Appendix D
Cost Engineering
Table of Contents
Project Background ........................................................................................................1
Basis of Cost ...................................................................................................................1
Contingencies ...............................................................................................................2
Planning, Engineering and Design ................................................................................3
Construction Management ............................................................................................3
Interest During Construction .......................................................................................3
Operation and Maintenance .........................................................................................3
Estimated Annual Charges ...........................................................................................4
Cost Summary ...............................................................................................................4

List of Tables
Table 1 – First Cost Table .............................................................................................1
Table 2 – Contingencies .................................................................................................3
Table 3 – Estimate Alternative 4a Annual Charges .........................................................3

List of Figures
Figure 1 – Construction Schedule ...............................................................................2
Figure 2 – Total Project Cost Summary .........................................................................5

List of Attachments
Attachment 1 – MII Report
Attachment 2 – District Quality Control (DQC)
INTRODUCTION

This appendix presents the detail cost estimate for Rahway Tidal (NED). Rahway Tidal project provides solution to reduce the impact of coastal flooding in the lower portions of the Rahway River Basin, which experienced damages during Hurricane Sandy. It consists of a combination of levees, floodwalls, drainages, and nonstructural treatments of properties in the flood prone areas. The Total First Cost is presented in Table 1.

<table>
<thead>
<tr>
<th>Feat. Acct.</th>
<th>Description</th>
<th>Qty</th>
<th>UoM</th>
<th>Subtotal</th>
<th>Cont. %</th>
<th>Cont $5</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Lands &amp; Damages</td>
<td>$ 6,471,300</td>
<td></td>
<td>$ 2,588,520</td>
<td>40.00%</td>
<td>$</td>
<td>$ 9,059,820</td>
</tr>
<tr>
<td></td>
<td>Total Lands &amp; Damages</td>
<td>$ 6,471,300</td>
<td></td>
<td>$ 2,588,520</td>
<td>40.00%</td>
<td>$</td>
<td>$ 9,059,820</td>
</tr>
<tr>
<td>02</td>
<td>Relocations</td>
<td>$ 1,373,175</td>
<td></td>
<td>$ 480,611</td>
<td>35.00%</td>
<td>$</td>
<td>$ 1,853,787</td>
</tr>
<tr>
<td></td>
<td>Relocations</td>
<td>$ 1,373,175</td>
<td></td>
<td>$ 480,611</td>
<td>35.00%</td>
<td>$</td>
<td>$ 1,853,787</td>
</tr>
<tr>
<td>06</td>
<td>Fish &amp; Wildlife Facilities</td>
<td>$ 2,157,112</td>
<td></td>
<td>$ 754,989</td>
<td>35.00%</td>
<td>$</td>
<td>$ 2,912,101</td>
</tr>
<tr>
<td></td>
<td>Total Fish &amp; Wildlife Facilities</td>
<td>$ 2,157,112</td>
<td></td>
<td>$ 754,989</td>
<td>35.00%</td>
<td>$</td>
<td>$ 2,912,101</td>
</tr>
<tr>
<td>11</td>
<td>Levees and Floodwalls</td>
<td>$ 17,147,714</td>
<td></td>
<td>$ 6,001,700</td>
<td>35.00%</td>
<td>$</td>
<td>$ 23,149,414</td>
</tr>
<tr>
<td></td>
<td>Total Levees and Floodwalls</td>
<td>$ 17,147,714</td>
<td></td>
<td>$ 6,001,700</td>
<td>35.00%</td>
<td>$</td>
<td>$ 23,149,414</td>
</tr>
<tr>
<td>18</td>
<td>Cultural Resource Preservation</td>
<td>$ 1,070,000</td>
<td></td>
<td>$ 374,500</td>
<td>35.00%</td>
<td>$</td>
<td>$ 1,444,500</td>
</tr>
<tr>
<td></td>
<td>Total Cultural Resource Preservation</td>
<td>$ 1,070,000</td>
<td></td>
<td>$ 374,500</td>
<td>35.00%</td>
<td>$</td>
<td>$ 1,444,500</td>
</tr>
<tr>
<td>19</td>
<td>Buildings, Grounds &amp; Utilities</td>
<td>$ 12,620,889</td>
<td></td>
<td>$ 4,417,311</td>
<td>35.00%</td>
<td>$</td>
<td>$ 17,038,200</td>
</tr>
<tr>
<td></td>
<td>Total Buildings, Grounds &amp; Utilities</td>
<td>$ 12,620,889</td>
<td></td>
<td>$ 4,417,311</td>
<td>35.00%</td>
<td>$</td>
<td>$ 17,038,200</td>
</tr>
<tr>
<td>30</td>
<td>Planning, Engineering, and Design</td>
<td>1 LS</td>
<td></td>
<td>$ 3,608,733</td>
<td>35.00%</td>
<td>$</td>
<td>$ 4,871,790</td>
</tr>
<tr>
<td>31</td>
<td>Construction Management</td>
<td>1 LS</td>
<td></td>
<td>$ 3,608,733</td>
<td>35.00%</td>
<td>$</td>
<td>$ 4,871,790</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>$ 55,041,145</td>
<td></td>
<td>$ 18,887,966</td>
<td>$</td>
<td>$</td>
<td>$ 71,929,111</td>
</tr>
</tbody>
</table>

