# APPENDIX A

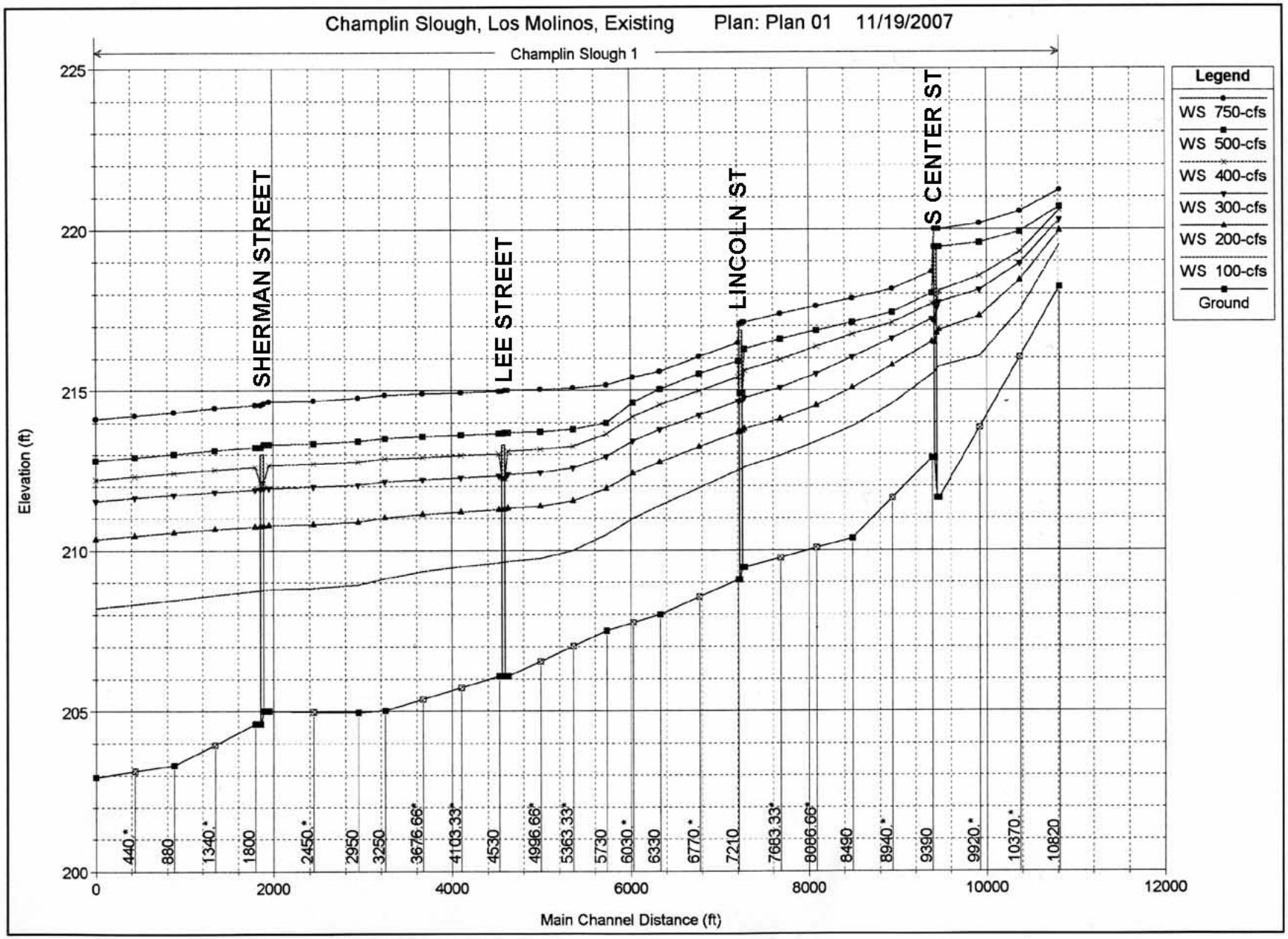
## Backwater Models

## Backwater Models

Backwater models were prepared to estimate the channel flow associated with incipient overtopping of the banks of Los Molinos Creek and Champlin Slough. The US Army Corps of Engineer's HEC-RAS backwater program was used for these models.

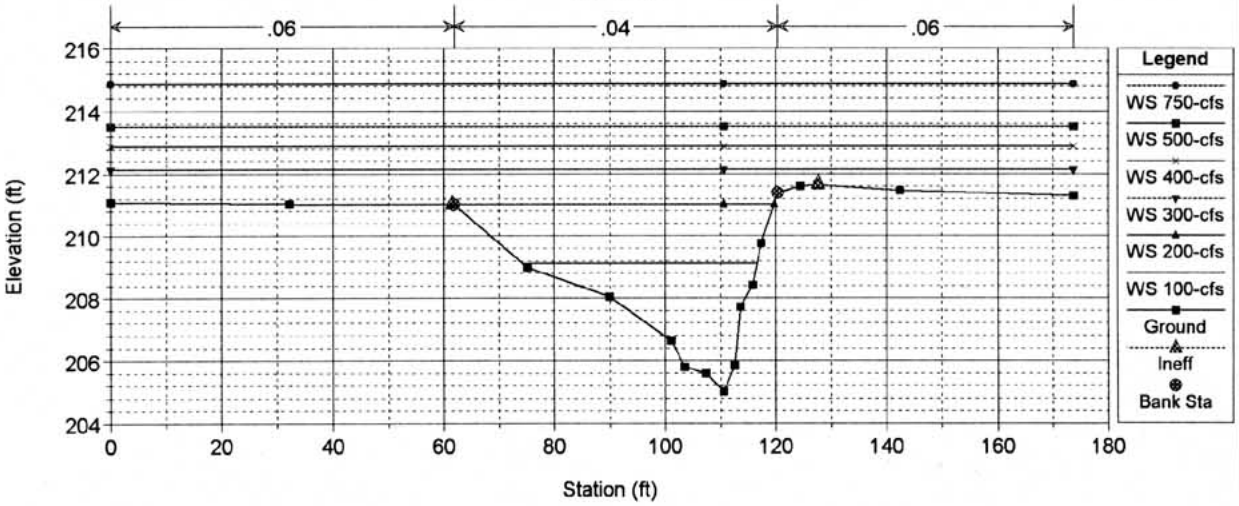
Geometric data for the Champlin Slough data were from surveyed cross-section and bridge data. For the purpose of estimating channel capacity the overbank areas some of the cross-section were assumed ineffective for conveying flow. Manning's roughness coefficients of ? and ? were used to represent the channel and overbanks respectively. These roughness coefficients were estimated by observation and comparison to similar channels identified in "Roughness Characteristics of Natural Channels". At some locations the roughness coefficients used in the model may be lower than supported by observed conditions but the values are generally representative of observed conditions as a whole. Contraction and expansion coefficients of 0.1 and 0.3 were used to represent the natural channel. In the vicinity of bridges, these coefficients were raised to 0.3 and 0.5 respectively. All bridges were modeled using pressure and weir flow methods (reverts to energy method if energy grade is below the bridge soffit). Interpolated cross-sections were inserted where appropriate to improve the performance of the model. These cross-sections were checked for interpolation error. The backwater model was run for a range of flows ranging from flow well contained in the channel to flow well above incipient overtopping for most of the channel reach. Water surface elevation data above the overtopping flow are not accurate and were not relied upon because the model does not fully represent the conveyance of overbank areas. Plotted flood profiles and selected cross-sections are included on the following pages along with a summary output table.

Geometric data for the Los Molinos Creek channel were estimated from surveyed bridge deck elevations, bridge opening dimensions estimated in the field, and assumed deck thicknesses. Channels were assumed to be near prismatic between bridges. Manning's roughness coefficients of ? and ? were used to represent the channel and overbanks respectively. These roughness coefficients were estimated by observation and comparison to similar channels identified in "Roughness Characteristics of Natural Channels". At some locations the roughness coefficients used in the model may be lower than supported by observed conditions but the values are generally representative of observed conditions as a whole. Contraction and expansion coefficients of 0.1 and 0.3 were used to represent the natural channel. In the vicinity of bridges, these coefficients were raised to 0.5 and 0.7 respectively. All bridges were modeled using culvert routines. Interpolated cross-sections were inserted where appropriate to improve the performance of the model. The backwater model was run for a range of flows ranging from flow well contained in the channel to flow above incipient overtopping for most of the channel reach. Water surface elevation data above the overtopping flow are not accurate and were not relied upon because the model does not fully represent the conveyance of overbank areas. Plotted flood profiles and selected cross-sections are included on the following pages along with a summary output table.


Champlin Slough, Los Molinos, Existing Plan: Plan 01 11/19/2007
Champlin Slough 1
SHERMAN STREET
LEE STREET
LINCOLN ST
S CENTER ST
Legend
WS 750-cfs
WS 500-cfs
WS 400-cfs
WS 300-cfs
WS 200-cfs
WS 100-cfs
Ground
Elevation (ft)
Main Channel Distance (ft)
225
220
215
210
205
200
0
2000
4000
6000
8000
10000
12000
440.*
880
1340.*
1800
2450.*
2950
3250
3676.66*
4103.33*
4530
4996.66*
5363.33*
5730
6030.*
6330
6770.*
7210
7663.33*
8066.66*
8490
8940.*
9390
9920.*
10370.*
10820

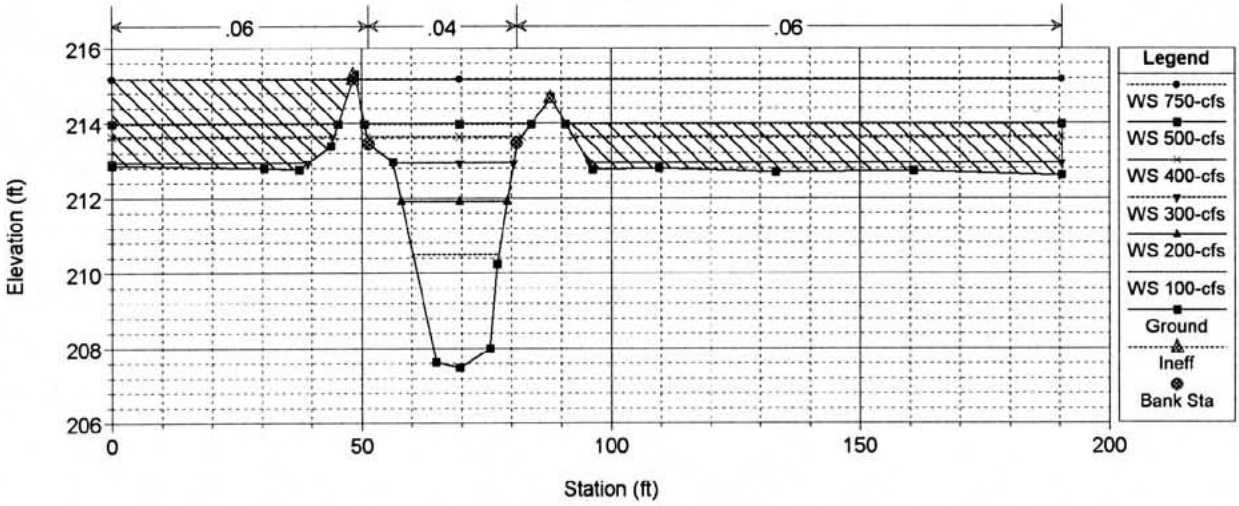
Champlin Slough, Los Molinos, Existing Plan: Plan 01 11/19/2007

