# Appendix for Model 03070204

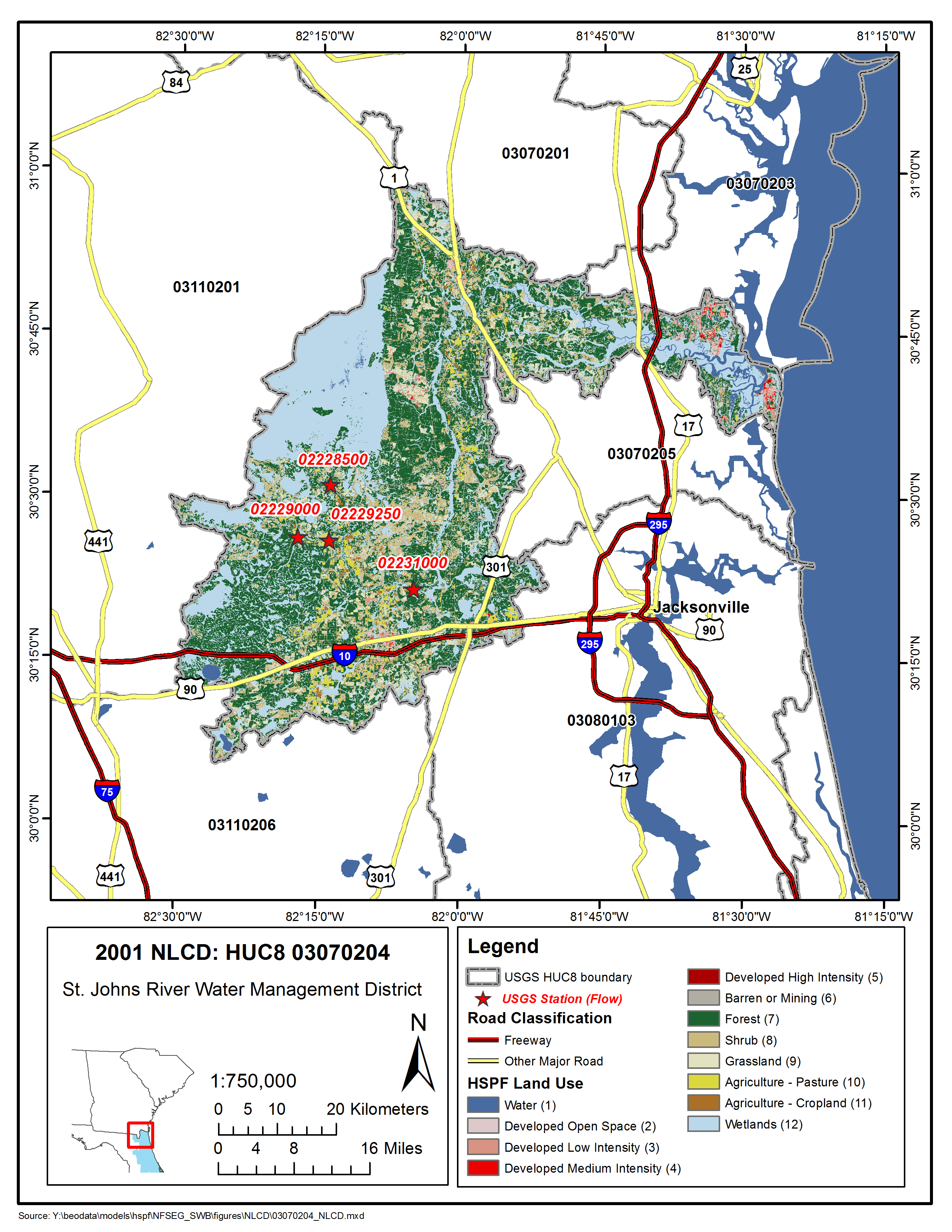


Figure 03070204-1: Land Cover from the National Land Cover Database.

