the RI report and are calculated as the sum of the 16 priority PAHs for PD-8
µg/L - micrograms per liter