RS = 3250



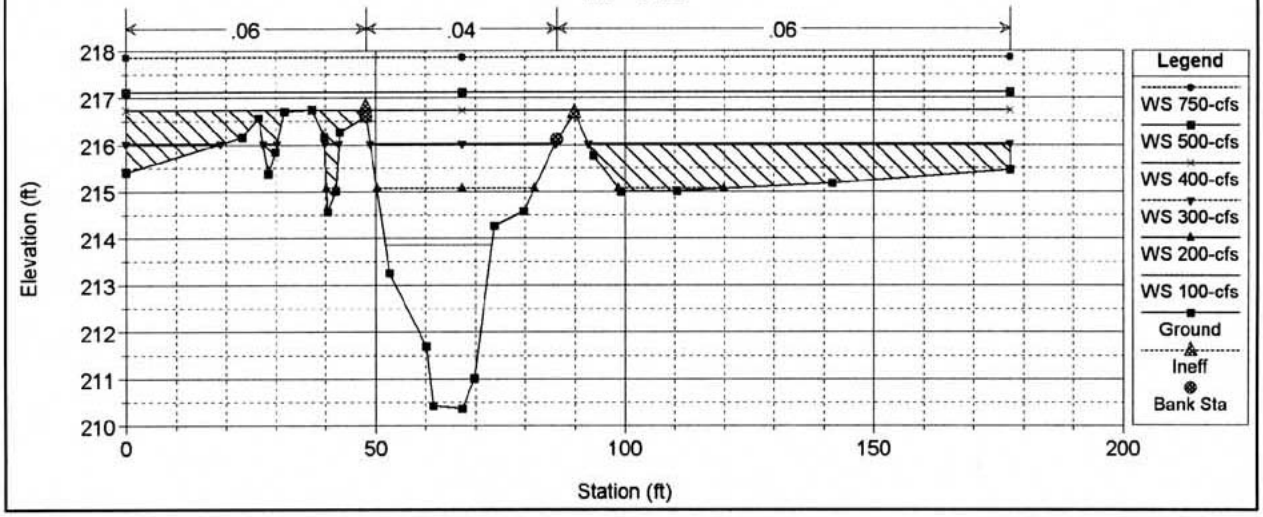

Champlin Slough, Los Molinos, Existing Plan: Plan 01 11/19/2007

RS = 5730




Champlin Slough, Los Molinos, Existing Plan: Plan 01 11/19/2007

RS = 8490



HEC-RAS Plan: Plan 01 River: Champlin Slough Reach: 1

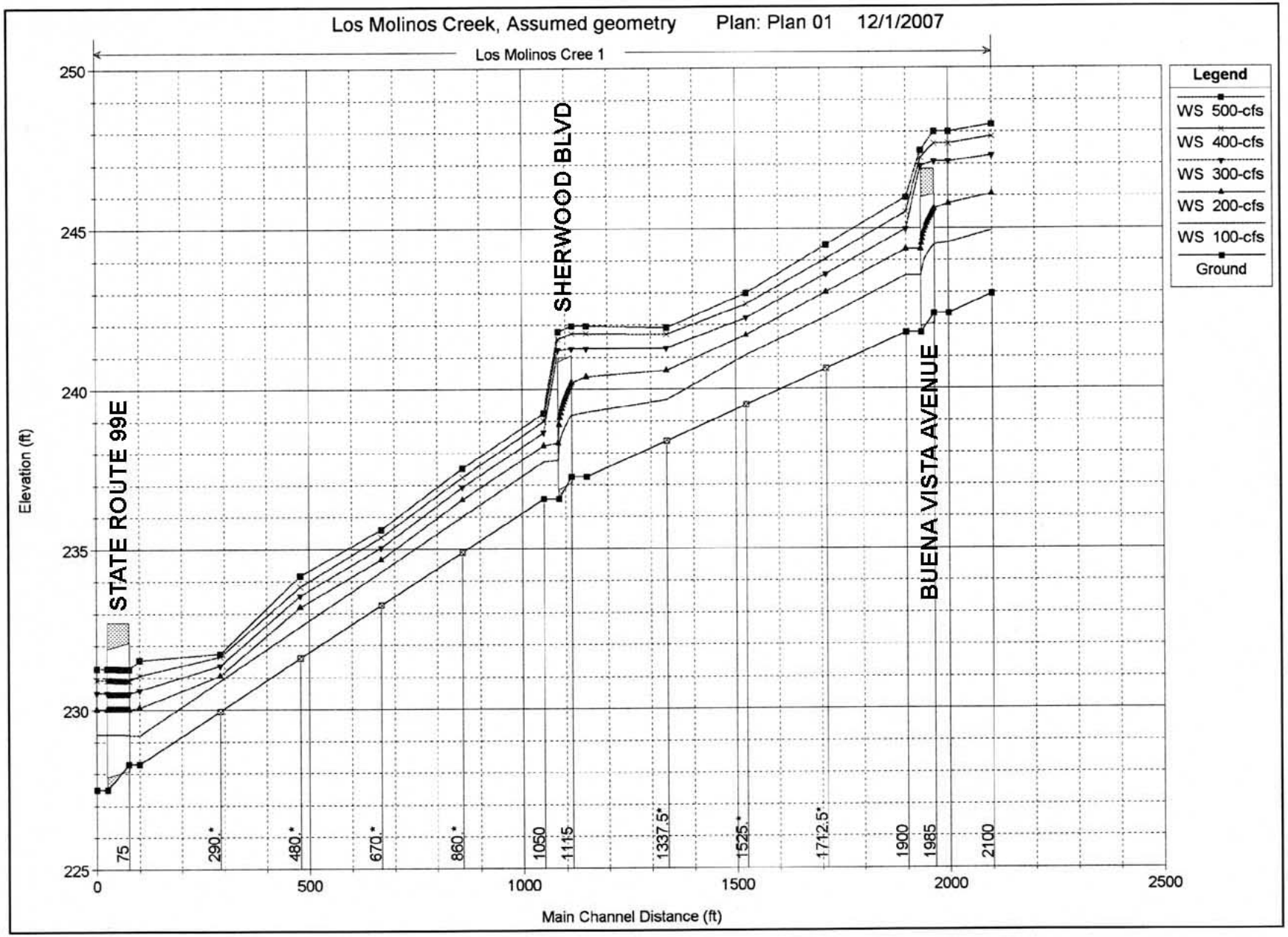
| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| 1 | 10820 | 200-cfs | 200.00 | 218.22 | 219.96 | 219.37 | 220.04 | 0.002981 | 2.44 | 94.02 | 224.41 | 0.37 |
| 1 | 10820 | 300-cfs | 300.00 | 218.22 | 220.29 | 219.58 | 220.40 | 0.003007 | 2.84 | 124.35 | 240.92 | 0.39 |
| 1 | 10820 | 400-cfs | 400.00 | 218.22 | 220.59 | 219.76 | 220.72 | 0.002912 | 3.13 | 154.20 | 253.14 | 0.39 |
| 1 | 10820 | 500-cfs | 500.00 | 218.22 | 220.69 | 219.92 | 220.76 | 0.001955 | 2.65 | 302.24 | 256.31 | 0.33 |
| 1 | 10820 | 750-cfs | 750.00 | 218.22 | 221.21 | 220.28 | 221.28 | 0.001536 | 2.73 | 436.37 | 263.35 | 0.30 |
| | | | | | | | | | | | | |
| 1 | 10370.* | 200-cfs | 200.00 | 216.02 | 218.41 | 217.52 | 218.54 | 0.003704 | 2.89 | 72.31 | 63.46 | 0.42 |
| 1 | 10370.* | 300-cfs | 300.00 | 216.02 | 218.93 | 217.93 | 219.07 | 0.002889 | 3.05 | 109.64 | 107.52 | 0.39 |
| 1 | 10370.* | 400-cfs | 400.00 | 216.02 | 219.29 | 218.28 | 219.45 | 0.002757 | 3.34 | 139.69 | 135.37 | 0.39 |
| 1 | 10370.* | 500-cfs | 500.00 | 216.02 | 219.92 | 218.52 | 220.02 | 0.001412 | 2.81 | 263.41 | 193.27 | 0.29 |
| 1 | 10370.* | 750-cfs | 750.00 | 216.02 | 220.55 | 218.99 | 220.65 | 0.001256 | 3.02 | 400.22 | 239.61 | 0.28 |
| | | | | | | | | | | | | |
| 1 | 9920.* | 200-cfs | 200.00 | 213.83 | 217.29 | 215.50 | 217.39 | 0.001839 | 2.49 | 80.90 | 51.02 | 0.31 |
| 1 | 9920.* | 300-cfs | 300.00 | 213.83 | 218.12 | 215.94 | 218.21 | 0.001319 | 2.54 | 132.69 | 113.43 | 0.27 |
| 1 | 9920.* | 400-cfs | 400.00 | 213.83 | 218.54 | 216.35 | 218.64 | 0.001210 | 2.68 | 197.74 | 130.50 | 0.27 |
| 1 | 9920.* | 500-cfs | 500.00 | 213.83 | 219.58 | 216.78 | 219.64 | 0.000528 | 2.14 | 351.10 | 175.87 | 0.18 |
| 1 | 9920.* | 750-cfs | 750.00 | 213.83 | 220.18 | 217.59 | 220.25 | 0.000636 | 2.57 | 470.91 | 229.99 | 0.21 |
| | | | | | | | | | | | | |
| 1 | 9470 | 200-cfs | 200.00 | 211.63 | 216.87 | 213.54 | 216.92 | 0.000636 | 1.86 | 108.31 | 77.94 | 0.19 |
| 1 | 9470 | 300-cfs | 300.00 | 211.63 | 217.73 | 214.04 | 217.81 | 0.000638 | 2.16 | 139.88 | 119.95 | 0.19 |
| 1 | 9470 | 400-cfs | 400.00 | 211.63 | 218.08 | 214.48 | 218.19 | 0.000855 | 2.65 | 152.50 | 123.86 | 0.23 |
| 1 | 9470 | 500-cfs | 500.00 | 211.63 | 219.44 | 214.91 | 219.47 | 0.000242 | 1.70 | 479.83 | 219.48 | 0.13 |
| 1 | 9470 | 750-cfs | 750.00 | 211.63 | 220.00 | 216.06 | 220.04 | 0.000331 | 2.11 | 604.14 | 230.37 | 0.15 |
| | | | | | | | | | | | | |
| 1 | 9445 | | Bridge | | | | | | | | | |
| | | | | | | | | | | | | |
| 1 | 9390 | 200-cfs | 200.00 | 212.89 | 216.50 | 214.96 | 216.61 | 0.001630 | 2.64 | 75.70 | 90.90 | 0.30 |
| 1 | 9390 | 300-cfs | 300.00 | 212.89 | 217.21 | 215.37 | 217.35 | 0.001618 | 3.05 | 98.32 | 99.54 | 0.31 |
| 1 | 9390 | 400-cfs | 400.00 | 212.89 | 217.68 | 215.73 | 217.88 | 0.001820 | 3.51 | 113.96 | 102.68 | 0.33 |
| 1 | 9390 | 500-cfs | 500.00 | 212.89 | 218.01 | 216.05 | 218.26 | 0.002130 | 4.01 | 124.73 | 114.64 | 0.37 |
| 1 | 9390 | 750-cfs | 750.00 | 212.89 | 218.67 | 216.71 | 219.08 | 0.002778 | 5.11 | 146.97 | 159.71 | 0.43 |
| | | | | | | | | | | | | |
| 1 | 8940.* | 200-cfs | 200.00 | 211.63 | 215.77 | 214.03 | 215.88 | 0.001610 | 2.60 | 76.92 | 54.49 | 0.30 |
| 1 | 8940.* | 300-cfs | 300.00 | 211.63 | 216.61 | 214.53 | 216.70 | 0.001197 | 2.59 | 146.76 | 115.52 | 0.26 |
| 1 | 8940.* | 400-cfs | 400.00 | 211.63 | 217.09 | 214.93 | 217.19 | 0.001150 | 2.76 | 192.77 | 165.88 | 0.26 |
| 1 | 8940.* | 500-cfs | 500.00 | 211.63 | 217.42 | 215.25 | 217.52 | 0.001082 | 2.85 | 275.29 | 182.67 | 0.26 |
| 1 | 8940.* | 750-cfs | 750.00 | 211.63 | 218.14 | 215.96 | 218.24 | 0.000952 | 3.00 | 407.58 | 182.67 | 0.25 |
| | | | | | | | | | | | | |
| 1 | 8490 | 200-cfs | 200.00 | 210.37 | 215.07 | 212.89 | 215.17 | 0.001527 | 2.54 | 78.82 | 54.66 | 0.28 |
| 1 | 8490 | 300-cfs | 300.00 | 210.37 | 216.02 | 213.44 | 216.13 | 0.001339 | 2.69 | 111.57 | 146.56 | 0.27 |
| 1 | 8490 | 400-cfs | 400.00 | 210.37 | 216.74 | 213.86 | 216.79 | 0.000650 | 2.12 | 270.78 | 177.19 | 0.20 |
| 1 | 8490 | 500-cfs | 500.00 | 210.37 | 217.11 | 214.25 | 217.16 | 0.000572 | 2.12 | 371.01 | 177.35 | 0.19 |
| 1 | 8490 | 750-cfs | 750.00 | 210.37 | 217.85 | 215.19 | 217.90 | 0.000561 | 2.35 | 502.25 | 177.35 | 0.19 |
| | | | | | | | | | | | | |
| 1 | 8086.66* | 200-cfs | 200.00 | 210.07 | 214.52 | 212.46 | 214.61 | 0.001233 | 2.45 | 81.75 | 29.49 | 0.26 |
| 1 | 8086.66* | 300-cfs | 300.00 | 210.07 | 215.51 | 212.95 | 215.61 | 0.001238 | 2.59 | 116.00 | 107.81 | 0.26 |
| 1 | 8086.66* | 400-cfs | 400.00 | 210.07 | 216.35 | 213.32 | 216.46 | 0.001060 | 2.64 | 151.63 | 184.53 | 0.25 |
| 1 | 8086.66* | 500-cfs | 500.00 | 210.07 | 216.86 | 213.65 | 216.92 | 0.000610 | 2.19 | 348.25 | 199.06 | 0.19 |
| 1 | 8086.66* | 750-cfs | 750.00 | 210.07 | 217.62 | 214.40 | 217.68 | 0.000564 | 2.36 | 498.74 | 199.06 | 0.19 |
| | | | | | | | | | | | | |
| 1 | 7683.33* | 200-cfs | 200.00 | 209.76 | 214.10 | 212.05 | 214.18 | 0.000929 | 2.19 | 91.19 | 31.44 | 0.23 |
| 1 | 7683.33* | 300-cfs | 300.00 | 209.76 | 215.07 | 212.49 | 215.16 | 0.000996 | 2.42 | 123.85 | 38.58 | 0.24 |
| 1 | 7683.33* | 400-cfs | 400.00 | 209.76 | 215.95 | 212.83 | 216.05 | 0.000970 | 2.47 | 162.20 | 152.24 | 0.24 |
| 1 | 7683.33* | 500-cfs | 500.00 | 209.76 | 216.59 | 213.12 | 216.66 | 0.000678 | 2.29 | 299.12 | 220.77 | 0.20 |
| 1 | 7683.33* | 750-cfs | 750.00 | 209.76 | 217.37 | 213.79 | 217.44 | 0.000601 | 2.43 | 472.07 | 220.77 | 0.20 |
| | | | | | | | | | | | | |
| 1 | 7280 | 200-cfs | 200.00 | 209.46 | 213.79 | 211.65 | 213.85 | 0.000708 | 1.93 | 103.81 | 35.45 | 0.20 |
| 1 | 7280 | 300-cfs | 300.00 | 209.46 | 214.76 | 212.05 | 214.83 | 0.000664 | 2.16 | 138.77 | 37.10 | 0.20 |
| 1 | 7280 | 400-cfs | 400.00 | 209.46 | 215.61 | 212.37 | 215.69 | 0.000781 | 2.28 | 175.77 | 49.63 | 0.21 |
| 1 | 7280 | 500-cfs | 500.00 | 209.46 | 216.28 | 212.64 | 216.37 | 0.000749 | 2.36 | 211.64 | 167.22 | 0.21 |
| 1 | 7280 | 750-cfs | 750.00 | 209.46 | 217.10 | 213.24 | 217.19 | 0.000663 | 2.52 | 419.64 | 242.48 | 0.21 |
| | | | | | | | | | | | | |
| 1 | 7260 | | Bridge | | | | | | | | | |
| | | | | | | | | | | | | |
| 1 | 7210 | 200-cfs | 200.00 | 209.08 | 213.69 | 211.63 | 213.76 | 0.000941 | 2.15 | 93.23 | 34.08 | 0.23 |
| 1 | 7210 | 300-cfs | 300.00 | 209.08 | 214.65 | 212.06 | 214.73 | 0.000861 | 2.35 | 127.57 | 37.64 | 0.23 |
| 1 | 7210 | 400-cfs | 400.00 | 209.08 | 215.40 | 212.41 | 215.50 | 0.000826 | 2.56 | 156.17 | 38.37 | 0.22 |
| 1 | 7210 | 500-cfs | 500.00 | 209.08 | 215.91 | 212.72 | 216.04 | 0.000896 | 2.84 | 178.64 | 60.69 | 0.23 |
| 1 | 7210 | 750-cfs | 750.00 | 209.08 | 216.47 | 213.39 | 216.66 | 0.001262 | 3.62 | 270.93 | 218.75 | 0.28 |
| | | | | | | | | | | | | |
| 1 | 6770.* | 200-cfs | 200.00 | 208.54 | 213.23 | 211.12 | 213.31 | 0.001085 | 2.35 | 85.10 | 30.21 | 0.25 |
| 1 | 6770.* | 300-cfs | 300.00 | 208.54 | 214.22 | 211.59 | 214.32 | 0.000999 | 2.57 | 116.86 | 33.86 | 0.24 |
| 1 | 6770.* | 400-cfs | 400.00 | 208.54 | 214.98 | 211.97 | 215.10 | 0.000990 | 2.79 | 143.67 | 186.23 | 0.25 |
| 1 | 6770.* | 500-cfs | 500.00 | 208.54 | 215.51 | 212.32 | 215.63 | 0.000946 | 2.92 | 206.52 | 219.14 | 0.24 |
| 1 | 6770.* | 750-cfs | 750.00 | 208.54 | 216.04 | 213.07 | 216.15 | 0.000894 | 3.04 | 412.39 | 222.51 | 0.24 |

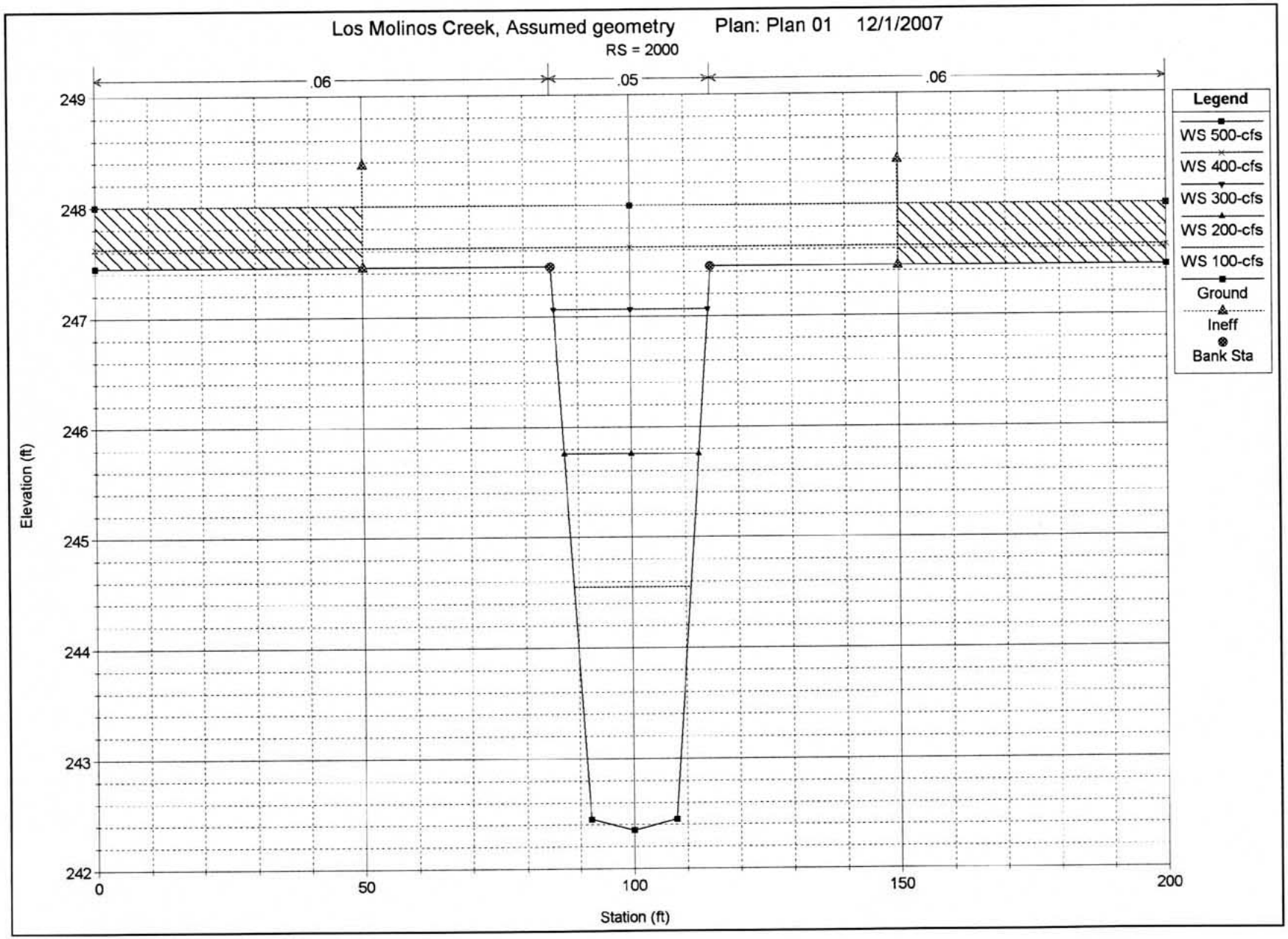
HEC-RAS Plan: Plan 01 River: Champlin Slough Reach: 1 (Continued)

| Reach | River Sta | Profile | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| 1 | 6330 | 200-cfs | 200.00 | 208.00 | 212.76 | 210.47 | 212.84 | 0.001047 | 2.37 | 84.24 | 28.18 | 0.24 |
| 1 | 6330 | 300-cfs | 300.00 | 208.00 | 213.77 | 210.96 | 213.88 | 0.000997 | 2.61 | 114.83 | 163.25 | 0.24 |
| 1 | 6330 | 400-cfs | 400.00 | 208.00 | 214.54 | 211.37 | 214.66 | 0.000975 | 2.86 | 140.81 | 187.63 | 0.25 |
| 1 | 6330 | 500-cfs | 500.00 | 208.00 | 215.03 | 211.74 | 215.18 | 0.001084 | 3.19 | 159.20 | 195.08 | 0.26 |
| 1 | 6330 | 750-cfs | 750.00 | 208.00 | 215.57 | 212.54 | 215.72 | 0.001081 | 3.38 | 306.44 | 199.70 | 0.27 |
| | | | | | | | | | | | | |
| 1 | 6030.* | 200-cfs | 200.00 | 207.74 | 212.39 | 210.08 | 212.50 | 0.001256 | 2.61 | 76.51 | 24.91 | 0.26 |
| 1 | 6030.* | 300-cfs | 300.00 | 207.74 | 213.42 | 210.63 | 213.55 | 0.001242 | 2.89 | 103.75 | 162.53 | 0.27 |
| 1 | 6030.* | 400-cfs | 400.00 | 207.74 | 214.17 | 211.08 | 214.33 | 0.001282 | 3.14 | 127.72 | 180.96 | 0.28 |
| 1 | 6030.* | 500-cfs | 500.00 | 207.74 | 214.61 | 211.50 | 214.81 | 0.001452 | 3.53 | 142.67 | 186.27 | 0.30 |
| 1 | 6030.* | 750-cfs | 750.00 | 207.74 | 215.40 | 212.36 | 215.46 | 0.000578 | 2.49 | 514.35 | 196.07 | 0.19 |
| | | | | | | | | | | | | |
| 1 | 5730 | 200-cfs | 200.00 | 207.49 | 211.92 | 209.72 | 212.06 | 0.001713 | 3.01 | 66.52 | 21.25 | 0.30 |
| 1 | 5730 | 300-cfs | 300.00 | 207.49 | 212.93 | 210.30 | 213.11 | 0.001715 | 3.35 | 89.57 | 158.24 | 0.31 |
| 1 | 5730 | 400-cfs | 400.00 | 207.49 | 213.63 | 210.81 | 213.84 | 0.002045 | 3.67 | 109.13 | 173.54 | 0.34 |
| 1 | 5730 | 500-cfs | 500.00 | 207.49 | 213.98 | 211.26 | 214.25 | 0.002362 | 4.19 | 120.25 | 178.34 | 0.37 |
| 1 | 5730 | 750-cfs | 750.00 | 207.49 | 215.17 | 212.21 | 215.26 | 0.000801 | 2.90 | 407.41 | 189.94 | 0.22 |
| | | | | | | | | | | | | |
| 1 | 5363.33* | 200-cfs | 200.00 | 207.02 | 211.53 | 209.01 | 211.60 | 0.000857 | 2.15 | 93.17 | 31.45 | 0.22 |
| 1 | 5363.33* | 300-cfs | 300.00 | 207.02 | 212.58 | 209.50 | 212.66 | 0.000807 | 2.33 | 128.69 | 167.34 | 0.22 |
| 1 | 5363.33* | 400-cfs | 400.00 | 207.02 | 213.25 | 209.92 | 213.36 | 0.000828 | 2.59 | 154.74 | 245.18 | 0.23 |
| 1 | 5363.33* | 500-cfs | 500.00 | 207.02 | 213.79 | 210.30 | 213.85 | 0.000483 | 2.15 | 363.54 | 273.80 | 0.18 |
| 1 | 5363.33* | 750-cfs | 750.00 | 207.02 | 215.07 | 211.08 | 215.10 | 0.000217 | 1.70 | 793.47 | 276.02 | 0.12 |
| | | | | | | | | | | | | |
| 1 | 4996.66* | 200-cfs | 200.00 | 206.55 | 211.37 | 208.39 | 211.40 | 0.000343 | 1.46 | 137.22 | 42.56 | 0.14 |
| 1 | 4996.66* | 300-cfs | 300.00 | 206.55 | 212.43 | 208.82 | 212.47 | 0.000324 | 1.63 | 184.55 | 215.04 | 0.14 |
| 1 | 4996.66* | 400-cfs | 400.00 | 206.55 | 213.17 | 209.18 | 213.20 | 0.000210 | 1.47 | 447.25 | 305.13 | 0.12 |
| 1 | 4996.66* | 500-cfs | 500.00 | 206.55 | 213.72 | 209.49 | 213.74 | 0.000171 | 1.42 | 620.73 | 330.61 | 0.11 |
| 1 | 4996.66* | 750-cfs | 750.00 | 206.55 | 215.03 | 210.12 | 215.04 | 0.000102 | 1.27 | 1086.77 | 361.54 | 0.09 |
| | | | | | | | | | | | | |
| 1 | 4630 | 200-cfs | 200.00 | 206.08 | 211.31 | 207.87 | 211.32 | 0.000137 | 1.02 | 197.03 | 52.97 | 0.09 |
| 1 | 4630 | 300-cfs | 300.00 | 206.08 | 212.37 | 208.17 | 212.39 | 0.000136 | 1.18 | 256.71 | 273.19 | 0.10 |
| 1 | 4630 | 400-cfs | 400.00 | 206.08 | 213.11 | 208.42 | 213.13 | 0.000147 | 1.35 | 302.29 | 360.66 | 0.10 |
| 1 | 4630 | 500-cfs | 500.00 | 206.08 | 213.69 | 208.65 | 213.70 | 0.000078 | 1.05 | 841.95 | 383.93 | 0.08 |
| 1 | 4630 | 750-cfs | 750.00 | 206.08 | 215.01 | 209.17 | 215.02 | 0.000055 | 1.00 | 1391.65 | 447.06 | 0.07 |
| | | | | | | | | | | | | |
| 1 | 4595 | | Bridge | | | | | | | | | |
| | | | | | | | | | | | | |
| 1 | 4530 | 200-cfs | 200.00 | 206.08 | 211.27 | 208.15 | 211.29 | 0.000163 | 0.98 | 203.49 | 66.75 | 0.10 |
| 1 | 4530 | 300-cfs | 300.00 | 206.08 | 212.33 | 208.45 | 212.35 | 0.000143 | 1.08 | 277.80 | 199.06 | 0.10 |
| 1 | 4530 | 400-cfs | 400.00 | 206.08 | 213.02 | 208.72 | 213.05 | 0.000148 | 1.22 | 328.71 | 283.06 | 0.10 |
| 1 | 4530 | 500-cfs | 500.00 | 206.08 | 213.65 | 208.96 | 213.66 | 0.000097 | 1.08 | 681.20 | 283.06 | 0.08 |
| 1 | 4530 | 750-cfs | 750.00 | 206.08 | 214.97 | 209.46 | 214.98 | 0.000073 | 1.09 | 1054.37 | 283.06 | 0.08 |
| | | | | | | | | | | | | |
| 1 | 4103.33* | 200-cfs | 200.00 | 205.73 | 211.20 | 207.93 | 211.22 | 0.000176 | 1.03 | 194.14 | 62.97 | 0.10 |
| 1 | 4103.33* | 300-cfs | 300.00 | 205.73 | 212.27 | 208.32 | 212.29 | 0.000142 | 1.09 | 337.96 | 246.63 | 0.10 |
| 1 | 4103.33* | 400-cfs | 400.00 | 205.73 | 212.97 | 208.60 | 212.99 | 0.000116 | 1.10 | 511.32 | 246.63 | 0.09 |
| 1 | 4103.33* | 500-cfs | 500.00 | 205.73 | 213.61 | 208.85 | 213.62 | 0.000098 | 1.10 | 667.83 | 246.63 | 0.08 |
| 1 | 4103.33* | 750-cfs | 750.00 | 205.73 | 214.93 | 209.40 | 214.95 | 0.000077 | 1.13 | 995.09 | 246.63 | 0.08 |
| | | | | | | | | | | | | |
| 1 | 3676.66* | 200-cfs | 200.00 | 205.37 | 211.12 | 207.81 | 211.14 | 0.000205 | 1.10 | 182.26 | 59.83 | 0.11 |
| 1 | 3676.66* | 300-cfs | 300.00 | 205.37 | 212.21 | 208.27 | 212.22 | 0.000146 | 1.11 | 348.52 | 210.20 | 0.10 |
| 1 | 3676.66* | 400-cfs | 400.00 | 205.37 | 212.92 | 208.59 | 212.94 | 0.000121 | 1.13 | 498.49 | 210.20 | 0.09 |
| 1 | 3676.66* | 500-cfs | 500.00 | 205.37 | 213.56 | 208.85 | 213.58 | 0.000104 | 1.14 | 633.35 | 210.20 | 0.09 |
| 1 | 3676.66* | 750-cfs | 750.00 | 205.37 | 214.90 | 209.42 | 214.91 | 0.000086 | 1.20 | 913.80 | 210.20 | 0.08 |
| | | | | | | | | | | | | |
| 1 | 3250 | 200-cfs | 200.00 | 205.02 | 211.01 | 207.73 | 211.04 | 0.000261 | 1.19 | 168.30 | 57.81 | 0.12 |
| 1 | 3250 | 300-cfs | 300.00 | 205.02 | 212.14 | 208.29 | 212.16 | 0.000160 | 1.15 | 338.63 | 173.77 | 0.10 |
| 1 | 3250 | 400-cfs | 400.00 | 205.02 | 212.86 | 208.69 | 212.88 | 0.000135 | 1.18 | 464.36 | 173.77 | 0.10 |
| 1 | 3250 | 500-cfs | 500.00 | 205.02 | 213.51 | 209.00 | 213.53 | 0.000119 | 1.21 | 576.93 | 173.77 | 0.09 |
| 1 | 3250 | 750-cfs | 750.00 | 205.02 | 214.85 | 209.55 | 214.87 | 0.000103 | 1.30 | 809.81 | 173.77 | 0.09 |
| | | | | | | | | | | | | |
| 1 | 2950 | 200-cfs | 200.00 | 204.96 | 210.89 | 207.09 | 210.94 | 0.000419 | 1.73 | 119.87 | 50.59 | 0.16 |
| 1 | 2950 | 300-cfs | 300.00 | 204.96 | 212.05 | 207.64 | 212.09 | 0.000317 | 1.80 | 216.97 | 94.64 | 0.14 |
| 1 | 2950 | 400-cfs | 400.00 | 204.96 | 212.77 | 208.10 | 212.82 | 0.000301 | 1.92 | 285.79 | 94.64 | 0.14 |
| 1 | 2950 | 500-cfs | 500.00 | 204.96 | 213.42 | 208.52 | 213.47 | 0.000288 | 2.02 | 347.32 | 94.64 | 0.14 |
| 1 | 2950 | 750-cfs | 750.00 | 204.96 | 214.76 | 209.47 | 214.82 | 0.000279 | 2.26 | 473.91 | 94.64 | 0.14 |
| | | | | | | | | | | | | |
| 1 | 2450.* | 200-cfs | 200.00 | 204.98 | 210.81 | 206.49 | 210.82 | 0.000121 | 1.00 | 199.57 | 59.01 | 0.09 |
| 1 | 2450.* | 300-cfs | 300.00 | 204.98 | 211.98 | 206.85 | 212.00 | 0.000108 | 1.13 | 300.83 | 93.60 | 0.09 |
| 1 | 2450.* | 400-cfs | 400.00 | 204.98 | 212.70 | 207.17 | 212.73 | 0.000116 | 1.27 | 368.57 | 93.60 | 0.09 |
| 1 | 2450.* | 500-cfs | 500.00 | 204.98 | 213.35 | 207.46 | 213.38 | 0.000122 | 1.40 | 429.24 | 93.60 | 0.10 |
| 1 | 2450.* | 750-cfs | 750.00 | 204.98 | 214.68 | 208.09 | 214.72 | 0.000135 | 1.66 | 553.91 | 93.60 | 0.10 |
| | | | | | | | | | | | | |
| 1 | 1950 | 200-cfs | 200.00 | 205.00 | 210.78 | 206.22 | 210.79 | 0.000048 | 0.76 | 262.53 | 74.62 | 0.06 |
| 1 | 1950 | 300-cfs | 300.00 | 205.00 | 211.94 | 206.50 | 211.96 | 0.000055 | 0.93 | 321.29 | 92.56 | 0.07 |