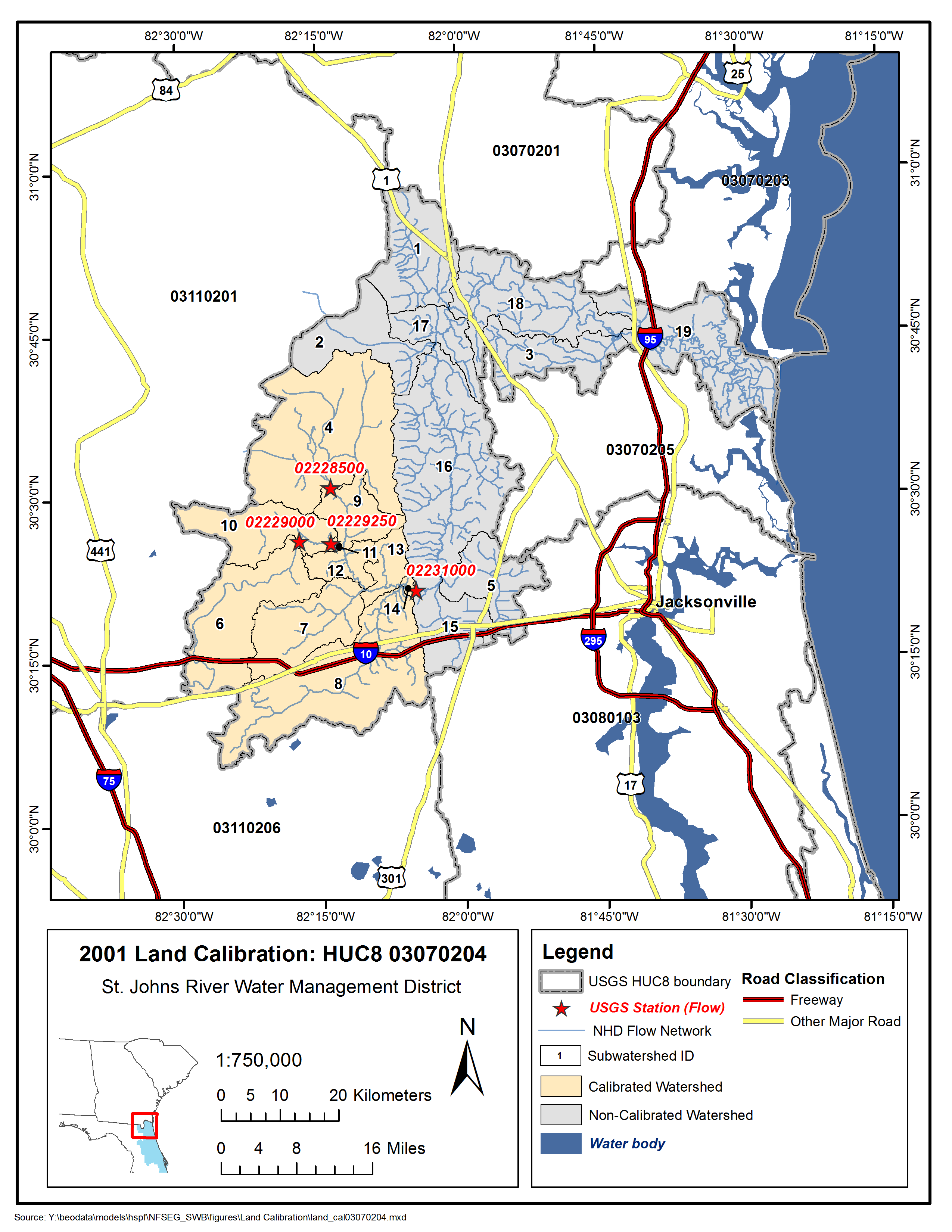


Figure 03070204-2: Calibrated sub-watersheds.

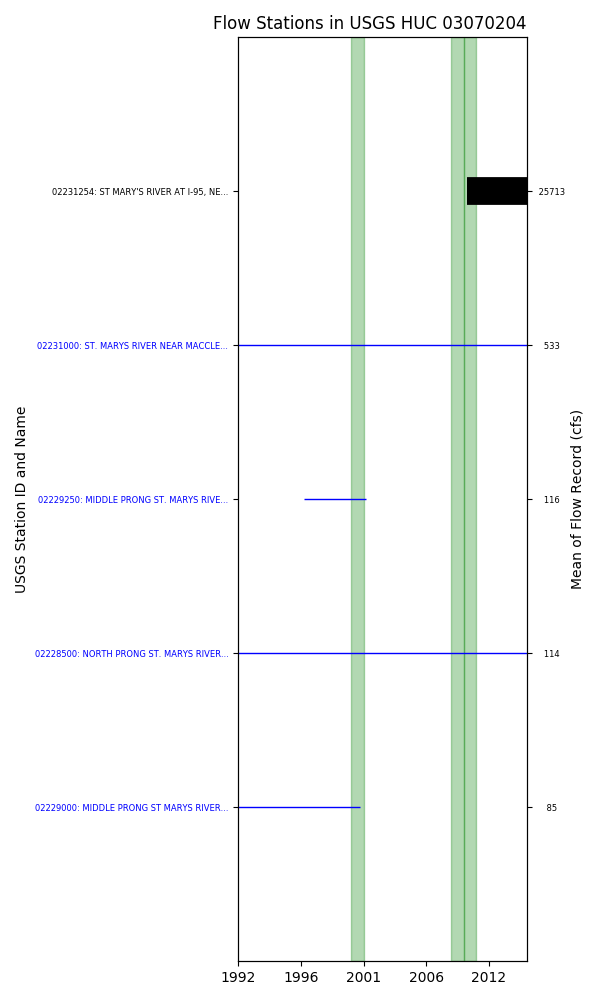


Figure 03070204-3: Station period of record. Blue color identifies gauges used for calibration.

## HSPF Reach 04, USGS Gauge 02228500

Table 03070204-1: Comparison Statistics Between HSPF Reach 04 and USGS Gauge 02228500.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | 2.71 |
| Standard error | 95.30 |
| Relative bias | 0.02 |
| Relative standard error | 0.46 |
| Nash-Sutcliffe coefficient | 0.79 |
| Coefficient of efficiency | 0.60 |
| Index of agreement | 0.81 |

