Appendix I

Hydrodynamic and Sediment Transport Analyses
for Rockaway Delivery Lateral Project: Addendum 2
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REFINED SIMULATION OF PIPELINE CONSTRUCTION AND POST-CONSTRUCTION BURIAL

Two additional hydrodynamic and sediment transport simulations were performed. The first provides refined representation of the proposed construction sequence and sediment releases during pipeline construction. The second evaluates potential impacts of post-construction pipeline burial. Sediment releases for these two simulations reflect the most up to date description of proposed construction methods, project duration, sequence of operations, and potential sediment disturbance. To improve realism, the simulations consider multiple passes of construction equipment across the site. The height of sediment releases into the water column also dynamically vary as a function of construction conditions and the height of the jet sled/dredge discharge port above the sediment bed. Sediment releases in earlier in the construction cycle occur higher in the water column while releases later in the cycle occur lower in the water column as the depth of pipeline placement into the bed increases. In addition, the total length of construction was increased by approximately 1000 ft (305 m) to account for the length of the “pigtail” where the pipeline trench connects to the Horizontal Directional Drilling (HDD) exit pit. In these simulations the total length for pipeline construction and burial was 11,308 ft (2.14 miles; 3,457 m). Further details for each simulation and corresponding model results follow.

THREE PASS PIPELINE CONSTRUCTION SIMULATION

This scenario assumes that construction occurs during three (3) passes of the trenching equipment (i.e., the jet sled) over the pipeline route to complete construction and place the pipeline to the target depth below the ambient sediment surface. Sediment evacuated from the trench is released through a discharge port that is 13.67 feet (4.17 m) above the base of the sled. With each pass over the pipeline route, the sled base moves below the starting elevation of the sediment bed such that with each pass the release point moves closer to the original (pre-construction) grade line of the bed. However, the discharge port is a fixed point above the base of the sled so that releases in shallow water occur higher in the water column than they occur in deep water. For each pass, the jet sled traverses the route at a different rate. During the first pass, trenching occurs at 400 feet per hour (122 m/hr), the discharge height is 13.67 feet (4.17 m) above the bed, and the sediment volume released is 9,109 yd³ (6,965 m³). During the second pass, trenching occurs at 250 feet per hour (76 m/hr), the discharge height is 11.67 feet (3.55 m) above the bed, and the sediment volume released is 7,198 yd³ (5,503 m³). During the third pass, trenching occurs at 200 feet per hour (61 m/hr), the discharge height is 10.17 feet (3.1 m) above the bed, and the sediment volume released is 8,314 yd³ (6,356 m³). The total volume of sediment released during all three passes is 24,621 yd³ (18,824 m³). For this simulation, the submarine portion of the pipeline is 11,308 feet (2.14 mi; 3,457 m) (and includes the pigtail connecting...
the submarine portion of the pipeline to the HDD exit pit portion) and releases occur in sequence into each of 33 model grid cells, representing sled movement along the pipeline route. The duration (i.e., time) and rate (i.e., mass per time) of sediment releases to the water column are directly related to the rate of trenching. For each pass, trenching duration is equal to trench length divided by trenching rate. In all cases, sediment is discharged at a rate of 70 liters per minute (18.5 gallons per minute). Consistent with the proposed construction schedule, hydrodynamic conditions for this simulation represent a May timeframe. A summary of trenching rates, durations, and sediment releases for each pass is presented in Table A2-1.

Water column and sediment bed results for this three pass trenching scenario are presented in Figures A2-1 through A2-15. Exceedance times for TSS levels exceeding thresholds of 50 and 100 mg/L are presented in Figures A2-16 and A2-17. Note these are the same types of figures that were previously presented in the main hydrodynamic and sediment transport modeling report and Addendum 1. Simulated suspended solids concentrations for the water column surface layer for this three pass trenching scenario are always less than ~1 mg/L (the maximum concentration occurs in just one cell and is 1.1 mg/L).