BASIS OF COST

The construction cost estimate was developed in MCACES, Second Generation (MII) using the appropriate Work Breakdown Structure (WBS) and based on current estimated quantities provided by the Hydraulics & Hydrology Engineers. The cost estimate was developed from these quantities using cost resources such as RSMeans, historical data from similar construction features, and MII Cost Libraries. The contingencies were developed based on input to the Cost Schedule Risk Analysis (CSRA) (template provided by the Cost Mandatory Center of Expertise, MCX, Walla Walla District). These contingencies were applied to the construction cost estimates to develop the Total Project First Cost. The overall construction duration was
estimated at 52 months as shown in Figure 1. The construction schedule was developed based on the crew outputs referenced from RSMeans with assumptions that multiple crews would work simultaneously.

**Figure 1 – Construction Schedule**

CONTINGENCIES

As stated in ER 1110-2-1302, the goal in contingency development is to identify the uncertainty associated with an item of work or task to an acceptable degree of confidence. Consideration must be given to the detail available at each stage of planning, design, or construction for which a cost estimate is being prepared. Contingency may vary throughout the cost estimate and could constitute a significant portion of the overall costs when data or design details are unavailable. Final contingency development and assessment of the potential for cost growth is included in this cost estimate. To develop the Total Project First Cost, contingencies developed in the CSRA were applied. The construction cost contingency developed per CSRA for Rahway Tidal is shown in Table 2 on the following page.
Table 2 – Contingencies

<table>
<thead>
<tr>
<th>Element</th>
<th>Contingency Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relocation</td>
<td>35%</td>
</tr>
<tr>
<td>Fish and Wildlife Facilities</td>
<td>35%</td>
</tr>
<tr>
<td>Levees and Floodwalls</td>
<td>35%</td>
</tr>
<tr>
<td>Cultural Resource Preservation</td>
<td>35%</td>
</tr>
<tr>
<td>Buildings, Grounds &amp; Utilities</td>
<td>35%</td>
</tr>
<tr>
<td><strong>Total Construction Contingency</strong></td>
<td><strong>35%</strong></td>
</tr>
<tr>
<td>Lands &amp; Damages</td>
<td>40%</td>
</tr>
<tr>
<td>Planning, Engineering, and Design</td>
<td>35%</td>
</tr>
<tr>
<td>Construction Management</td>
<td>35%</td>
</tr>
</tbody>
</table>

PLANNING, ENGINEERING, AND DESIGN

The costs were developed for all activities associated with the planning, engineering and design effort. The cost for this account includes the preparation of Design Documentation Reports and plans and specifications for each construction contract and engineering support during construction through project completion. It includes all the in-house labor based upon work-hour requirements, material and facility costs, travel and overhead.