Table 03070204-2: Hydrologic Indices Between USGS Gauge 02228500 and HSPF Reach 04.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02228500 | Simulated Reach 04 | Percent Difference |
| MA1: Mean, all daily flows | 115.87 | 117.76 | 1.63 |
| MA2: Median, all daily flows | 28.00 | 28.92 | 3.30 |
| MA3: CV, all daily flows | 184.65 | 180.64 | -2.17 |
| MA4: CV, log of all daily flows | 158.60 | 169.41 | 6.82 |
| MA5: Mean daily flow / median daily flow | 4.14 | 4.07 | -1.62 |
| MA9: (Q10 - Q90) / median daily flow | 10.70 | 10.50 | -1.82 |
| MA10: (Q20 - Q80) / median daily flow | 4.42 | 4.15 | -5.95 |
| MA11: (Q25 - Q75) / median daily flow | 3.10 | 3.11 | 0.29 |
| MA12: Mean monthly flow, January | 106.63 | 148.59 | 39.35 |
| MA13: Mean monthly flow, February | 165.42 | 208.17 | 25.84 |
| MA14: Mean monthly flow, March | 177.52 | 194.55 | 9.60 |
| MA15: Mean monthly flow, April | 92.05 | 75.54 | -17.93 |
| MA16: Mean monthly flow, May | 38.25 | 28.13 | -26.46 |
| MA17: Mean monthly flow, June | 79.63 | 78.08 | -1.95 |
| MA18: Mean monthly flow, July | 75.58 | 76.45 | 1.15 |
| MA19: Mean monthly flow, August | 172.34 | 113.75 | -34.00 |
| MA20: Mean monthly flow, September | 141.55 | 138.13 | -2.42 |
| MA21: Mean monthly flow, October | 121.83 | 107.35 | -11.89 |
| MA22: Mean monthly flow, November | 38.72 | 46.53 | 20.18 |
| MA23: Mean monthly flow, December | 40.26 | 58.18 | 44.50 |
| ML1: Mean minimum monthly flow, January | 34.21 | 48.29 | 41.18 |
| ML2: Mean minimum monthly flow, February | 65.73 | 89.13 | 35.60 |
| ML3: Mean minimum monthly flow, March | 59.72 | 61.44 | 2.87 |
| ML4: Mean minimum monthly flow, April | 26.88 | 23.73 | -11.72 |
| ML5: Mean minimum monthly flow, May | 6.82 | 6.03 | -11.58 |
| ML6: Mean minimum monthly flow, June | 7.56 | 13.92 | 83.99 |
| ML7: Mean minimum monthly flow, July | 22.43 | 29.47 | 31.39 |
| ML8: Mean minimum monthly flow, August | 24.32 | 26.95 | 10.80 |
| ML9: Mean minimum monthly flow, September | 38.98 | 32.46 | -16.73 |
| ML10: Mean minimum monthly flow, October | 21.90 | 21.84 | -0.27 |
| ML11: Mean minimum monthly flow, November | 21.43 | 24.23 | 13.04 |
| ML12: Mean minimum monthly flow, December | 19.06 | 24.87 | 30.44 |
| ML13: CV of minimum monthly flows | 169.57 | 172.00 | 1.43 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.01 | 0.01 | -11.66 |
| ML15: Mean minimum annual flow / mean annual flow | 0.01 | 0.00 | -26.89 |
| ML16: Median minimum annual flow / median annual flow | 0.00 | 0.01 |  |
| ML20: Ratio of baseflow volume to total flow volume | 0.38 | 0.43 | 13.86 |
| ML22: Mean annual minimum flow divided by catchment area | 9090.92 | 9090.91 | -0.00 |
| RA1: Mean of positive changes from one day to next (rise rate) | 50.11 | 32.40 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 361.37 | 578.00 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 16.46 | 13.75 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 391.87 | 465.63 |  |
| RA5: Ratio of days that are higher than previous day | 0.22 | 0.30 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.22 | 0.10 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.10 | 0.07 |  |
| RA8: Number of flow reversals from one day to the next | 58.64 | 48.64 |  |
| RA9: CV, number of flow reversals from one day to the next | 35.24 | 34.82 |  |

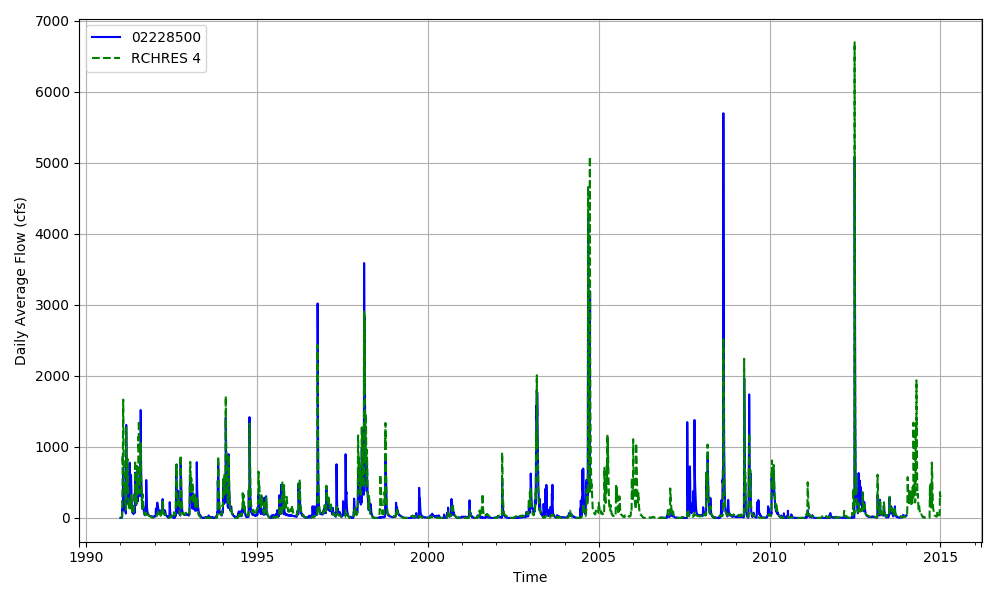


Figure 03070204-4: Daily flow for HSFP reach 04 and USGS station 02228500.