**TWO PASS PIPELINE POST-CONSTRUCTION BURIAL SIMULATION**

This scenario assumes that pipeline burial occurs during two (2) passes of suction dredging equipment over the pipeline route to provide sediment cover following construction. Sediment is released through a discharge port that is 3 feet (0.91 m) above the base of the dredge. The discharge port is a fixed point above the base of the dredge so that releases in shallow water occur higher in the water column than they occur in deep water. For each pass, the dredge traverses the route at a rate of 100 feet per hour (30 m/hr) and releases 2,250 yd$^3$ (1,720 m$^3$) of sediment. The total volume of sediment released during both passes is 4,500 yd$^3$ (3,440 m$^3$). For this simulation, the pipeline length is 11,308 feet (2.14 mi; 3,457 m) and releases occur in sequence into each of 33 model grid cells, representing dredge movement along the pipeline route. The duration (i.e., time) and rate (i.e., mass per time) of sediment releases to the water column are directly related to the rate of cover placement. For each pass, placement duration is equal to trench length divided by cover placement rate. In all cases, sediment is discharged at a rate of 70 liters per minute (18.5 gallons per minute). Consistent with the proposed construction schedule, hydrodynamic conditions for this simulation represent an August timeframe. A summary of placement rates, durations, and sediment releases for each pass is presented in Table A2-1.

Water column and sediment bed results for this two pass burial scenario are presented in Figures A2-18 through A2-27. Exceedance times for TSS levels exceeding thresholds of 50 and 100 mg/L are presented in Figures A2-28 and A2-29. As previously noted, these are the same types of figures that were presented in the main hydrodynamic and sediment transport modeling report and Addendum 1.
transport modeling report and Addendum 1. Simulated suspended solids concentrations for the water column surface layer for this two pass burial scenario are always less than 1 mg/L.

**DISCUSSION**

Consistent with all prior simulations, results for these two scenarios were reported as time averages over 6-minute intervals in each model grid cell. For each grid cell, the number of time intervals when TSS levels exceeded the threshold value was summed. The time of exceedance in each cell was determined by multiplying the sum of exceedances by the time interval (6 minutes) and then converting to time in hours. Some caution is needed when examining the cumulative time that TSS levels in any grid cell exceed a target threshold. In particular, the sum of exceedances only indicates the total time that concentrations in a cell exceeded the threshold; it does not indicate whether exceedances were consecutive in time. For the three pass trenching scenario, there is a hiatus of roughly 16 hours between each pass. This represents time required to reposition equipment and reverse direction for the next pass in the sequence. For the two pass burial scenario, there is a 2 hour hiatus between each pass. The hiatus for the burial scenario is shorter because equipment used is smaller and can be more quickly repositioned. Recalling that plumes are expected to rapidly dissipate following the end of construction, it is unlikely that exceedances will be continuous over time. However, assuming that all exceedances are consecutive in time provides an upper bound worst case to evaluate acute and chronic exposure because consecutive exceedances would result in the maximum duration of any exposure.
ADDENDUM 2: TABLES
Table A2-1. Simulated trenching rates, durations, and sediment release characteristics.

<table>
<thead>
<tr>
<th>Construction Rate (m/hr or ft/hr)</th>
<th>Duration (hrs) (1)</th>
<th>Sediment Discharge Height (m or ft)</th>
<th>Sediment Volume Released (m$^3$ or yd$^3$) (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Three Pass Trenching (May Hydrodynamic Conditions)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>122 (400 ft/hr)</td>
<td>28.3</td>
<td>4.17 (13.67 ft)</td>
<td>Pass 1: 6,965 (9,109 yd$^3$)</td>
</tr>
<tr>
<td>76 (250 ft/hr)</td>
<td>45.2</td>
<td>3.55 (11.67 ft)</td>
<td>Pass 2: 5,503 (7,198 yd$^3$)</td>
</tr>
<tr>
<td>61 (200 ft/hr)</td>
<td>56.5</td>
<td>3.10 (10.17 ft)</td>
<td>Pass 3: 6,356 (8,314 yd$^3$)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Total: 18,824 (24,621 yd$^3$)</td>
</tr>
<tr>
<td>Two Pass Burial (August Hydrodynamic Conditions)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30 (100 ft/hr)</td>
<td>113.1</td>
<td>0.91 (3 ft)</td>
<td>Pass 1: 1,720 (2,250 yd$^3$)</td>
</tr>
<tr>
<td>30 (100 ft/hr)</td>
<td>113.1</td>
<td>0.91 (3 ft)</td>
<td>Pass 2: 1,720 (2,250 yd$^3$)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Total: 3,740 (4,500 yd$^3$)</td>
</tr>
</tbody>
</table>

