

LOWER MINNESOTA RIVER WATERSHED DISTRICT

Executive Summary for Action

Lower Minnesota River Watershed District Board of Managers Meeting Wednesday April 17, 2019

Agenda Item Item 6. B. - Dredge Management

Prepared By Linda Loomis, Administrator

Summary

i. Funding for dredge material management

The LMRWD is included in the BWSR budget for \$480,000 for the biennium. We were surprised (as was BWSR) to find this in the House omnibus bill from the Environment and Natural Resource Finance Committee. Apparently, when the appropriation for the LMRWD was included in 2017 legislation it did not specify that funding was a one time appropriation.

ii. Vernon Avenue Dredge Material Management site

The no-rise evaluation and the 60% design plan has been provided to the City of Savage. Staff is meeting with the city staff on Friday, April 12 to discuss the proposed reconfiguration of the site.

I visited the site on Tuesday, April 9 and was not able to get in as Vernon Avenue and the access road into the site were flooded. The river elevation that day was just above 708 feet; flood stage is 702 feet. The berm containing the private dredge material exhibited some minor erosion; however, it appears the flood water did not overtop the berm.

iii. Private Dredge Material Placement

Private terminals are in the process of getting DNR permits to dredge this spring. They will have to wait until the flood waters recede in order to remove material currently on site. New material cannot be placed until the prior year's material has been removed.

Attachments No-rise evaluation

60% design plan set

Recommended Action No recommended action



Technical Memorandum

To: Della Schall Young, Young Environmental Consulting Group
From: Jeff Weiss, Barr Engineering Co.
Subject: Minnesota River No-Rise Certification Evaluation - DRAFT
Date: March 8, 2019
Project: 23701082

The purpose of this memorandum is to provide a summary of the evaluation of potential impacts of the proposed modifications to the Cargill East River Dredge Material Site (Dredge Site) on the modeled water surface elevations for 1% Annual Exceedance Probability Flood, commonly referred to as the 100-year flood, on the Minnesota River. The Dredge Site Project will require information that supports a Minnesota "No-Rise" Certification, which certifies the project will have not result in a modification of the flood plain by more than 0.00 feet. The memorandum summarizes the analysis completed to determine the conditions for which a "No-Rise" Certification can be achieved.

Project Overview and Study Area

The purpose of the Dredge Site Project is to establish permanent berms and facilities to store and dewater dredge material generated from the Minnesota River and nearby commercial facilities. Dredge material is current stored at the site on a temporary basis; however, the Dredge Site Project will establish a permanent configuration for stored materials. Background information on the Dredge Site Project is included in a technical memorandum from Burns & McDonnell and Young Environmental Consulting Group, dated February 15, 2017, and the Cargill East River (MN – 14.2 RMP) Dredge Material Site Management Plan (Lower Minnesota River Watershed District, 2013).

The study area is on the floodplain of the Minnesota River, near the Soo Line Railroad Bridge in Savage, MN (Figure 1). The main study area was concentrated between rivers stations 35 and 39; however, as discussed in the hydraulic analysis section below, the analysis reviewed modeling results further upstream of River Station 39.

Hydraulic Analysis

The hydraulic analysis utilized the HEC-RAS model (version 5.0.6) used by the U.S. Army Corps of Engineers (USACE) to develop the effective floodplain for the Minnesota River within the study area. The USACE developed the base model in 2004 (see Attachment A). The original model configuration was preserved as a reference, and to be consistent with other FEMA floodplain analyses the original configuration is referred to as the Duplicate Effective Model.

Barr Engineering Co. (Barr) modified the Duplicate Effective Model to more accurately model existing conditions at and near the Dredge Material Site. The modified model is referred to as the Corrected Effective Model and is used as a basis of comparison for the Proposed Conditions Model. The focused area of study is shown in Figure 1.

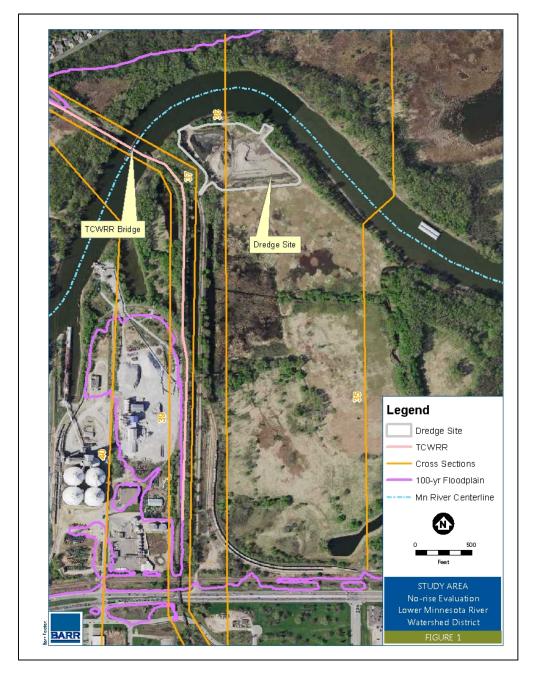


Figure 1 – Dredge site study area between cross sections 35 and 39.

The following bullet points highlight key modifications to create the Corrected Effective Model:

- Ineffective flow areas upstream and downstream of the TCWRR Bridge were modified to more accurately model the flow at the bridge
- Manning's n roughness values were adjusted in some areas to reflect existing vegetation cover.
- Additional cross sections were added in the study area to more accurately model transitions between different topographic features.

All other aspects of the model (e.g. flows, boundary conditions, modeling parameters, etc.) were left unchanged between the duplicate effective and corrected effective models. However, one feature that should be noted is that neither the Duplicate Effective Model nor the Corrected Effective Model include the temporary berms and dredge material that is often on site.

Ineffective flow areas

The modifications to the ineffective flow areas were the most significant change made to the Corrected Effective Model and warrant additional discussion. The ineffective flow areas were initially adjusted by using guidelines in the Bridge Hydraulic Analysis with HEC-RAS (USACE, 1996). The ineffective flow areas were further modified to more accurately account for the specific flow characteristics regarding depth of overtopping flow and the height of the railroad in relation to the floodplain. The top of the railroad is significantly higher (~16 feet) than much of the adjacent floodplain. If flood flows remain below the top of the railroad creates a significant "shadow" where most of the water adjacent to the railroad is effectively backwater and not actively flowing. A portion of the railroad and bridge is overtopped by a relatively small depth (~2.5 feet on average) during the 100-year flood; however the depth of overtopping the railroad is significantly smaller than the elevation difference between the top of the railroad and the adjacent floodplain. To accurately account for the effective flow area upstream and downstream of the bridge, the effective flow and ineffective flow areas were modeled in the following ways:

- The expansion and contraction of the effective flow areas were modeled using guidelines in Bridge Hydraulic Analysis with HEC-RAS (USACE, 1996)
- The area of effective flow above the top of the bridge due to overtopping flows was preserved in upstream and downstream cross sections
- Areas of ineffective flow were preserved if they were too far from the bridge opening to be effective flow or too far below the elevation of the overtopping railroad and bridge to be effective flow.

The difference in the modeled ineffective flow areas for the Duplicate Effective Model and the Corrected Effective Model are illustrated in Figures 2 and 3.

To:Della Schall Young, Young Environmental Consulting GroupFrom:Jeff Weiss, Barr Engineering Co.Subject:Minnesota River No-Rise Certification Evaluation - DRAFTDate:March 8, 2019Page:4

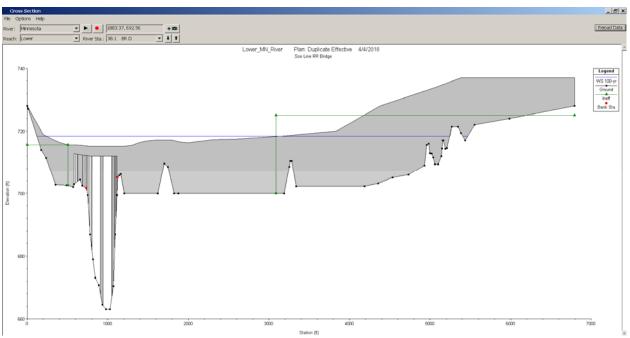


Figure 2 – Cross Section at Railroad Bridge in Duplicate Effective Model. Note little ineffective flow area (inside green outline) below the top of the railroad

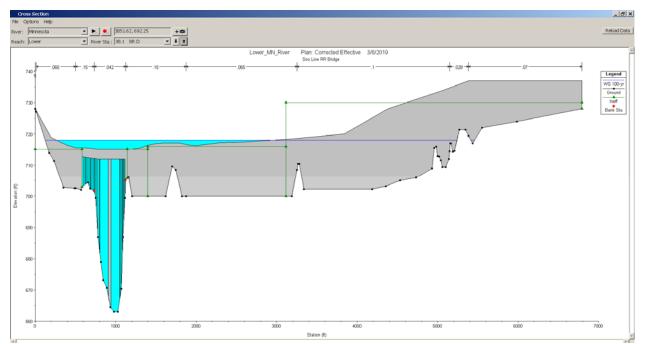


Figure 3 – Cross Section at Railroad Bridge in Corrected Effective Model. Note added ineffective flow area (green outlines) below the top of the railroad

Proposed Conditions Model

The modifications made to create the Corrected Effective Model were carried forward to the Proposed Conditions Model such that the only changes made to the proposed conditions model was to add the proposed permanent storage and dewatering areas for dredge materials. The comparison of existing and proposed cross sections is shown in Figures 4 and 5 on the following page.

Table 1 includes the comparison of modeled water surface elevations for the Corrected Effective and Proposed conditions models. The no-rise certification requires a change of no more than 0.00 for any modeled water surface elevation. The proposed berm elevations are 715.0 for the northtwo western storage areas and 706.0 feet for the eastern storage area. These initial berm elevations were found to create changes to the modeled 100-year floodplain, so the berm elevations were modified iteratively until the maximum elevations were found that would also comply with the criteria to complete a No-Rise Certification. Table 1 shows the modeling results for the project area.

| | River Station | 35 | 35.5ª | 35.75ª | 36 | 36 .5ª | 37 | TCWRR Bridge | 39 | 40 |
|----------|------------------------|--------|--------|--------|--------|---------------|--------|-----------------|--------|--------|
| Event | Corrected Effective | 717.36 | 717.41 | 717.45 | 717.53 | 717.67 | 717.75 | | 718.00 | 718.61 |
| 1% AEP | Proposed | 717.36 | 717.41 | 717.45 | 717.53 | 717.67 | 717.75 | | 718.00 | 718.61 |
| 1% | Difference | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 |
| vay | Corrected Effective | 717.58 | 717.62 | 717.67 | 717.73 | 717.91 | 717.98 | | 718.18 | 718.78 |
| Floodway | Proposed | 717.58 | 717.62 | 717.66 | 717.73 | 717.91 | 717.98 | | 718.18 | 718.78 |
| | Difference | 0.00 | 0.00 | -0.01 | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 |

a - Cross section added to more accurately model the project area

The no-rise certification requires no more than a 0.00 change in the water surface elevation for any modeled cross section for both the 1% AEP Event and the Floodway. As can be seen in Table 1, this criteria is met for all cross sections except for cross section 35.75, where the proposed conditions model results have a decrease of 0.01 feet for the Floodway model. When the model results are expanded to more decimal places, the modeled water surface elevations for the corrected effective and proposed conditions for the Floodway model are 717.6660 and 717.6649, respectively. Therefore, the difference in the modeled water surface elevation is only 0.0011 feet and the difference shown in Table 1 is attributed to rounding. The HEC-RAS model results are both the 1% AEP Event and the Floodway model are included as attachments A and B to this memorandum.