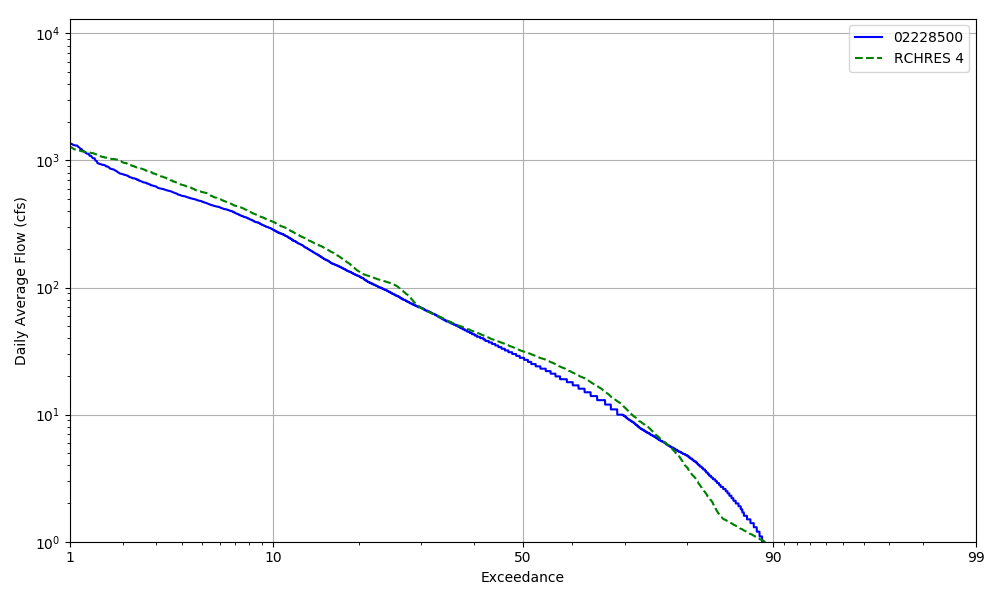


Figure 03070204-5: Daily exceedance for HSFP reach 04 and USGS station 02228500.

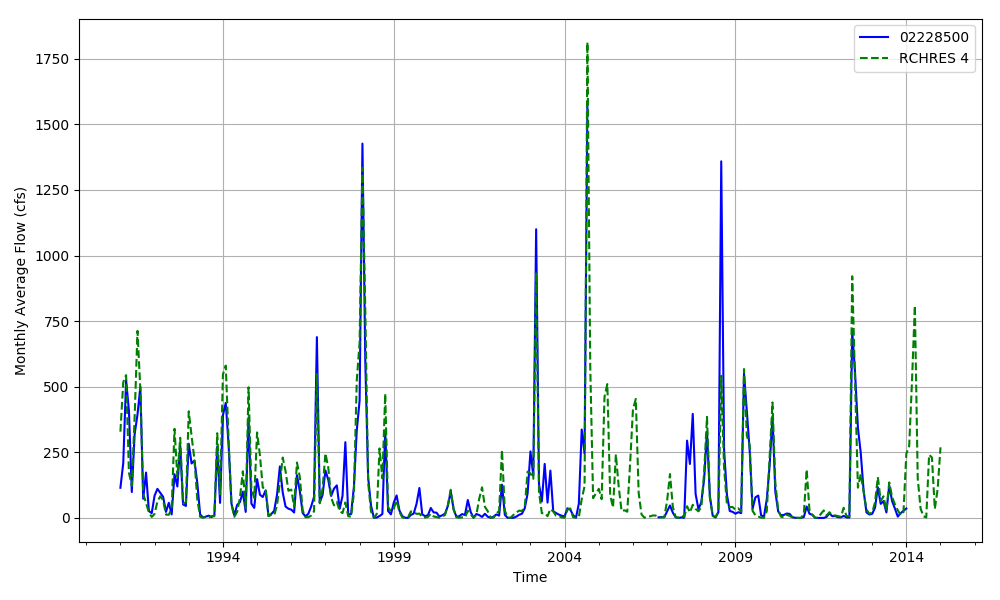


Figure 03070204-6: Monthly flow for HSFP reach 04 and USGS station 02228500.

## HSPF Reach 06, USGS Gauge 02229000

Table 03070204-3: Comparison Statistics Between HSPF Reach 06 and USGS Gauge 02229000.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | -32.61 |
| Standard error | 106.77 |
| Relative bias | -0.34 |
| Relative standard error | 0.64 |
| Nash-Sutcliffe coefficient | 0.58 |
| Coefficient of efficiency | 0.53 |
| Index of agreement | 0.73 |