Notes: (1) duration values exclude hiatus periods when equipment is repositioned between passes; (2) Total sediment volume released is in situ volume; sediments are assumed to have a dry bulk density of 1,495 kg/m$^3$. 
ADDENDUM 2: FIGURES
Figure A2-1. Three pass trenching: simulated suspended solids near water column bottom, Pass 1, start of pass, rate = 122 m/hr.
Figure A2-2. Three pass trenching: simulated suspended solids near water column bottom, Pass 1, 50% complete, rate = 122 m/hr.
Figure A2-3. Three pass trenching: simulated suspended solids near water column bottom, Pass 1, end of trenching, rate = 122 m/hr.
Figure A2-4. Three pass trenching: simulated suspended solids near water column bottom, Pass 1, 4 hrs after end, rate = 122 m/hr.
Figure A2-5. Three pass trenching: simulated suspended solids near water column bottom, Pass 2, start of trenching, rate = 76 m/hr.
Figure A2-6. Three pass trenching: simulated suspended solids near water column bottom, Pass 2, 50% complete, rate = 76 m/hr.
Figure A2-7. Three pass trenching: simulated suspended solids near water column bottom, Pass 2, end of trenching, rate = 76 m/hr.
Figure A2-8. Three pass trenching: simulated suspended solids near water column bottom, Pass 2, 4 hrs after end, rate = 76 m/hr.
Figure A2-9. Three pass trenching: simulated suspended solids near water column bottom, Pass 3, start of trenching, rate = 61 m/hr.
Figure A2-10. Three pass trenching: simulated suspended solids near water column bottom, Pass 3, 50% complete, rate = 61 m/hr.
Figure A2-11. Three pass trenching: simulated suspended solids near water column bottom, Pass 3, end of trenching, rate = 61 m/hr.
Figure A2-12. Three pass trenching: simulated suspended solids near water column bottom, Pass 3, 4 hrs after end, rate = 61 m/hr.
Figure A2-13. Three pass trenching: maximum simulated suspended solids in any cell of each water column sigma layer.
Notes: Values indicate the maximum solids concentration that occurred in each model grid at any time during the simulation (all trenching passes). It should be noted the concentrations are elevated near the point of construction and rapidly decrease over time as a consequence of the relatively high settling velocities of sediment grains. Plumes clear the water column within 4 hours following the end of each construction pass.

Figure A2-14. Three pass trenching: maximum simulated suspended solids extent in selected water column sigma layers (all passes).
Figure A2-15. Three pass trenching: simulated thickness of deposited solids on bed surface following trenching (all passes).
Figure A2-16. Three pass trenching: cumulative time that simulated suspended solids concentrations near water column bottom exceed a threshold of 50 mg/L.
Figure A2-17. Three pass trench: cumulative time that simulated suspended solids concentrations near water column bottom exceed a threshold of 100 mg/L.
Figure A2-18. Two pass burial: simulated suspended solids near water column bottom, Pass 1, start of burial, rate = 30 m/hr.
Figure A2-19. Two pass burial: simulated suspended solids near water column bottom, Pass 1, 50% complete, rate = 30 m/hr.
Figure A2-20. Two pass burial: simulated suspended solids near water column bottom, Pass 1, end of burial, rate = 30 m/hr.
Figure A2-21. Two pass burial: simulated suspended solids near water column bottom, Pass 2, start of burial, rate = 30 m/hr.
Figure A2-22. Two pass burial: simulated suspended solids near water column bottom, Pass 2, 50% complete, rate = 30 m/hr.
Figure A2-23. Two pass burial: simulated suspended solids near water column bottom, Pass 2, end of burial, rate = 30 m/hr.
Figure A2-24. Two pass burial: simulated suspended solids near water column bottom, Pass 2, 4 hrs after end, rate = 30 m/hr.
Figure A2-25. Two pass burial: maximum simulated suspended solids in any cell of each water column sigma layer.
Notes: Values indicate the maximum solids concentration that occurred in each model grid at any time during the simulation (all burial passes). It should be noted the concentrations are elevated near the point of construction and rapidly decrease over time as a consequence of the relatively high settling velocities of sediment grains. Plumes clear the water column within 4 hours following the end of each burial pass.

Figure A2-26. Two pass burial: maximum simulated suspended solids extent in selected water column sigma layers (all passes).
Figure A2-27. Two pass burial: simulated thickness of deposited solids on bed surface following burial (all passes).
Figure A2-28. Two pass burial: cumulative time that simulated suspended solids concentrations near water column bottom exceed a threshold of 50 mg/L.
Figure A1-29. Two pass burial: cumulative time that simulated suspended solids concentrations near water column bottom exceed a threshold of 100 mg/L.