HEC-RAS Plan: Plan 01 River: Champlin Slough Reach: 1 (Continued)

| Reach | River Sta | Profile | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| 1 | 1950 | 400-cfs | 400.00 | 205.00 | 212.66 | 206.73 | 212.68 | 0.000069 | 1.12 | 357.38 | 92.56 | 0.07 |
| 1 | 1950 | 500-cfs | 500.00 | 205.00 | 213.31 | 206.96 | 213.33 | 0.000066 | 1.05 | 516.11 | 92.56 | 0.07 |
| 1 | 1950 | 750-cfs | 750.00 | 205.00 | 214.64 | 207.45 | 214.67 | 0.000078 | 1.29 | 638.90 | 92.56 | 0.08 |
| | | | | | | | | | | | | |
| 1 | 1895 | | Bridge | | | | | | | | | |
| | | | | | | | | | | | | |
| 1 | 1800 | 200-cfs | 200.00 | 204.61 | 210.74 | 206.95 | 210.76 | 0.000141 | 1.05 | 190.69 | 53.29 | 0.09 |
| 1 | 1800 | 300-cfs | 300.00 | 204.61 | 211.90 | 207.33 | 211.92 | 0.000131 | 1.21 | 248.36 | 105.96 | 0.10 |
| 1 | 1800 | 400-cfs | 400.00 | 204.61 | 212.60 | 207.63 | 212.63 | 0.000150 | 1.41 | 283.26 | 121.13 | 0.10 |
| 1 | 1800 | 500-cfs | 500.00 | 204.61 | 213.22 | 207.91 | 213.25 | 0.000140 | 1.36 | 451.55 | 158.06 | 0.10 |
| 1 | 1800 | 750-cfs | 750.00 | 204.61 | 214.54 | 208.50 | 214.57 | 0.000130 | 1.51 | 659.46 | 158.06 | 0.10 |
| | | | | | | | | | | | | |
| 1 | 1340.* | 200-cfs | 200.00 | 203.96 | 210.66 | 206.40 | 210.68 | 0.000186 | 1.15 | 174.11 | 48.39 | 0.11 |
| 1 | 1340.* | 300-cfs | 300.00 | 203.96 | 211.83 | 206.92 | 211.85 | 0.000173 | 1.28 | 240.56 | 82.91 | 0.11 |
| 1 | 1340.* | 400-cfs | 400.00 | 203.96 | 212.52 | 207.37 | 212.55 | 0.000182 | 1.45 | 299.39 | 103.92 | 0.11 |
| 1 | 1340.* | 500-cfs | 500.00 | 203.96 | 213.14 | 207.84 | 213.17 | 0.000183 | 1.57 | 377.83 | 120.40 | 0.11 |
| 1 | 1340.* | 750-cfs | 750.00 | 203.96 | 214.45 | 208.56 | 214.50 | 0.000178 | 1.77 | 536.07 | 120.40 | 0.12 |
| | | | | | | | | | | | | |
| 1 | 880 | 200-cfs | 200.00 | 203.32 | 210.56 | 205.92 | 210.58 | 0.000247 | 1.30 | 153.77 | 42.50 | 0.12 |
| 1 | 880 | 300-cfs | 300.00 | 203.32 | 211.73 | 206.48 | 211.76 | 0.000227 | 1.46 | 206.99 | 55.51 | 0.12 |
| 1 | 880 | 400-cfs | 400.00 | 203.32 | 212.41 | 206.98 | 212.45 | 0.000250 | 1.68 | 247.32 | 79.64 | 0.13 |
| 1 | 880 | 500-cfs | 500.00 | 203.32 | 213.02 | 207.41 | 213.07 | 0.000259 | 1.84 | 303.67 | 82.73 | 0.13 |
| 1 | 880 | 750-cfs | 750.00 | 203.32 | 214.33 | 208.32 | 214.39 | 0.000271 | 2.15 | 411.56 | 82.73 | 0.14 |
| | | | | | | | | | | | | |
| 1 | 440.* | 200-cfs | 200.00 | 203.14 | 210.46 | 205.84 | 210.49 | 0.000200 | 1.24 | 161.03 | 40.87 | 0.11 |
| 1 | 440.* | 300-cfs | 300.00 | 203.14 | 211.63 | 206.52 | 211.67 | 0.000199 | 1.42 | 217.13 | 79.37 | 0.11 |
| 1 | 440.* | 400-cfs | 400.00 | 203.14 | 212.31 | 206.96 | 212.35 | 0.000215 | 1.61 | 280.02 | 89.17 | 0.12 |
| 1 | 440.* | 500-cfs | 500.00 | 203.14 | 212.92 | 207.37 | 212.97 | 0.000223 | 1.75 | 334.32 | 89.17 | 0.13 |
| 1 | 440.* | 750-cfs | 750.00 | 203.14 | 214.22 | 208.19 | 214.28 | 0.000234 | 2.04 | 450.32 | 89.17 | 0.13 |
| | | | | | | | | | | | | |
| 1 | 0 | 200-cfs | 200.00 | 202.95 | 210.36 | 205.39 | 210.39 | 0.000250 | 1.34 | 149.61 | 39.85 | 0.12 |
| 1 | 0 | 300-cfs | 300.00 | 202.95 | 211.53 | 205.91 | 211.57 | 0.000250 | 1.49 | 213.79 | 92.49 | 0.12 |
| 1 | 0 | 400-cfs | 400.00 | 202.95 | 212.21 | 206.38 | 212.25 | 0.000250 | 1.64 | 291.28 | 95.61 | 0.13 |
| 1 | 0 | 500-cfs | 500.00 | 202.95 | 212.82 | 206.80 | 212.86 | 0.000250 | 1.76 | 349.44 | 95.61 | 0.13 |
| 1 | 0 | 750-cfs | 750.00 | 202.95 | 214.12 | 207.78 | 214.17 | 0.000250 | 2.01 | 473.75 | 95.61 | 0.13 |


Los Molinos Creek, Assumed geometry
Plan: Plan 01
12/1/2007
Los Molinos Cree 1
STATE ROUTE 99E
SHERWOOD BLVD
BUENA VISTA AVENUE
Legend
WS 500-cfs
WS 400-cfs
WS 300-cfs
WS 200-cfs
WS 100-cfs
Ground
Elevation (ft)
Main Channel Distance (ft)
250
245
240
235
230
225
0
500
1000
1500
2000
2500
75
290.*
480.*
670.*
860.*
1050
1115
1337.5*
1525.*
1712.5*
1900
1985
2100


Los Molinos Creek, Assumed geometry
Plan: Plan 01
12/1/2007
RS = 2000
.06
.05
.06
Legend
WS 500-cfs
WS 400-cfs
WS 300-cfs
WS 200-cfs
WS 100-cfs
Ground
Ineff
Bank Sta
Elevation (ft)
249
248
247
246
245
244
243
242
0
50
100
150
200
Station (ft)

HEC-RAS Plan: Plan 01 River: Los Molinos Cree Reach: 1

| Reach | River Sta | Profile | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| 1 | 2100 | 200-cfs | 200.00 | 242.95 | 246.06 | 244.62 | 246.22 | 0.003847 | 3.25 | 61.60 | 24.42 | 0.36 |
| 1 | 2100 | 300-cfs | 300.00 | 242.95 | 247.27 | 245.09 | 247.43 | 0.002653 | 3.22 | 93.13 | 27.80 | 0.31 |
| 1 | 2100 | 400-cfs | 400.00 | 242.95 | 247.85 | 245.50 | 248.05 | 0.002969 | 3.64 | 109.75 | 29.43 | 0.33 |
| 1 | 2100 | 500-cfs | 500.00 | 242.95 | 248.22 | 245.87 | 248.48 | 0.003376 | 4.09 | 133.07 | 200.00 | 0.36 |
| | | | | | | | | | | | | |
| 1 | 2000 | 200-cfs | 200.00 | 242.35 | 245.76 | 244.03 | 245.89 | 0.002770 | 2.90 | 69.03 | 25.26 | 0.31 |
| 1 | 2000 | 300-cfs | 300.00 | 242.35 | 247.06 | 244.49 | 247.19 | 0.001920 | 2.87 | 104.44 | 28.92 | 0.27 |
| 1 | 2000 | 400-cfs | 400.00 | 242.35 | 247.62 | 244.90 | 247.79 | 0.002157 | 3.27 | 133.22 | 200.00 | 0.29 |
| 1 | 2000 | 500-cfs | 500.00 | 242.35 | 248.00 | 245.27 | 248.18 | 0.002259 | 3.55 | 170.71 | 200.00 | 0.30 |
| | | | | | | | | | | | | |
| 1 | 1985 | | Culvert | | | | | | | | | |
| | | | | | | | | | | | | |
| 1 | 1900 | 200-cfs | 200.00 | 241.75 | 244.34 | 243.42 | 244.60 | 0.007314 | 4.05 | 49.41 | 22.98 | 0.49 |
| 1 | 1900 | 300-cfs | 300.00 | 241.75 | 244.97 | 243.89 | 245.31 | 0.007642 | 4.66 | 64.32 | 24.73 | 0.51 |
| 1 | 1900 | 400-cfs | 400.00 | 241.75 | 245.49 | 244.30 | 245.91 | 0.007894 | 5.15 | 77.70 | 26.20 | 0.53 |
| 1 | 1900 | 500-cfs | 500.00 | 241.75 | 245.95 | 244.66 | 246.43 | 0.008128 | 5.56 | 89.96 | 27.48 | 0.54 |
| | | | | | | | | | | | | |
| 1 | 1712.5* | 200-cfs | 200.00 | 240.62 | 243.00 | 242.20 | 243.25 | 0.007043 | 4.03 | 49.69 | 25.37 | 0.51 |
| 1 | 1712.5* | 300-cfs | 300.00 | 240.62 | 243.57 | 242.64 | 243.91 | 0.007323 | 4.63 | 64.74 | 27.35 | 0.53 |
| 1 | 1712.5* | 400-cfs | 400.00 | 240.62 | 244.05 | 243.02 | 244.46 | 0.007553 | 5.12 | 78.20 | 29.01 | 0.55 |
| 1 | 1712.5* | 500-cfs | 500.00 | 240.62 | 244.47 | 243.36 | 244.94 | 0.007745 | 5.52 | 90.63 | 30.45 | 0.56 |
| | | | | | | | | | | | | |
| 1 | 1525.* | 200-cfs | 200.00 | 239.50 | 241.68 | 240.98 | 241.93 | 0.007187 | 4.02 | 49.78 | 28.05 | 0.53 |
| 1 | 1525.* | 300-cfs | 300.00 | 239.50 | 242.21 | 241.40 | 242.54 | 0.007263 | 4.58 | 65.49 | 30.39 | 0.55 |
| 1 | 1525.* | 400-cfs | 400.00 | 239.50 | 242.64 | 241.76 | 243.04 | 0.007535 | 5.07 | 78.95 | 32.27 | 0.57 |
| 1 | 1525.* | 500-cfs | 500.00 | 239.50 | 242.97 | 242.08 | 243.45 | 0.008130 | 5.56 | 89.87 | 33.71 | 0.60 |
| | | | | | | | | | | | | |
| 1 | 1337.5* | 200-cfs | 200.00 | 238.38 | 240.59 | 239.79 | 240.78 | 0.005078 | 3.53 | 56.73 | 32.40 | 0.47 |
| 1 | 1337.5* | 300-cfs | 300.00 | 238.38 | 241.28 | 240.17 | 241.50 | 0.004136 | 3.72 | 80.70 | 36.33 | 0.44 |
| 1 | 1337.5* | 400-cfs | 400.00 | 238.38 | 241.71 | 240.51 | 241.97 | 0.004186 | 4.12 | 101.10 | 84.66 | 0.45 |
| 1 | 1337.5* | 500-cfs | 500.00 | 238.38 | 241.91 | 240.80 | 242.25 | 0.004909 | 4.70 | 115.33 | 128.87 | 0.50 |
| | | | | | | | | | | | | |
| 1 | 1150 | 200-cfs | 200.00 | 237.25 | 240.38 | 238.58 | 240.44 | 0.000775 | 1.90 | 113.50 | 149.24 | 0.21 |
| 1 | 1150 | 300-cfs | 300.00 | 237.25 | 241.27 | 238.93 | 241.29 | 0.000323 | 1.50 | 307.54 | 200.00 | 0.14 |
| 1 | 1150 | 400-cfs | 400.00 | 237.25 | 241.74 | 239.25 | 241.77 | 0.000281 | 1.53 | 402.16 | 200.00 | 0.14 |
| 1 | 1150 | 500-cfs | 500.00 | 237.25 | 241.97 | 239.52 | 242.00 | 0.000324 | 1.70 | 448.28 | 200.00 | 0.15 |
| | | | | | | | | | | | | |
| 1 | 1115 | | Culvert | | | | | | | | | |
| | | | | | | | | | | | | |
| 1 | 1050 | 200-cfs | 200.00 | 236.55 | 238.23 | 237.88 | 238.53 | 0.009796 | 4.41 | 45.33 | 34.08 | 0.67 |
| 1 | 1050 | 300-cfs | 300.00 | 236.55 | 238.64 | 238.24 | 239.03 | 0.009748 | 5.00 | 60.04 | 37.24 | 0.69 |
| 1 | 1050 | 400-cfs | 400.00 | 236.55 | 238.99 | 238.55 | 239.45 | 0.009662 | 5.43 | 73.60 | 39.93 | 0.71 |
| 1 | 1050 | 500-cfs | 500.00 | 236.55 | 239.24 | 238.83 | 239.79 | 0.009747 | 5.94 | 87.26 | 78.77 | 0.72 |
| | | | | | | | | | | | | |
| 1 | 860.* | 200-cfs | 200.00 | 234.90 | 236.54 | 236.13 | 236.79 | 0.008276 | 4.04 | 49.54 | 37.55 | 0.62 |
| 1 | 860.* | 300-cfs | 300.00 | 234.90 | 236.92 | 236.47 | 237.25 | 0.008700 | 4.67 | 64.19 | 40.51 | 0.65 |
| 1 | 860.* | 400-cfs | 400.00 | 234.90 | 237.23 | 236.76 | 237.65 | 0.009034 | 5.18 | 77.27 | 42.97 | 0.68 |
| 1 | 860.* | 500-cfs | 500.00 | 234.90 | 237.51 | 237.02 | 237.99 | 0.008864 | 5.57 | 91.71 | 73.29 | 0.69 |
| | | | | | | | | | | | | |
| 1 | 670.* | 200-cfs | 200.00 | 233.25 | 234.67 | 234.41 | 234.96 | 0.011388 | 4.36 | 45.89 | 39.50 | 0.71 |
| 1 | 670.* | 300-cfs | 300.00 | 233.25 | 235.04 | 234.72 | 235.41 | 0.010792 | 4.89 | 61.31 | 42.53 | 0.72 |
| 1 | 670.* | 400-cfs | 400.00 | 233.25 | 235.36 | 235.00 | 235.80 | 0.010425 | 5.30 | 75.42 | 45.13 | 0.72 |
| 1 | 670.* | 500-cfs | 500.00 | 233.25 | 235.61 | 235.24 | 236.12 | 0.010895 | 5.78 | 86.57 | 47.08 | 0.75 |
| | | | | | | | | | | | | |
| 1 | 480.* | 200-cfs | 200.00 | 231.60 | 233.19 | 232.70 | 233.37 | 0.006191 | 3.46 | 57.84 | 44.61 | 0.54 |
| 1 | 480.* | 300-cfs | 300.00 | 231.60 | 233.54 | 232.99 | 233.79 | 0.006639 | 4.05 | 74.14 | 47.53 | 0.57 |
| 1 | 480.* | 400-cfs | 400.00 | 231.60 | 233.83 | 233.25 | 234.15 | 0.007097 | 4.54 | 88.09 | 49.90 | 0.60 |
| 1 | 480.* | 500-cfs | 500.00 | 231.60 | 234.17 | 233.49 | 234.52 | 0.006389 | 4.73 | 107.11 | 85.03 | 0.58 |
| | | | | | | | | | | | | |
| 1 | 290.* | 200-cfs | 200.00 | 229.95 | 231.06 | 230.99 | 231.43 | 0.019515 | 4.90 | 40.83 | 44.30 | 0.90 |
| 1 | 290.* | 300-cfs | 300.00 | 229.95 | 231.37 | 231.27 | 231.83 | 0.017500 | 5.44 | 55.10 | 46.95 | 0.89 |
| 1 | 290.* | 400-cfs | 400.00 | 229.95 | 231.65 | 231.52 | 232.18 | 0.016039 | 5.83 | 68.58 | 49.33 | 0.87 |
| 1 | 290.* | 500-cfs | 500.00 | 229.95 | 231.74 | 231.74 | 232.47 | 0.020879 | 6.86 | 72.88 | 50.06 | 1.00 |
| | | | | | | | | | | | | |
| 1 | 100 | 200-cfs | 200.00 | 228.30 | 230.06 | 229.30 | 230.17 | 0.003018 | 2.59 | 77.19 | 53.60 | 0.38 |
| 1 | 100 | 300-cfs | 300.00 | 228.30 | 230.61 | 229.57 | 230.73 | 0.002512 | 2.79 | 107.68 | 58.34 | 0.36 |
| 1 | 100 | 400-cfs | 400.00 | 228.30 | 231.07 | 229.80 | 231.20 | 0.002106 | 2.91 | 145.98 | 200.00 | 0.34 |
| 1 | 100 | 500-cfs | 500.00 | 228.30 | 231.54 | 230.01 | 231.63 | 0.001222 | 2.52 | 267.53 | 200.00 | 0.27 |
| | | | | | | | | | | | | |
| 1 | 75 | | Culvert | | | | | | | | | |
| | | | | | | | | | | | | |
| 1 | 0 | 200-cfs | 200.00 | 227.50 | 230.02 | 228.51 | 230.06 | 0.000801 | 1.66 | 121.20 | 200.00 | 0.21 |
| 1 | 0 | 300-cfs | 300.00 | 227.50 | 230.52 | 228.76 | 230.57 | 0.000800 | 1.93 | 170.66 | 200.00 | 0.21 |
| 1 | 0 | 400-cfs | 400.00 | 227.50 | 230.92 | 229.00 | 230.99 | 0.000801 | 2.13 | 210.94 | 200.00 | 0.22 |
| 1 | 0 | 500-cfs | 500.00 | 227.50 | 231.28 | 229.21 | 231.35 | 0.000801 | 2.30 | 246.55 | 200.00 | 0.22 |

# APPENDIX B

## Regional Method Hydrology

Regional Method Hydrology

Hydrologic Stability: Infrequent floods in Champlin Slough are substantially natural and not likely to be significantly affected by cultural activities in the basin. A private irrigation ditch may catch hillside runoff and contribute it to Champlin Slough but the magnitude of flow conveyed by the irrigation ditch is likely to be insignificant with respect to infrequent peak flows in Champlin Slough

Flood History: Overflow from the Champlin Slough channel occurs on a relatively frequent basis and results in shallow flooding.