CONSTRUCTION MANAGEMENT

The costs were developed for all construction management activities from pre-award requirements through final contract closeout. These costs include the in-house labor based upon work-hour requirements, materials, facility costs, support contracts, travel and overhead. Costs were developed based on the input from the construction division in accordance with the CWBS and include but are not limited to anticipated items such as the salaries of the resident engineer and staff, surveyors, inspectors, draftsmen, clerical, and custodial personnel; operation, maintenance and fixed charges for transportation and for other field equipment; field supplies; construction management, general construction supervision; project office administration, distributive cost of area office and general overhead charged to the project. The work items and activities would include, but not be limited to: the salaries of all supervisory, engineering (including resident geologist and geological staff), office and safety field personnel; all on site expenses.

INTEREST DURING CONSTRUCTION

Interest during construction (IDC) is the cost of construction money invested before the beginning of the period of economic analysis and before the accumulation of benefits by the project. IDC costs have been added to the project cost to determine investment costs. Average annual costs were determined based on investment costs which include IDC. The pre-base year costs were estimated using the Federal interest rate of 2.75 percent (FY20).

OPERATION AND MAINTENANCE

The Operation and Maintenance (O&M) costs were estimated to represent the anticipated annual costs necessary to maintain the project at full operating efficiency throughout the project life. Following
completion of the project, operation and maintenance of project facilities would be performed by the local cooperating agency in accordance with federal regulations and operations manual.

**ESTIMATED ANNUAL CHARGES**

Annualized costs are based on an economic project life of 50 years and an interest rate of 2.75%. The annual charges include the annualized investment costs along with annual operation and maintenance costs. A detailed breakdown of annual costs is presented in Table 3.

Table 3 – Annualized Cost

<table>
<thead>
<tr>
<th>Cost Category</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First Cost</strong></td>
<td>$71,929,111</td>
</tr>
<tr>
<td><strong>Investment Cost</strong></td>
<td></td>
</tr>
<tr>
<td>Interest During Construction (a)</td>
<td>$2,424,017</td>
</tr>
<tr>
<td><strong>Total Investment Cost</strong></td>
<td>$74,353,128</td>
</tr>
<tr>
<td><strong>Annual Costs</strong></td>
<td></td>
</tr>
<tr>
<td>Annualized Investment Cost (b)</td>
<td>$2,754,108</td>
</tr>
<tr>
<td>Annualized Operation &amp; Maintenance Cost (c)</td>
<td>$231,990</td>
</tr>
<tr>
<td><strong>Total Annual Cost</strong></td>
<td>$2,986,098</td>
</tr>
</tbody>
</table>

October 2019 PL
(a) Based on 52 months of construction @ 2.75% (IDC, E&D and RE costs calculated separately and included in this total)
(b) Annualized investment cost only includes the remaining features. I = 2.75% and n = 50 yrs
(c) Assume 0.5% of total Construction Cost based on historical data.

**COST SUMMARY**

The Total Fully Funded Project cost is $88,130,000.
### Figure 2 – Total Project Cost Summary

**PROJECT:** Rahway Tidal  
**PROJECT NO:** P2 # 403353  
**LOCATION:** Rahway, NJ  

This Estimate reflects the scope and schedule in report;  