Table 03070204-4: Hydrologic Indices Between USGS Gauge 02229000 and HSPF Reach 06.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02229000 | Simulated Reach 06 | Percent Difference |
| MA1: Mean, all daily flows | 94.99 | 62.29 | -34.43 |
| MA2: Median, all daily flows | 16.00 | 19.67 | 22.91 |
| MA3: CV, all daily flows | 179.12 | 127.28 | -28.94 |
| MA4: CV, log of all daily flows | 171.07 | 138.78 | -18.87 |
| MA5: Mean daily flow / median daily flow | 5.94 | 3.17 | -46.65 |
| MA9: (Q10 - Q90) / median daily flow | 16.27 | 8.64 | -46.93 |
| MA10: (Q20 - Q80) / median daily flow | 7.97 | 4.93 | -38.21 |
| MA11: (Q25 - Q75) / median daily flow | 5.60 | 3.38 | -39.55 |
| MA12: Mean monthly flow, January | 105.53 | 98.23 | -6.92 |
| MA13: Mean monthly flow, February | 175.31 | 136.82 | -21.96 |
| MA14: Mean monthly flow, March | 153.01 | 113.45 | -25.85 |
| MA15: Mean monthly flow, April | 75.69 | 46.38 | -38.73 |
| MA16: Mean monthly flow, May | 41.29 | 18.34 | -55.59 |
| MA17: Mean monthly flow, June | 52.37 | 26.32 | -49.74 |
| MA18: Mean monthly flow, July | 66.34 | 38.41 | -42.10 |
| MA19: Mean monthly flow, August | 88.56 | 51.93 | -41.36 |
| MA20: Mean monthly flow, September | 59.08 | 43.42 | -26.51 |
| MA21: Mean monthly flow, October | 229.11 | 85.12 | -62.85 |
| MA22: Mean monthly flow, November | 25.48 | 33.12 | 29.96 |
| MA23: Mean monthly flow, December | 45.58 | 43.38 | -4.83 |
| ML1: Mean minimum monthly flow, January | 24.49 | 32.08 | 30.98 |
| ML2: Mean minimum monthly flow, February | 65.41 | 58.22 | -11.00 |
| ML3: Mean minimum monthly flow, March | 58.19 | 41.79 | -28.18 |
| ML4: Mean minimum monthly flow, April | 18.17 | 16.93 | -6.82 |
| ML5: Mean minimum monthly flow, May | 15.11 | 10.62 | -29.70 |
| ML6: Mean minimum monthly flow, June | 16.89 | 11.01 | -34.79 |
| ML7: Mean minimum monthly flow, July | 23.05 | 19.79 | -14.15 |
| ML8: Mean minimum monthly flow, August | 15.30 | 11.97 | -21.77 |
| ML9: Mean minimum monthly flow, September | 11.99 | 15.46 | 28.95 |
| ML10: Mean minimum monthly flow, October | 24.40 | 16.70 | -31.53 |
| ML11: Mean minimum monthly flow, November | 9.52 | 16.27 | 70.91 |
| ML12: Mean minimum monthly flow, December | 9.73 | 18.72 | 92.26 |
| ML13: CV of minimum monthly flows | 187.79 | 168.65 | -10.19 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.04 | 0.01 | -86.26 |
| ML15: Mean minimum annual flow / mean annual flow | 0.01 | 0.00 | -76.43 |
| ML16: Median minimum annual flow / median annual flow | 0.03 | 0.00 | -94.31 |
| ML20: Ratio of baseflow volume to total flow volume | 0.43 | 0.53 | 21.40 |
| ML22: Mean annual minimum flow divided by catchment area | 0.01 | 0.00 | -89.55 |
| RA1: Mean of positive changes from one day to next (rise rate) | 31.36 | 13.79 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 347.31 | 317.52 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 11.41 | 5.20 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 236.72 | 226.97 |  |
| RA5: Ratio of days that are higher than previous day | 0.24 | 0.27 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.15 | 0.14 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.09 | 0.09 |  |
| RA8: Number of flow reversals from one day to the next | 67.27 | 62.27 |  |
| RA9: CV, number of flow reversals from one day to the next | 12.79 | 9.80 |  |

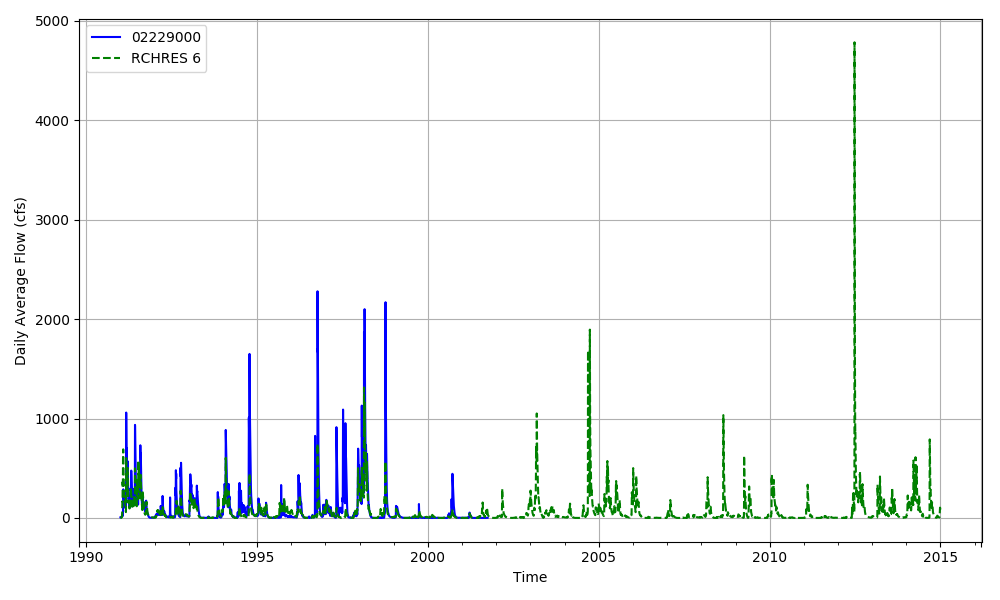


Figure 03070204-7: Daily flow for HSFP reach 06 and USGS station 02229000.