Translation Analysis: Translation analysis consists of estimating the infrequent flood peak flows in a basin with no flood flow records by comparison with flood frequency statistics from streams or rivers having sufficient records of flood peak flows. After identification of representative basins with stream flow records, flood frequency relationships for these basins are determined by computing the normal probability Log-Pearson Type III curve fit. The curve fit is then plotted against the original data to verify the adequacy of the curve fit to represent the peak magnitude of infrequent floods. If the Log-Pearson type III curve fit reasonably represents the plotted data for the higher flows, it is considered representative of the basin having records and is used as a basis of comparison. If not, a line of best visual fit may be used as a basis of comparison.

After identifying representative flood-frequency relationships for the basins having records, candidate flood frequency relationships representing the stream or river at the proposed project site are estimated by adjusting the flood frequency relationships representing basins with flow records to account for differences in characteristics between the source basin and the project basin. These adjustments are made using the area, elevation, and precipitation exponents of the appropriate USGS regional equation.

Basin Characteristics – Characteristics of the Champlin Slough basin and of potentially representative basins having sufficient stream flow records to reasonably identify the infrequent flood peak flows are identified below.

TABLE 1
Basin Characteristics

| Basin Description | USGS Gage ID | Area (sq mi) | Average Annual Precip (inches) | Elevation Index | Years of Record |
|---|---|---|---|---|---|
| Champlin Slough | n/a | 4.18 | 23 | 0.35 | n/a |
| Mill Creek | 11381500 | 131 | 43 | 2.8 | 78 |
| Deer Creek | 11383500 | 208 | 47 | 2.8 | 90 |

Gaged basin flood frequency curves – Plotted flood frequency data and curves for the gaged basins used in this analysis are shown on the following pages.

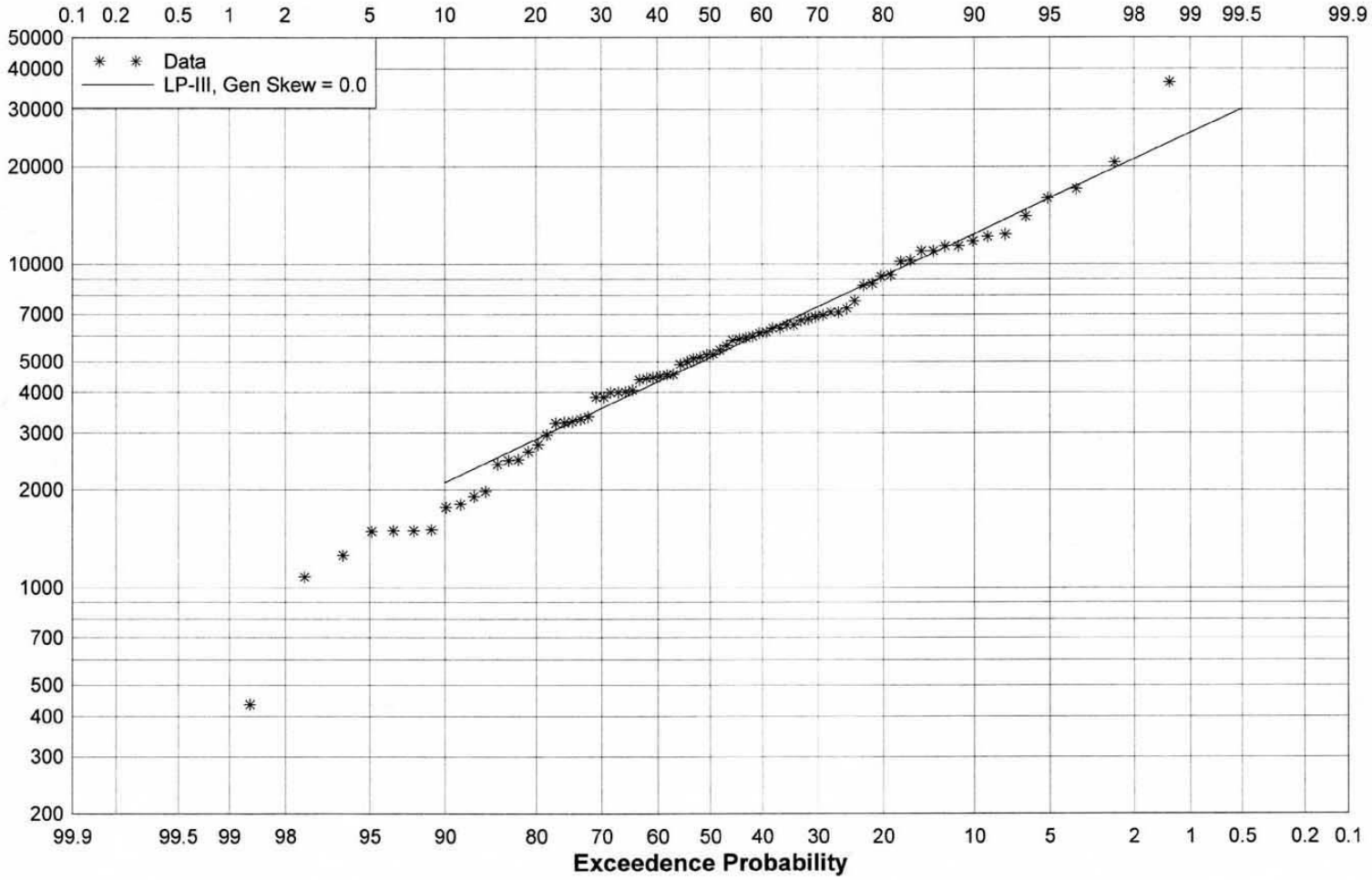
Regional Equations: Approach – The USGS has published a set of regional equations for estimating infrequent flood peak flows in natural streams and rivers not having flow records and not affected by lakes, reservoirs, substantial development or substantial reclamation projects throughout most of California. These equations are useful for planning level and rough preliminary estimates of infrequent flood peak flows and verification of flood frequency estimates using more detailed procedures. Flood peak flows estimated by these equations should only be relied upon for design if confidence in other methodologies is low and if verified by other methodologies. The empirical equations estimate flood peak flows from basin characteristics including area, elevation index and precipitation. Use of the area, elevation index and precipitation factor exponents of the regional equation for adjustment of flood characteristics from representative basins having sufficient flow records (described in Translation Analysis above) is generally considered to provide a more reliable estimate of infrequent flood peak flows for the basin without records.

Results: A figure showing the flood frequency relationships from the regional methods follows.

# Mill Creek nr Los Molinos

**USGS Streamgage 11381500: 78-years, 131 sq-mi, MAP=43-in, EI=2.8**

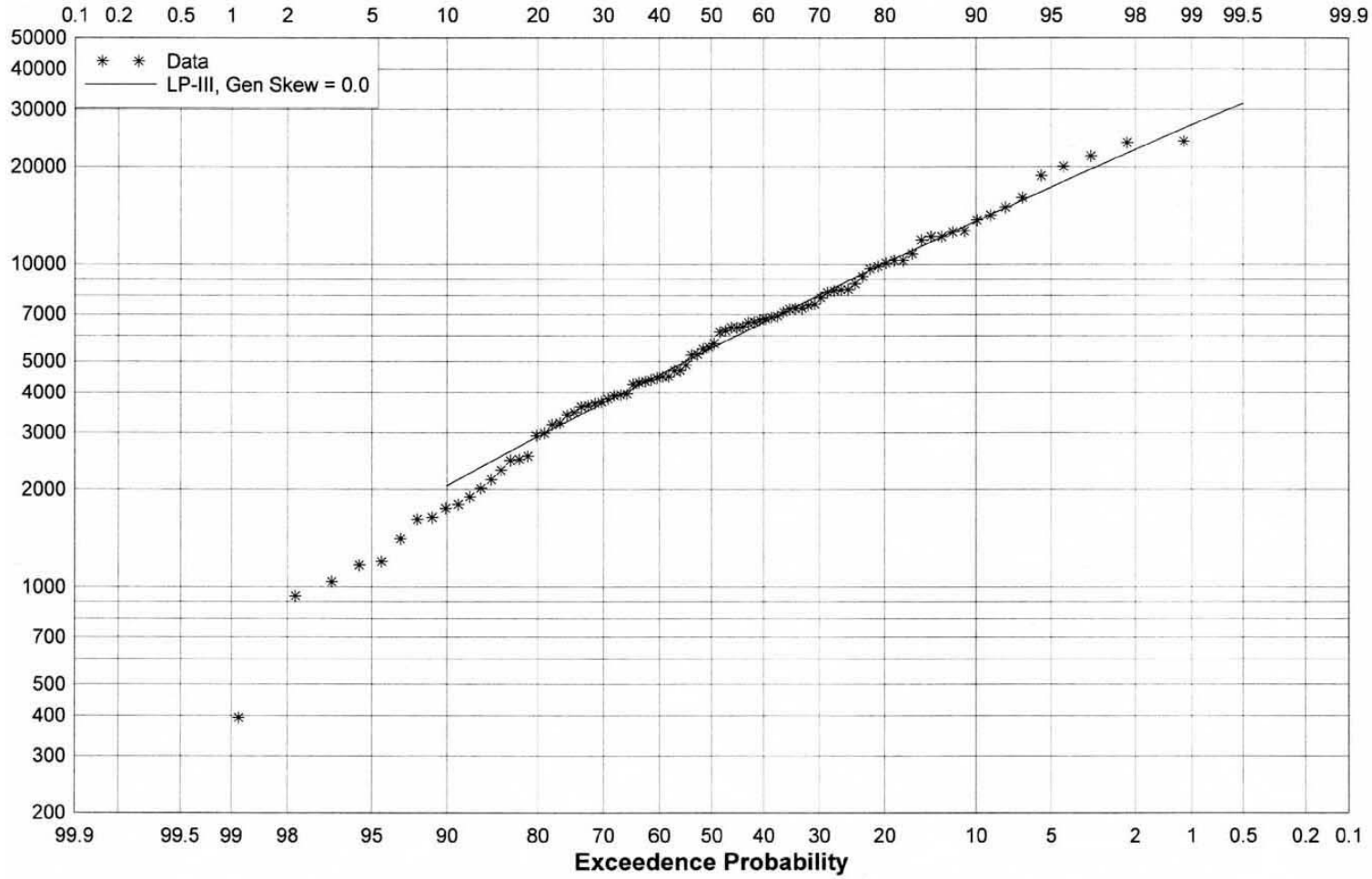
**Active**

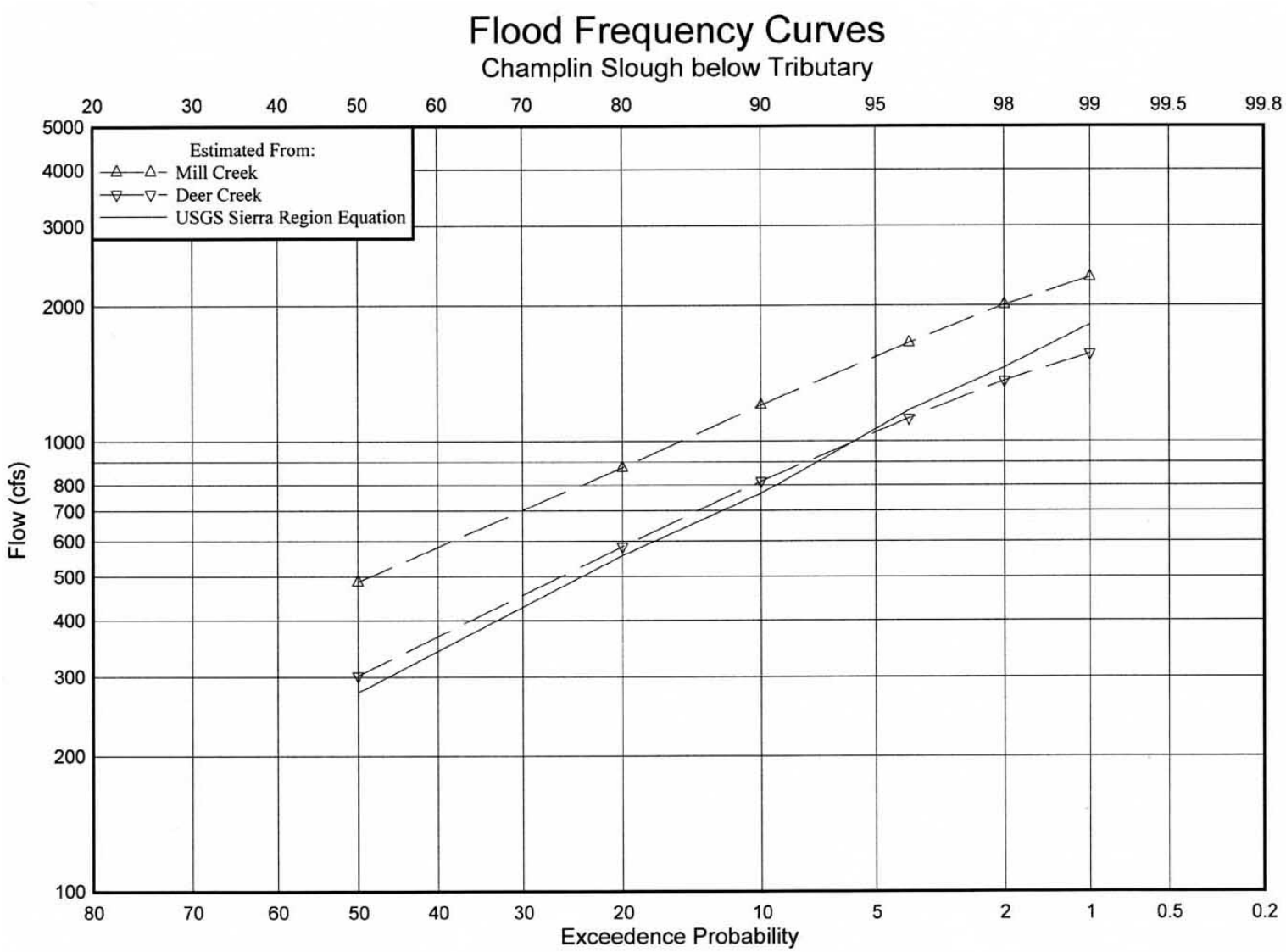


# Deer Creek nr Vina

**USGS Streamgage 11383500: 90-years, 208 sq-mi, MAP=47-in, El=2.8**

**Active**




Flood Frequency Curves
Champlin Slough below Tributary
Estimated From:
Mill Creek
Deer Creek
USGS Sierra Region Equation
Flow (cfs)
5000
4000
3000
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99.5
99.8
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70
60
50
40
30
20
10
5
2
1
0.5
0.2
Exceedence Probability

# APPENDIX C

## References

**REFERENCES**


1) American Society of Civil Engineers, Manuals and Reports of Engineering Practice No. 28, "Hydrology Handbook" 2nd Ed., 1996, ASCE, 345 East 47th Street, New York, NY 10017-2398.

2) Ponce, V.M., 1989, "Engineering Hydrology, Principals and Practices," Prentice Hall, Englewood Cliffs, New Jersey 07632.

3) United States Army Corps of Engineers, 1997, "HEC-RAS, River Analysis System" User's Manual, Version 2.0. Hydrologic Engineering Center, Davis, CA

4) United States Army Corps of Engineers, 1997, "HEC-RAS, River Analysis System, Hydraulic Reference Manual," Version 2.0, Hydraulic Engineering Center, Davis, CA.

5) United States Army Corps of Engineers, 2001, "Hydrologic Modeling System HEC-HMS, Users Manual," Publication No. CPD-74A, Version 2.1, Hydrologic Engineering Center, Davis, CA

6) United States Geological Survey, "Water Resources Data for California," Many years, Many volumes, U.S.G.S., Sacramento, CA.

7) United States Geological Survey, Hydrology Subcommittee "Guidelines for Determining Flood Flow Frequency," Bulletin #17B, Rev. Sept. 1981, Ed. Corrections, March 1982, Office of Water Data Coordination.

8) United States Geological Survey, Waananan and Crippen, 1977, "Magnitude and Frequency of Floods in California," Report number USGS/WRI 77-21, U.S.G.S., Menlo Park, CA.

9) Walesh, Stewart G., 1989, "Urban Surface Water Management," John Wiley and Sons, New York, NY.

Los Molinos Drainage Study

Existing Condition Flood Hydrology

Tehama County

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December 13, 2007

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Los Molinos Drainage Study
Existing Condition Flood Hydrology

## INTRODUCTION

The Town of Los Molinos experiences shallow flooding on a relatively frequent basis. The State of California Department of Transportation (Caltrans) is developing drainage improvements along State Route 99E through the Town of Los Molinos. The Caltrans improvements are substantially limited to construction of facilities within Caltrans right-of-way. Tehama County has received grant funding to study drainage problems in the Town of Los Molinos. Unlike Caltrans, Tehama County is able to locate new drainage facilities where they can be more effective. A combined effort of Tehama County and Caltrans may produce the most cost effective and best functioning drainage system for both the Town of Los Molinos and along State Route 99E.

Knowledge of the sources and rough extents of flooding is necessary for an understanding of the existing flood problem and for identifying reasonable flood damage reduction measures. This study and report has been commissioned to identify the sources and general characteristics of flooding in the Town of Los Molinos.

## HYDROLOGIC ENVIRONMENT

The developed area of Los Molinos is located east of the Sacramento River, west of Champlain Slough and south of Los Molinos Creek on recent mildly south sloping alluvial deposits from Mill Creek. The developed area of town is located out of the Sacramento River 100-year floodplain but may have been in the Sacramento River 100-year floodplain before construction of Shasta Dam. Water surface elevations in the Sacramento River during times of flooding are a concern for design of storm drainage facilities exiting to the Sacramento River floodplain. Champlin Slough has two main branches draining a 4.18-square mile basin of the low foothills along the east edge of the Sacramento River valley. At the base of the foothills, the Champlin Slough channels change direction from west to south. Los Molinos Creek drains a small basin of 1.84-square miles between the Champlin Slough basin and the Mill Creek channel. Mill Creek drains a 131-square mile basin on the western slopes of the most southerly portions of the Cascade Range. Topographic features indicate that at some time in the past, the Mill Creek channel may have been located where the Los Molinos Creek channel now exists. Average annual precipitation ranges from approximately 23-inches near the Town of Los Molinos to approximately 25-inches at the headwaters of Champlin Slough. Two irrigation ditches have the potential to affect flood peak flows to a minor degree. A lower ditch is owned and operated by the Los Molinos Mutual Water Company and an upper ditch is privately owned and operated. The upper ditch has the potential to capture runoff from a small tributary to Mill Creek and convey it to Los Molinos Creek or Champlin Slough. Figure 1 shows the Los Molinos Creek and Champlin Slough drainage basins along with the Mill Creek tributary basin and a basin representing local drainage in the developed area in the Town of Los Molinos.