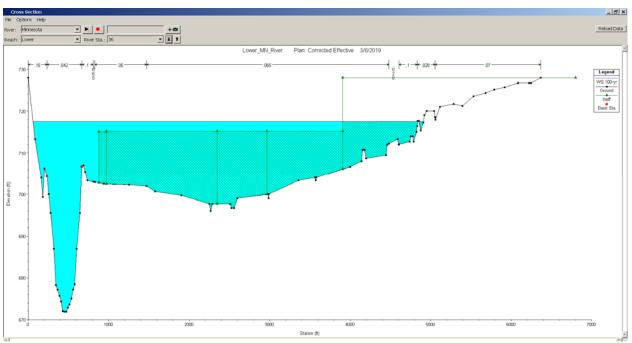


Figure 4 – Cross Section at River Station 36 in Corrected Effective Model. Green hatch areas are ineffective flow areas.

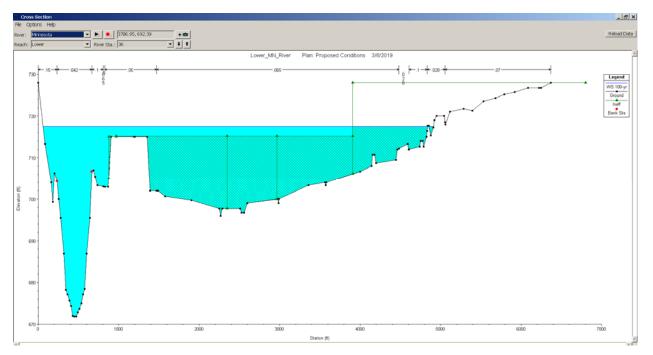


Figure 5 - Cross Section at River Station 36 in Proposed Conditions Model. Green hatch areas are ineffective flow areas. Ground was modified to show proposed berms and storage areas

To:Della Schall Young, Young Environmental Consulting GroupFrom:Jeff Weiss, Barr Engineering Co.Subject:Minnesota River No-Rise Certification Evaluation - DRAFTDate:March 8, 2019Page:7

Conclusion

The proposed project to construct permanent berms within the project area will not cause an increase in modeled flood elevations, and a no-rise certification is justified.

References

Burns & McDonnell, Technical Memorandum, February 15, 2017

- LMRWD. January 2013. "Cargill East River (MN 14.2 RMP) Dredge Material Site Management Plan" Lower Minnesota River Watershed District.
- USACE. April 1996. "Bridge Hydraulic Analysis with HEC-RAS" TP 151. US Army Corps of Engineers Institute for Water Resources, Hydrologic engineering Center, Davis, CA

Attachments:

Attachment A: HEC-RAS model results for the 1% AEP Event Attachment B: HEC-RAS model results for the Floodway model Attachment C: Minnesota "No-Rise" Certification

| Reach | River Sta | Profile | Profile: 100-yr Plan | Q Total | Min Ch El | W.S. Elev | Crtt W.S. | E.G. Elev | E.G. Slope | Vel Chn! | Flow Area | Top Width | Froude # Ch |
|--------|--------------|------------------|----------------------------|-----------|------------------|------------------|------------------|------------------|------------|----------|----------------------|--------------------|-------------|
| Headin | THUS OLD | Tiona | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (fl/s) | (sq ft) | (ft) | |
| ower | 41 | 100-yr | Corrected Eff | 103000.00 | 670.20 | 718.94 | 689,97 | 719.01 | 0.000060 | 3.15 | 73948.68 | 4531.93 | 0. |
| ower | 41 | 100-ут | Ppsd cond | 103000.00 | 670.20 | 718.94 | 689.97 | 719.01 | 0.000060 | 3.15 | 73951.13 | 4531.95 | 0. |
| | 40 | 100 | On marked FR | 102000.00 | 870.40 | 740.64 | 800.40 | 740.05 | 0.000142 | 4 99 | 43016.01 | 4050.11 | 0. |
| ower | 40 40 | 100-уг 100-ут | Corrected Eff Ppsd cond | 103000.00 | 672.10 672.10 | 718.61 | 692.10 692.10 | 718.85 | 0.000143 | 4.88 | 43016.01 | 4050.15 | 0. |
| Uner | | 100-31 | | 100000.00 | 012.10 | 110.01 | 002.10 | 110.00 | 0.000110 | 1.00 | 10017.00 | 1000.10 | |
| ower | 39 | 100-yr | Corrected Eff | 103000.00 | 663.80 | 718.00 | 687.05 | 718.65 | 0.000239 | 6.60 | 24190.55 | 3527.52 | 0.1 |
| ower | 39 | 100-ут | Ppsd cond | 103000.00 | 663,80 | 718.00 | 687.05 | 718.65 | 0.000239 | 6.60 | 24192.51 | 3527.60 | 0. |
| _ | | | | | | | | | | | | | |
| owef | 38.1 | | | Bridge | | | | _ | | | | | |
| ower | 37 | 100-уг | Corrected Eff | 103000.00 | 663.00 | 717.75 | | 718.29 | 0.000207 | 6.03 | 23791.95 | 5143.71 | 0, |
| ower | 37 | 100-уг | Ppsd cond | 103000.00 | 663.00 | 717.75 | | 718.29 | 0.000207 | 6.03 | 23794.50 | 5143.76 | D . |
| | | | | | | | | | | | | | |
| ower | 36.500* | 100-уг | Corrected Eff | 103000.00 | 667.45 | 717.67 | | 718.17 | 0.000225 | 5.95 | 26979.89 | 4943.44 | 0. |
| ower | 36.500* | 100-yr | Ppsd cond | 103000.00 | 667.45 | 717.67 | | 718.17 | 0.000225 | 5.94 | 26982.93 | 4943.45 | 0. |
| ower | 36 | 100-yr | Corrected Eff | 103000.00 | 671.90 | 717.53 | 692.40 | 718.06 | 0.000270 | 6.13 | 26797.74 | 4837.54 | 0. |
| owar | 36 | 100-уг | Ppsd cond | 103000.00 | 671.90 | 717.53 | 692.40 | 718.06 | 0.000270 | 6.13 | 26788.50 | 4837.55 | 0. |
| 1/25 | | | | | | | | | | _ | | | |
| ower | 35.75 | 100-yr | Corrected Eff | 103000.00 | 671.51 | 717.45 | 692.54 | 717.86 | 0.000241 | 5.80 | 35151.00 | 4810.16 | 0. |
| ower | 35.75 | 100-уг | Ppsd cond | 103000.00 | 671.51 | 717.45 | 692.54 | 717.86 | 0.000241 | 5.81 | 33959.60 | 4810.13 | 0. |
| ower | 35.5 | 100-уг | Corrected Eff | 103000.00 | 671.33 | 717.41 | 692.52 | 717.68 | 0.000186 | 5.09 | 42580.00 | 4996.97 | 0 |
| ower | 35.5 | 100-уг | Ppsd cond | 103000.00 | 671.33 | 717.41 | 692.52 | 717.68 | 0.000186 | 5.09 | 42580.00 | 4996.97 | 0 |
| | | | | | | | | | | | | | |
| ower | 35 | 100-yr | Corrected Eff | 103000.00 | 671.10 | 717.36 | 692.51 | 717.52 | 0.000133 | 4.29 | 52487.17 | 5189.26 | 0. |
| ower | 35 | 100-уг | Ppsd cond | 103000.00 | 671.10 | 717.36 | 692.51 | 717.52 | 0.000133 | 4.29 | 52487.17 | 5189.26 | 0. |
| ower | 34 | 100-yr | Corrected Eff | 103000.00 | 672.80 | 717.27 | | 717.35 | 0.000077 | 3.16 | 67286.31 | 4056.92 | 0. |
| ower | 34 | 100-yr | Ppsd cond | 103000.00 | 672.80 | 717.27 | | 717.35 | 0.000077 | 3.16 | 67286.31 | 4056.92 | 0. |
| | | | | | | | | | | | | | |
| ower | 33 | 100-уг | Corrected Eff | 103000.00 | 671.20 | 717.14 | 697.73 | 717.25 | 0.000099 | 3.63 | 54708.24 | 2893.41 | 0. |
| ower | 33 | 100-yr | Ppsd cond | 103000.00 | 671.20 | 717.14 | 697.73 | 717.25 | 0.000099 | 3.63 | 54708.24 | 2893.41 | 0. |