<table>
<thead>
<tr>
<th>Civil Works Work Breakdown Structure</th>
<th>ESTIMATED COST</th>
<th>PROJECT FIRST COST</th>
<th>TOTAL PROJECT COST</th>
<th>11/21/2019</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(Constant Dollar Basis)</td>
<td>(FULLY FUNDED)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(A)</td>
<td>(B)</td>
<td>(C)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>COST</td>
<td>CNTG</td>
<td>CNTG</td>
</tr>
<tr>
<td>02 RELOCATIONS</td>
<td>$1,373</td>
<td>$481</td>
<td>35.0%</td>
<td>$1,854</td>
</tr>
<tr>
<td>06 FISH &amp; WILDLIFE FACILITIES</td>
<td>$2,157</td>
<td>$755</td>
<td>35.0%</td>
<td>$2,912</td>
</tr>
<tr>
<td>11 LEVEES &amp; FLOODWALLS</td>
<td>$17,148</td>
<td>$6,002</td>
<td>35.0%</td>
<td>$23,149</td>
</tr>
<tr>
<td>18 CULTURAL RESOURCE PRESERVATION</td>
<td>$1,070</td>
<td>$375</td>
<td>35.0%</td>
<td>$1,445</td>
</tr>
<tr>
<td>19 BUILDINGS, GROUNDS &amp; UTILITIES</td>
<td>$12,621</td>
<td>$4,417</td>
<td>35.0%</td>
<td>$17,038</td>
</tr>
<tr>
<td><strong>CONSTRUCTION ESTIMATE TOTALS</strong></td>
<td>$34,309</td>
<td>$12,029</td>
<td></td>
<td>$46,398</td>
</tr>
<tr>
<td>01 LANDS AND DAMAGES</td>
<td>$6,471</td>
<td>$2,589</td>
<td>40.0%</td>
<td>$9,060</td>
</tr>
<tr>
<td>30 PLANNING, ENGINEERING &amp; DESIGN</td>
<td>$6,092</td>
<td>$3,007</td>
<td>35.0%</td>
<td>$11,600</td>
</tr>
<tr>
<td>31 CONSTRUCTION MANAGEMENT</td>
<td>$3,609</td>
<td>$1,263</td>
<td>35.0%</td>
<td>$4,872</td>
</tr>
<tr>
<td><strong>PROJECT COST TOTALS</strong></td>
<td>$53,041</td>
<td>$18,888</td>
<td>35.6%</td>
<td>$71,929</td>
</tr>
</tbody>
</table>