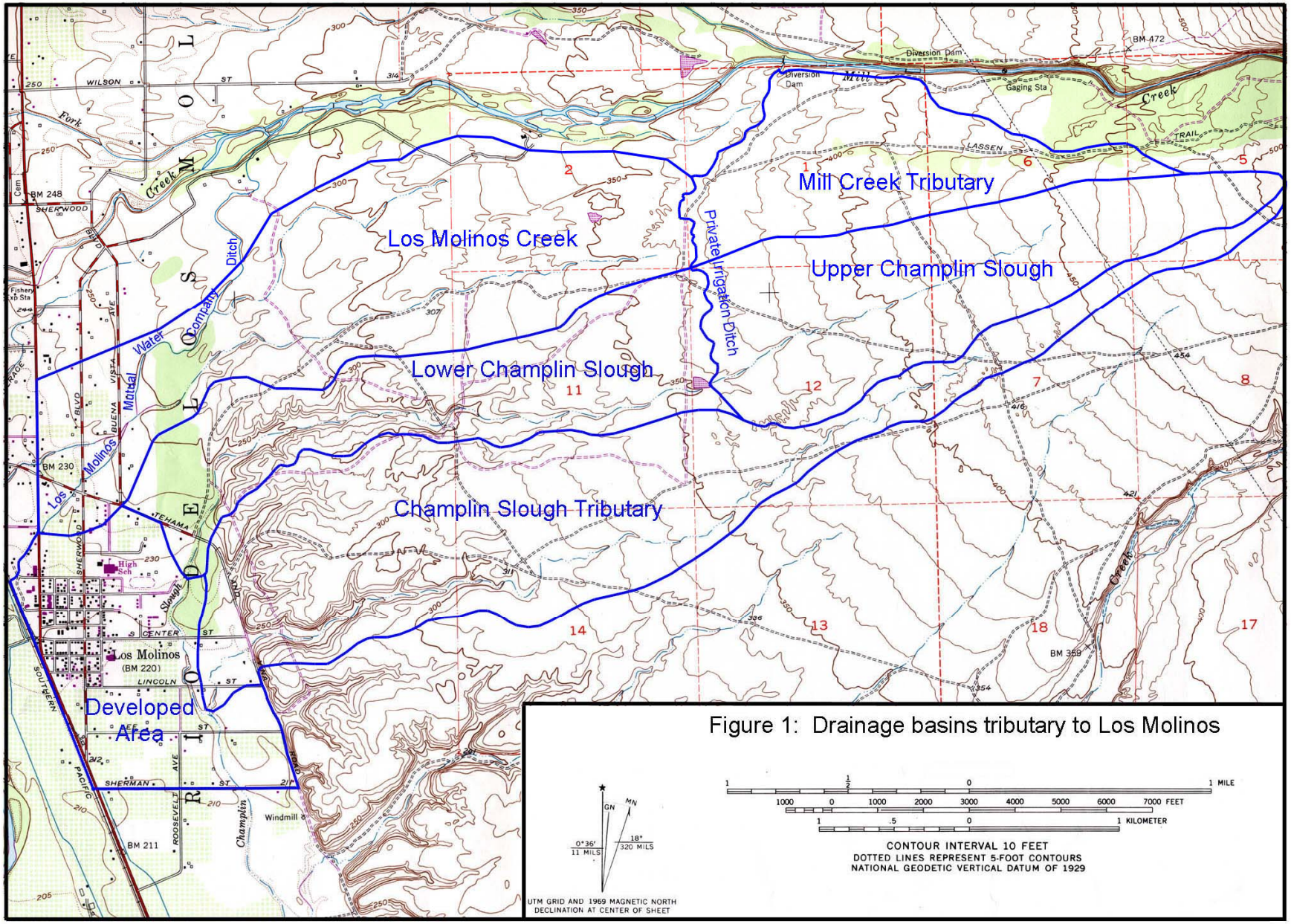


Figure 1: Hydrologic Environment

Floods in the Sacramento River are generally associated with large frontal storm events that seldom produce flooding on small tributary streams such as Los Molinos Creek and Champlin Slough. Floods in Los Molinos Creek and Champlin Slough as well as local flooding are associated with large local cloudburst events. Although it is unlikely that a large local cloudburst event will coincide with the Sacramento River peak flow, given the flood control operation of Shasta Dam on the Sacramento River it is possible for the local cloudburst event to combine with high flows in the Sacramento River.

## SITE AND STREAM CHANNELS

From a point upstream of Buena Vista Road to a point downstream of State Route 99E, flow in Los Molinos Creek is conveyed by a substantially straight constructed channel approximately 50-feet in width and 4-feet in depth and having an average slope of approximately 0.7 percent (decimal 0.007). Box culvert type structures convey flows in Los Molinos Creek under Buena Vista Avenue, Sherwood Boulevard, and State Route 99E. Presently, the Los Molinos Creek channel has a healthy growth of cattail and willow upstream of Sherwood Boulevard. The Los Molinos Mutual Water Company ditch supplying irrigation water to users in the vicinity of Los Molinos enters then exits the Los Molinos Creek channel upstream of Buena Vista Road. According to LMMWC staff, the water company ditch is gated during the winter flood season. Water leaving Los Molinos Creek as overflow will be conveyed to the south into the developed area as shallow overflow.

In the vicinity of the Town of Los Molinos Champlin Slough has a mildly meandering substantially natural channel of varying width and depth with an average slope of approximately 0.10-percent (decimal .0010) upstream of Lincoln Street and of approximately 0.025-percent (decimal 0.00025) downstream of Lincoln Street. Portions of the Champlin Slough channel also presently support a heavy growth of vegetation. South Center Street, Lee Street, Lincoln Street, and Sherman Street all cross the Champlin Slough channel over short span bridge structures. Overflow from Champlin Slough is generally conveyed to the south as shallow overflow adjacent to the channel.

The Town of Los Molinos does not have a storm drainage collection system. Local runoff in the Town of Los Molinos along with any overflow from Los Molinos Creek is conveyed in a southerly direction through the developed area of town as shallow overflow. Some of this flow will combine with overflow from Champlin Slough to the east and south of town and some will continue to the south as shallow overflow along the east side of State Route 99E. Ponding occurs in low lying areas and upstream of roads having crowns higher than the surrounding ground.

## HYDROLOGIC ANALYSIS

No flow data are available in Los Molinos Creek, Champlin Slough, or other small east side tributaries of the Sacramento River from which to estimate infrequent flood peak flows. Long term records of flow are available for Mill Creek and Deer Creek but these stream basins are much larger than the Los Molinos Creek and Champlin Slough basins and will respond to storms in a different manner. Nevertheless, estimates of infrequent flood peak flows in Champlin

Slough by adjustment of infrequent flood statistics in these larger basins can provide an idea of the infrequent flood peak flows that can be expected in Champlin Slough.

Given the complexity of the hydrologic environment producing shallow flooding in the Town of Los Molinos including upstream flow diversions, overflow from Los Molinos Creek and Champlin Slough, and timing differences between overflow peaks and locally generated runoff peaks, a HEC-HMS rainfall-runoff model using a synthetic design storm has been selected for characterizing infrequent flood hydrologic conditions in and adjacent to the Town of Los Molinos. Initial results of the rainfall-runoff model were compared to runoff estimated using regional methods and adjustments were made to rainfall-runoff data as necessary and appropriate to reach reasonable agreement between the methods. The HEC-RAS backwater program has been selected for estimating incipient overflow from the Los Molinos Creek and Champlin Slough channels.

A rainfall-runoff model was prepared using the US Army Corps of Engineer's HEC-HMS program to assist in the identification of existing causes of flooding. Contributing subbasins were identified from USGS topographic maps considering potential influences by irrigation ditches. Although surface drainage from the developed area in the Town of Los Molinos is conveyed away from town at several locations, a single subbasin was used to represent the entire developed area. Subbasins used in the model are schematically identified on Figure 2. With the exception of 10-cfs assumed to be conveyed by the upper diversion ditch to Champlin Slough, flow in the Mill Creek tributary was assumed not to contribute to Los Molinos Creek or Champlin Slough. Initial model results indicate runoff on the order of 500-cfs from this tributary. Flow of this magnitude will most likely overtop the diversion ditch and be conveyed down the Mill Creek tributary rather than be captured by the ditch and conveyed to the Los Molinos Creek or Champlin Slough basins.

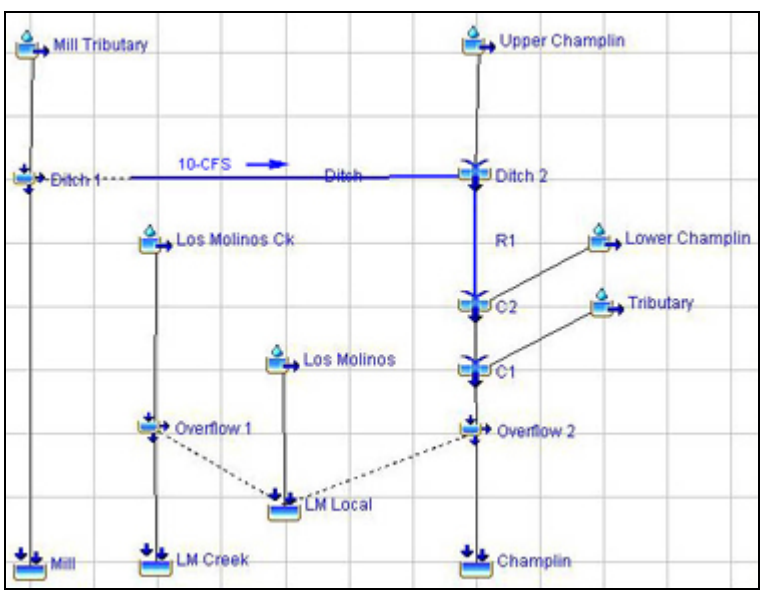


Figure 2: Rainfall-Runoff Model Subbasin Schematic

The SCS method (now sometimes referred to NRCS method) was selected to represent abstraction and transform. Abstraction data for the subbasins including land use and hydrologic soil class were provided by Tehama County. Within each subbasin, SCS curve numbers were assigned each combination of land use and soil class and an area weighted average SCS curve number was computed for the entire subbasin. Table 1 identifies the curve numbers assigned each combination of land use and soil class. After identification of an area weighted SCS curve number for each subbasin, an initial abstraction was assigned to each subbasin in accordance with the data identified in Table 2. Impervious percents were estimated from observation of aerial photographs. For the stream basins, impervious percents of 1- to 3-percent were used. In the developed are of the Town of Los Molinos, the impervious surfaces were estimated at 15-percent. When compared to peak flow estimates from regional methods, initial rainfall-runoff model results using these data significantly underestimated peak flows that would be expected during the most probable 100-year flood in Champlin Slough. After adjusting the subbasin SCS curve numbers and initial abstractions to represent Antecedent Moisture Condition (AMC)-III (wet ground), rainfall-runoff model results compared well with the regional methods. Table 3 identifies the AMC-III SCS curve numbers corresponding to the area weighed AMC-II (average ground moisture) SCS curve numbers. Table 4 identifies the area weighted subbasin SCS curve numbers and initial abstraction data determined and used in the rainfall-runoff model for all subbasins.

Table 1
SCS Curve Numbers (compiled from various sources)

| Land Use / Cover | Soil Group | | |
|---|---|---|---|
| | B | C | D |
| Commercial/Highways/Parking | 80 | 87 | 90 |
| Apartments/Offices/Trailers | 79 | 86 | 90 |
| Condominiums/Schools/Industry | 76 | 84 | 88 |
| Residential >10 units/acre | 72 | 81 | 86 |
| Residential 4-10 units/acre | 69 | 79 | 84 |
| Residential 1-4 units/acre | 66 | 76 | 83 |
| Residential <1 unit/acre | 63 | 73 | 82 |
| Bare/Rockland/Newly Graded | 86 | 91 | 93 |
| Pasture/Mowed Grass | 69 | 79 | 84 |
| Agricultural Crops | 78 | 85 | 89 |
| Orchards | 66 | 77 | 83 |
| Natural Grassland | 61 | 74 | 80 |
| Dense Oak/Pine/Vines/Brush | 45 | 55 | 70 |
| Open Oak/Pine Woodland/Grass | 65 | 77 | 82 |
| Chaparral/Shrubs/Weeds | 62 | 74 | 85 |
| Urban Landscaping | 56 | 69 | 75 |
| Urban Lawns (fair quality) | 65 | 77 | 82 |
| Urban Lawns (poor quality) | 74 | 83 | 87 |

Table 2
Initial Abstraction (USDA)

| Curve Number | Initial Abstraction (inches) | Curve Number | Initial Abstraction (inches) |
|---|---|---|---|
| 60 | 1.333 | 80 | 0.500 |
| 61 | 1.279 | 81 | 0.469 |
| 62 | 1.226 | 82 | 0.439 |
| 63 | 1.175 | 83 | 0.410 |
| 64 | 1.125 | 84 | 0.381 |
| 65 | 1.077 | 85 | 0.353 |
| 66 | 1.030 | 86 | 0.326 |
| 67 | 0.985 | 87 | 0.299 |
| 68 | 0.941 | 88 | 0.273 |
| 69 | 0.899 | 89 | 0.247 |
| 70 | 0.857 | 90 | 0.222 |
| 71 | 0.817 | 91 | 0.198 |
| 72 | 0.778 | 92 | 0.174 |
| 73 | 0.740 | 93 | 0.151 |
| 74 | 0.703 | 94 | 0.128 |
| 75 | 0.667 | 95 | 0.105 |
| 76 | 0.632 | 96 | 0.083 |
| 77 | 0.597 | 97 | 0.062 |
| 78 | 0.564 | 98 | 0.041 |
| 79 | 0.532 | | |

Table 3
SCS Curve Numbers for AMC-III (USDA)

| AMC-II Curve Number | AMC-III Curve Number | AMC-II Curve Number | AMC-III Curve Number |
|---|---|---|---|
| 60 | 78 | 80 | 91 |
| 61 | 78 | 81 | 92 |
| 62 | 79 | 82 | 92 |
| 63 | 80 | 83 | 93 |
| 64 | 81 | 84 | 93 |
| 65 | 82 | 85 | 94 |
| 66 | 82 | 86 | 94 |
| 67 | 83 | 87 | 95 |
| 68 | 84 | 88 | 95 |
| 69 | 84 | 89 | 96 |
| 70 | 85 | 90 | 96 |
| 71 | 86 | 91 | 97 |
| 72 | 86 | 92 | 97 |
| 73 | 87 | 93 | 98 |
| 74 | 88 | 94 | 98 |
| 75 | 88 | 95 | 98 |
| 76 | 89 | 96 | 99 |
| 77 | 89 | 97 | 99 |
| 78 | 90 | 98 | 99 |
| 79 | 91 | 99 | 100 |

Table 4
Area Weighted Curve Numbers and Initial Abstractions

| Subbasin | AMC-II (from abstraction data) | | AMC-III (used in model) | |
|---|---|---|---|---|
| | Curve Nunber | Initial Abstraction | Curve Number | Initial Abstraction |
| Mill Tributary | 81 | .469 | 92 | 0.174 |
| Los Molinos Ck | 70 | .857 | 85 | 0.353 |
| Upper Champlin | 80 | .500 | 91 | 0.198 |
| Lower Champlin | 75 | .667 | 88 | 0.273 |
| Champlin Trib | 78 | .564 | 90 | 0.222 |
| Developed Area | 71 | .817 | 86 | 0.326 |

Subbasin lag data were estimated using the Synthetic Unit Hydrograph Lag Time Equation (USBR) and Snyder's Method. Coefficients for these methods were selected within reasonable recommended limits such that the two methods were close to agreement. The coefficients settled upon were 0.023 for the USBR Kn and 1.0 for Snyder Ct. The average of the lag times estimated by the two methods was used in the rainfall-runoff model. Data and computed lag times are summarized in Table 5

Table 5
Lag Time Data and Computation

| Subbasin | High Elev (feet) | Low (feet) | L (miles) | Lca (miles) | S (ft/ft) | USBR Lag (minutes) | Snyder Lag (minutes) | Average (minutes) |
|---|---|---|---|---|---|---|---|---|
| Mill Creek Trib | 480 | 365 | 2.0 | 0.7 | 0.011 | 85 | 66 | 75 |
| Los Molinos Ck | 365 | 225 | 3.0 | 1.7 | 0.009 | 133 | 97 | 115 |
| Upper Champlin | 510 | 365 | 2.7 | 1.1 | 0.010 | 111 | 84 | 97 |
| Lower Champlin | 365 | 220 | 2.7 | 1.4 | 0.010 | 119 | 90 | 105 |
| Champlin Trib | 510 | 245 | 5.3 | 1.5 | 0.009 | 153 | 112 | 133 |
| Developed Area | 235 | 222 | 0.9 | 0.5 | 0.003 | 71 | 46 | 58 |

Design storm precipitation data were from rainfall statistics collected in the City of Corning. No long term rainfall data records from which to identify depth-duration-frequency relationships for development of a design storm were identified at a location closer to the Town of Los Molinos. Nine years of short duration precipitation records and forty years of long duration precipitation records at rain gauges in the City of Corning were reduced, plotted, and transposed to develop depth-duration-frequency curves for the City of Corning. The transposed data and visual fit curves of these data are shown in Figure 3. From these data, depth statistics for a 24-hour, 100-year storm were entered as data and a centered, balanced hyetograph was selected as the design storm for the rainfall-runoff model.

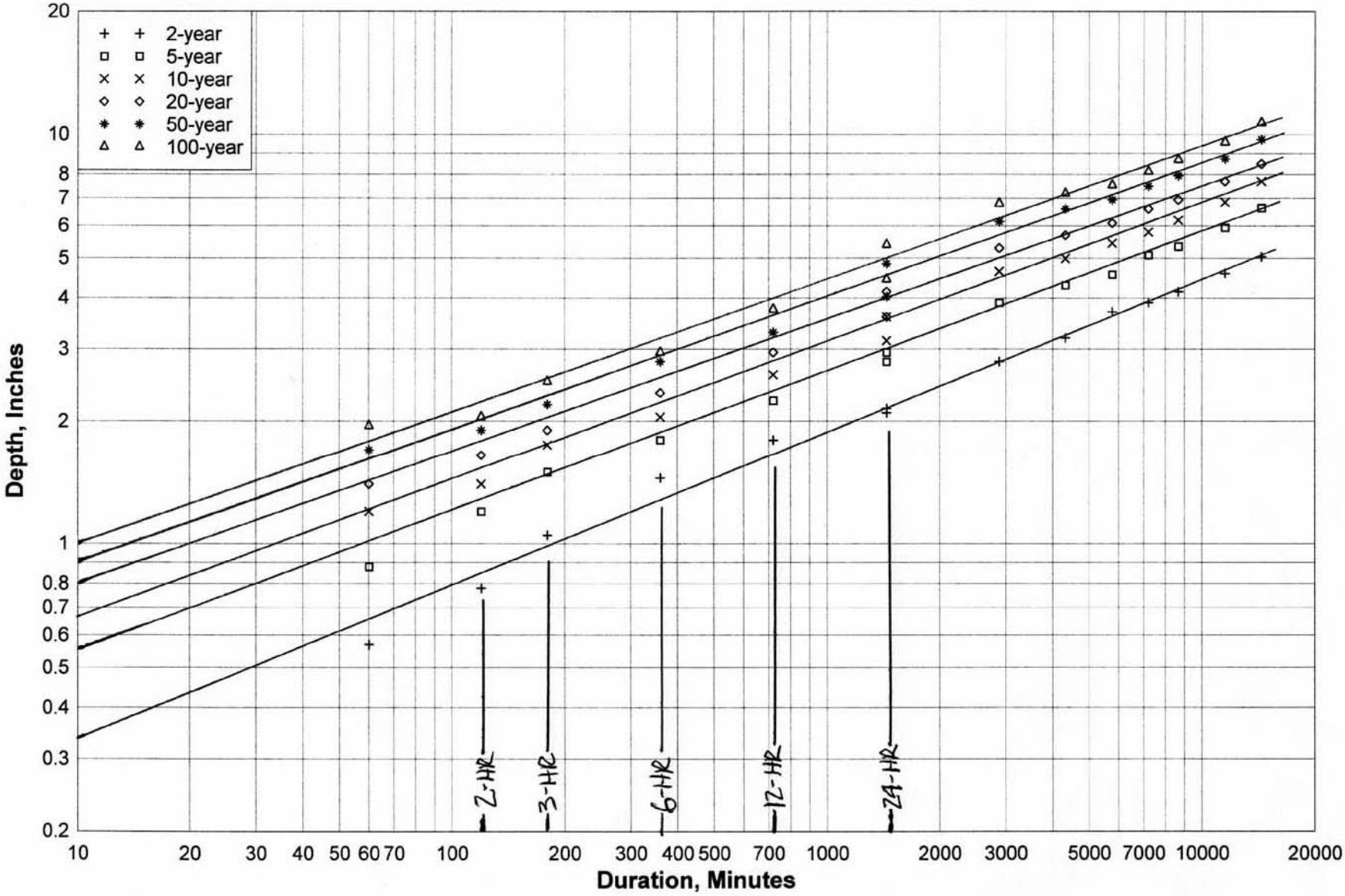


Figure 3: Precipitation Depth-Duration-Frequency Data for Corning

Routing data were only included for flows from the upper Champlin Slough basin. A 45-minute delay estimated by dividing the distance traveled through the lower Champlin Slough basin by reasonable natural channel velocities were added to the flow from the upper Champlin Slough basin. As a consequence, the combined flows from upper and lower Champlin Slough basins produced a peak flow coinciding with the peak flow of the Champlin Slough tributary. This is expected because the shape and area of the Champlin Slough tributary is similar to the combined shape and area of the upper and lower Champlin Slough subbasins.

Incipient overflow from Los Molinos Creek and Champlin Slough were estimated from backwater models prepared for these channels. The US Army Corps of Engineer's HEC-RAS backwater program was used for the backwater models. A detailed model was prepared for Champlin Slough and a substantially hypothetical model based on bridge data was prepared for Los Molinos Creek. The nominal capacity of the Los Molinos Creek channel was estimated to be approximately 350-cfs. Between South Center Street and Lincoln Street, the nominal capacity of the Champlin Slough channel was estimated to be approximately 400-cfs. During large floods, the confluence of Champlin Slough with the tributary is functionally upstream of Lincoln Avenue. A separate but similar bridge has been provided at Lincoln Street for the tributary. Therefore, assuming similar hydraulic capacity for both bridges, the combined nominal channel capacities above Lincoln Street have been assumed approximately 800-cfs for the calculation of overflow in the rainfall-runoff model. A reasonable division of flow between the channel and overbank areas was assumed after incipient overflow. Overflow data for the rainfall-runoff model are shown in Figure 4. Both overflows were assumed to contribute to the subbasin representing the developed area in the Town of Los Molinos. Backwater model descriptions and results are included in Appendix A.