| ower | 32 | 100-уг | Corrected Eff | 103000.00 | 661.10 | 717.04 | | 717.17 | 0.000093 | 3.77 | 48587.19 | 2354.22 | 0. |
| ower | 32 | 100-ут | Ppsd cond | 103000.00 | 661.10 | 717.04 | | 717.17 | 0.000093 | 3.77 | 48587.19 | 2354.22 | 0. |
| | | 200 | | | | | | | | | | | |
| ower | 31 | 100-ут | Corrected Eff | 103000.00 | 671.60 | 716.83 | 691.62 | 717.00 | 0.000122 | 4.06 | 53328.17 | 5752.21 | 0. |
| ower | 31 | 100-yr | Ppsd cond | 103000.00 | 671.60 | 716.83 | 691.62 | 717.00 | 0.000122 | 4.06 | 53328.17 | 5752.21 | 0.1 |
| ower | 30 | 100-уг | Corrected Eff | 103000.00 | 675.00 | 716.63 | 695.59 | 716.79 | 0.000132 | 4.35 | 60893.74 | 6500.88 | 0. |
| ower | 30 | 100-yr | Ppsd cond | 103000.00 | 675.00 | 716.63 | 695.59 | 716.79 | 0.000132 | 4.35 | 60893.74 | 6500.88 | 0, |
| | | - | A DESTRUCTION OF | | | | | | | | | | |
| ower | 29 | 100-уг | Corrected Eff | 103000.00 | 674.20 | 716.47 | 693,35 | 716.58 | 0.000091 | 3.53 | 56719.04 | 6860.31 | 0. |
| ower | 29 | 100-yr | Ppsd cond | 103000.00 | 674.20 | 716.47 | 693.35 | 716.58 | 0.000091 | 3.53 | 56719.04 | 6860.31 | 0. |
| ower | 28 | 100-уг | Corrected Eff | 103000.00 | 675.00 | 716.35 | 697.48 | 716.44 | 0.000089 | 3.38 | 66195.98 | 5448.76 | 0. |
| ower | 28 | 100-yr | Ppsd cond | 103000.00 | 675.00 | 716.35 | 697.48 | 716.44 | 0.000089 | 3.38 | 66195.98 | 5448.76 | D. |
| | | | | | | | | | | | | | |
| ower | 27 | 100-yr | Corrected Eff | 103000.00 | 670.40 | 716.21 | 691.90 | 716.31 | 0.000083 | 3.44 | 57433.64 | 5465.55 | 0. |
| ower | 27 | 100-уг | Ppsd cond | 103000.00 | 670.40 | 716.21 | 691.90 | 716.31 | 0.000083 | 3.44 | 57433.64 | 5465.55 | 0. |
| ower | 26 | 100-уг | Corrected Eff | 103000.00 | 671.70 | 715.94 | 691.50 | 716.12 | 0.000130 | 4.33 | 45451.97 | 2437.52 | 0. |
| ower | 26 | 100-yr | Ppsd cond | 103000.00 | 671.70 | 715.94 | 691.50 | 716.12 | 0.000130 | 4.33 | 45451.97 | 2437.52 | 0. |
| - | | | | | | | | | | | | | |
| ower | 25 | 100-yr | Corrected Eff | 103000.00 | 673.70 | 715.37 | 691.59 | 715.74 | 0.000226 | 5.54 | 35690.85 | 6438.40 | 0. |
| ower | 25 | 100-уг | Ppsd cond | 103000.00 | 673.70 | 715.37 | 691.59 | 715.74 | 0.000226 | 5.54 | 35690.85 | 6438.40 | 0. |
| ower | 23.7 | 100-yr | Corrected Eff | 103000.00 | 670.40 | 715.22 | 691.01 | 715.65 | 0.000256 | 5.68 | 25785.78 | 6041.83 | 0. |
| ower | 23.7 | 100-yr 100-yr | Ppsd cond | 103000.00 | 670.40 | 715.22 | 691.01 | 715.65 | 0.000256 | 5.68 | 25785.78 | 6041.83 | 0. |
| | | | | | | | | | | | | | |
| ower | 23.6 | | | Bridge | | | | | | | | | |
| | 02.5 | 100.00 | Competent F# | 102000.00 | 070.40 | 745.00 | 691.01 | 715.52 | 0.000259 | 5.69 | 25807.77 | 6023.82 | 0. |
| ower | 23.5 23.5 | 100-уг 100-уг | Corrected Eff Ppsd cond | 103000.00 | 670.40 670.40 | 715.09 | 691.01 | 715.52 | 0.000259 | 5.69 | 25807.77 | 6023.82 | 0. |
| | 20.0 | . 50-ji | . pos conta | 100000.00 | 510.45 | , 10.08 | Seriel | . 10.02 | 0.000100 | 0.00 | | - SEVIOL | 0. |
| ower | 23 | 100-уг | Corrected Eff | 103000.00 | 671.00 | 715.04 | 691.01 | 715.47 | 0.000247 | 5.80 | 30255.32 | 4955.19 | 0. |
| ower | 23 | 100-yr | Ppsd cond | 103000.00 | 671.00 | 715.04 | 691.01 | 715.47 | 0.000247 | 5.80 | 30255.32 | 4955.19 | 0. |
| | 00.5 | 400. | 0 | 400000 00 | 007 77 | 745.44 | 800 11 | 745 46 | 0.000077 | 0.07 | EPROD OC | 0004.00 | ^ |
| ower | 22.5 22.5 | 100-ут 100-ут | Corrected Eff Ppsd cond | 103000.00 | 667.70 667.70 | 715.10 715.10 | 690.11 690.11 | 715.19 715.19 | 0.000077 | 3.27 | 58602.93 58602.93 | 6984.06 6984.06 | 0. |
| | EE.J | .00-yi | | | 001.10 | 710.10 | 000.11 | 110.10 | 5.000017 | 5.21 | 20002.00 | 0004.00 | 0. |
| wer | 22 | 100-yr | Corrected Eff | 103000.00 | 667.10 | 715.07 | 691.19 | 715.09 | 0.000027 | 1.96 | 103498.50 | 6214.75 | 0. |
| wer | 22 | 100-yr | Ppsd cond | 103000.00 | 667.10 | 715.07 | 691.19 | 715.09 | 0.000027 | 1.96 | 103498.50 | 6214.75 | 0. |
| - | | 100 | | | | | AAC | 745.44 | | | 100100.05 | F040 10 | - |
| ower | 21 | 100-yr | Corrected Eff | 103000.00 | 666.00 666.00 | 715.01 | 692.25 692.25 | 715.04 | 0.000026 | 1.96 | 106168.60 | 5842.16 5842.16 | 0. |
| ower | 21 | 100-ут | Ppsd cond | 103000.00 | 000.00 | 7 10,01 | 082.20 | / 10.04 | 0.000020 | 1.80 | 100100.00 | 5542.10 | 0. |
| ower | 20 | 100-уг | Corrected Eff | 103000.00 | 674.30 | 714.93 | 693.30 | 714.96 | 0.000030 | 2.04 | 100034.40 | 5458.79 | 0. |
| ower | 20 | 100-ут | Ppsd cond | 103000.00 | 674.30 | 714.93 | 693.30 | 714.96 | 0.000030 | 2.04 | 100034.40 | 5458.79 | 0. |
| | | | 200 | | | | | | | | | | |
| ower | 19 | 100-yr | Corrected Eff | 103000.00 | 675.40 | 714.83 | 694.86 | 714.87 | 0.000044 | 2.41 | 73574.34 | 4882.91 | 0.0 |
| wer | 19 | 100-уг | Ppsd cond | 103000.00 | 675.40 | 714.83 | 694.86 | 714.87 | 0.000044 | 2.41 | 73574.34 | 4882.91 | 0. |
| ower | 18.4 | 100-yr | Corrected Eff | 103000.00 | 670.20 | 714.74 | 690.54 | 714.82 | 0.000067 | 3.14 | 60514.66 | 4410.26 | 0. |
| wer | 18.4 | 100-yr | Ppsd cond | 103000.00 | 670.20 | 714.74 | 690.54 | 714.82 | 0.000067 | 3.14 | 60514.66 | 4410.26 | 0 |

