Non-Structural Flood Control Measures for Passaic River

By: Dr. Hormoz Pazwash, P.E., F.ASCE. D.WRE

Boswell Engineering
South Hackensack, NJ 07606
Passaic River Drainage Basin

Source:
http://www.passaicriver.org/passaicriverinfo.html
History of Flooding
During the Past 50 Years
Little Falls, New Jersey

- 51 floods
- 15 major floods
- Annual flood damage cost = $120,000,000

Flood of 1984
- $462,000,000 damage
- 3 lives lost
- 6,000 displacements
### Major Floods in Passaic River
#### During the Past 50 Years
#### Little Falls, New Jersey

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Peak Flood Stage Feet</th>
<th>Mean Daily Discharge CFS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1968</td>
<td>May 31</td>
<td>10.73</td>
<td>13,500</td>
</tr>
<tr>
<td>1972</td>
<td>June 25</td>
<td>9.45</td>
<td>10,300</td>
</tr>
<tr>
<td>1973</td>
<td>Feb. 5</td>
<td>9.45</td>
<td>10,600</td>
</tr>
<tr>
<td>1978</td>
<td>Mar. 29</td>
<td>9.18</td>
<td>10,100</td>
</tr>
<tr>
<td>1979</td>
<td>Jan. 27</td>
<td>9.21</td>
<td>10,200</td>
</tr>
<tr>
<td>1980</td>
<td>Apr. 11</td>
<td>9.06</td>
<td>9,870</td>
</tr>
<tr>
<td>1983</td>
<td>Mar. 22</td>
<td>9.00</td>
<td>9,740</td>
</tr>
<tr>
<td>1984</td>
<td>Apr. 7</td>
<td>12.91</td>
<td>18,400</td>
</tr>
<tr>
<td>1987</td>
<td>Apr. 6</td>
<td>9.29</td>
<td>10,300</td>
</tr>
<tr>
<td>1989</td>
<td>May 19</td>
<td>9.44</td>
<td>10,700</td>
</tr>
<tr>
<td>1999</td>
<td>Sep. 18</td>
<td>9.84</td>
<td>11,600</td>
</tr>
<tr>
<td>2005</td>
<td>Apr. 4</td>
<td>10.11</td>
<td>12,100</td>
</tr>
<tr>
<td>2007</td>
<td>Apr. 18</td>
<td>11.88</td>
<td>15,800</td>
</tr>
<tr>
<td>2010</td>
<td>Mar. 16</td>
<td>11.97</td>
<td>15,600</td>
</tr>
</tbody>
</table>
Flood Control Studies

Flood District Commission 1902-1936
U.S. Army C.O.E.

» Proposed structural detentions

• Dry detention basin
• Channel improvements
• Property acquisition
• Construction of levees & flood walls
• Two large dams
• Flood tunnel (40’ diameter, 20.1 mile span & 22’ diameter, 1.2 mile span)
## Rainfall Depths, Inches
### During Floods of Over 10 Feet Stage and Tropical Storm Floyd

<table>
<thead>
<tr>
<th>Rainfall Period</th>
<th>Wanaque Raymond Reservoir</th>
<th>Charlottsburg Reservoir</th>
<th>Other Stations</th>
<th>Average(1) Inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>29-30 May 1968</td>
<td>5.96</td>
<td>6.67</td>
<td></td>
<td>6.32</td>
</tr>
<tr>
<td>5-6 Apr. 1984</td>
<td>4.15</td>
<td>4.34</td>
<td></td>
<td>4.25</td>
</tr>
<tr>
<td>16-17 Sep. 1999</td>
<td>8.87</td>
<td>7.96</td>
<td>14.13 (Little Falls)</td>
<td>10.32</td>
</tr>
<tr>
<td>2-3 Apr. 2005</td>
<td>3.02</td>
<td>2.72</td>
<td></td>
<td>2.87</td>
</tr>
<tr>
<td>15-17 Apr. 2007</td>
<td>5.40</td>
<td>5.68</td>
<td>6.73 Newark</td>
<td>5.54</td>
</tr>
<tr>
<td>13-15 Mar. 2010</td>
<td>3.51(2)</td>
<td>5.76</td>
<td>4.82 Newark</td>
<td>4.64</td>
</tr>
</tbody>
</table>

(1) The averages exclude the Newark data which is listed for comparison.
(2) Data at Wayne Station (No data available at Wanaque Raymond Reservoir).
Source of Data: nrcc@cornell.edu
<table>
<thead>
<tr>
<th>Date of Flood</th>
<th>Stage Ft.</th>
<th>Discharge CFS</th>
<th>Rainfall Amount (1) CFS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apr. 7, 1984</td>
<td>12.91</td>
<td>18,400</td>
<td>4.25</td>
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<tr>
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<td>10.32</td>
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</table>

(1) See Table 2 for the rainfall period (2 days for floods of 1968, 1984, 1999 and April 2005, 3 days for floods of 2007 and 2010).
Hydrograph of March 2010 Flood
Non-Structural Flood Control Solutions

- Regular Maintenance
- Acquisition of Flood Prone Structures
- Retrofitting Existing Drainage Systems
- Revisiting Drainage Ordinance
- Reservoirs Operations
Appendix

Estimating per capita roof area (inclusive of dwellings, commercial and public) at 400 ft$^2$, the amount of runoff for 5 inches of rain is calculated as follows:

\[
A = 3 \times 10^6 \times 400 \times \frac{5}{12} = 500 \times 10^6 \text{ ft}^2
\]

where 3 million is a population in the Passaic River basin.

According to Figure 1, the flow volume during 8.5 days of discharge over 6,000 cfs is estimated at:

\[
(15,600 - 6,000) \times 8.5 \times 86,400/2 = 3,525 \times 10^6 \text{ cfs}
\]

Removing 500 x $10^6$ cubic feet of water from the flood volume would result in a reduced discharge as calculated below:

\[
\text{Reduced flood volume} = 3,525 \times 10^6 - 500 \times 10^6 = 3,025 \times 10^6 \text{ cfs}
\]

\[
\text{Peak discharge above 6,000 cfs:}\]

\[
Q_R = \frac{3,025 \times 10^6}{(8.5 \times 86,400)/2} = 8,238 \text{ cfs}
\]

\[
\text{Reduced peak discharge} = 6,000 + 8,238 = 14,238 \quad \text{Say 14,200 cfs}
\]

\[
\text{Net Reduction} = 15,600 - 14,200 = 1,400 \text{ cfs}
\]

\[
\text{Percent reduction:}
\]

\[
\frac{1,400}{15,600} = 9\%
\]
References

(1) U.S. Army Corp of Engineers, 1995, "General Design Memorandum, Passaic River Drainage Reduction Project". Department of the Army, N.Y. District Corp of Engineers, 255P.

(2) https://nwis.waterdata.usgs.gov/nj/nwis/peak

(3) http://waterdata.usgs.gov/nj/nwis/sw

(4) http://en.wikipedia.org/wiki/passaic_river_flood_tunnel


Questions?