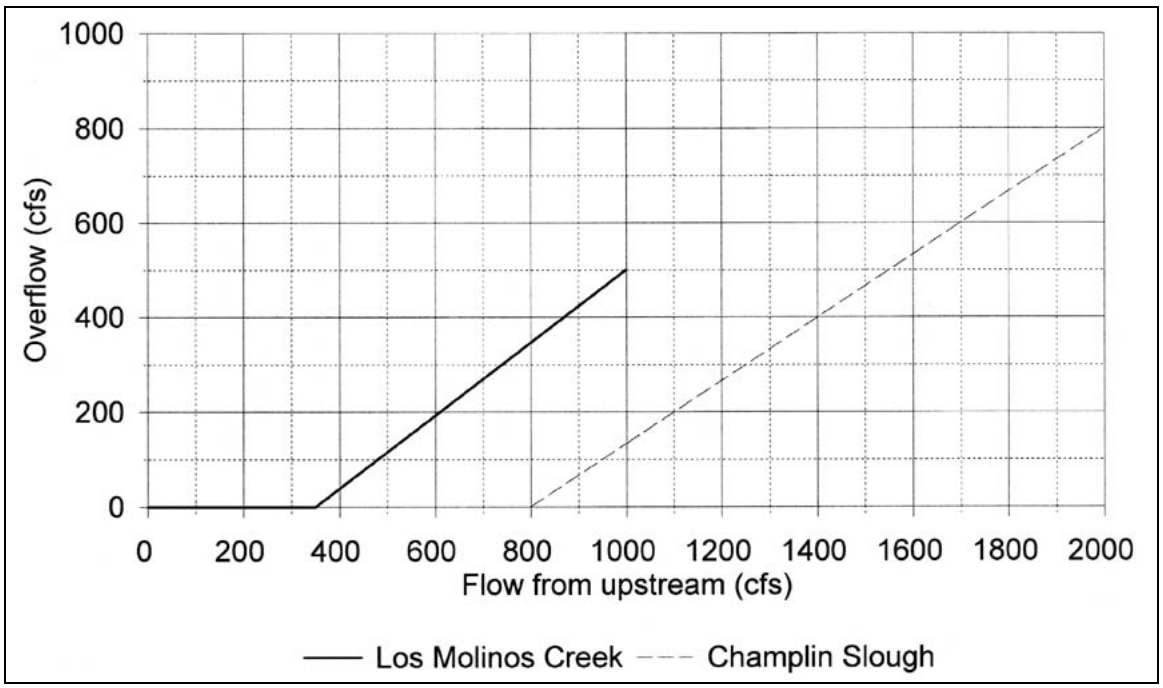


Figure 4: Overflow Relationships

No precipitation records or flow measurements are available for calibration of the rainfall-runoff model. The rainfall-runoff model was verified, however, by comparison with the peak flow estimated for Champlin Slough by regional methods from stream flow records collected at Mill Creek and Deer Creek and by direct application of the USGS Sierra Region Equation. The 100-year flood peak flows estimated for Champlin Slough below the tributary confluence by all methods are summarized in Table 6. Additional data and plots developed from the regional methods are included in Appendix B.

Table 6
Summary of 100-Year Flood Peak Flow Estimates

| Estimated From | 100-Year Peak Flow (cfs) |
|---|---|
| Mill Creek | 2312 |
| Deer Creek | 1566 |
| USGS Sierra Region Equation | 1816 |
| Rainfall-Runoff Model | 1972 |

## RESULTS AND CONCLUSIONS

The rainfall-runoff model indicates a 100-year flood peak flow of 800-cfs in Los Molinos Creek. Of this, approximately 350-cfs will leave the channel and be conveyed south through the developed area as shallow overflow. The 100-year flood peak flow in Champlin Slough downstream of the tributary confluence is estimated to be 1970-cfs with approximately 780-cfs of this leaving the channel as overflow. Total 100-year flood peak runoff generated from the developed area is estimated to be approximately 440-cfs. Including overflow from Los Molinos Creek and Champlin Slough, a total combined 100-year flood peak flow of approximately 1350-cfs can be expected from the developed area.

Under present conditions the flow emanating from the developed area drains to Champlin Slough, along the east side of State Route 99E, and possibly over and along the west side of State Route 99E. Capturing and conveying the high peak flows from the developed area resulting from the combination of direct runoff and overflow will be difficult given the low gradients in the Town of Los Molinos Creek and the high water surface elevations in the Sacramento River during times of flooding. If projects capable of preventing overflow from Los Molinos Creek and Champlin Slough can be identified, drainage facilities within the developed area may be designed to collect and convey the much lower peak flows from local contributing areas. Both channels may benefit from vegetation management programs that reduce the hydraulic roughness of the channel areas. Preliminary backwater model calculations indicate that the State Route 99E bridge over Los Molinos Creek has the capacity to convey the 100-year flood peak flow estimated for Los Molinos Creek. It appears likely that a combination of channel, minor bridge, and LMMWC facility improvements may be capable of preventing overflow from Los Molinos Creek. Given the very low gradients and wide floodplain along Champlin Slough, preventing overflow from Champlin Slough will require considerably more work including significant improvements to and possibly replacement of crossings at South Center Street and Lincoln Street. Overflow from Champlin Slough, however, is not likely to enter the more densely developed areas near the center of town. Should protection of less dense development near Champlin Slough be desired, projects that focus on management of overflows such as set back embankments preventing overflow from extending far from the channel may be a more cost effective project addressing Champlin Slough flow.

If overflow from Los Molinos Creek and Champlin Slough can be prevented from entering the developed area, it should be possible to design reasonable facilities to capture and convey runoff from the developed area to the existing outlets, Champlin Slough and along the east side of State Route 99E, and new outlets that may be considered west of State Route 99E including Mill Creek off the west end of Grant Street (conveyed under UPRR using improved LMMWC facilities), and Mill Creek off the west end of South Center Street (new facilities required under UPRR), and possibly other locations.

## RECOMMENDATIONS

Additional study is recommended to investigate the capacity of Los Molinos Creek and of improvements preventing overflow from Los Molinos Creek. This study should include preparation of a detailed backwater model based on surveyed cross-section and bridge data.

Further refinement of the backwater model prepared to identify the capacity of Champlin Slough is recommended to more accurately estimate the water surface elevations and to identify the extent of flooding during the most probable 100-year flood. This requires extension of cross-section data to represent the floodplain.

Contingent on the results of the prior recommendation if overflow from Champlin Slough is considered to be a problem needing to be addressed, after identification of projects to prevent or minimize overflow from Champlin Slough, hydraulic evaluation of these projects is recommended to verify the ability of the projects to address the overflow without increasing flood risk for other property owners.

After identification of candidate local drainage facilities, modification of the rainfall-runoff model is recommended to better identify runoff from the contributing area of each facility.

Los Molinos Drainage Study

Hydraulic Assessment of Primary Drainage Facilities

Tehama County

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Los Molinos Drainage Study
Hydraulic Assessment of Primary Drainage Facilities

## INTRODUCTION

The Town of Los Molinos experiences shallow flooding on a relatively frequent basis. The sources and rough extents of flooding have been studied and documented the report "Los Molinos Drainage Study, Existing Condition Flood Hydrology, Tehama County" dated December 13, 2007. Subsequent to preparation of this report, Tehama County has prepared a preliminary drainage facility plan and has requested hydraulic assessment of the primary facilities. This study and report includes flood hydrology for, and hydraulic assessment of the primary drainage facilities during a 50-year flood in the Sacramento River.

## PRELIMINARY DRAINAGE PLAN

The preliminary drainage plan identified by Tehama County includes the following features:

- Prevent overflow from Los Molinos Creek from entering the developed area of Los Molinos.
- Construct new storm drainage facilities to collect runoff north of Grant Street and convey it to Mill Slough using a new storm drain pipe under State Route 99E (SR-99E) and the Union Pacific Railroad (UPRR) tracks.
- Construct new storm drainage facilities to collect runoff between Grant Street and South Center Street and convey it to a new open channel leading to Mill Slough using a new storm drain pipe under SR-99E and the UPRR tracks.
- Construct new storm drainage facilities to collect runoff between South Center Street and Lee Street and convey it to a new open channel leading to Mill Slough using a new storm drain pipe under SR-99E and the UPRR tracks.
- Modify the Los Molinos Mutual Water Company (LMMWC) crossing under the UPRR tracks to better accommodate winter storm drainage.

Overflow from Los Molinos Creek will be prevented using a combination of channel improvements, earth berms, modification of the LMMWC irrigation ditch crossing of Los Molinos Creek, and, if necessary, bridge improvements. The three proposed storm drainage facilities described above are shown on Figure 1 as "North", "Center", and "South" facilities along with their contributing drainage basins. A small area located south of Los Molinos Creek presently draining to the LMMWC irrigation ditch is assumed to continue draining to the irrigation ditch. Overflow from Champlin Slough which is presently believed to flow in a southerly direction parallel to the slough are assumed to be confined to the Champlin Slough floodplain and not enter the more densely developed areas in the Town of Los Molinos. The area located south of Grant Street between the UPRR tracks and SR-99E presently drains to a low lying area with no apparent outlet. At present the preliminary drainage plan does not include facilities to drain this low lying area.

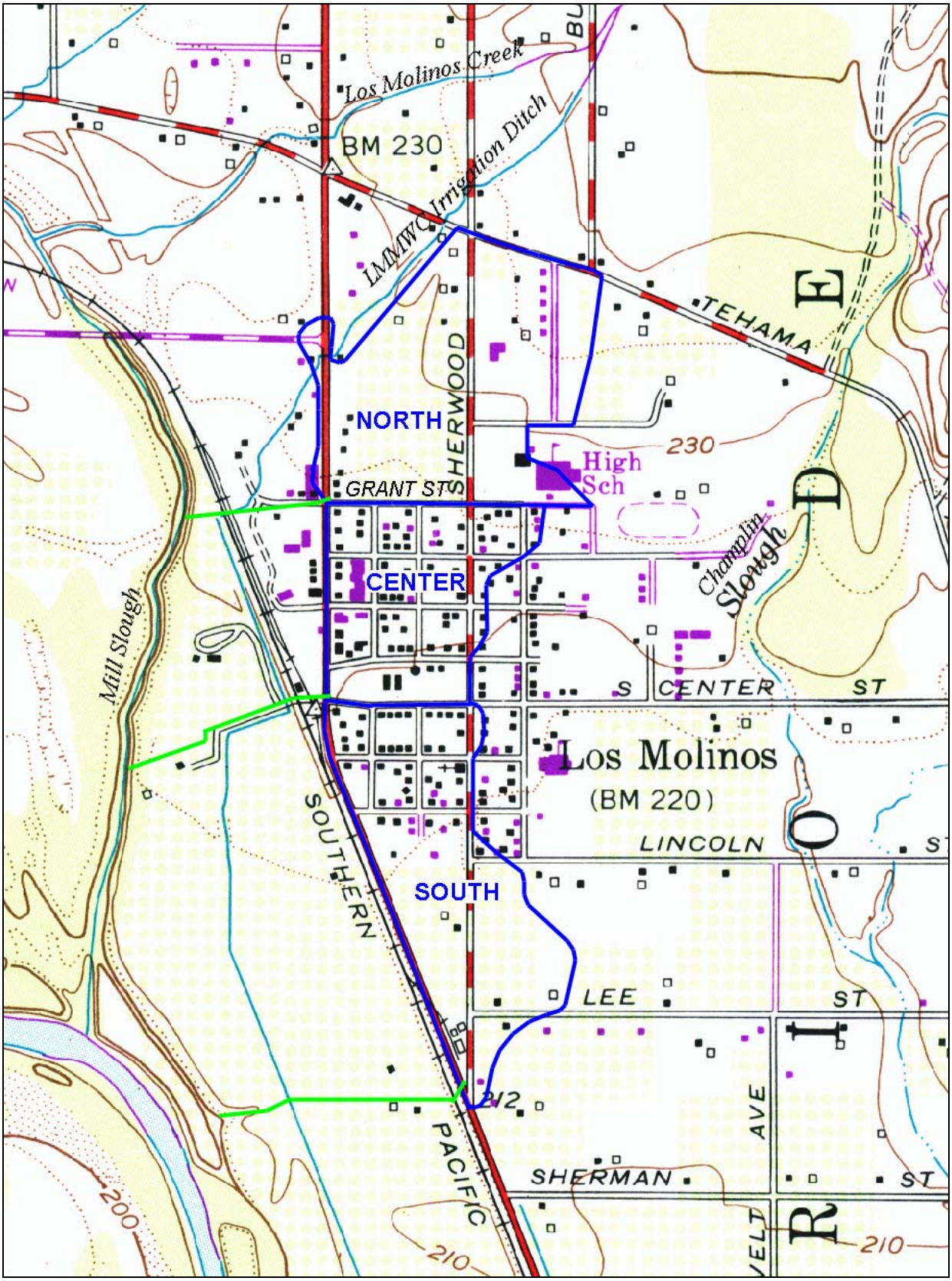


Figure 1: Los Molinos Drainage Basins and Primary Drainage Facilities

The primary drainage facilities addressed by this study are identified on Figure 1 by the green lines between the identified drainage basins and Mill Slough. The preliminary drainage plan identifies these facilities as follows:

- North – 1280-feet of 48-inch CMP and metal pipe with a downstream invert elevation of 216.0-feet and an upstream invert elevation of 218.0-feet.
- Center – 680-feet of 48-inch CMP and 600-feet of open channel. The upstream invert elevation is identified as 214.8-feet. The channel is identified as having a bottom width of 3.0-feet and side slopes of 2H:1V in a 25-foot wide easement.
- South – Approximately 110-feet of 60-inch CMP and approximately 1890-feet of open channel.

Water surface elevations in the Sacramento River are estimated to be 214-, 213-, and 210-feet at the outfalls of these three new facilities respectively. Although the outfalls will be to Mill Slough, large floods in the Sacramento River inundate Mill Slough.

## HYDROLOGIC ANALYSIS

The peak flow during a 100-year storm was estimated for each of the three new facilities by modifying a copy of the rainfall-runoff model prepared for the existing condition flood hydrologic analysis and rerunning. A schematic of the rainfall-runoff model modified to reflect the preliminary drainage study facilities is shown in Figure 2.

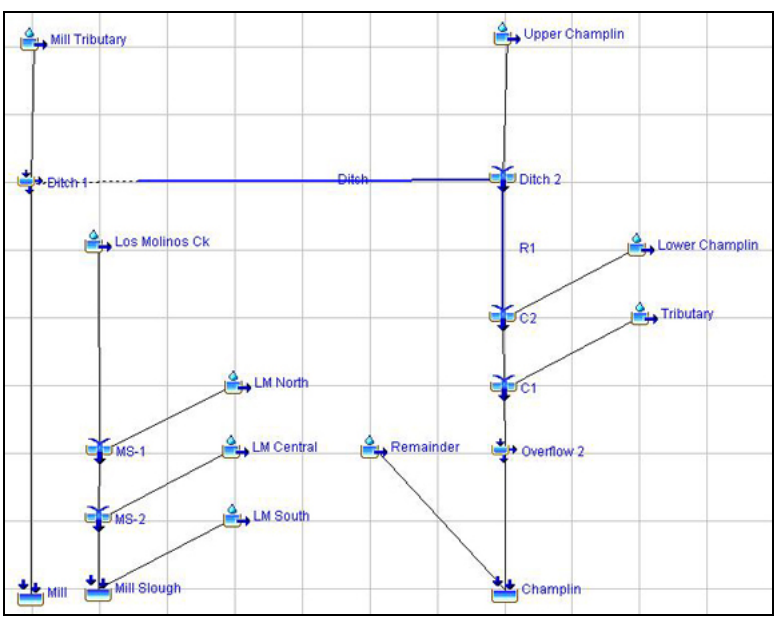


Figure 2: Revised Rainfall-Runoff Model Subbasin Schematic

Abstraction data for the new basins were estimated from abstraction data identified for the "developed area" subbasin of the existing condition rainfall-runoff model and from a recent aerial photograph. Area weighted curve numbers and initial abstractions were estimated as described in the existing condition flood hydrology report. The curve numbers and abstraction data initially determined and used in the model are summarized in Table 1.

Table 1
Area Weighted Curve Numbers and Initial Abstractions

| Subbasin | AMC-II (from abstraction data) | | AMC-III (used in model) | |
|---|---|---|---|---|
| | Curve Number | Initial Abstraction | Curve Number | Initial Abstraction |
| North | 71 | 0.817 | 86 | 0.326 |
| Center | 71 | 0.817 | 86 | 0.326 |
| South | 69 | 0.899 | 84 | 0.381 |

Subbasin lag data were roughly estimated by experience to be 20-, 15-, and 30-minutes for the north, center, and south basins respectively. Actual subbasin lag times in these basins will be a function of the efficiency of the new drainage facilities.

Design storm precipitation data developed for the existing condition flood hydrologic analysis were also used in the rainfall-runoff model prepared to identify the requirements of the primary drainage facilities.

Results of the rainfall-runoff model are summarized in Table 2.

Table 2
Peak Flows From 100-Year Storm

| Subbasin | 100-Year Peak Flow (cfs) |
|---|---|
| North | 151 |
| Center | 115 |
| South | 84 |

## HYDRAULIC ANALYSIS AND RESULTS

Hydraulic evaluation of primary drainage facilities was accomplished by conducting trial and error hydraulic calculations using a spreadsheet. The headwater elevation necessary to convey the peak flow estimated during the 100-year storm was calculated for culverts assuming submerged outlet control conditions during a 50-year flood in the Sacramento River and considering appropriate gradient for the open channel sections between the culverts and Mill Slough. The required headwater was then compared to the ground elevations at the upstream end of the culvert to determine if the culvert was capable of conveying the arriving flow or not. If the initially identified primary drainage facility was not capable of conveying the peak flow estimated during the 100-year storm, other pipe types and sizes were tested until an acceptable pipe was found. Entrance and outlet coefficients were assumed to be 0.4 (square edge) and 1.0 velocity heads respectively. Manning's roughness coefficients of 0.024 and 0.013 were used to represent CMP and smooth (steel or concrete) pipe respectively. The slope of open channels was initially assumed to be 0.2-percent (decimal 0.002). At the south facility, however, this slope produced a water surface elevation at the upstream end of the open channel in excess of the ground elevation at State Route 99E. Therefore, the slope of the open channel for this facility was reduced to 0.1-percent (decimal 0.001). The culvert calculations are summarized in Table 3. A printed copy of the spreadsheet is included in Appendix A.

Table 3
Summary of Culvert Calculations

| Location & 100-year flow | Diameter (inches) | Material | Tailwater Elev (feet) | Req'd Head -water (ft) | Ground Elev (feet) | Condition |
|---|---|---|---|---|---|---|
| North, 151-cfs | 48 | CMP | 214 | 265.2 | 224.5 | Inadequate |
| | 48 | Smooth | 214 | 231.2 | 224.5 | Inadequate |
| | 54 | Smooth | 214 | 223.2 | 224.5 | OK |
| Center, 115-cfs | 48 | CMP | 214.2 | 230.8 | 220.0 | Inadequate |
| | 48 | Smooth | 214.2 | 220.4 | 220.0 | Inadequate |
| | 54 | Smooth | 214.2 | 217.5 | 220.0 | OK |
| South, 84-cfs | 60 | | 213.8[1] | | 212.5 | Inadequate |
| | 60 | CMP | 211.9[2] | 213.0 | 212.5 | Inadequate |
| | 60 | Smooth | 211.9[2] | 212.5 | 212.5 | OK |

Notes: 1) 0.2-percent energy slope assumed for downstream open channel. Water surface elevation at upstream end of open channel exceeds elevation of State Route 99E.
2) 0.1-percent energy slope assumed for downstream open channel.

After identifying adequate culverts, the dimensions of open channels were estimated by trial and error using a spreadsheet. Manning's roughness for the open channels was assumed to be 0.040, representative of small size RSP and managed vegetation. Side slopes of 2H:1V were assumed for all open channels. Energy slopes of 0.2- and 0.1-percent were assumed for channels downstream of the center and south drainage areas respectively. The culvert calculations are summarized in Table 4. A printed copy of the spreadsheet is included in Appendix A.

Table 4
Summary of Open Channel Calculations

| Location & 100-year flow | Base (feet) | Slope | Depth (feet) | Capacity (cfs) | Condition |
|---|---|---|---|---|---|
| Center, 115-cfs | 3 | .002 | 3.1 | 123 | OK |
| South, 84-cfs | 3 | .001 | 3.1 | 87 | OK |

## OTHER CONSIDERATIONS

Upstream Drainage: Unless designed considering surcharged conditions, during surcharged conditions of the primary drainage facilities, the upstream contributing drainage facilities will also surcharge. When this happens, flood water is stored in connected low lying areas and, if water surface elevations get high enough, conveyed in other directions as shallow overflow. Therefore, some ponding and shallow overflow may occur during large local storm events when water surface elevations in the Sacramento River are high.

Culvert Outlets: Energy dissipaters will be necessary to prevent erosion at the outlet of the culverts. The velocity of water in the culverts is likely to be higher during storm/flood combinations of lesser magnitude than the preliminary design condition.

Open Channel Invert Elevations: The invert elevations of open channels must be set at least 3.1-feet below the hydraulic grade line for open channels. The hydraulic grade line for the open channel draining the center facility is 214.2-feet at the culvert outlet and decreasing at a slope of 0.2-percent to an elevation of approximately 213.0-feet at Mill Slough. The hydraulic grade line for the open channel draining the south facility is 211.9-feet at the culvert outlet and decreasing at a slope of 0.1-percent to an elevation of approximately 210.0-feet at Mill Slough.

Open Channel Top Width: Although the width of the channel at the preliminary design water surface elevation will be approximately 15-feet, the total width of the channel will be determined by the depth of the channel with respect to the surrounding ground and the geometry of the channel above the design water surface elevation.

Culvert-Open Channel Conform: This preliminary design has been based on energy grade line calculations with submerged outlet control assumed for the culverts. As such, the minimum (highest) calculated invert of the open channels will be higher than the invert of the culverts feeding the channels and conform sections will be necessary at the upstream end of the channels. Construction of the primary drainage facilities in this manner may result in deposition of sediment in conforms and a requirement of periodic cleaning. Alternatively, the invert of the open channels may be lowered resulting in higher channel construction costs if the energy grade line is maintained as identified, or greater deposition may occur in the channels if the energy gradient is reduced. Use of multiple smaller diameter culverts having an equal total capacity may also avoid the disparity in invert elevations at conforms.