| Reach | River Sta | Profile | Pian | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chni | Flow Area | Top Width | Froude # Ch |
|----------------|-----------|------------------|----------------------------|-----------|------------------|------------------|------------------|------------------|------------|--------------|------------------------|--------------------|-------------|
| | | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| | | | | | | | | | | | | | |
| Lower Lower | 18 | 100-yr 100-yr | Corrected Eff Ppsd cond | 103000.00 | 668.80 668.80 | 714.73 714.73 | 689.61 689.61 | 714.81 714.81 | 0.000062 | 3.03 | 61698.26 61698.26 | 5155.64 5155.64 | (|
| LOWEI | 10 | loosyi | r pau conu | 100000.00 | 000.00 | 114.75 | 008.01 | 714.01 | 0.000002 | 0.00 | 01030.20 | 0100.04 | |
| Lower | 17 | 100-уг | Corrected Eff | 103000.00 | 668.50 | 714.67 | 691.09 | 714.74 | 0.000070 | 3.16 | 59891.38 | 5116.47 | C |
| Lower | 17 | 100-yr | Posd cond | 103000.00 | 668.50 | 714.67 | 691.09 | 714.74 | 0.000070 | 3.16 | 59891.38 | 5116.47 | 0 |
| _ | 10 | 100 | 0 | 100000.00 | | 744.04 | | 744.00 | 0.000050 | 0.05 | 7110101 | 5000.04 | |
| Lower Lower | 16 16 | 100-yr 100-yr | Corrected Eff Ppsd cond | 103000.00 | 671.30 671.30 | 714.61 | 690.42 690.42 | 714.66 714.66 | 0.000050 | 2.65 | 71164.64 | 5622.31 5622.31 | 0 |
| Lower | 10 | Tuo-y | i pou ourio | 100000.00 | 071.00 | 114.01 | 000.42 | 114.00 | 0.000000 | 2.00 | 71104.04 | 0022.01 | |
| Lower | 15 | 100-уг | Corrected Eff | 103000.00 | 674.50 | 714.58 | 695.17 | 714.59 | 0.000017 | 1.46 | 123899.00 | 6712.99 | 0 |
| Lower | 15 | 100-yr | Ppsd cond | 103000.00 | 674.50 | 714.58 | 695.17 | 714.59 | 0.000017 | 1.46 | 123899.00 | 6712.99 | C |
| | 4.4 | 100 | Connected 5% | 402000.00 | 870.00 | 744.55 | 000.00 | 744 60 | 0.00004.5 | 4.42 | 130247.20 | 7047.04 | |
| Lower | 14 | 100-ут 100-ут | Corrected Eff Ppsd cond | 103000.00 | 672.90 672.90 | 714.55 714.55 | 696.28 696.28 | 714.56 714.56 | 0.000015 | 1.43 | 130247.20 | 7047.24 | 0 |
| Long | 14 | 100-34 | r pau oona | 100000.00 | 012,00 | 114.00 | 030.20 | 14,00 | 0.000010 | 1.40 | 100241,20 | 1041.24 | |
| Lower | 13.4 | 100-ут | Corrected Eff | 103000.00 | 668.40 | 714.45 | 692.37 | 714.52 | 0.000067 | 2.97 | 71865.44 | 7111.87 | 0 |
| Lower | 13.4 | 100-yr | Ppsd cond | 103000.00 | 658.40 | 714.45 | 692.37 | 714.52 | 0.000067 | 2.97 | 71865.44 | 7111.87 | C |
| | | | | | | | | | | | | | |
| Lower | 13.3 | - | | Bridge | | | | | | | | | |
| Lower | 13.2 | 100-ут | Corrected Eff | 103000.00 | 668.40 | 714.41 | 692.37 | 714.48 | 0.000066 | 2.94 | 68411.14 | 7165.72 | |
| Lower | 13.2 | 100-yr | Ppsd cond | 103000.00 | 668.40 | 714.41 | 692.37 | 714.48 | 0.000066 | 2.94 | 68411.14 | 7165.72 | |
| | | | | | | | | | | | | | |
| Lower | 12.7 | 100-уг | Corrected Eff | 103000.00 | 674.00 | 714.42 | 697.06 | 714.44 | 0.000027 | 1.85 | 98992.77 | 7263.38 | 0 |
| Lower | 12.7 | 100-ут | Ppsd cond | 103000.00 | 674.00 | 714.42 | 697.06 | 714.44 | 0.000027 | 1.85 | 98992.77 | 7263.38 | C |
| Lower | 12.5 | | - | Bridge | | | | | | | | | |
| | 12.0 | | 1.12 | Diago | | | | | | | | | |
| Lower | 12.3 | 100-ут | Corrected Eff | 103000.00 | 674.00 | 714.41 | 696.96 | 714.43 | 0.000029 | 1.94 | 100027.40 | 7046.76 | 0 |
| Lower | 12.3 | 100-ут | Ppsd cond | 103000.00 | 674.00 | 714.41 | 696.96 | 714.43 | 0.000029 | 1.94 | 100027.40 | 7046.76 | c |
| | | | | 100000.00 | | | - | | | | | | |
| Lower Lower | 12 | 100-ут 100-уг | Corrected Eff Ppsd cond | 103000.00 | 671.90 671.90 | 714.40 | 694.40 694.40 | 714.42 | 0.000023 | 1.77 | 108192.60 108192.60 | 7121.24 | 0 |
| conor | 16 | 100 91 | i pas cona | 100000.00 | 011.00 | | 004.40 | 11-176 | 0.000020 | 647 | 100102.00 | 7 14 1 4 7 | |
| Lower | 11 | 100-yr | Corrected Eff | 103000.00 | 669.70 | 714.37 | 689.08 | 714.38 | 0.000017 | 1.58 | 127035.60 | 7312.78 | 0 |
| Lower | 11 | 100-уг | Ppsd cond | 103000.00 | 669.70 | 714.37 | 689.08 | 714.38 | 0.000017 | 1.58 | 127035.60 | 7312.78 | 0 |
| | | | | | | | | | | | | | |
| Lower Lower | 10 | 100-yr 100-yr | Corrected Eff Ppsd cond | 103000.00 | 673.00 673.00 | 714.32 714.32 | 695.61 695.61 | 714.34 | 0.000017 | 1.56 | 147946.80 147946.80 | 8891.12 8891.12 | 0 |
| Lower | 10 | roo-yr | Ppsa cona | 103000.00 | 073.00 | 7 14.02 | 095,61 | 7 14,04 | 0.000017 | 1.00 | 147940.00 | 0091.12 | |
| Lower | 9 | 100-уг | Corrected Eff | 103000.00 | 671.40 | 714.27 | | 714.28 | 0.000013 | 1.35 | 149712.40 | 8740.81 | 0 |
| Lower | 9 | 100-уг | Ppsd cond | 103000.00 | 671.40 | 714.27 | | 714.28 | 0.000013 | 1.35 | 149712.40 | 8740.81 | 0 |
| _ | - | | | | | | | | | | | | |
| Lower Lower | 8 | 100-уг 100-уг | Corrected Eff Ppsd cond | 103000.00 | 675.90 675.90 | 714.19 714.19 | | 714.21 | 0.000029 | 1.89 1.89 | 129059.90 129059.90 | 8034.65 8034.65 | 0 |
| LOWOI | 0 | 100-yi | -psu conu | 103000.00 | 075.90 | 114.10 | | / 14.21 | 0.000029 | 1.03 | 129039.90 | 6034.03 | |
| Lower | 7.1 | 100-ут | Corrected Eff | 103000.00 | 671.20 | 714.10 | 689.70 | 714.12 | 0.000023 | 1.83 | 111312.10 | 6739.34 | |
| Lower | 7.1 | 100-ут | Ppsd cond | 103000.00 | 671.20 | 714.10 | 689.70 | 714.12 | 0.000023 | 1.83 | 111312.10 | 6739.34 | C |
| | | | | | | | | | | | | | |
| Lower | 6.7 | 100-ут | Corrected Eff | 103000.00 | 674.00 | 714.05 | 689.78 | 714.09 | 0.000053 | 2.68 | 70937.00 | 6893.22 | C |
| Lower | 6.7 | 100-yr | Ppsd cond | 103000.00 | 674.00 | 714.05 | 689.78 | 714.09 | 0.000053 | 2.68 | 70937.00 | 6893.22 | (|
| Lower | 6.6 | 11111 | | Bridge | | | | | | | | | |
| | | 100,000 | | | | | | | | | | | |
| Lower | 6.5 | 100-yr | Corrected Eff | 103000.00 | 670.30 | 714.03 | 688.67 | 714.08 | 0.000049 | 2.67 | 72018.45 | 7007.20 | C |
| Lower | 6.5 | 100-ут | Ppsd cond | 103000.00 | 670.30 | 714.03 | 688.67 | 714.08 | 0.000049 | 2.67 | 72018.45 | 7007.20 | C |
| 00005 | 6.1 | 100.10 | Corrected Eff | 103000.00 | 672.20 | 712.09 | 692.27 | 714.03 | 0.000057 | 2.69 | 74014.85 | 6104.78 | C |
| Lower Lower | 6.1 | 100-yr 100-yr | Ppsd cond | 103000.00 | 672.20 | 713.98 713.98 | 692.27 | 714.03 | 0.000057 | 2.69 | 74014.85 | 6104.78 | (|
| Lowell | 0.1 | Tuo yi | i pua cona | 100000.00 | UTE.EU | 110.00 | UCELET | 114.00 | 0.000007 | 2.00 | 14014.00 | 0104.10 | |
| Lower | 5 | 100-yr | Corrected Eff | 103000.00 | 670.00 | 713.87 | 690.14 | 713.92 | 0.000043 | 2.44 | 76349.61 | 5516.05 | (|
| Lower | 5 | 100-yr | Ppsd cond | 103000.00 | 670.00 | 713.87 | 690.14 | 713.92 | 0.000043 | 2.44 | 76349.61 | 5516.05 | (|
| | | | | | | | | | | | | | |
| Lower | 4 | 100-yr | Corrected Eff Ppsd cond | 103000.00 | 669.70 669.70 | 713.77 713.77 | | 713.81 | 0.000044 | 2.52 | 79582.76 79582.76 | 4466.99 4466.99 | с (|
| Lower | + | 100-yr | -had coug | 103000.00 | 909.10 | /15.// | | 713.81 | 0.000044 | 2.52 | 19002.76 | 4400.99 | |
| Lower | 3 | 100-ут | Corrected Eff | 103000.00 | 668.30 | 713.62 | | 713.69 | 0.000057 | 2.93 | 71361.66 | 4071.40 | |
| Lower | 3 | 100-yr | Ppsd cond | 103000.00 | 668.30 | 713.62 | | 713.69 | 0.000057 | 2.93 | 71361.66 | 4071.40 | |
| | | | | | | | | | | | | | |
| Lower | 2 | 100-yr | Corrected Eff | 103000.00 | 670.10 | 713.48 | | 713.56 | 0.000078 | 3.40 | 60877.46 | 3785.07 | (|
| Lower | 2 | 100-ут | Ppsd cond | 103000.00 | 670.10 | 713.48 | | 713.56 | 0.000078 | 3.40 | 60877.46 | 3785.07 | C |
| OWER | 1 | 100.00 | Corrected 54 | 102000 00 | FEE OO | 740 00 | 600 07 | 749 40 | 0.000097 | 0.04 | BOARE OF | 2075.05 | C |
| Lower | 1 | 100-yr 100-yr | Corrected Eff Ppsd cond | 103000.00 | 665.20 665.20 | 713.32 713.32 | 690.87 690.87 | 713.43 713.43 | 0.000097 | 3.84 3.84 | 60465.26 60465.26 | 3275.95 3275.95 | (|

