Summary Hydraulic Report

Jordan Creek Bridge
Jordan Avenue, Juneau, Alaska

Prepared for:
City and Borough of Juneau
Engineering Department
155 South Seward Street
Juneau, Alaska 99801

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1. Project Description

PND Engineers, Inc. (PND) has provided this Summary Hydraulic Report to address the hydraulic impacts of replacing the existing Jordan Creek Bridge at Jordan Avenue with a new bridge. The current bridge consists of two spans with in-stream-piers and is approximately 40 feet long and 30 feet wide. The surveyed top of curb elevation of the existing bridge is approximately 29.8 feet MLLW, while the low chord elevation is approximately 27.3 feet MLLW. The proposed replacement bridge will consist of only one span 50 feet long and will eliminate the need for in-stream-piers.

2. Hydraulic History

Jordan Creek originates in the steep, mountainous area along the eastern edge of the Mendenhall Valley and then flows within a narrow strip of undeveloped muskeg and spruce forest. Downstream from Egan Drive, the creek enters an urbanized setting and flows past office complexes, parking lots and road crossings; additionally, several storm drains enter Jordan Creek in this area. Finally, the creek discharges into a tidal slough that empties into Fritz Cove. Jordan Creek is an anadromous fish stream.

While there is no regular confluence along Jordan Creek, hydraulic analysis and LIDAR data indicate that during a 100-year-flood inter-basin flow occurs from Duck Creek to Jordan Creek. Floodwaters will exit Duck Creek at a low area about 500 feet downstream of Egan Drive and travel across residential land and enter Jordan Creek upstream of the bridge at Jordan Avenue (Curran, 2006).

Approximately 600 feet upstream of the Jordan Avenue crossing, a bridge at Trout Street spans the creek and at 1000 feet upstream the creek is conveyed under Egan Drive through two 8-ft-diameter culverts. At approximately 900 feet downstream of the Jordan Avenue crossing the creek is conveyed under Glacier Highway by two 8-ft-diameter culverts. Hydraulic analyses of Jordan Creek indicate that backwater conditions are present at both the Glacier Highway and Egan Drive culverts during 10 year and greater flood events.

At the crossing, the channel material consists of sand and gravels up to 2 inches in diameter (Curran, 2006) and vegetation consists of mature spruce trees up to 3 feet in diameter. An asphalt parking lot is located on the left bank upstream of the bridge and a gravel parking lot is located on the left bank downstream of the bridge. The bridge at Jordan Avenue is located at a bend in the creek and the flow is from east to west through the crossing, with the thalweg located on the outside of the bend or closer to the left bank. ADOT&PF inspection reports for the existing Jordan Creek Bridge state that the left bank abutment or south abutment has been subject to scour in the past.
3. Hydrology and Hydraulic Design

Jordan Creek has a low gradient at the bridge site and a drainage area of approximately 2.6 square miles. Steep, mountainous terrain at Jordan Creek’s headwaters cause the creek to have flashy, quickly rising and declining stream flows.

At the bridge crossing the stream bed elevation is approximately 24 feet MLLW while the Ordinary High Water (OHW) is at 26.5 feet MLLW.

In the lower reach of Jordan Creek, surface water elevations are influenced by tidal changes. Model simulations demonstrate that if high tide were to occur during a 100-year flood event, backwater effects from the tide are present up to 750 feet upstream of Yandukin Drive on Jordan Creek (Curran, 2006). The tidal influence does not affect Jordan Creek at the Jordan Avenue crossing.

U.S. Geological Survey (USGS) gaging station 15052475 was located just downstream of the Jordan Creek crossing at Egan Drive, and was used to collect 8 years of stream flow records from 1997 to 2005 when it was discontinued. The highest flow recorded at the stream gaging station was 149 ft³/sec on December 28, 1999. The peak flow was in response to a storm that dropped a total 2.95 inches of rainfall in two days. During this storm minor flooding was reported along Jordan Creek below Egan Drive.

The FEMA 100-year flood level at the project site is approximately 26 feet MLLW based on a 1990 Flood Insurance Study (FIS). Since the 1990 FIS was published, the USGS has collected 8 years of stream flow records and completed an updated analysis of flood magnitudes and water surface elevations in cooperation with the City and Borough of Juneau (Curran, 2006). Table 1 summarizes the newly estimated peak stream flows for Jordan Creek.