Maintenance: The velocity of water flowing in the smooth walled culverts during larger floods should be sufficient to prevent accumulation of sediments in the bottom of the culverts. Maintenance of the hydraulic capacity of the open channels will require management of vegetation. Acceptable vegetation includes grasses and reeds that will lean over in water moving at three-feet per second. Unacceptable vegetation includes blackberry, Arundo, and trees or large shrubs having trunks in the flood channel. The velocity of water flowing in the open channels will not be sufficient to prevent deposition of sediment. Therefore, unless the open channels are oversized or constructed with a paved bottom, occasional removal of deposited sediment will be necessary to maintain hydraulic capacity. Given the low gradient topography of the contributing basins, the nature of sediment is expected to be silt, sand and limited volumes of gravel (primarily from imported sources).

## RECOMMENDATIONS

Design of Primary Drainage Facilities: Complete hydraulic design calculations, including entrance control conditions, should be conducted as part of the process to select and identify primary drainage facilities to be constructed. Upstream contributing facilities should be designed considering surcharged conditions at the primary drainage facilities or overflow should be expected and accommodated in road sections during the design condition.

A detailed backwater analysis of Los Molinos Creek is recommended to identify improvements necessary to prevent overflow during the most probable 100-year storm.

# APPENDIX A

## Spreadsheet Calculations

Los Molinos Drainage Study
Drainage System Requirements during Q50 on Sacramento River
December 26, 2007

Primary Culverts:

| | | | | | Submerged Outlet Control | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Description | Q (cfs) | D (feet) | L (feet) | V (fps) | Ke | n | H | TW | HW | DI Invert | Ground | Condition | Notes |
| Grant St | 151 | 4.00 | 1280 | 12.0 | 0.4 | 0.024 | 51.176 | 214 | 265.2 | 218.0 | 224.5 | *Surcharge* | CMP, TW = FEMA E50 |
| | 151 | 4.00 | 1280 | 12.0 | 0.4 | 0.013 | 17.238 | 214 | 231.2 | 218.0 | 224.5 | *Surcharge* | Concrete or Smooth Steel, TW = FEMA E50 |
| | 151 | 4.50 | 1280 | 9.5 | 0.4 | 0.013 | 9.2009 | 214 | 223.2 | 218.0 | 224.5 | OK | Concrete or Smooth Steel, TW = FEMA E50 |
| S Center St | 115 | 4.00 | 680 | 9.2 | 0.4 | 0.024 | 16.624 | 214.2 | 230.8 | 214.8 | 220.0 | *Surcharge* | CMP, TW = FEMA E50 + 1.2-feet (0.002 ditch slope) |
| | 115 | 4.00 | 680 | 9.2 | 0.4 | 0.013 | 6.1666 | 214.2 | 220.4 | 214.8 | 220.0 | *Surcharge* | Concrete or Smooth Steel, TW = FEMA E50 + 1.2-feet (0.002 ditch slope) |
| | 115 | 4.50 | 680 | 7.2 | 0.4 | 0.013 | 3.2915 | 214.2 | 217.5 | 214.8 | 220.0 | OK | Concrete or Smooth Steel, TW = FEMA E50 + 1.2-feet (0.002 ditch slope) |
| Lee Street | 84 | 5.00 | 240 | 4.3 | 0.4 | 0.024 | 1.1447 | 213.8 | 214.9 | | 212.5 | *Surcharge* | CMP, TW = FEMA E50 + 3.8-feet (0.002 ditch slope) |
| | 84 | 5.00 | 240 | 4.3 | 0.4 | 0.024 | 1.1447 | 211.9 | 213.0 | | 212.5 | *Surcharge* | CMP, TW = FEMA E50 + 1.9-feet (0.001 ditch slope) |
| | 84 | 5.00 | 240 | 4.3 | 0.5 | 0.013 | 0.5664 | 211.9 | 212.5 | | 212.5 | OK | Concrete or Smooth Steel, TW = FEMA E50 + 1.9-feet (0.001 ditch slope) |

Downstream Ditches:

| Description | B (feet) | Slope | H:V | n | Assumed D (feet) | A | Rh | V | Cap (cfs) | Top (ft) | Q (cfs) | Condition | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S Center St | 3 | 0.002 | 2 | 0.04 | 3.1 | 28.5 | 4.1 | 4.3 | 123 | 15.4 | 115 | OK | Narrow ditch |
| | 4 | 0.002 | 2 | 0.04 | 2.8 | 26.9 | 4.3 | 4.4 | 119 | 15.2 | 115 | OK | Wide ditch |
| Lee Street | 3 | 0.001 | 2 | 0.04 | 3.1 | 28.5 | 4.1 | 3.0 | 87 | 15.4 | 84 | OK | Narrow ditch |
| | 4 | 0.001 | 2 | 0.04 | 2.8 | 26.9 | 4.3 | 3.1 | 84 | 15.2 | 84 | OK | Wide ditch |

# APPENDIX B

## References

# REFERENCES


1) Design and Construction of Urban Stormwater Management Systems, Urban Water Resources Research Council of the American Society of Civil Engineers, ASCE Manuals and Reports of Engineering Practice 77, ASCE, 1992

2) Los Molinos Drainage Study, Existing Condition Flood Hydrology, Tehama County (unpublished report), Pacific Hydrologic Incorporated, December 13, 2007

# REQUEST FOR PROPOSALS
# LOS MOLINOS STORM DRAIN MASTER PLAN

The Federal Housing and Urban Development (HUD) Agency provides funds to states to principally benefit low income people, eliminate slums and blight, and/or meet an urgent community development need. The California Department of Housing and Community Development (HCD) administer this funding to local jurisdictions through the Community Development Block Grant (CDBG) program. The County of Tehama has received CDBG Planning and Technical Assistance Grant funding to complete a storm drain master plan within the community of Los Molinos in Tehama County. The selected contractor shall conduct this work in accordance with state and federal laws and regulations.

Tehama County Public Works is seeking proposals from qualified consulting firms to prepare this storm drain master plan. Work includes field surveying, hydrologic and hydraulic modeling and analysis of the Champlin Slough, the Los Molinos Community Core area and preliminary design of a storm drain system identified in the Request for Proposal solicitation.

Interested parties should contact Tehama County Public Works at www.tehamacountypublicworks.ca.gov/engineering/projects.htm for proposal submittal requirements. Questions may be directed to Tim Wood at (530) 385-1462 extension 3016.

Proposals are due no later than August 24, 2012, 4:00 PM at Tehama County Public Works Department offices, 9380 San Benito Avenue, Gerber, CA 96035.

Please advertise as legal notice August 10 and 17, 2012.

**COUNTY OF TEHAMA**
**DEPARTMENT OF PUBLIC WORKS**
9380 San Benito Avenue
Gerber, CA 96035-9701
Bus: (530) 385-1462
Fax: (530) 385-1189

Road Commissioner
Surveyor
Engineer
Public Transit
Flood Control and
Water Conservation District
Sanitation District No. 1

# Los Molinos Storm Drain Master Plan

Request for Proposal

The Federal Housing and Urban Development (HUD) Agency provides funds to states to principally benefit low income people, eliminate slums and blight, and/or meet an urgent community development need. The California Department of Housing and Community Development (HCD) administer this funding to local jurisdictions through the Community Development Block Grant (CDBG) program. The County of Tehama has received CDBG Planning and Technical Assistance Grant funding to complete a storm drain master plan within the community of Los Molinos in Tehama County. The selected contractor shall conduct this work in accordance with state and federal laws and regulations as described in Exhibit A.

This RFP is for a master plan and preliminary design for a storm drain collection system in the community of Los Molinos. Los Molinos was developed over the past 100 years with limited infrastructure to collect and discharge excess stormwater. Localized flooding is a chronic problem in this area. The watershed is complicated by runoff from the Sierra Nevada foothills. This watershed was analyzed in 2007 in studies titled "Los Molinos Drainage Study, Existing Condition Flood Hydrology, Tehama County" and "Los Molinos Drainage Study, Hydraulic Assessment of Preliminary Drainage Facilities, Tehama County" by Pacific Hydrologic Incorporated. These studies determined the gross runoff from the foothills and sized outfall structures. One outfall is in construction with a connection point at the intersection of Grant Street and SR 99E. Two other outfalls are identified, however, funding is uncertain. It may be 5 to 20 years before other outfalls are constructed.

## Project Requirements

Key components to this study are:

1. Detailed backwater analysis of Champlin Slough as identified as a recommended item from previous studies. The focused area should be between Tehama Vina Road and Sherman Street at all cross streets and structures. Analysis should consider backwater effects from Sacramento River which could extend analysis downstream beyond Sherman Street.
2. Hydrologic and Hydraulic Master Plan the Community Core Area. This area is generally bound by 99E at the west and Champlin Slough at the east, Grant Street at the north and Lincoln Street at the south.

The hydrologic and hydraulic analysis will need to identify and quantify deficiencies of the existing conditions and relative magnitude of these deficiencies, identify prioritized proposed conditions to adequately drain the study area. Both of these conditions will be incorporated into a comprehensive and dynamic surface water/storm sewer hydrologic and hydraulic model such as EPA SWMM, XP SWMM or PC SWMM. Preferably, a non-proprietary model with significant use history would be used. Said model will need to be calibrated for a more accurate representation of the physical condition.

a. Quantify existing conditions
    i. Consider previous studies for upper basin flows and outfall conditions
    ii. Study constructed outfall conditions
    iii. Delineate existing minor basins within study area (all high and low points). Basin sizes should generally be the contributing area for a single inlet or design point.

b. Proposed Conditions
    i. Determine appropriate outfall locations and capacity
    ii. Delineate drainage sub-basins within the stormwater basin. Each sub-basin shall consist of geographically contiguous lands that are characterized by uniform modeling characteristics and a shared path of discharge to another sub-basin or receiving stream.
    iii. Horizontal and vertical design of storm sewer system to adequately drain study area. Considerations with the design shall include
        1) Spread of flow
        2) Clogging factors
        3) Inlet capacity
        4) Surcharge conditions
        5) Overtopping/major event condition (id where surface water will flow)
    iv. Identify locations that show potential strategic value as detention, water quality, or controlled surcharge flood storage areas based on geography, ownership, capacity, land value and development potential. Evaluation of infiltration capacity shall be provided for at a minimum of 3 locations within the Core Area.
    v. Preliminary design of interceptor channel/ system to divert inflow drainage from the Los Molinos drainage area to the south as outlined in 3) below

vi. Provide a prioritization list of which lines/inlet should be installed first, and rationalization for the selection.

3. Prepare a preliminary design for a Foothill Interceptor running along or adjacent to Tehama Vina Road with a discharging south into Toomes Creek or one of several sloughs south of Los Molinos.

In order to aid the preliminary and future final design of this system the project area shall be surveyed with the following minimum parameters:

1. Community Core Area. Road cross sections of each block between the intersections at a 100 foot interval and the intersections. Cross sections shall go from property line (generally fence) to property line at a maximum of 50 feet between points. The cross section information should include; fences, property line, flow line, shoulder, edge of pavement, centerline, etc. The survey shall include all found utility features on and between the cross sections. The survey shall include a minimum of 2 permanent control points per street block tied to State Plane Coordinates and NGVD 88. Survey shall also include elevations of Grant Street/SR99E stormdrain trunkline connection point and Orange Street inlets.
2. Foothill interceptor. Survey shall include road cross sections on Tehama Vina Road from Ricala Lane to Toomes Creek. Road cross sections of each block at a minimum 500 foot intervals including all high and low points with a control point set at each cross section location.

Deliverables

The selected consultant shall prepare a summary report signed by a licensed Civil Engineer. This report shall give a summary of findings, recommendations for the collection system, infiltration results, a table of control points and reduced copies of the exhibits below.

The consultant shall prepare AutoCad plots in 24 x 36 sheets which include:

1. Community Core Area in plan view showing property lines, control point layout and contours based on cross sections. Plot shall be made with and without a superimposed aerial. Plots shall also be provided in PDF format.
2. Community Core Area collection system in plan view showing preliminary location and sizes of pipes, culverts, inlets and catch basins. Elevations of inlets and catch basins with intersecting pipes shall be shown in a tabular format on the drawing. Plots shall also be provided in PDF format.
3. Typical Street Block Design. Plan and profile of a typical street block design generally showing location of pavement, collection infiltration system (pipes and inlets), path or sidewalk. Plots shall also be provided in PDF format.

Electronic Files

The consultant shall provide summary report in MS Word and PDF format, and all of the above files in with the model and paper space layouts in Autocad 2010 or newer format. A point data base file shall also be provided in PNEZD format TXT and Excel format. SMMM model and with existing and proposed scenario data files shall be provided.

County will provide

Parcel layer from GIS

Tehama County Land Development Standards in .pdf format

Pacific Hydrologic Incorporated Studies

As-Built from 99E safety project which constructed the Grant Street outfall.

Tentative Schedule

| | |
|---|---|
| Advertise RFPs | August 10 and 17, 2012 |
| Proposals Due | August 24, 2012 |
| Award Contract | September 11, 2012 |

Proposal Format

Please prepare your Proposal in accordance with the following requirements:

1. Proposal (excluding attachments and the transmittal letter) must not exceed 10 single sided 8 1/2" x 11" pages. The proposal includes a cover letter, proposal, and additional forms as described in the RFP.2. Transmittal letter describing your firm's interest and commitment to providing services. Please be sure to include your name, address, phone, fax, and email if available. The person authorized by the firm to negotiate a contract with the county must sign the cover letter. Address the cover letter to our office attention Tim Wood, Chief Deputy Director.
2. Introduction of the understanding of the RFP along with a detailed description of the work plan for providing the required services.
3. Provide a schedule to complete work by December 15, 2012.
4. Qualifications and Experience: The proposal should provide resumes with qualifications and experience of the Consultant team that will be available for providing the requested
5. Additional Relevant Information: Provide additional relevant information that may be helpful in the selection process such as a "hard copy" of a materials testing and recommendation for mix design, compaction rates, additives, etc. The work sample will not count against the 10 page proposal limit. Only one work sample should be included.

6. References: Provide at least three client references (names and current phone numbers) from recent work (previous three years) similar to this scope of services. Include a brief description of each project associated with the references and the role of each team member (references are not counted against the Proposal page limit).
7. Cost of the proposal shall be submitted in a separate sealed envelope. It shall include a cost and man-hour breakdown of the key tasks. A standard billing rate sheet shall also be included
8. Submittal of Proposal: Two bound and one unbound copy of the proposal package are due at the County Public Works office no later than the time and date specified below.

Evaluation

Proposals will be evaluated by County staff in the following areas:

1. Technical approach and understanding of the scope of this solicitation.
2. Technical qualifications and experience of Consultant
3. Ability to meet project deadlines, attend meetings, site visits and complete the project by December 15, 2012.
4. Consultant specific related experience with backwater and SWMM models
5. Cost effectiveness of proposal

General Condition

Interested parties should contact Tehama County Public Works at www.tehamacountypublicworks.ca.gov/engineering/projects.htm for proposal submittal requirements. Questions may be directed to Tim Wood at (530) 385-1462 extension 3016.

1. Limitations
   This RFQ does not commit the County to award a contract or to pay any costs incurred in the preparation of a proposal in response to this RFQ.
2. Rejection of Proposals
   The County reserves the right to reject any or all proposals.
4. Award
   Successful firms will be required to participate in negotiations and to submit such pricing, technical or other revisions to their proposals as may result from negotiations. Accordingly, each initial proposal should be submitted on the most favorable terms from an economic and technical viewpoint.
5. Workscope Modifications
   The County reserves the right to request changes to the staffing and/or scope of services contained in any of the proposals and to enter into negotiations with any of the firm(s) regarding their submittal.
6. Consultant Services Agreement

A sample Consulting Services Agreement (including special conditions) is included in the attachments.

7. Non-Discrimination
   Contractors shall not discriminate on the basis of race, color, national origin, sex, or physical disability in the performance of County contracts,

Please see the following attachment:

Sample Agreement (including specific conditions)

**AGREEMENT BETWEEN THE COUNTY OF TEHAMA AND**
*(Name of Consultant)*

---

This agreement is entered into between the County of Tehama, through its Department of Public Works, ("County") and ---------- ("Consultant") for the preparation of the Los Molinos Storm Drain Master Plan as described herein.

## 1. RESPONSIBILITIES OF CONSULTANT

During the term of this agreement, Consultant shall prepare the Los Molinos Storm Drain Master Plan and preliminary design for storm water collection facilities in accordance with the Special Provisions, and Scope of Work shown in Exhibits "B" & "C", provided with this agreement.

## 2. RESPONSIBILITIES OF THE COUNTY

County shall compensate Consultant for said services pursuant to Section 3 and 4 of this agreement and completed to the satisfaction of the County.

## 3. COMPENSATION

Contractor shall be paid in accordance with the rates set forth in the Fee Schedule, attached hereto as Exhibit "D" after satisfactorily completing the duties described in this Agreement. The Maximum Compensation payable under this Agreement shall not exceed $--------. Contractor shall not be entitled to payment or reimbursement for any tasks or services performed except as specified herein. Contractor shall have no claim against County for payment of any compensation or reimbursement, of any kind whatsoever, for any service provided by Contractor after the expiration or other termination of this Agreement. Contractor shall not be paid any amount in excess of the Maximum Compensation amount set forth above, and Contractor agrees that County has no obligation, whatsoever, to compensate or reimburse Contractor for any expenses, direct or indirect costs, expenditures, or charges of any nature by Contractor that exceed the Maximum Compensation amount set forth above. Should Contractor receive any such payment it shall immediately notify County and shall immediately repay all such funds to County. This provision shall survive the expiration or other termination of this Agreement.

## 4. BILLING AND PAYMENT

On or before the 15th of each month, Contractor shall submit to County an itemized invoice for all services rendered during the preceding calendar month. County shall make payment of all undisputed amounts within 30 days of receipt of Contractor's invoice. County shall be obligated to pay only for services properly invoiced in accordance with this section.

## 5. TERM OF AGREEMENT

This agreement shall commence on the date of signing and shall terminate *(insert date)*, unless terminated in accordance with section 6 below.

## 6. TERMINATION OF AGREEMENT

If Consultant fails to perform his/her duties to the satisfaction of the County, or if Consultant fails to fulfill in a timely and professional manner his/her obligations under this agreement, or if Consultant violates any of the terms or provisions of this agreement, then the County shall have the right to terminate this agreement effective immediately upon the County giving written notice thereof to the Consultant. Either party may terminate this agreement on 30 days' written notice. County shall pay Consultant for all work satisfactorily completed as of the date of notice. County may terminate this agreement immediately upon oral notice should funding cease or be materially decreased, or should the Tehama County Board of Supervisors fail to appropriate sufficient funds for this agreement in any fiscal year.

The County's right to terminate this agreement may be exercised by the Director of Public Works.

## 7. ENTIRE AGREEMENT; MODIFICATION

This agreement for the services specified herein supersedes all previous agreements for these services and constitutes the entire understanding between the parties hereto. Consultant shall be entitled to no other benefits other than those specified herein. No changes, amendments or alterations shall be effective unless in writing and signed by both parties. Consultant specifically

acknowledges that in entering into and executing this agreement, Consultant relies solely upon the provisions contained in this agreement and no other oral or written representation.

## 8. NONASSIGNMENT OF AGREEMENT

Inasmuch as this agreement is intended to secure the specialized services of Consultant, Consultant may not assign, transfer, delegate or sublet any interest herein without the prior written consent of the County.

## 9. EMPLOYMENT STATUS

Consultant shall, during the entire term of this agreement, be construed to be an independent Consultant and nothing in this agreement is intended nor shall be construed to create an employer-employee relationship, a joint venture relationship, or to allow County to exercise discretion or control over the professional manner in which Consultant performs the services which are the subject matter of this agreement; provided always, however, that the services to be provided by Consultant shall be provided in a manner consistent with the professional standards applicable to such services. The sole interest of the County is to insure that the services shall be rendered and performed in a competent, efficient and satisfactory manner. Consultant shall be fully responsible for payment of all taxes due to the State of California or the Federal government, which would be withheld from compensation of Consultant, if Consultant were a County employee. County shall not be liable for deductions for any amount for any purpose from Consultant's compensation. Consultant shall not be eligible for coverage under County's Workers Compensation Insurance Plan nor shall Consultant be eligible for any other County benefit.

## 10. INDEMNIFICATION

Consultant shall defend, hold harmless, and indemnify Tehama County, its elected officials, officers, employees, agents, and volunteers against all claims, suits, actions, costs, expenses (including but not limited to reasonable attorney's fees of County), damages, judgments, or decrees by reason of any person's or persons' injury, including death, or property (including property of County) being damaged, arising out of Consultant's performance of work hereunder

or its failure to comply with any of its obligations contained in this agreement, whether by negligence or otherwise. Consultant shall, at its own expense, defend any suit or action founded upon a claim of the foregoing. Consultant shall also defend and indemnify County against any adverse determination made by the Internal Revenue Service or the State Franchise Tax Board and/or any other taxing or regulatory agency against the County with respect to Consultant's "independent Consultant" status that would establish a liability for failure to make social security or income tax withholding payments, or any other legally mandated payment.

## 11. INSURANCE

Consultant shall procure and maintain insurance pursuant to Exhibit A, "Insurance Requirements For Consultant," attached hereto and incorporated by reference.