| Reach | River Sta | Profile | r Profile: 100-yr Fl Plan | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|--------|-----------|------------------------------|------------------------------|------------|------------------|------------------|------------------|------------------|------------|--------------|----------------------|--------------------|--------------|
| Neaun | NIVEL OIL | FIOIAG | Fian | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | FIGULE # OII |
| ower | 41 | 100-yr Fldwy | Corrected Eff | 103000.00 | 670.20 | 719.02 | 689.96 | 719,19 | 0.000109 | 4.27 | 52655.25 | 2541.47 | 0.4 |
| ower | 41 | 100-yr Fidwy | Ppsd cond | 103000.00 | 670.20 | 719.02 | 689.96 | 719.19 | 0.000109 | 4.27 | 52656.80 | 2541.47 | 0.1 |
| | 40 | 400 ve Eldury | Computed F# | 102000.00 | 870.40 | 740 70 | 800.40 | 740.01 | 0.000139 | 4.02 | 43326.02 | 0000.05 | 0.1 |
| ower | 40 | 100-yr Fldwy 100-yr Fldwy | Corrected Eff Ppsd cond | 103000.00 | 672.10 672.10 | 718.78 718.78 | 692.10 692.10 | 719.01 | 0.000139 | 4.82 | 43320.02 | 2330.05 2330.05 | 0.1 |
| | | 1 | | | | | | | | | | _ | |
| ower | 39 | 100-yr Fldwy | Corrected Eff | 103000.00 | 663.80 | 718.18 | 687.04 | 718.82 | 0.000234 | 6.55 | 24465.88 | 2778.22 | 0.1 |
| .ower | 39 | 100-yr Fidwy | Ppsd cond | 103000.00 | 663.80 | 718.18 | 687.04 | 718.82 | 0.000234 | 6.55 | 24467.75 | 2778.22 | 0.1 |
| .ower | 38.1 | | | Bridge | | | | | | | | | |
| | | | | | | | | | | | | | |
| Lower | 37 37 | 100-yr Fldwy 100-yr Fldwy | Corrected Eff Ppsd cond | 103000.00 | 663.00 663.00 | 717.98 | | 718.52 | 0.000203 | 5.99 5.99 | 24035.63 24038.33 | 2761.69 2761.71 | 0.1 |
| | | | . her anne | | | | | | | | | | |
| .ower | 36.500* | 100-yr Fldwy | Corrected Eff | 103000.00 | 667.45 | 717.91 | | 718.40 | 0.000218 | 5.87 | 27774.36 | 4947.33 | 0.1 |
| OMBL | 36.500* | 100-yr Fldwy | Ppsd cond | 103000.00 | 667.45 | 717.91 | | 718.40 | 0.000218 | 5.87 | 27777.59 | 4947.35 | 0.11 |
| ower | 36 | 100-yr Fidwy | Corrected Eff | 103000.00 | 671.90 | 717.73 | 692.40 | 718.27 | 0,000273 | 6.18 | 24327.51 | 2574.83 | 0.1 |
| ower | 36 | 100-yr Fidwy | Ppsd cond | 103000.00 | 671.90 | 717.73 | 692.40 | 718.27 | 0.000273 | 6.18 | 24317.88 | 2574.83 | 0.14 |
| ower | 35.75 | 100-yr Fldwy | Corrected Eff | 103000.00 | 671.51 | 717.67 | 692.54 | 718.06 | 0.000232 | 5.71 | 35980.51 | 4817.43 | 0.11 |
| _ower | 35.75 | 100-yr Fldwy | Ppsd cond | 103000.00 | 671.51 | 717.66 | 692.54 | 718.06 | 0.000232 | 5.72 | 34788.41 | 4817.39 | 0.1 |
| | | | | | | | | | | | | | |
| ower | 35.5 | 100-yr Fidwy | Corrected Eff | 103000.00 | 671.33 | 717.62 | 692.52 | 717.89 | 0.000179 | 5.01 | 43428.58 | 5052.12 | 0.15 |
| .ower | 35.5 | 100-yr Fldwy | Ppsd cond | 103000.00 | 671.33 | 717.62 | 692.52 | 717.89 | 0.000179 | 5.01 | 43428.58 | 5052.12 | 0.15 |
| ower | 35 | 100-yr Fldwy | Corrected Eff | 103000.00 | 671.10 | 717.58 | 692.51 | 717.74 | 0.000129 | 4.24 | 51229.02 | 3412.15 | 0.12 |
| Lower | 35 | 100-yr Fldwy | Ppsd cond | 103000.00 | 671.10 | 717.58 | 692.51 | 717.74 | 0.000129 | 4.24 | 51229.02 | 3412.15 | 0,12 |
| ower | 34 | 100-yr Fidwy | Corrected Eff | 103000.00 | 672.80 | 717.48 | | 717.57 | 0.000077 | 3.18 | 64534.80 | 3556.97 | 0.10 |
| Lower | 34 | 100-yr Fldwy | Ppsd cond | 103000.00 | 672.80 | 717.48 | | 717.57 | 0.000077 | 3.18 | 64534.80 | 3556.97 | 0.10 |
| | | | | | | | | | | | | | |
| Lower | 33 33 | 100-yr Fldwy 100-yr Fldwy | Corrected Eff Ppsd cond | 103000.00 | 671.20 671.20 | 717.36 | 697.73 697.73 | 717.47 | 0.000096 | 3.59 | 55358.89 55358.89 | 2897.26 2897.26 | 0.11 |
| .ower | 33 | TUO-yr Pidwy | rpsu conu | 103000.00 | 0/1.20 | 117.30 | 081.13 | 117.47 | 0.000090 | 3.08 | 00000.09 | 2097.20 | 0.1 |
| Lower | 32 | 100-yr Fldwy | Corrected Eff | 103000.00 | 661.10 | 717.27 | | 717.40 | 0.000090 | 3.73 | 49122.60 | 2355.75 | 0.11 |
| .ower | 32 | 100-yr Fldwy | Ppsd cond | 103000.00 | 661.10 | 717.27 | | 717.40 | 0.000090 | 3.73 | 49122.60 | 2355.75 | 0.11 |
| ower | 31 | 100-yr Fldwy | Corrected Eff | 103000.00 | 671.60 | 717.02 | 691.62 | 717.22 | 0.000134 | 4.27 | 45016.23 | 2309.19 | 0.13 |
| ower | 31 | 100-yr Fldwy | Ppsd cond | 103000.00 | 671.60 | 717.02 | 691.62 | 717.22 | 0.000134 | 4.27 | 45016.23 | 2309.19 | 0.13 |
| | | | | | | | | | | | | | |
| _ower | 30 30 | 100-yr Fldwy 100-yr Fldwy | Corrected Eff Ppsd cond | 103000.00 | 675.00 675.00 | 716.80 | 695.59 695.59 | 716.98 716.98 | 0.000148 | 4.61 | 52974.34 52974.34 | 2745.01 2745.01 | 0.14 |
| Joirei | | ioo ji riany | | 100000.00 | 010,00 | , 10,00 | 000.00 | 110.00 | 0.000140 | 4.01 | 02014.04 | 21 10.01 | 0.14 |
| ower | 29 | 100-yr Fldwy | Corrected Eff | 103000.00 | 674.20 | 716.65 | 693.35 | 716.76 | 0.000089 | 3.50 | 57230.14 | 2860.23 | 0.10 |
| ower | 29 | 100-yr Fidwy | Ppsd cond | 103000.00 | 674.20 | 716.65 | 693.35 | 716.76 | 0.000089 | 3.50 | 57230.14 | 2860.23 | 0.10 |
| ower | 28 | 100-yr Fldwy | Corrected Eff | 103000.00 | 675,00 | 716.53 | 697,48 | 716.62 | 0.000087 | 3.35 | 66795.66 | 3379.69 | 0.10 |
| .ower | 28 | 100-yr Fldwy | Ppsd cond | 103000.00 | 675.00 | 718.53 | 697.48 | 716.62 | 0.000087 | 3.35 | 66795.66 | 3379.69 | 0.10 |
| | 07 | | Compared Eff | 103000.00 | 670.40 | 716.40 | 691.90 | 716.49 | 0.000081 | 3.40 | 58017.46 | 3932.42 | 0.10 |
| .ower | 27 27 | 100-yr Fldwy 100-yr Fldwy | Corrected Eff Ppsd cond | 103000.00 | 670.40 | 716.40 | 691.90 | 716.49 | 0.000081 | 3.40 | 58017.46 | 3932.42 | 0.10 |
| | | | | | | | | | | | | | |
| ower | 26 | 100-yr Fldwy | Corrected Eff | 103000.00 | 671.70 | 716.13 | 691.49 | 716.31 | 0.000127 | 4.28 | 45919.02 | 2434.25 | 0.13 |
| ower | 26 | 100-yr Fldwy | Ppsd cond | 103000.00 | 671.70 | 716.13 | 691.49 | 716.31 | 0.000127 | 4.28 | 45919.02 | 2434.25 | 0.13 |
| ower | 25 | 100-yr Fldwy | Corrected Eff | 103000.00 | 673.70 | 715.57 | 691.59 | 715.93 | 0.000220 | 5.48 | 36053.77 | 2141.00 | 0.16 |
| ower | 25 | 100-yr Fidwy | Ppsd cond | 103000.00 | 673.70 | 715.57 | 691.59 | 715.93 | 0.000220 | 5.48 | 36053.77 | 2141.00 | 0.16 |
| ower | 23.7 | 100-yr Fldwy | Corrected Eff | 103000.00 | 670.40 | 715.44 | 691.01 | 715.85 | 0.000246 | 5.60 | 26032.03 | 1280.25 | 0.17 |
| ower | 23.7 | 100-yr Fldwy | Ppsd cond | 103000.00 | 670.40 | 715.44 | 691.01 | 715.85 | 0.000246 | 5.60 | 26032.03 | 1280.25 | 0.17 |
| | | | | | | | | | | | | | |
| .ower | 23.6 | | | Bridge | | | | | | | | | |
| ower | 23.5 | 100-yr Fidwy | Corrected Eff | 103000.00 | 670.40 | 715.31 | 691.01 | 715.72 | 0.000248 | 5.60 | 26007.74 | 2361.22 | 0.17 |
| ower | 23.5 | 100-yr Fidwy | Ppsd cond | 103000.00 | 670.40 | 715.31 | 691.01 | 715.72 | 0.000248 | 5.60 | 26007.74 | 2361.22 | 0.17 |
| 1 | 00 | 100 | 0 | 4000000 00 | 071.05 | 745.05 | PO1 D/ | 745.00 | 0.0000.17 | | 00000 0- | 2022.00 | |
| ower | 23 23 | 100-yr Fldwy 100-yr Fldwy | Corrected Eff Ppsd cond | 103000.00 | 671.00 671.00 | 715.25 | 691.01 691.01 | 715.67 | 0.000240 | 5.74 5.74 | 30620.96 30620.96 | 3060.83 3060.83 | 0.17 |
| | | | . poo cond | | 511.00 | . 10.20 | 551.01 | . 10.07 | J.JOULTU | 0.74 | 00020.00 | | |
| ower | 22.5 | 100-yr Fidwy | Corrected Eff | 103000.00 | 667.70 | 715.31 | 690.11 | 715.40 | 0.000075 | 3.24 | 59220.81 | 4663.42 | 0.10 |
| ower | 22.5 | 100-yr Fldwy | Ppsd cond | 103000.00 | 667.70 | 715.31 | 690.11 | 715.40 | 0.000075 | 3.24 | 59220.81 | 4663.42 | 0.10 |
| ower | 22 | 100-yr Fldwy | Corrected Eff | 103000.00 | 667.10 | 715.28 | 691.19 | 715.30 | 0.000026 | 1.94 | 103351.70 | 5566.90 | 0.06 |
| ower | 22 | 100-yr Fidwy | Ppsd cond | 103000.00 | 667.10 | 715.28 | 691.19 | 715.30 | 0.000026 | 1.94 | 103351.70 | 5566.90 | 0.06 |
| _ | 24 | 400 511 | O | 402000 00 | 800.00 | 745.00 | 000.00 | 745.05 | 0.000002 | 1.00 | 407400.00 | 5000.00 | |
| ower | 21 21 | 100-yr Fldwy 100-yr Fldwy | Corrected Eff Ppsd cond | 103000.00 | 666.00 666.00 | 715.23 715.23 | 692.26 692.26 | 715.25 | 0.000025 | 1.93 1.93 | 107403.90 | 5828.60 5828.60 | 0.06 |
| | | | | | | | | | | | | | |
| ower | 20 | 100-yr Fldwy | Corrected Eff | 103000.00 | 674.30 | 715.15 | 693.30 | 715.18 | 0.000029 | 2.01 | 101210.10 | 5450.00 | 0.06 |
| ower | 20 | 100-yr Fidwy | Ppsd cond | 103000.00 | 674.30 | 715.15 | 693.30 | 715.18 | 0.000029 | 2.01 | 101210.10 | 5450.00 | 0.08 |
| ower | 19 | 100-yr Fldwy | Corrected Eff | 103000.00 | 675.40 | 715.05 | 694.86 | 715.09 | 0.000043 | 2.38 | 74372.60 | 4880.74 | 0.07 |
| | 19 | 100-yr Fldwy | Ppsd cond | 103000.00 | 675.40 | 715.05 | 694.86 | 715.09 | 0.000043 | 2.38 | 74372.60 | 4880.74 | 0.07 |

