HYDRAULIC REPORT

Naples Bay Bridge – Route 302, Naples, Br #2047

The hydraulic analysis for the project was conducted by using the design flows obtained in the Hydrology section in two stages; the first stage was for existing bridge opening, and the second for the proposed bridge opening.

Based on the analysis results, the ability of existing and proposed channel to accommodate and safely pass flood flows is determined. To achieve this, a computer program developed by the Hydrologic Engineering Center of the US Army Corps of Engineers; HEC-RAS was utilized. The program develops a hydraulic model for the river or channel, and applies the flood flows to it.

The analysis results in corresponding water stage elevations, and flow velocity for each flow condition. Based on the stage elevations obtained, the adequacy of the channel can be determined. If the channel is deemed inadequate, a recommendation to modify the existing opening for the new bridge can be proposed. One must bear in mind that any decision to modify an existing channel or embankment must be approved by the regulating environmental agency. This is largely due to impact on wetlands, ecology, and possibly fish passage.

Existing bridge opening analysis and results

The analysis of the existing swing bridge opening was conducted for the entire channel width with obstructions only at the bridge, due to the existing concrete turntable platform. The results of the analysis for the existing bridge opening were obtained and tabulated as follows:

Type	Flow (cfs)	Headwater Elev (ft)	Velocity(ft/s)
$Q_{1.1}$	600	267.60	6.72
Q_{10}	970	268.20	6.67
Q_{50}	1175	268.51	6.86
Q_{100}	1246	268.62	6.94
Q_{500}	1355	268.77	7.09

Freeboard @ Q_{50} = 5.4 ft

From the above results, it can be concluded that the stage for all flows remain steady with only very slight variation. The reasoning behind that is that the difference in flows is small to affect a considerable rise in elevations. It is thus safe to adopt the Q50 design flow stage of 268.51 ft, which results in minimum free board of 5.4 feet, and a flow speed of 7.1 ft/sec at the Q500 to check scour effects.

Scour Analysis:

A comprehensive scour analysis was conducted for the existing bridge and channel using HEC-RAS software; to study the effects of scour on the existing substructure, and the timber pile system that support the foundations. Since the flow is not considered to be river type flow, but rather a lake-pond type flow system with considerable storage volume upstream and downstream of the bridge, scour was computed for the 500 yr flood flows. Both river bed contraction scours and local scours at abutments were computed and recorded as follows:

Total scour within channel

1- Local Scour (Pier shaft and footing) = 0 ft
2- Contraction = 3.99 ft +/-

Total scour Depth within channel = 3.99 ft +/-

Stream Bed elevation after scour has occurred = 257.4 ft

Total scour at left abutment

1- Local Scour (Abutment scour) = 13.41 ft
2- Contraction = 0 ft +/-

Total scour Depth within channel = 13.41 ft +/-

Stream Bed elevation after scour has occurred = 262.5 ft

Total scour at Right abutment

1- Local Scour (Abutment scour) = 13.25 ft
2- Contraction = 0 ft +/-

Total scour Depth within channel = 13.25 ft +/-

Stream Bed elevation after scour has occurred = 263.4 ft

From the results above, the 500 yr flood flow scour at existing left and right abutments are in the range of 13.0'±; at elevation 263'±. The bottom elevation of existing abutment pile caps is 256.43', and the wooden piles embedded 39' to an elevation of 217.43'. Therefore the existing abutments are safe from scour effects.

Proposed bridge opening analysis and results

The analysis of the proposed bridge opening was conducted for the entire channel width with obstructions only at the proposed central pier, and with the existing concrete platform for the existing swing bridge removed. The results of the analysis were obtained and tabulated as follows:

Type	Flow (cfs)	Headwater Elev (ft)	Velocity(ft/s)
$Q_{1.1}$	600	267.35	7.14
Q_{10}	970	268.08	8.06
Q_{50}	1175	268.42	8.54
Q_{100}	1246	268.53	8.69
Q_{500}	1355	268.70	8.89

Freeboard @ Q_{50} = 11.98 ft

From the above results, it can be concluded that the stage for all flows remain steady with only very slight variation. The reasoning behind that is that the difference in flows is small to affect a considerable rise in elevations. It is thus safe to adopt the Q50 design flow stage of 268.42 ft, which results in minimum free board of 11.98 feet, and a flow speed of 8.89 ft/sec at the Q500 to check scour effects. It must be noted that the large freeboard is also a result of the proposed bridge being raised 5' above the existing.

Scour Analysis:

A detailed scour analysis was conducted for the proposed bridge and channel using HEC-RAS software; to study the effects of scour on the proposed substructure, and the H pile system that support the foundations. Scour computations were conducted for the 500 year flood flow. River bed contraction scour and local scours of central pier and abutments were computed and reported as follows:

Total scour within channel

1 - Local Scour (Bent Pile Pier only) = 9.38 ft
2 - Contraction = 2.16 ft +/-

Total scour Depth within channel = 11.54 ft +/-

Stream Bed elevation after scour has occurred = 248.71 ft

Total scour at left abutment

1- Local Scour (Abutment scour) = 16.59 ft
2- Contraction = 0 ft
Total scour Depth within channel = 16.59 ft +/-
Stream Bed elevation after scour has occurred = 254.0 ft

Total scour at Right abutment

1- Local Scour (Abutment scour) = 15.04 ft
2- Contraction = 2.16 ft +/-

Total scour Depth within channel = 17.20 ft +/-

Stream Bed elevation after scour has occurred = 246.4 ft

From the results above, the controlling 500 yr flood flow scour is pertinent to that of right abutment with the highest value noted is 17.2 feet. The stream bed elevation after scour has been determined to be 246.4' at right abutment, and 254.0' at left abutment. The bottom elevations of seals were thus set at 249.0' with Maximum pile exposure of 2.6' at the right abutment.

Reported By:

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