## 12. PREVAILING WAGE

Consultant certifies that it is aware of the requirements of California Labor Code Sections 1720 et seq. and 1770 et seq., as well as California Code of Regulations, Title 8, Section 16000 et seq. ("Prevailing Wage Laws"), which require the payment of prevailing wage rates and the performance of other requirements on certain "public works" and "maintenance" projects. If the Services are being performed as part of an applicable "public works" or "maintenance" project, as defined by the Prevailing Wage Laws, and if the total compensation is $1,000 or more, Consultant agrees to fully comply with and to require its subcontractors to fully comply with such Prevailing Wage Laws, to that extent that such laws apply. If applicable, County will maintain the general prevailing rate of per diem wages and other information set forth in Labor Code section 1773 at its principal office, and will make this information available to any interested party upon request. Consultant shall defend, indemnify and hold the County, its elected officials, officers, employees and agents free and harmless from any claims, liabilities, costs, penalties, or interest arising out of any failure or alleged failure of the Consultant or its subcontractors to comply with the Prevailing Wage Laws. Without limiting the generality of the foregoing, Consultant specifically acknowledges that County has not affirmatively represented to Consultant in writing, in the call for bids, or otherwise, that the work to be covered by the bid or contract was not a "public work." To the fullest extent permitted by law, Consultant hereby

specifically waives and agrees not to assert, in any manner, any past, present, or future claim for indemnification under Labor Code section 1781.

## 13. NON-DISCRIMINATION

Consultant shall not employ discriminatory practices in the treatment of persons in relation to the circumstances provided for herein, including assignment of accommodations, employment of personnel, or in any other respect on the basis of race, religious creed, color, national origin, ancestry, physical disability, mental disability, medical condition, marital status, sex, age, or sexual orientation.

## 14. GREEN PROCUREMENT POLICY

Tehama County Resolution No. 49-2002, the Green Procurement Policy (available upon request) supports recycling and waste reduction, and promotes the purchase of products made with recycled materials when product fitness and quality are equal and they are available at no more than the total cost of non-recycled products. Consultant is encouraged to conform to this policy.

## 15. COMPLIANCE WITH LAWS AND REGULATIONS

All services to be performed by Consultant under to this Agreement shall be performed in accordance with all applicable federal, state, and local laws, ordinances, rules, and regulations. Any change in status, licensure, or ability to perform activities, as set forth herein, must be reported to the County immediately.

## 16. LAW AND VENUE

This agreement shall be deemed to be made in, and shall be governed by and construed in accordance with the laws of the State of California (excepting any conflict of laws provisions which would serve to defeat application of California substantive law). Venue for any action arising from this agreement shall be in Tehama County, California.

## 17. AUTHORITY

Each party executing this Agreement and each person executing this Agreement in any representative capacity, hereby fully and completely warrants to all other parties that he or she has full and complete authority to bind the person or entity on whose behalf the signing party is purposing to act.

18. **NOTICES**

Any notice required to be given pursuant to the terms and provisions of this agreement shall be in writing and shall be sent first class mail to the following addresses:

If to County: Gary B. Antone, Director
Tehama County Public Works Department
9380 San Benito Ave.
Gerber, CA 96035
Tel: 530.385.1462, Fax: 530.385.1189

If to Consultant: ----------
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Notice shall be deemed to be effective two days after mailing.

19. **NON-EXCLUSIVE AGREEMENT**:

Consultant understands that this is not an exclusive agreement, and that County shall have the right to negotiate with and enter into agreements with others providing the same or similar services to those provided by Consultant, or to perform such services with County's own forces, as County desires.

20. **EXHIBITS**

Contractor shall comply with all provisions of Exhibits A through D, attached hereto and incorporated by reference. In the event of a conflict between the provisions of the main body of this Agreement and any attached Exhibit(s), the main body of the Agreement shall take precedence.

21. **STANDARDS OF THE PROFESSION**

Contractor agrees to perform its duties and responsibilities pursuant to the terms and conditions of this agreement in accordance with the standards of the profession for which Contractor has been properly licensed to practice.

## 22. OWNERSHIP OF DOCUMENTS

All documents, notes, reports, electronic storage media, plans or any other materials produced by Contractor during the term of this agreement for any purpose related to the agreement shall become the property of the County. Contractor shall deliver, upon full payment by the County for services rendered hereunder, all such materials to County.

## 23. DOCUMENTS AND RETENTION

1. Contractor and County agree to retain all documents relevant to this agreement for three (3) years from final project completion and the termination of the agreement or until all audits, Federal and/or State, are complete, whichever is later. Upon request, Contractor shall make available these records to the County, State or Federal government representatives.
2. If the agreement requires the contractor to prepare reports or other documents add: "Contractor shall provide County all finished and unfinished reports, data, studies, photographs, charts and other documents prepared by Contractor pursuant to this agreement, should this agreement be terminated."
3. Contractor shall develop and maintain records concerning the services provided pursuant to this agreement. Contractor shall also provide all information necessary for quarterly reports or other reports required by County, State or the Federal government. Contractor shall fully cooperate with the County in providing any information needed by any governmental entity concerning this agreement.

## 24. AVAILABILITY OF FUNDS

All funding under this agreement is subject to the availability of Federal, State and County funds. If at any time during the period covered by this agreement the funding from any source is discontinued or decreased, this agreement shall no longer be binding upon the County or the Contractor, effective with the date funding is discontinued or decreased.

In the event of an audit exception or exceptions, the party responsible for not meeting the program requirement or requirements shall be responsible for the deficiency.

**IN WITNESS WHEREOF**, County and Consultant have executed this agreement on the day and year set forth below.

**COUNTY OF TEHAMA**

Date: _____

_____
Bob Williams, Chairman
Tehama County Board of Supervisors

---------- **(Bold & Capital letters)**

Date: _____

_____
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Vendor Number

Approved as to form by
Tehama County Counsel

_____
By: Arthur Wylene

Standard Form of Agreement – Services adopted 4-27-10

Exhibit A

## INSURANCE REQUIREMENTS FOR CONSULTANT

Consultant shall procure and maintain, for the duration of the contract, insurance against claims for injuries to persons or damages to property which may arise from or in connection with the performance of the work described herein and the results of that work by Consultant, his/her agents, representatives, employees or subContractors. At a minimum, Consultant shall maintain the insurance coverage, limits of coverage and other insurance requirements as described below.

Commercial General Liability (including operations, products and completed operations) $1,000,000 per occurrence for bodily injury, personal injury and property damage. If coverage is subject to an aggregate limit, that aggregate limit will be twice the occurrence limit, or the general aggregate limit shall apply separately to this project/location.

Automobile Liability

Automobile liability insurance is required with minimum limits of $1,000,000 per accident for bodily injury and property damage, including owned and non-owned and hired automobile coverage, as applicable to the scope of services defined under this agreement.

Workers' Compensation

If Consultant has employees, he/she shall obtain and maintain continuously Workers' Compensation insurance to cover Consultant and Consultant's employees and volunteers, as required by the State of California, as well as Employer's Liability insurance in the minimum amount of $1,000,000 per accident for bodily injury or disease.

Professional Liability (Consultant/Professional services standard agreement only)

If Consultant is a state-licensed architect, engineer, contractor, counselor, attorney, accountant, medical provider, and/or other professional licensed by the State of California to practice a profession, Consultant shall provide and maintain in full force and effect while providing services pursuant to this contract a professional liability policy (also known as Errors and Omissions or Malpractice liability insurance) with single limits of liability not less than $1,000,000 per claim and $2,000,000 aggregate on a claims made basis. However, if coverage is

written on a claims made basis, the policy shall be endorsed to provide coverage for at least three years from termination of agreement.

If Consultant maintains higher limits than the minimums shown above, County shall be entitled to coverage for the higher limits maintained by Consultant.

All such insurance coverage, except professional liability insurance, shall be provided on an "occurrence" basis, rather than a "claims made" basis.

Endorsements: Additional Insureds

The Commercial General Liability and Automobile Liability policies shall include, or be endorsed to include "Tehama County, its elected officials, officers, employees and volunteers" as an additional insured.

The certificate holder shall be "County of Tehama."

Deductibles and Self-Insured Retentions

Any deductibles or self-insured retentions of $25,000 or more must be declared to, and approved by, the County. The deductible and/or self-insured retentions will not limit or apply to Consultant's liability to County and will be the sole responsibility of Consultant.

Primary Insurance Coverage

For any claims related to this project, Consultant's insurance coverage shall be primary insurance as respects the County, its officers, officials, employees and volunteers. Any insurance or self-insurance maintained by the County, its officers, officials, employees or volunteers shall be excess of Consultant's insurance and shall not contribute with it.

Coverage Cancellation

Each insurance policy required herein shall be endorsed to state that "coverage shall not be reduced or canceled without 30 days' prior written notice certain to the County."

Acceptability of Insurers

Consultant's insurance shall be placed with an insurance carrier holding a current A.M. Best & Company's rating of not less than A:VII unless otherwise acceptable to the County. The County reserves the right to require rating verification. Consultant shall ensure that the insurance carrier shall be authorized to transact business in the State of California.

Subcontractors

Consultant shall require and verify that all subcontractors maintain insurance that meets all the requirements stated herein.

Material Breach

If for any reason, Consultant fails to maintain insurance coverage or to provide evidence of renewal, the same shall be deemed a material breach of contract. County, in its sole option, may terminate the contract and obtain damages from Consultant resulting from breach. Alternatively, County may purchase such required insurance coverage, and without further notice to Consultant, County may deduct from sums due to Consultant any premium costs advanced by County for such insurance.

Policy Obligations

Consultant's indemnity and other obligations shall not be limited by the foregoing insurance requirements.

Verification of Coverage

Consultant shall furnish County with original certificates and endorsements effecting coverage required herein. All certificates and endorsements shall be received and approved by the County prior to County signing the agreement and before work commences. However, failure to do so shall not operate as a waiver of these insurance requirements.

The County reserves the right to require complete, certified copies of all required insurance policies, including endorsements affecting the coverage required by these specifications at any time.

**Exhibit** B

## State and Federal Laws and Regulations
## LABOR STANDARDS

1. State Labor Standards Provisions

   Ml contractors and subcontractors shall give the following certification to the Grantee and forward this certification to the Grantee within (10) days after the execution of any contract or subcontract.

   a) "I am aware of the provisions of Section 1720 et seq. of the California Labor Code which requires that the State prevailing wage rate shall be paid to employees where this rate exceeds the federal wage rate."

   b) "I am aware of the provisions of Section 3700 of the Labor Code which requires every employer to be insured against liability for workers' compensation or to undertake self-insurance in accordance with the provisions of that Code; and I will comply with such provisions before commencing the performance of the Work of this contract."

   c) "It is further agreed that, except as may be provided in Section 1815 of the California Labor Code, the maximum hours a worker is to be employed is limited to eight hours a day and 40 hours a week and the subcontract shall forfeit, as a penalty, $25 for each worker employed in the execution of the subcontract for each calendar day during which a worker is required or permitted to labor more than eight hours in any calendar day or more than 40 hours in any calendar week and is not paid overtime."

2. Federal labor Standards Provisions (Davis-Bacon and Related Acts)

   Except with respect to the rehabilitation of residential property designed for residential use for less than eight families, the Grantee and all contractors and subcontractors of the Grantee engaged under contracts in excess of $2,000 for the construction, prosecution, completion or repair of any building or work financed in whole or in part with assistance provided under this Agreement, shall comply with HUD requirements pertaining to such contracts and the applicable requirements of the regulations of the Department of Labor under 29 CFR Parts 3' 5 and 5a governing the payment of wages and the ratio of apprentices and trainees to journeymen: provided, that if wage rates higher than those required under such regulations are imposed by State or local law, nothing hereunder is intended to relive the Grantee or any contractor/subcontractor of their obligation, if any, to require payment of the higher rates. The Grantee shall cause or require to be inserted in full, in all such contracts subject to such regulations, provisions meeting the requirements of 29 CFR 5.5 and, for such contracts in excess of $10,000, 29 CFR 5a.3.

## EQUAL OPPORTUNITY

1. The Civil Rights. HCD. Age Discrimination and Rehabilitation Acts Assurance:
During the performance of this Agreement, the Grantee assures that no otherwise qualified person shall be excluded from participation or employment, denied program benefits, or be subjected to discrimination based on race, color, national origin, sex, age, or handicap, under any program or activity funded by this contract, as required by Title VI of the Civil Rights Act of 1964, Title I of the Housing and Community Development Act of 1974, as amended, the Age Discrimination Act of 1975, and the Rehabilitation Act of 1973, and all impending regulations.

2. The Training. Employment. and Contracting Opportunities for Business and Lower Income Persons Assurance of Compliance:

   a) The work to be performed under this Agreement is on a project assisted under a program providing direct federal financial assistance from the Department of Housing and Urban Development and is subject to the requirements of Section 3 of the Housing and Urban Development Act of 1968, as amended, 12 USC 1701u. Section 3 requires that to the greatest extent feasible, opportunities for training and employment be given lower income residents of the project area and contracts for Work in connection with the project be awarded to business concerns which are located in, or owned in substantial part by persons residing in the area of the project.

   b) The parties to this Agreement will comply with the provisions of said Section 3 and the regulations issued pursuant thereto by the Secretary of Housing and Urban Development set forth in 24 CFR Part 135, and all applicable rules and orders of the Department issued there under prior to the execution of the contract. The parties to this contract certify and agree that they are under no contractual or other disability which would prevent them from complying with these requirements.

   c) The Grantee will send to each labor organization or representative of workers with which he has a collective bargaining agreement or other contract or understanding, if any, a notice advertising the said labor organization or worker's representative of his commitments under this Section 3 clause and shall post copies of the notice in conspicuous places available to employees and applicants for employment or training.

   d) The Grantee will include these Section 3 clauses in every contract and subcontract for Work in connection with the project and will, at the direction of the State, take appropriate action pursuant to the contract upon a finding that the Grantee or any contractor or subcontractor is in violation of regulations issued by the Secretary of Housing and Development, 24 CFR Part 135 and, will not let any contract unless the

Grantee or contractor or subcontractor has first provided it with a preliminary statement of ability to comply with the requirements of these regulations.

e) Compliance with the provisions of Section 3, the regulations set forth in 24 CFR Part 135, and all applicable rules and orders of the Department issued thereunder prior to the execution of the Agreement shall be a condition of the federal financial assistance provided to the project, binding upon the Grantee, its successors, and assigns. Failure to fulfill these requirements shall subject the Grantee, its contractors and subcontractors, its successors, and assigns to those sections specified by the grant or contract through which federal assistance is provided, and to such sanctions as are specified by 24 CFR Part 135.

3. State Nondiscrimination Clause:

a) During the performance of this contract, contractor and its subcontractors shall not unlawfully discriminate against any employee or applicant for employment because of race, religion, color, national origin, ancestry physical handicap, medical condition, marital status, age (over 40) or sex. Contractors and subcontractors shall ensure that the evaluation and treatment of their employees and applicants for employment are free of such discrimination. Contractors and subcontractors shall comply with the provisions of the Fair Employment and Housing Act (Government Code, Section 12900 et seq.) and the applicable regulations promulgated thereunder (California Administrative Code, Title 2, Section 7258.0 et seq.) The applicable regulations of the Fair Employment and Housing Commission implementing Government Code, Section 12990, set forth in Chapter 5 of Division 4 of Title 2 of the California Administrative Code are incorporated into this contract by reference and made a part hereof as if set forth in lull. Contractor and its subcontractors shall give written notice of their obligations under this clause to labor organizations with which they have a collective bargaining or other agreement.

b) This contractor shall include the nondiscrimination and compliance provisions of this clause in all subcontracts to perform work under the contracts.

4. Assurance of Compliance with Requirements Placed on Construction Contracts of $10,000 or More:
Grantee hereby agrees to place in every contract and subcontract for construction exceeding $10,000 the Notice of Requirement for Affirmative Action to ensure Equal Employment Opportunity executive Order 11246), and the Standard Equal Employment Opportunity Construction Contract Specifications. Grantee furthermore agrees to insert the appropriate Goals and Timetables issued by the U.S. Department of Labor in such contracts and sub contracts. Grantee shall refer to Chapter V of the State CDBG Grant Management Manual or shall contact the State for further guidance regarding compliance with this requirement.

## OTHER REQUIRED FEDERAL PROVISIONS

1. Flood Disaster Protection:
   This Agreement is subject to the requirements of the Flood Disaster Protection Act of 1973 ~.L. 93-234). No portion of the assistance provided under this Agreement is approved for acquisition or construction purposes as defined under Section 3(a) of said Act, for use in an area identified by the Secretary as having special flood hazards which is located in a community not then in compliance with the requirements for participation in the national flood insurance program pursuant to Section 201(d) of said Act; and the use of any assistance provided under this Agreement for such acquisition or construction in such identified areas in communities then participating in the national flood insurance program shall be subject to the mandatory purchase of flood insurance requirements of Section 102 of said Act.

   Any contract or agreement for the sale, lease or other transfer of land acquired, cleared or improved with assistance provided under this Agreement shall contain, if such land is located in an area identified by the Secretary as having special flood hazards and in which the sale of flood insurance has been made available under the national Flood Insurance Act of 1968, as amended, 42 USC 4001 et seq., provisions obligating the transferee and its successors or assigns to obtain and maintain, during the ownership of such land such flood insurance as required with respect to financial assistance or acquisition or construction purposes under Section 102(s) of the Flood Disaster Protection Act of 1973. Such provisions shall be required notwithstanding the fact that the construction on such land is not itself funded with assistance provided by this Agreement.

2. Lead Based Paint Hazards
   The construction or rehabilitation of residential structures with assistance provided under this Agreement is subject to the HUD lead-Based Paint Regulations, 24 CFR Part 35. Any grants or loans made by the Grantee for the rehabilitation of residential structures with assistance provided under this Agreement shall be made subject to the provisions for the elimination of lead-based paint hazards under subpart B of said regulations, and the Grantee shall be responsible for the inspections and certifications required under Section 35.14 (f) thereof

3. Compliance with Air and Water Acts:
   This Agreement is subject to the requirements of the Clean Air Act, as amended, 42 USC 1857 et seq., the Federal Water Pollution Control Act, as amended, 33 USC 1251 et seq., and the regulations of the Environmental Protection Agency with respect thereto, at 40 CFR Part *15,* as amended from time to time.

   In compliance with said regulations, the Grantee shall cause or require to be inserted in lull in all contracts and subcontracts with respect to any nonexempt transaction ther eunder funded with assistance provided under this Agreement, the following requirements:

   a) A stipulation by the contractor or subcontractor or subcontractor that any facility be utilized in the performance of any nonexempt contract or subcontract is not listed on the

List of Violating Facilities issued by the Environmental Protection Agency ~PA) pursuant to 40 CFR 15.20.

b) Agreement by the contractor to comply with all the requirements of Section 114 of the Clean Air Act, as amended (42 USC 1857c-8), and Section 308 of the Federal Water Pollution Control Act, as amended (33 USC 1318), relating to inspection, monitoring, entry, reports, and information, as well as all other requirements specified in said Section 114 and Section 308, and all regulations and guidelines issued thereunder.

c) A stipulation that as a condition for the award of the contract, prompt notice will be given to any notification received from the Director, office of Federal Activities, EPA, indicating that a facility utilized or to be utilized for the contract is under consideration to be listed on the EPA List of Violating Facilities.

d) Agreement by the contractor that he will include or cause to be included the criteria and requirements in paragraphs (a) through (d) of this section in every nonexempt subcontract and requiring that the contractor will take such action as the government may direct as a means of enforcing such provisions.

In no event shall any amount of the assistance provided under this Agreement be utilized with respect to a facility which has given rise to a conviction under Section 113 (c)( 1) of the Clean Air Act or Section 309(c) of the Federal Water Pollution Control Act.

4. Obligations of Grantee with Respect to Certain Third Party Relationships:
The Grantee shall remain fully obligated under the provisions of the Agreement notwithstanding its designation of any third party or parties for the undertaking of all or any part of the program with respect to which assistance is being provided under this Agreement to the Grantee. Any Grantee shall comply with all lawful requirements of the State necessary to ensure that the program with respect to which assistance is being provided under this Agreement to the Grantee is carried out in accordance with the State's Assurance and Certifications, including those with respect to the assumption of environmental responsibilities of the State under Section 104(h) of the Housing and Community Development Act of 1974.

5. Interest of Certain Federal Officials:
No member of or delegate to the Congress of the United States, and no resident commissioner, shall be admitted to any share or part of this Agreement or to any benefit to arise from the same.

6. Interest of Members Officer or Employees of Contractors. Members of Local Governing Body. or Other Public Officials:
No member, officer or employee of the Grantee, or its designees or agents, no member of the governing body of the locality or localities who exercise any functions or responsibilities with respect to the program during his/her tenure or for one year thereafter, shall have any interest, direct or indirect, in any contract or subcontract, or the proceeds thereof, for Work to be performed in connection with the program assisted under the Agreement. The Grantee

shall incorporate, or cause to be incorporated, in all such contracts or subcontracts a provision prohibiting such interest pursuant to the purposes of this section.

7. Prohibition Against Payments of Bonus or Commission:
The assistance provided under this Agreement shall not be used in the payment of any bonus or commission for the purpose of obtaining HCD approval of the application for such assistance, or HCD approval of the applications for additional assistance, or any other approval of concurrence of HCD required under this Agreement, Title I of the Housing and Community Development Act of 1974, or HCD regulations with respect thereto; provided, however, that reasonable fees or bona fide technical, consultant, managerial or other such services, other than actual solicitation, are not hereby prohibited if otherwise eligible as program costs.