| Reach | River Sta | Profile | Profile: 100-yr Flo Plan | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chi |
|-------|-----------|------------------------------|-----------------------------|-----------|------------------|-----------|------------------|-----------|------------|--------------|------------------------|-----------|--------------|
| reach | THE OLD | TIONS | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| - C | | | | | | | | | | | | | |
| ower | 18.4 | 100-yr Fidwy | Corrected Eff | 103000.00 | 670.20 | 714.97 | 690.54 | 715.04 | 0.000065 | 3.11 | 61220.41 | 4483.86 | 0.0 |
| .ower | 18.4 | 100-yr Fldwy | Ppsd cond | 103000.00 | 670.20 | 714.97 | 690.54 | 715.04 | 0,000000 | 3.11 | 61220.41 | 4483.86 | 0.08 |
| ower | 18 | 100-yr Fidwy | Corrected Eff | 103000.00 | 668.80 | 714.96 | 689.61 | 715.03 | 0.000060 | 3.00 | 62410.70 | 4945.31 | 0.09 |
| .ower | 18 | 100-yr Fidwy | Ppsd cond | 103000.00 | 668.80 | 714.96 | 689.61 | 715.03 | 0.000060 | 3.00 | 62410.70 | 4945.31 | 0.09 |
| | | 100 511 | 0 1 1 5 1 | 400000 00 | 000.50 | 714.00 | 004.00 | 744.07 | 0.000000 | 2.40 | 60602.98 | 5118.86 | 0.09 |
| ower | 17 | 100-yr Fldwy 100-yr Fldwy | Corrected Eff Posd cond | 103000.00 | 668.50 668.50 | 714.89 | 691.08 691.08 | 714.97 | 0.000068 | 3.13 3.13 | 60602.98 | | 0.06 |
| ower | | ioo-ji i iawy | | 100000.00 | 000.00 | 111.00 | 001.00 | | 0.000000 | 0.10 | | | |
| .ower | 16 | 100-yr Fldwy | Corrected Eff | 103000.00 | 671.30 | 714.84 | 690.41 | 714.89 | 0.000049 | 2.61 | 72070.45 | | 0,08 |
| ower | 16 | 100-yr Fldwy | Ppsd cond | 103000.00 | 671.30 | 714.84 | 690.41 | 714.89 | 0.000049 | 2.61 | 72070.45 | 5553.08 | 0.08 |
| ower | 15 | 100-yr Fldwy | Corrected Eff | 103000.00 | 674.50 | 714.80 | 695.17 | 714.82 | 0.000016 | 1.44 | 123251.80 | 6165.95 | 0.04 |
| ower | 15 | 100-yr Fldwy | Ppsd cond | 103000.00 | 674.50 | 714.80 | 695.17 | 714.82 | 0.000016 | 1.44 | 123251.80 | | 0.04 |
| | LI FOR | | | | | | | | | | | | |
| .ower | 14 | 100-yr Fldwy | Corrected Eff | 103000.00 | 672.90 | 714.78 | 696.28 | 714.79 | 0.000015 | 1.41 | 131745.90 | | 0.04 |
| ower | 14 | 100-yr Fldwy | Ppsd cond | 103000.00 | 672.90 | 714.78 | 696.28 | 714.79 | 0.000015 | 1.41 | 131745.90 | 6984.97 | 0.04 |
| ower | 13.4 | 100-yr Fldwy | Corrected Eff | 103000.00 | 668.40 | 714.66 | 692.36 | 714.74 | 0.000079 | 3.25 | 65478.77 | 5168.94 | 0.10 |
| ower | 13.4 | 100-yr Fkiwy | Ppsd cond | 103000.00 | 668.40 | 714.66 | 692.36 | 714.74 | 0.000079 | 3.25 | 65478.77 | | 0.10 |
| | | | | | | | | | | | | | |
| ower | 13.3 | - | | Bridge | | | | | | | | | |
| ower | 13.2 | 100-yr Fldwy | Corrected Eff | 103000.00 | 668.40 | 714.61 | 692.36 | 714.68 | 0.000071 | 3.08 | 64939.44 | 5115.78 | 0.08 |
| ower | 13.2 | 100-yr Fldwy | Ppsd cond | 103000.00 | 668.40 | 714.81 | 692.36 | 714.68 | 0.000071 | 3.08 | 64939.44 | | 0.00 |
| | | | 714 | | | | | | | | | | |
| .ower | 12.7 | 100-yr Fldwy | Corrected Eff | 103000.00 | 674.00 | 714.62 | 697.06 | 714.64 | 0.000026 | 1.83 | 100008.90 | | 0.0 |
| ower | 12.7 | 100-yr Fidwy | Ppsd cond | 103000.00 | 674.00 | 714.62 | 697.06 | 714.64 | 0.000026 | 1.83 | 100008.90 | 5137.12 | 0.06 |
| ower | 12.5 | 1.000 | | Bridge | | | | | | | | | |
| | | | Contraction of the | | | | | | | | | | |
| ower | 12.3 | 100-yt Fidwy | Corrected Eff | 103000.00 | 674.00 | 714.61 | 696.96 | 714.63 | 0.000029 | 1.92 | 101053.70 | | 0.06 |
| .ower | 12.3 | 100-yr Fldwy | Ppsd cond | 103000.00 | 674.00 | 714.61 | 696.96 | 714.63 | 0.000029 | 1.92 | 101053.70 | 5180.72 | 0.06 |
| ower | 12 | 100-yr Fldwy | Corrected Eff | 103000.00 | 671.90 | 714.60 | 694.40 | 714.62 | 0.000023 | 1.75 | 109303.40 | 6841.88 | 0.05 |
| ower | 12 | 100-yr Fldwy | Ppsd cond | 103000.00 | 671.90 | 714.60 | 694.40 | 714.62 | 0.000023 | 1.75 | 109303.40 | | 0.05 |
| | | | | | | | | | | | | | |
| ower | 11 | 100-yr Fldwy | Corrected Eff | 103000.00 | 669.70 | 714.56 | 689.08 | 714.58 | 0.000017 | 1.56 | 128387.10 | | 0.05 |
| ower | 11 | 100-yr Fldwy | Ppsd cond | 103000.00 | 669.70 | 714.56 | 689.08 | 714.58 | 0.000017 | 1.56 | 128387.10 | 7313.63 | 0.05 |
| ower | 10 | 100-yr Fldwy | Corrected Eff | 103000.00 | 673.00 | 714.52 | 695.61 | 714.54 | 0.000017 | 1.58 | 141601.50 | 8068.57 | 0.05 |
| ower | 10 | 100-yr Fldwy | Ppsd cond | 103000.00 | 673.00 | 714.52 | 695.61 | 714.54 | 0.000017 | 1.58 | 141601.50 | | 0.05 |
| | | | | | | | | | | | | | |
| ower | 9 | 100-yr Fldwy | Corrected Eff | 103000.00 | 671.40 | 714.47 | | 714.48 | 0.000013 | 1.34 | 151450.20 | | 0.04 |
| ower | 9 | 100-yr Fldwy | Ppsd cond | 103000.00 | 671.40 | 714.47 | | 714.48 | 0.000013 | 1.34 | 151450.20 | 8718.11 | 0.04 |
| ower | 8 | 100-yr Fldwy | Corrected Eff | 103000.00 | 675.90 | 714.39 | | 714.41 | 0.000028 | 1.86 | 130676.10 | 8012.80 | 0.06 |
| .ower | 8 | 100-yr Fldwy | Ppsd cond | 103000.00 | 675.90 | 714.39 | | 714.41 | 0.000028 | 1.88 | 130676.10 | 8012.80 | 0.06 |
| | | _ | - | | | | | | | | | | |
| ower | 7.1 | 100-yr Fldwy | Corrected Eff | 103000.00 | 671.20 671.20 | 714.31 | 689.70 689.70 | 714.33 | 0.000023 | 1.81 | 112590.60 112590.60 | | 0.0 |
| ower | 7.1 | 100-yr Fldwy | Ppsd cond | 103000.00 | 071.20 | 7 14.31 | 009.70 | 114.00 | 0.000023 | 1.01 | 112580.00 | 0131.00 | 0.0. |
| ower | 6.7 | 100-yr Fldwy | Corrected Eff | 103000.00 | 674.00 | 714.25 | 689.78 | 714.30 | 0.000052 | 2.68 | 71808.13 | 4198.63 | 0.04 |
| ower | 6.7 | 100-yr Fldwy | Ppsd cond | 103000.00 | 674.00 | 714.25 | 689.78 | 714.30 | 0.000052 | 2.66 | 71808.13 | 4198.63 | 0.0 |
| - | | _ | | | | | | | | | | | |
| .ower | 6.6 | | | Bridge | | | | | | | | | |
| ower | 6.5 | 100-yr Fklwy | Corrected Eff | 103000.00 | 670.30 | 714.24 | 688.67 | 714.28 | 0.000048 | 2.65 | 72891.29 | 4196.93 | 0.0 |
| .ower | 6.5 | 100-yr Fldwy | Ppsd cond | 103000.00 | | 714.24 | 688.67 | 714.28 | 0.000048 | 2.65 | 72891.29 | | 0.0 |
| | | 1000 | 1.1 | | | | | | | | | | |
| .ower | 6.1 | 100-yr Fldwy | Corrected Eff | 103000.00 | | | 692.27 | 714.24 | 0.000055 | 2.66 | 74808.56 | | 0.0 |
| .ower | 6.1 | 100-yr Fldwy | Ppsd cond | 103000.00 | 672.20 | 714.19 | 692.27 | 714.24 | 0.000055 | 2.66 | 74808.56 | 5591.74 | 0.0 |
| .ower | 5 | 100-yr Fldwy | Corrected Eff | 103000.00 | 670.00 | 714.09 | 690.14 | 714.13 | 0.000041 | 2.41 | 77169.77 | 5514.32 | 0.0 |
| .ower | 5 | 100-yr Fldwy | Ppsd cond | 103000.00 | | | 690.14 | 714.13 | 0.000041 | 2.41 | 77169.77 | | 0.0 |
| | | | | | | | | | | | | | |
| .ower | 4 | 100-yr Fldwy | Corrected Eff | 103000.00 | 669.70 | | | 714.02 | 0.000042 | 2.49 | 80549.72 | | 0.0 |
| .ower | 4 | 100-yr Fldwy | Ppsd cond | 103000.00 | 669.70 | 713.98 | | 714.02 | 0.000042 | 2.49 | 80549.72 | 4468.60 | 0.0 |
| .ower | 3 | 100-yr Fldwy | Corrected Eff | 103000.00 | 668.30 | 713.84 | | 713.91 | 0.000055 | 2.89 | 72196.19 | 4052.74 | 0.0 |
| .ower | 3 | 100-yr Fldwy | Ppsd cond | 103000.00 | | | | 713.91 | 0.000055 | 2.89 | 72196.19 | | 0.0 |
| | | | | | | | | | | | | | |
| | 2 | 100-yr Fldwy | Corrected Eff | 103000.00 | | | | 713.78 | 0.000075 | 3.37 | 61721.76 | | 0.1 |
| .ower | | 100-yr Fldwy | Ppsd cond | 103000.00 | 670.10 | 713.70 | | 713,78 | 0.000075 | 3.37 | 61721.76 | 3779.46 | 0.1 |
| .ower | 2 | TOO-yr Fidwy | i pou oonu | | | | | | | | | | |
| | 2 | 100-yr Fldwy | Corrected Eff | 103000.00 | | 713.55 | 690.80 | 713.65 | 0.000094 | 3.80 | 61163.47 | 3247.61 | 0.1 |