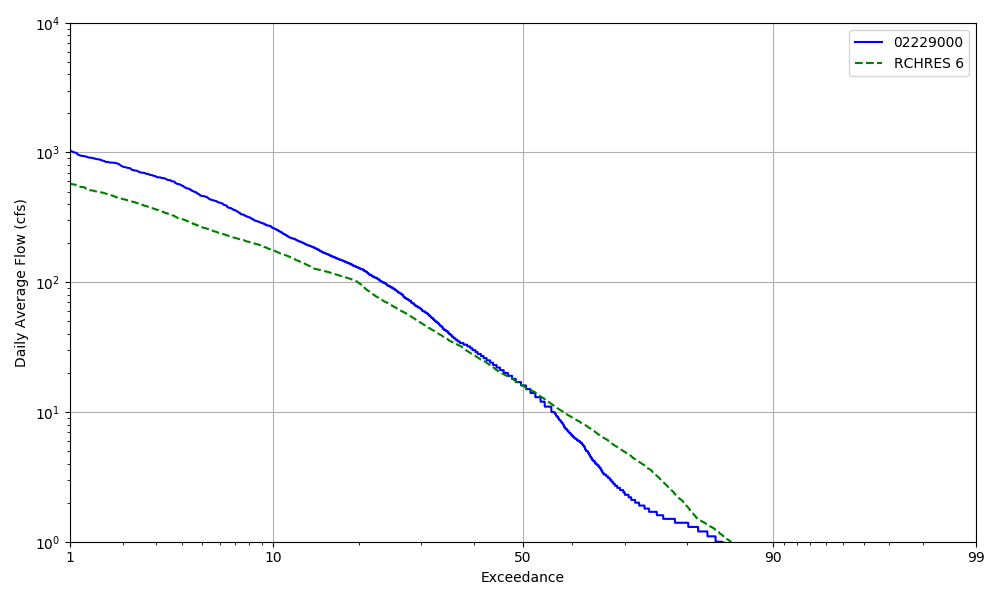


Figure 03070204-8: Daily exceedance for HSFP reach 06 and USGS station 02229000.

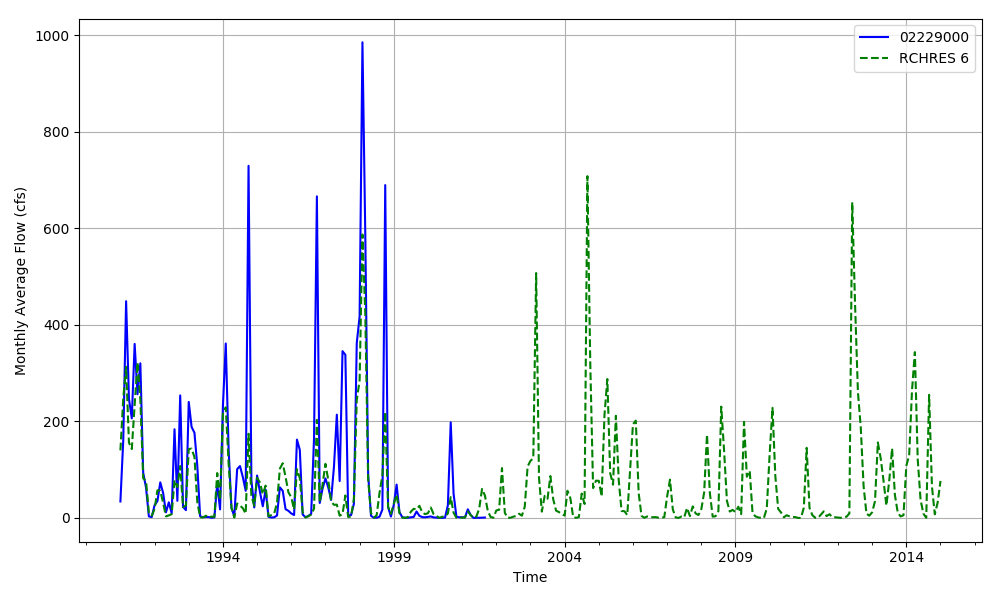


Figure 03070204-9: Monthly flow for HSFP reach 06 and USGS station 02229000.

## HSPF Reach 10, USGS Gauge 02229250

Table 03070204-5: Comparison Statistics Between HSPF Reach 10 and USGS Gauge 02229250.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | -40.30 |
| Standard error | 154.62 |
| Relative bias | -0.34 |
| Relative standard error | 0.55 |
| Nash-Sutcliffe coefficient | 0.69 |
| Coefficient of efficiency | 0.61 |
| Index of agreement | 0.77 |

Table 03070204-6: Hydrologic Indices Between USGS Gauge 02229250 and HSPF Reach 10.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02229250 | Simulated Reach 10 | Percent Difference |
| MA1: Mean, all daily flows | 116.47 | 75.54 | -35.14 |
| MA2: Median, all daily flows | 5.20 | 18.76 | 260.69 |
| MA3: CV, all daily flows | 217.46 | 147.20 | -32.31 |
| MA4: CV, log of all daily flows | 228.95 | 190.94 | -16.60 |
| MA5: Mean daily flow / median daily flow | 22.40 | 4.03 | -82.02 |
| MA9: (Q10 - Q90) / median daily flow | 57.77 | 7.85 | -86.41 |
| MA10: (Q20 - Q80) / median daily flow | 15.88 | 3.31 | -79.19 |
| MA11: (Q25 - Q75) / median daily flow | 8.36 | 2.40 | -71.24 |
| MA12: Mean monthly flow, January | 113.94 | 90.15 | -20.88 |
| MA13: Mean monthly flow, February | 288.33 | 184.99 | -35.84 |
| MA14: Mean monthly flow, March | 171.72 | 171.52 | -0.12 |
| MA15: Mean monthly flow, April | 54.22 | 31.14 | -42.58 |
| MA16: Mean monthly flow, May | 55.50 | 10.22 | -81.59 |
| MA17: Mean monthly flow, June | 18.98 | 4.37 | -76.99 |
| MA18: Mean monthly flow, July | 69.87 | 17.40 | -75.10 |
| MA19: Mean monthly flow, August | 100.63 | 54.83 | -45.51 |
| MA20: Mean monthly flow, September | 43.18 | 58.24 | 34.87 |
| MA21: Mean monthly flow, October | 180.13 | 75.16 | -58.27 |
| MA22: Mean monthly flow, November | 19.61 | 20.32 | 3.60 |
| MA23: Mean monthly flow, December | 74.40 | 69.18 | -7.02 |
| ML1: Mean minimum monthly flow, January | 45.46 | 58.66 | 29.02 |
| ML2: Mean minimum monthly flow, February | 74.08 | 79.50 | 7.32 |
| ML3: Mean minimum monthly flow, March | 71.74 | 61.64 | -14.07 |
| ML4: Mean minimum monthly flow, April | 8.76 | 11.92 | 36.02 |
| ML5: Mean minimum monthly flow, May | 15.70 | 2.88 | -81.69 |
| ML6: Mean minimum monthly flow, June | 16.99 | 0.65 | -96.19 |
| ML7: Mean minimum monthly flow, July | 20.26 | 9.55 | -52.87 |
| ML8: Mean minimum monthly flow, August | 14.14 | 15.85 | 12.08 |
| ML9: Mean minimum monthly flow, September | 8.94 | 17.94 | 100.76 |
| ML10: Mean minimum monthly flow, October | 21.99 | 16.78 | -23.72 |
| ML11: Mean minimum monthly flow, November | 11.11 | 12.34 | 11.05 |
| ML12: Mean minimum monthly flow, December | 16.14 | 21.64 | 34.09 |
| ML13: CV of minimum monthly flows | 247.37 | 250.08 | 1.10 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.14 | 0.01 | -95.82 |
| ML15: Mean minimum annual flow / mean annual flow | 0.02 | 0.00 | -85.95 |
| ML16: Median minimum annual flow / median annual flow | 0.12 | 0.01 | -95.44 |
| ML20: Ratio of baseflow volume to total flow volume | 0.39 | 0.56 | 42.72 |
| ML22: Mean annual minimum flow divided by catchment area | 0.01 | 0.00 | -91.86 |
| RA1: Mean of positive changes from one day to next (rise rate) | 44.45 | 20.11 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 414.70 | 397.02 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 15.61 | 6.92 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 334.28 | 353.56 |  |
| RA5: Ratio of days that are higher than previous day | 0.24 | 0.26 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.14 | 0.17 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.08 | 0.10 |  |
| RA8: Number of flow reversals from one day to the next | 54.83 | 61.17 |  |
| RA9: CV, number of flow reversals from one day to the next | 28.52 | 38.61 |  |