Table 1. Estimated Peak Stream Flows in Jordan Creek (2.6 mi.²)

<table>
<thead>
<tr>
<th>Return Period (years)</th>
<th>Annual Exceedance Probability</th>
<th>Estimated from Streamflow Data (ft³/sec)</th>
<th>Estimated from Regional Equations (ft³/sec)</th>
<th>Weighted Estimate (ft³/sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>50%</td>
<td>83</td>
<td>375</td>
<td>99</td>
</tr>
<tr>
<td>10</td>
<td>10%</td>
<td>149</td>
<td>649</td>
<td>202</td>
</tr>
<tr>
<td>50</td>
<td>2%</td>
<td>215</td>
<td>896</td>
<td>329</td>
</tr>
<tr>
<td>100</td>
<td>1%</td>
<td>246</td>
<td>999</td>
<td>389</td>
</tr>
<tr>
<td>200</td>
<td>0.5%</td>
<td>278</td>
<td>1110</td>
<td>448</td>
</tr>
<tr>
<td>500</td>
<td>0.2%</td>
<td>324</td>
<td>1250</td>
<td>530</td>
</tr>
</tbody>
</table>


In addition to new peak stream flow values, new cross sections along the creek were surveyed and used to create a HEC-RAS model of the creek. From this HEC-RAS model
new water surface profiles were determined at different flood intervals. At the Jordan Avenue, Jordan Creek Bridge the estimated 100-year flood level is 28.5 feet MLLW. Table 2 presents the estimated water surface elevations for select return intervals at the bridge.

Table 2. Estimated Water Surface Elevations at Jordan Creek Bridge

<table>
<thead>
<tr>
<th>Return Period</th>
<th>Water Surface Elevation, (ft MLLW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>27.1</td>
</tr>
<tr>
<td>50</td>
<td>28.1</td>
</tr>
<tr>
<td>100</td>
<td>28.5</td>
</tr>
<tr>
<td>500</td>
<td>29.1</td>
</tr>
</tbody>
</table>


PND has reviewed the 2006 USGS investigation results and created its own HEC-RAS model for the Jordan Creek Bridge using the weighted peak stream flow estimates and survey data from the 2006 USGS investigation and from a field survey conducted by PND. The results from the PND analysis agree with the higher water surface profiles of the 2006 USGS investigation.

An additional HEC-RAS model was then created to compare the hydraulic effects of the new bridge if the low chord is placed at either an elevation of 27 feet MLLW or at 28.5 feet MLLW. The lower chord bridge will create backwater effects upstream during flood levels equal to or greater than the 50-year flood. If the bridge is designed with a low chord of 28.5 feet MLLW there will be no backwater effects of the bridge.

4. Scour

At the bridge site, the bank material consists of silt, organic detritus and sand. Scour along the south or left bank abutment has been noted in previous ADOT&PF bridge inspection reports. Additionally, spruce trees along the left bank have been undercut by the stream. HEC-RAS model estimates by PND for abutment scour are between 4 and 8 feet below the current stream bed for a 50-year flood and 5 to 9 feet for a 100-year flood. Abutment scour was estimated by HEC-18 techniques using Froehlich’s abutment scour equation with flow velocities through the bridge of 2.9 ft/sec and 3.2 ft/sec for the 50-year flood and 100-year flood, respectively.

If conventional footings are used at the abutments, the base of the footings will need to be placed at the normal stream elevation or lower. Scour countermeasures, such as riprap, will then be required to armor the abutments. The use of riprap protection at abutments was evaluated using guidelines in FHWA HEC-23. The resulting recommended Ds0 values for the riprap at the abutments is 0.17 ft for 50 year flood levels and 0.20 feet for 100 year flood levels. Based on the results of these analyses, it is recommended that ADOT&PF Class 1 riprap or equivalent scour protection be provided to a depth of at least 3 feet below the existing stream bed at the bridge.
5. Certification

The proposed replacement of the Jordan Avenue, Jordan Creek Bridge will have negligible effect on the hydrologic and hydraulic attributes on the drainage.

Jim Campbell, P.E.    Cindy Wright, EIT
Senior Engineer    Staff Engineer
6. References


### Jordan Creek Bridge at Jordan Avenue, Juneau, Alaska

**HYDROLOGIC AND HYDRAULIC SUMMARY**

<table>
<thead>
<tr>
<th>Return Period</th>
<th>2 yrs</th>
<th>50 yrs</th>
<th>100 yrs</th>
<th>500 yrs</th>
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</thead>
<tbody>
<tr>
<td>Exceedance Probability</td>
<td>50%</td>
<td>2%</td>
<td>1%</td>
<td>0.2%</td>
</tr>
<tr>
<td>Design Discharge (cfs)</td>
<td>99</td>
<td>329</td>
<td>389</td>
<td>530</td>
</tr>
<tr>
<td>Design High Water (ft MLLW)</td>
<td>25.8 ft</td>
<td>28.1 ft</td>
<td>28.5 ft</td>
<td>29.1 ft</td>
</tr>
<tr>
<td>Anticipated Additional Backwater (ft)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.2 ft</td>
</tr>
<tr>
<td>Contraction Scour</td>
<td>0.0 ft</td>
<td>0.0 ft</td>
<td>0.0 ft</td>
<td>0.0 ft</td>
</tr>
<tr>
<td>Abutment Scour</td>
<td>nc</td>
<td>nc</td>
<td>nc</td>
<td>nc</td>
</tr>
<tr>
<td>Drainage Area</td>
<td>2.6 square miles for this crossing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydraulic Capacity</td>
<td>389 cfs at Low Superstructure Elevation of 28.5 feet MLLW which has an exceedance probability of equal or less than 1 percent.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*nc = not calculated, abutment protection installed*