| Reach | River Sta | Profile | Plan | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chni | Flow Area | Top Width | Froude # Chl |
|----------------|--------------|------------------------------|----------------------------|------------------------|------------------|----------------------|------------------|------------------|------------|--------------|----------------------|--------------------|--------------|
| | | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| ower | 41 | 100-yr Fldwy | Corrected Eff | 103000.00 | 670.20 | 719.0162 | 689.96 | 719.19 | 0.000109 | 4.27 | 52655.25 | 2541.47 | 0.1 |
| ower | 41 | 100-yr Fldwy | Ppsd cond | 103000.00 | 670.20 | 719.0168 | 689.96 | 719.19 | 0.000109 | 4.27 | 52656.80 | 2541.47 | 0.1 |
| ower | 40 | 100 ve Elebrar | Corrected Eff | 103000.00 | 672.10 | 718.7837 | 692.10 | 719.01 | 0.000139 | 4.82 | 43326.02 | 2330.05 | 0.1 |
| Lower | 40 | 100-yr Fidwy 100-yr Fidwy | Ppsd cond | 103000.00 | 672.10 | 718.7843 | 692.10 | 719.01 | 0.000139 | 4.82 | 43320.02 | 2330.05 | 0.1 |
| | | | | | | | | | | | | | |
| Lower | 39 | 100-yr Fldwy | Corrected Eff | 103000.00 | 663.80 | 718.1833 | 687.04 | 718.82 | 0.000234 | 6.55 | 24465.88 | 2778.22 | 0.17 |
| Lower | 39 | 100-yr Fldwy | Ppsd cond | 103000.00 | 663.80 | 718.1840 | 687.04 | 718.82 | 0.000234 | 6.55 | 24467.75 | 2778.22 | 0.17 |
| Lower | 38.1 | | - | Bridge | | | | | | | | | |
| | | | | | | | | | | | | | |
| Lower | 37 | 100-yr Fldwy | Corrected Eff | 103000.00 | 663.00 | 717.9800 | | 718.52 | 0.000203 | 5.99 | 24035.63 | 2761.69 | 0.16 |
| Lower | 37 | 100-yr Fidwy | Ppsd cond | 103000.00 | 663.00 | 717.9810 | | 718.52 | 0.000203 | 5.99 | 24038.33 | 2761.71 | 0.16 |
| Lower | 36.500* | 100-yr Fldwy | Corrected Eff | 103000.00 | 667.45 | 717.9122 | | 718.40 | 0.000218 | 5.87 | 27774.36 | 4947.33 | 0.17 |
| Lower | 36.500* | 100-yr Fldwy | Ppsd cond | 103000.00 | 667.45 | 717.9132 | | 718.40 | 0.000218 | 5.87 | 27777.59 | 4947.35 | 0.17 |
| | 1. | | 10000 | | | | | | | | | | |
| Lower Lower | 36 36 | 100-yr Fldwy | Corrected Eff | 103000.00 | 671.90 671.90 | 717.7318 | 692.40 692.40 | 718.27 | 0.000273 | 6.18 6.18 | 24327.51 24317.88 | 2574.83 2574.83 | 0.18 |
| LOWEI | 30 | 100-yr Fidwy | Ppsd cond | 103000.00 | 071.80 | 111.1321 | 082.40 | 110.21 | 0.000213 | 0.18 | 24317.00 | 2014.00 | 0.10 |
| Lower | 35.75 | 100-yr Fldwy | Corrected Eff | 103000.00 | 671.51 | 717.6660 | 692.54 | 718.06 | 0.000232 | 5.71 | 35980.51 | 4817.43 | 0,17 |
| ower | 35.75 | 100-yr Fldwy | Ppsd cond | 103000.00 | 671.51 | 717.6649 | 692.54 | 718.06 | 0.000232 | 5.72 | 34788.41 | 4817.39 | 0.17 |
| | 05.5 | 400 - Elb | 0 | 400000.00 | 074.00 | 747 0044 | 000.50 | 747.00 | 0.000470 | C 04 | 10100 50 | 5050.40 | |
| Lower Lower | 35.5 35.5 | 100-yr Fidwy 100-yr Fidwy | Corrected Eff Ppsd cond | 103000.00 | 671.33 671.33 | 717.6241 | 692.52 692.52 | 717.89 717.89 | 0.000179 | 5.01 5.01 | 43428.58 43428.58 | 5052.12 5052.12 | 0.15 |
| | | | . pes world | | 0,1.00 | | 002.02 | | 0.000110 | 0.01 | | 0002.12 | 0.10 |
| Lower | 35 | 100-yr Fldwy | Corrected Eff | 103000.00 | 671.10 | 717.5794 | 692.51 | 717.74 | 0.000129 | 4.24 | 51229.02 | 3412.15 | 0.12 |
| Lower | 35 | 100-yr Fldwy | Ppsd cond | 103000.00 | 671.10 | 717.5794 | 692.51 | 717.74 | 0.000129 | 4.24 | 51229.02 | 3412.15 | 0.12 |
| lower | 34 | 100-yr Fldwy | Corrected Eff | 103000.00 | 672.80 | 717.4839 | | 717.57 | 0.000077 | 3.18 | 64534.80 | 3556.97 | 0.10 |
| Lower | 34 | 100-yr Fldwy | Ppsd cond | 103000.00 | 672.80 | 717.4839 | | 717.57 | 0.000077 | 3.18 | 64534.80 | 3556.97 | 0.10 |
| | | | 1.5.5 | | | | | | | | | | |
| Lower | 33 | 100-yr Fldwy | Corrected Eff | 103000.00 | 671.20 | 717.3616 | 697.73 | 717.47 | 0.000096 | 3.59 | 55358.89 | 2897.26 | 0.11 |
| Lower | 33 | 100-yr Fidwy | Ppsd cond | 103000.00 | 671.20 | 717.3616 | 697.73 | 717.47 | 0.000096 | 3.59 | 55358.89 | 2897.26 | 0.11 |
| ower | 32 | 100-yr Fldwy | Corrected Eff | 103000.00 | 661.10 | 717.2680 | | 717.40 | 0.000090 | 3.73 | 49122.60 | 2355.75 | 0.11 |
| ower | 32 | 100-yr Fldwy | Ppsd cond | 103000.00 | 661.10 | 717.2680 | | 717.40 | 0,000090 | 3.73 | 49122.60 | 2355.75 | 0.11 |
| _ | | | | | | | | | | | | | |
| ower | 31 | 100-yr Fldwy | Corrected Eff | 103000.00 | 671.60 | 717.0158 | 691.62 | 717.22 | 0.000134 | 4.27 | 45016.23 | 2309.19 | 0.13 |
| _ower | 31 | 100-yr Fldwy | Ppsd cond | 103000.00 | 671.60 | 717.0158 | 691.62 | 717.22 | 0.000134 | 4.27 | 45016.23 | 2309.19 | 0.13 |
| .ower | 30 | 100-yr Fldwy | Corrected Eff | 103000.00 | 675.00 | 716.7966 | 695.59 | 716.98 | 0.000148 | 4.61 | 52974.34 | 2745.01 | 0.14 |
| ower | 30 | 100-yr Fldwy | Ppsd cond | 103000.00 | 675.00 | 716.7966 | 695.59 | 716.98 | 0.000148 | 4.61 | 52974.34 | 2745.01 | 0.14 |
| | 20 | 400 ut Eldur | Computed Eff | 402000.00 | 674.00 | 748 6522 | 603.35 | 748 78 | 0.000080 | 3 50 | 57000 44 | 0000.02 | 0.40 |
| .ower | 29 29 | 100-yr Fldwy 100-yr Fldwy | Corrected Eff Ppsd cond | 103000.00 | 674.20 674.20 | 716.6533 716.6533 | 693.35 693.35 | 716.76 | 0.000089 | 3.50 | 57230.14 57230.14 | 2860.23 2860.23 | 0.10 |
| | | | | | | | | | | | | | |
| .ower | 28 | 100-yr Fldwy | Corrected Eff | 103000.00 | 675.00 | 716.5294 | 697.48 | 716.62 | 0.000087 | 3.35 | 66795,66 | 3379.69 | 0.10 |
| ower | 28 | 100-yr Fldwy | Ppsd cond | 103000,00 | 675.00 | 716.5294 | 697.48 | 716.62 | 0.000087 | 3.35 | 66795.66 | 3379.69 | 0.10 |
| ower | 27 | 100-yr Fldwy | Corrected Eff | 103000.00 | 670.40 | 716.3952 | 691.90 | 716.49 | 0.000081 | 3.40 | 58017.46 | 3932.42 | 0.10 |
| .ower | 27 | 100-yr Fldwy | Ppsd cond | 103000.00 | 670.40 | 716.3952 | 691.90 | 716.49 | 0.000081 | 3.40 | 58017.46 | 3932.42 | 0.10 |
| | | | | | | | | | | | | | |
| ower | 26 26 | 100-yr Fidwy | Corrected Eff | 103000.00 | 671.70 | 716.1349 | 691.49 691.49 | 716.31 | 0.000127 | 4.28 | 45919.02 | 2434.25 | 0.13 |
| ower | 20 | 100-yr Fldwy | Ppsd cond | 103000.00 | 671.70 | 716.1349 | 091.49 | 110.31 | 0.000127 | 4.28 | 45919.02 | 2434.25 | 0.13 |
| .ower | 25 | 100-yr Fldwy | Corrected Eff | 103000.00 | 673.70 | 715.5724 | 691.59 | 715.93 | 0.000220 | 5.48 | 36053.77 | 2141.00 | 0.16 |
| .ower | 25 | 100-yr Fidwy | Ppsd cond | 103000.00 | 673.70 | 715.5724 | 691.59 | 715.93 | 0.000220 | 5.48 | 36053.77 | 2141.00 | 0.16 |
| | 00.7 | 100 - Filter | 0 | 400000.00 | 070.40 | 745 4440 | 001.04 | 745.05 | 0.000040 | 5.00 | 00000.00 | 4000.05 | 0.17 |
| .ower | 23.7 23.7 | 100-yr Fidwy 100-yr Fidwy | Corrected Eff Ppsd cond | 103000.00 | 670.40 670.40 | 715.4418 715.4418 | 691.01 691.01 | 715.85 | 0.000246 | 5.60 5.60 | 26032.03 26032.03 | 1280.25 | 0.17 |
| .oner | LOIT | loc jernany | 1 pauloonu | 100000.00 | 010.40 | 110.4410 | 001101 | 110.00 | 0.000240 | 0.00 | 20002.00 | TEGOLEO | 0.17 |
| ower | 23.6 | | | Bridge | | | | | | | | | |
| | | | | | | | | | | | | | |
| ower | 23.5 23.5 | 100-yr Fldwy 100-yr Fldwy | Corrected Eff Ppsd cond | 103000.00 103000.00 | 670.40 670.40 | 715.3146 715.3146 | 691.01 691.01 | 715.72 | 0.000248 | 5.60 5.60 | 26007.74 26007.74 | 2361.22 2361.22 | 0.17 |
| OWEI | 23.3 | Too-y Fluwy | r psd cond | 103000.00 | 070.40 | 713.3140 | 091.01 | 113.12 | 0.000240 | 5.00 | 20001.74 | 2301.22 | 0.17 |
| ower | 23 | 100-yr Fldwy | Corrected Eff | 103000.00 | 671.00 | 715.2489 | 691.01 | 715.67 | 0.000240 | 5.74 | 30620.96 | 3060.83 | 0.17 |
| ower | 23 | 100-yr Fldwy | Ppsd cond | 103000.00 | 671.00 | 715.2489 | 691.01 | 715.67 | 0.000240 | 5.74 | 30620.96 | 3060.83 | 0.17 |
| awar | 22.5 | 100 | Competed Ff | 100000.00 | 007 70 | 745 9494 | 000 44 | 745 40 | 0.000075 | 0.04 | 50000 04 | 1000 10 | |
| ower | 22.5 22.5 | 100-yr Fldwy 100-yr Fldwy | Corrected Eff Ppsd cond | 103000.00 | 667.70 667.70 | 715.3104 715.3104 | 690.11 690.11 | 715.40 | 0.000075 | 3.24 | 59220.81 59220.81 | 4663.42 4663.42 | 0.10 |
| | | | , providente | | | | | | | 0.2.7 | | 100.12 | 0.10 |
| ower | 22 | 100-yr Fidwy | Corrected Eff | 103000.00 | 667.10 | 715.2792 | 691.19 | 715.30 | 0.000026 | 1.94 | 103351.70 | 5566.90 | 0.06 |
| ower | 22 | 100-yr Fldwy | Ppsd cond | 103000.00 | 667.10 | 715.2792 | 691.19 | 715.30 | 0.000026 | 1.94 | 103351.70 | 5566.90 | 0.06 |
| ower | 21 | 100-yr Fidwy | Corrected Eff | 103000.00 | 666.00 | 715.2257 | 692.26 | 715.25 | 0.000025 | 1.93 | 107403.90 | 5828.60 | 0.06 |
| ower | 21 | 100-yr Fldwy | Ppsd cond | 103000.00 | 666.00 | 715.2257 | 692.26 | 715.25 | 0.000025 | 1.93 | 107403.90 | 5828.60 | 0.06 |
| | | , . , | | | | | | | | | | | |
| ower | 20 | 100-yr Fldwy | Corrected Eff | 103000.00 | 674,30 | 715.1508 | 693.30 | 715.18 | 0.000029 | 2.01 | 101210.10 | 5450.00 | 0.06 |
| ower | 20 | 100-yr Fldwy | Ppsd cond | 103000.00 | 674.30 | 715.1508 | 693.30 | 715.18 | 0.000029 | 2.01 | 101210.10 | 5450.00 | 0.06 |
| ower | 19 | 100-yr Fldwy | Corrected Eff | 103000.00 | 675.40 | 715.0464 | 694.86 | 715.09 | 0.000043 | 2.38 | 74372.60 | 4880.74 | 0.07 |
| ower | 19 | 100-yr Fldwy | Ppsd cond | 103000.00 | 675,40 | 715.0464 | 694.86 | 715.09 | 0.000043 | 2.38 | 74372.60 | 4880.74 | 0.07 |