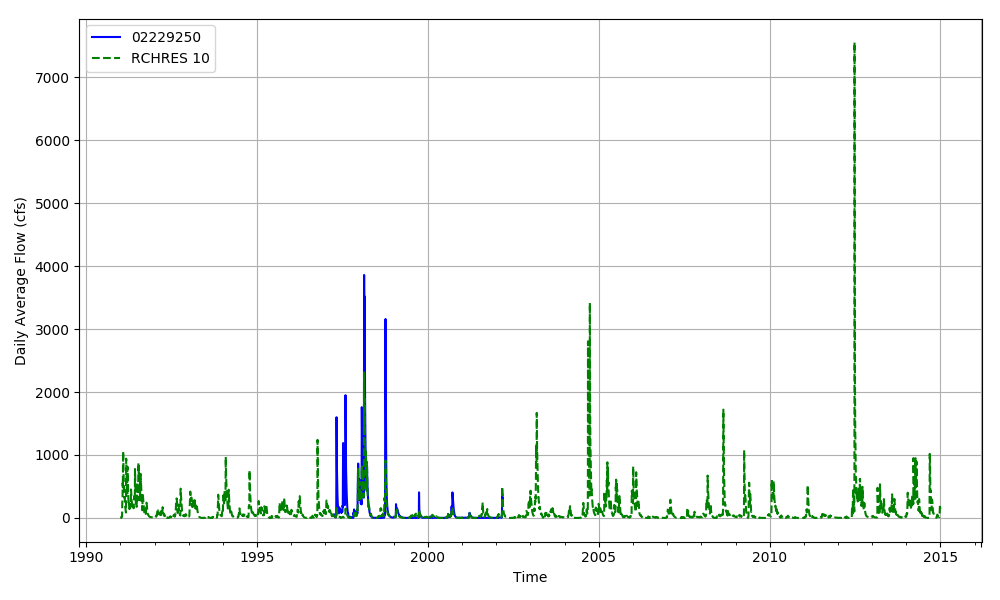


Figure 03070204-10: Daily flow for HSFP reach 10 and USGS station 02229250.

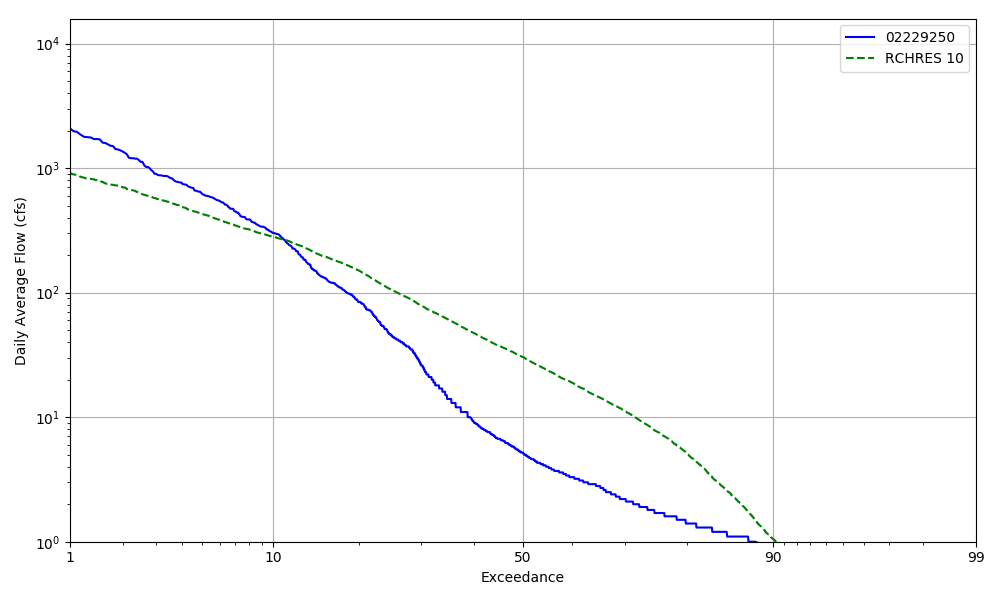


Figure 03070204-11: Daily exceedance for HSFP reach 10 and USGS station 02229250.