**CHIEF, COST ENGINEERING, Mukesh Kumar**  
**PROJECT MANAGER, Rifat Salim**  
**CHIEF, REAL ESTATE, Lydia William**

**ESTIMATED TOTAL PROJECT COST:** **$88,130**
<table>
<thead>
<tr>
<th>WBS NUMBER</th>
<th>Civil Works Feature &amp; Sub-Feature Description</th>
<th>ESTIMATED COST</th>
<th>PROJECT FIRST COST (Constant Dollar Basis)</th>
<th>TOTAL PROJECT COST (FULLY FUNDED)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>COST ($)</td>
<td>CNTG (%)</td>
<td>TOTAL ($)</td>
</tr>
<tr>
<td>A</td>
<td>PHASE 1 or CONTRACT 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>02</td>
<td>RELOCATIONS</td>
<td>$1,373</td>
<td>$481</td>
<td>35.0%</td>
</tr>
<tr>
<td>06</td>
<td>FISH &amp; WILDLIFE FACILITIES</td>
<td>$2,157</td>
<td>$755</td>
<td>35.0%</td>
</tr>
<tr>
<td>11</td>
<td>LEVEES &amp; FLOODWALLS</td>
<td>$17,148</td>
<td>$6,002</td>
<td>35.0%</td>
</tr>
<tr>
<td>18</td>
<td>CULTURAL RESOURCE PRESERVATION</td>
<td>$1,070</td>
<td>$375</td>
<td>35.0%</td>
</tr>
<tr>
<td>19</td>
<td>BUILDINGS, GROUNDS &amp; UTILITIES</td>
<td>$12,621</td>
<td>$4,417</td>
<td>35.0%</td>
</tr>
<tr>
<td><strong>CONSTRUCTION ESTIMATE TOTALS:</strong></td>
<td></td>
<td>$34,369</td>
<td>$12,029</td>
<td>35.0%</td>
</tr>
<tr>
<td>01</td>
<td>LANDS AND DAMAGES</td>
<td>$6,471</td>
<td>$2,589</td>
<td>40.0%</td>
</tr>
<tr>
<td>30</td>
<td>PLANNING, ENGINEERING &amp; DESIGN</td>
<td>$569</td>
<td>$501</td>
<td>35.0%</td>
</tr>
<tr>
<td>1.0%</td>
<td>Project Management</td>
<td>$569</td>
<td>$501</td>
<td>35.0%</td>
</tr>
<tr>
<td>12.5%</td>
<td>Engineering &amp; Design</td>
<td>$569</td>
<td>$501</td>
<td>35.0%</td>
</tr>
<tr>
<td>1.0%</td>
<td>Reviews, ATRIs, IEPBs, VE</td>
<td>$569</td>
<td>$501</td>
<td>35.0%</td>
</tr>
<tr>
<td>1.0%</td>
<td>Life Cycle Updates (cost, schedule, risks)</td>
<td>$569</td>
<td>$501</td>
<td>35.0%</td>
</tr>
<tr>
<td>1.0%</td>
<td>Contracting &amp; Reprographics</td>
<td>$569</td>
<td>$501</td>
<td>35.0%</td>
</tr>
<tr>
<td>1.0%</td>
<td>Engineering During Construction</td>
<td>$569</td>
<td>$501</td>
<td>35.0%</td>
</tr>
<tr>
<td>1.0%</td>
<td>Planning During Construction</td>
<td>$569</td>
<td>$501</td>
<td>35.0%</td>
</tr>
<tr>
<td>1.0%</td>
<td>Adaptive Management &amp; Monitoring</td>
<td>$569</td>
<td>$501</td>
<td>35.0%</td>
</tr>
<tr>
<td>0.0%</td>
<td>Project Operations</td>
<td>$0</td>
<td>$0</td>
<td>35.0%</td>
</tr>
<tr>
<td>31</td>
<td>CONSTRUCTION MANAGEMENT</td>
<td>$3,609</td>
<td>$1,263</td>
<td>35.0%</td>
</tr>
<tr>
<td>10.5%</td>
<td>Construction Management</td>
<td>$3,609</td>
<td>$1,263</td>
<td>35.0%</td>
</tr>
<tr>
<td>0.0%</td>
<td>Project Operation</td>
<td>$0</td>
<td>$0</td>
<td>35.0%</td>
</tr>
<tr>
<td>0.0%</td>
<td>Project Management</td>
<td>$0</td>
<td>$0</td>
<td>35.0%</td>
</tr>
<tr>
<td><strong>CONTRACT COST TOTALS:</strong></td>
<td></td>
<td>$53,041</td>
<td>$18,888</td>
<td>$71,929</td>
</tr>
</tbody>
</table>

This Estimate reflects the scope and schedule in report.
<table>
<thead>
<tr>
<th>Description</th>
<th>UOM</th>
<th>Quantity</th>
<th>Project Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summary</td>
<td>LS</td>
<td>1.0000</td>
<td>34,378,528.50</td>
</tr>
<tr>
<td>Optimized Plan</td>
<td>LS</td>
<td>1.0000</td>
<td>1,373,175.25</td>
</tr>
<tr>
<td>02 Relocation</td>
<td>LS</td>
<td>1.0000</td>
<td>2,157,111.59</td>
</tr>
<tr>
<td>06 Fish &amp; Wildlife</td>
<td>LS</td>
<td>1.0000</td>
<td>17,157,353.03</td>
</tr>
<tr>
<td>11 Levees and Floodwalls</td>
<td>LS</td>
<td>1.0000</td>
<td>1,070,000.00</td>
</tr>
<tr>
<td>18 Cultural Resource Preservation</td>
<td>LS</td>
<td>1.0000</td>
<td>12,620,888.62</td>
</tr>
<tr>
<td>19 Buildings, Grounds, &amp; Utilities</td>
<td>LS</td>
<td>1.0000</td>
<td>34,378,528.50</td>
</tr>
</tbody>
</table>