| Reach | River Sta | Profile | Plan | dwy (Continued) Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|----------------|------------|---|----------------------------|----------------------------|------------------|----------------------|------------------|------------------|------------|--------------|------------------------|--------------------|--------------|
| rtouon | Turor out | 1 tonio | 1, 1001 | (cfs) | (ft) | (ft) | (ft) | (ft) | (秔/秔) | (ft/s) | (sq ft) | (ft) | |
| | | | | | | | | | | | | | |
| -ower | 18.4 | 100-yr Fldwy 100-yr Fldwy | Corrected Eff | 103000.00 | 670.20 670.20 | 714.9663 714.9663 | 690.54 690.54 | 715.04 | 0.000065 | 3.11 | 61220.41 61220.41 | 4483.86 4483.86 | 0.0 |
| _ower | 18.4 | Too-yr Fluwy | Ppsd cond | 103000.00 | 070.20 | 714.8003 | 080.04 | 715.04 | 0.000003 | 0.11 | 01220.41 | 4403.00 | 0.02 |
| ower | 18 | 100-yr Fldwy | Corrected Eff | 103000.00 | 668.80 | 714.9559 | 689.61 | 715.03 | 0.000060 | 3.00 | 62410.70 | 4945.31 | 0.08 |
| Lower | 18 | 100-yr Fldwy | Ppsd cond | 103000.00 | 668.80 | 714.9559 | 689.61 | 715.03 | 0.000060 | 3.00 | 62410.70 | 4945.31 | 0.06 |
| - | - | | | | | | | | | | | | |
| Lower | 17 | 100-yr Fidwy 100-yr Fidwy | Corrected Eff Ppsd cond | 103000.00 | 668.50 668.50 | 714.8942 | 691.08 691.08 | 714.97 714.97 | 0.000068 | 3.13 3.13 | 60602.98 60602.98 | 5118.86 5118.86 | 0.08 |
| LOWEI | 17 | Too-yr Flowy | rpsu conu | 10000.00 | 000.00 | 714.0042 | 001.00 | 114.07 | 0.000000 | 0.10 | 00002.80 | 0110.00 | 0.00 |
| Lower | 16 | 100-yr Fldwy | Corrected Eff | 103000.00 | 671.30 | 714.8358 | 690.41 | 714.89 | 0.000049 | 2.61 | 72070.45 | 5553.08 | 0.08 |
| Lower | 16 | 100-yr Fldwy | Ppsd cond | 103000.00 | 671.30 | 714.8358 | 690.41 | 714.89 | 0.000049 | 2.61 | 72070.45 | 5553.08 | 0.08 |
| | 45 | 100 | Duran da d E% | 100000.00 | 074.50 | 744 0000 | 805 47 | 744.00 | 0.00004.0 | 1.11 | 400054.00 | 84.85 OF | 0.04 |
| Lower | 15 | 100-yr Fldwy 100-yr Fldwy | Corrected Eff Ppsd cond | 103000.00 | 674.50 674.50 | 714.8033 | 695.17 695.17 | 714.82 | 0.000016 | 1.44 | 123251.80 123251.80 | 6165.95 6165.95 | 0.04 |
| .onui | 10 | 100 yr riawy | i pod corki | 100000.00 | 014.00 | 114.0000 | 000.117 | 111102 | 0.000010 | | 120201.00 | 0.00.00 | |
| Lower | 14 | 100-yr Fidwy | Corrected Eff | 103000.00 | 672.90 | 714.7791 | 696.28 | 714.79 | 0.000015 | 1.41 | 131745.90 | 6984.97 | 0.04 |
| Lower | 14 | 100-yr Fldwy | Ppsd cond | 103000.00 | 672.90 | 714.7791 | 696.28 | 714.79 | 0.000015 | 1.41 | 131745.90 | 6984.97 | 0.04 |
| | 10.1 | 100 511 | a | 100000 00 | 000.40 | 744.0500 | 200.00 | 744.74 | 0.000070 | 0.05 | 05 470 77 | 5480.04 | 0.40 |
| Lower Lower | 13.4 | 100-yr Fldwy 100-yr Fldwy | Corrected Eff Ppsd cond | 103000.00 | 668.40 668.40 | 714.6569 714.6569 | 692.36 692.36 | 714.74 | 0.000079 | 3.25 3.25 | 65478.77 65478.77 | 5168.94 5168.94 | 0.10 |
| LOWBI | 13.4 | Toosyn Thawy | T pad cond | 10000.00 | 000.40 | 714.0000 | 002.00 | 114.14 | 0.00007.0 | 0.20 | 00410.11 | 0100.04 | 0.10 |
| Lower | 13.3 | | | Bridge | | | | | | | | | |
| | 1,211 | | | | | | | | | | | | |
| Lower | 13.2 | 100-yr Fldwy | Corrected Eff | 103000.00 | 668.40 | 714.6064 | 692.36 | 714.68 | 0.000071 | 3.08 | 64939.44 | 5115.78 | 0.09 |
| Lower | 13.2 | 100-yr Fldwy | Ppsd cond | 103000.00 | 668.40 | 714,6064 | 692.36 | 714.68 | 0.000071 | 3.08 | 64939.44 | 5115.78 | 0.09 |
| Lower | 12.7 | 100-yr Fldwy | Corrected Eff | 103000.00 | 674.00 | 714.6180 | 697.06 | 714.64 | 0.000026 | 1.83 | 100008.90 | 5137.12 | 0.06 |
| Lower | 12.7 | 100-yr Fldwy | Ppsd cond | 103000.00 | 674.00 | 714.6180 | 697.06 | 714.64 | 0.000026 | 1.83 | 100008.90 | 5137.12 | 0.06 |
| | | | | | | | | | | | | | |
| Lower | 12.5 | | | Bridge | | | | | | | | | |
| Lower | 12.3 | 100-yr Fldwy | Corrected Eff | 103000.00 | 674.00 | 714.6067 | 696.96 | 714.63 | 0.000029 | 1.92 | 101053.70 | 5180.72 | 0.06 |
| Lower | 12.3 | 100-yr Fldwy | Ppsd cond | 103000.00 | 674.00 | 714.6067 | 696,96 | 714.63 | 0.000029 | 1.92 | 101053.70 | 5180.72 | 0.06 |
| | | | | | | | | | | | | | |
| Lower | 12 | 100-yr Fldwy | Corrected Eff | 103000.00 | 671.90 | 714,5950 | 694.40 | 714.62 | 0.000023 | 1.75 | 109303.40 | 6841.88 | 0.05 |
| Lower | 12 | 100-yr Fldwy | Ppsd cond | 103000.00 | 671.90 | 714.5950 | 694.40 | 714.62 | 0.000023 | 1.75 | 109303.40 | 6841.88 | 0.05 |
| Lower | 11 | 100-yr Fldwy | Corrected Eff | 103000.00 | 669.70 | 714.5646 | 689.08 | 714.58 | 0.000017 | 1.56 | 128387.10 | 7313.63 | 0.05 |
| Lower | 11 | 100-yr Fldwy | Ppsd cond | 103000.00 | 669.70 | 714.5646 | 689.08 | 714.58 | 0.000017 | 1.56 | 128387.10 | 7313.63 | 0.05 |
| | | | | | | | | | | | | | |
| Lower | 10 | 100-yr Fldwy | Corrected Eff | 103000.00 | 673.00 | 714.5234 | 695.61 | 714.54 | 0.000017 | 1.58 | 141601.50 | 8068.57 | 0.05 |
| Lower | 10 | 100-yr Fldwy | Ppsd cond | 103000.00 | 673.00 | 714.5234 | 695.61 | 714.54 | 0.000017 | 1.58 | 141601.50 | 8068.57 | 0.05 |
| Lower | 9 | 100-yr Fldwy | Corrected Eff | 103000.00 | 671.40 | 714.4683 | | 714.48 | 0.000013 | 1.34 | 151450.20 | 8718.11 | 0.04 |
| Lower | 9 | 100-yr Fldwy | Ppsd cond | 103000.00 | 671.40 | 714.4683 | | 714.48 | 0.000013 | 1.34 | 151450.20 | 8718.11 | 0.04 |
| | | | | | | | | | | | | | |
| Lower | 8 | 100-yr Fldwy | Corrected Eff | 103000.00 | 675.90 | 714.3905 | | 714.41 | 0.000028 | 1.86 | 130676.10 | 8012.80 | 0.06 |
| Lower | 8 | 100-yr Fldwy | Ppsd cond | 103000.00 | 675.90 | 714.3905 | | 714.41 | 0.000028 | 1.86 | 130676.10 | 8012.80 | 0.06 |
| Lower | 7.1 | 100-yr Fldwy | Corrected Eff | 103000.00 | 671.20 | 714.3109 | 689.70 | 714.33 | 0.000023 | 1.81 | 112590.60 | 6731.56 | 0.05 |
| Lower | 7.1 | 100-yr Fldwy | Ppsd cond | 103000.00 | 671.20 | 714.3109 | 689.70 | 714.33 | 0.000023 | 1.81 | 112590.60 | 6731.56 | 0,05 |
| | | | | | | | | | | | | | |
| Lower | 6.7 | 100-yr Fldwy | Corrected Eff | 103000.00 | 674.00 | 714.2526 | 689.78 | 714.30 | 0.000052 | 2.66 | 71808.13 | 4198.63 | 0.08 |
| Lower | 6.7 | 100-yr Fldwy | Ppsd cond | 103000.00 | 674.00 | 714.2526 | 689.78 | 714.30 | 0.000052 | 2.66 | 71808.13 | 4198.63 | 0.08 |
| Lower | 6.6 | | | Bridge | | | | | | | | | |
| | | 171 10 | le l | Dinge | | | | | | _ | | | |
| Lower | 6.5 | 100-yr Fldwy | Corrected Eff | 103000.00 | 670.30 | 714.2350 | 688.67 | 714.28 | 0.000048 | 2.65 | 72891.29 | 4196.93 | 0.08 |
| Lower | 6.5 | 100-yr Fldwy | Ppsd cond | 103000.00 | 670.30 | 714.2350 | 688.67 | 714.28 | 0.000048 | 2.65 | 72891.29 | 4196.93 | 0.08 |
| | | 400 511 | 0.1157 | 103000.00 | 070.00 | 744 4000 | 000.07 | 714.24 | 0.000055 | 2.66 | 74808.56 | 5591,74 | 0.08 |
| Lower Lower | 6.1 6.1 | 100-yr Fldwy 100-yr Fldwy | Corrected Eff Ppsd cond | 103000.00 | 672.20 672.20 | 714.1860 714.1860 | 692.27 692.27 | 714.24 | 0.000055 | 2.66 | 74808.56 | 5591.74 | 0.08 |
| Lonor | | ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,, | I pro totio | | | | | | | | | | |
| Lower | 5 | 100-yr Fldwy | Corrected Eff | 103000.00 | 670.00 | 714.0867 | 690.14 | 714.13 | 0.000041 | 2.41 | 77169.77 | 5514.32 | 0.07 |
| Lower | 5 | 100-yr Fldwy | Ppsd cond | 103000.00 | 670.00 | 714.0867 | 690.14 | 714.13 | 0.000041 | 2.41 | 77169.77 | 5514.32 | 0.07 |
| | | 100 | Compat-1 F# | 103000.00 | 800.70 | 742 0040 | | 744.00 | 0.000040 | 0.40 | 80549.72 | 4468.60 | 0.07 |
| Lower Lower | 4 | 100-yr Fldwy 100-yr Fldwy | Corrected Eff Ppsd cond | 103000.00 | 669.70 669.70 | 713.9819 713.9819 | | 714.02 | 0.000042 | 2.49 | 80549.72 | 4468.60 | 0.07 |
| Longi | - | 100-js r iuwy | , pour corru | 100000.00 | 556.70 | 710.0010 | | 114.02 | 0.000042 | 2.78 | 00040.12 | | 0.07 |
| Lower | 3 | 100-yr Fidwy | Corrected Eff | 103000.00 | 668.30 | 713.8400 | | 713.91 | 0.000055 | 2.89 | 72196.19 | 4052.74 | 0.08 |
| Lower | 3 | 100-yr Fldwy | Ppsd cond | 103000.00 | 668.30 | 713.8400 | | 713.91 | 0.000055 | 2.89 | 72196.19 | 4052.74 | 0.08 |
| | 0 | 400. 51 | 0 | 400000-01 | 070 10 | 740 7000 | | 740 70 | 0.000075 | | 04701 70 | 0770 14 | |
| Lower | 2 | 100-yr Fldwy 100-yr Fldwy | Corrected Eff Ppsd cond | 103000.00 | 670.10 670.10 | 713.7009 | | 713.78 713.78 | 0.000075 | 3.37 3.37 | 61721.76 61721.76 | 3779.46 3779.46 | 0.10 |
| | 6 | 100-yi Fidwy | r pau cond | 10000.00 | 070.10 | 710,1008 | | /10.70 | 0.000010 | 0.07 | 51121.10 | 5118.40 | 0.10 |
| Lower | 1 | 100-yr Fldwy | Corrected Eff | 103000.00 | 665.20 | 713.5500 | 690.80 | 713.65 | 0.000094 | 3.80 | 61163.47 | 3247.61 | 0.11 |
| Lower | 1 | 100-yr Fldwy | Ppsd cond | 103000.00 | 665.20 | 713.5500 | 690.80 | 713.65 | 0.000094 | 3.80 | 61163.47 | 3247.61 | 0.11 |

| MINNESOTA "NO-RISE" CERTIFICATION |
|--|
| This is to certify that I am a duly qualified professional engineer licensed to practice in the State of Minnesota. |
| It is further to certify that the attached technical data supports the fact that the proposal |
| to construct a permanent dredge material management site (development name / short project description) |
| will not impact the floodway width or 100-year flood elevation (will not raise or lower by more than 0.00 feet) on <u>the Minnesota River</u> (Name of stream) at published sections in the Flood Insurance Study for <u>Savage</u> (Name of Community) dated <u>(Study Date)</u> and will not impact the 100-year flood elevation (will not raise or lower by more than 0.00 feet) at unpublished cross-sections in the vicinity of the proposed development / project. |
| Attached are the following documents that support my findings: |
| HEC-RAS output tables |
| Sumary memorandum |
| Date: 3/8/19 |
| Signature: <u>Al 2000</u> PE 48031 {SEAL} Title: <u>Sr. Water Resources Engineer</u> |