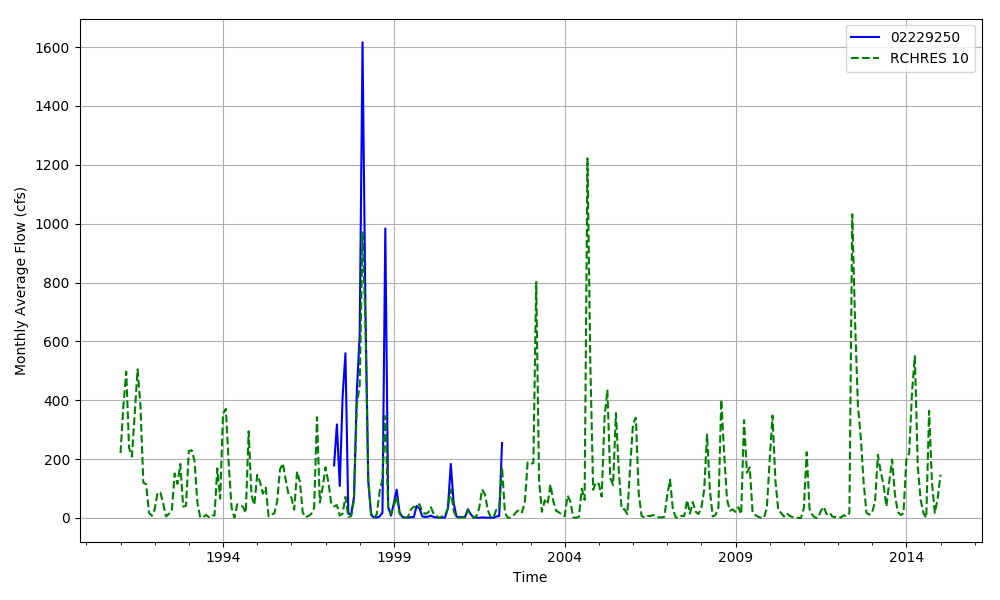


Figure 03070204-12: Monthly flow for HSFP reach 10 and USGS station 02229250.

## HSPF Reach 14, USGS Gauge 02231000

Table 03070204-7: Comparison Statistics Between HSPF Reach 14 and USGS Gauge 02231000.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | -50.19 |
| Standard error | 336.23 |
| Relative bias | -0.09 |
| Relative standard error | 0.38 |
| Nash-Sutcliffe coefficient | 0.86 |
| Coefficient of efficiency | 0.65 |
| Index of agreement | 0.81 |

Table 03070204-8: Hydrologic Indices Between USGS Gauge 02231000 and HSPF Reach 14.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02231000 | Simulated Reach 14 | Percent Difference |
| MA1: Mean, all daily flows | 534.54 | 483.46 | -9.56 |
| MA2: Median, all daily flows | 155.00 | 150.55 | -2.87 |
| MA3: CV, all daily flows | 186.89 | 183.10 | -2.03 |
| MA4: CV, log of all daily flows | 135.75 | 134.10 | -1.21 |
| MA5: Mean daily flow / median daily flow | 3.45 | 3.21 | -6.88 |
| MA9: (Q10 - Q90) / median daily flow | 7.93 | 7.44 | -6.12 |
| MA10: (Q20 - Q80) / median daily flow | 3.95 | 3.88 | -1.81 |
| MA11: (Q25 - Q75) / median daily flow | 2.88 | 2.93 | 1.87 |
| MA12: Mean monthly flow, January | 424.14 | 575.48 | 35.68 |
| MA13: Mean monthly flow, February | 695.41 | 725.86 | 4.38 |
| MA14: Mean monthly flow, March | 805.60 | 708.10 | -12.10 |
| MA15: Mean monthly flow, April | 451.66 | 342.08 | -24.26 |
| MA16: Mean monthly flow, May | 245.31 | 174.43 | -28.89 |
| MA17: Mean monthly flow, June | 456.84 | 498.67 | 9.16 |
| MA18: Mean monthly flow, July | 519.73 | 465.18 | -10.50 |
| MA19: Mean monthly flow, August | 737.34 | 566.65 | -23.15 |
| MA20: Mean monthly flow, September | 623.18 | 583.38 | -6.39 |
| MA21: Mean monthly flow, October | 752.72 | 501.81 | -33.33 |
| MA22: Mean monthly flow, November | 175.60 | 177.85 | 1.28 |
| MA23: Mean monthly flow, December | 274.40 | 263.21 | -4.08 |
| ML1: Mean minimum monthly flow, January | 150.12 | 134.61 | -10.34 |
| ML2: Mean minimum monthly flow, February | 255.30 | 225.24 | -11.78 |
| ML3: Mean minimum monthly flow, March | 262.22 | 192.97 | -26.41 |
| ML4: Mean minimum monthly flow, April | 133.26 | 85.05 | -36.18 |
| ML5: Mean minimum monthly flow, May | 74.47 | 38.72 | -48.00 |
| ML6: Mean minimum monthly flow, June | 82.75 | 66.06 | -20.17 |
| ML7: Mean minimum monthly flow, July | 169.22 | 138.91 | -17.91 |
| ML8: Mean minimum monthly flow, August | 162.78 | 128.87 | -20.83 |
| ML9: Mean minimum monthly flow, September | 174.22 | 120.11 | -31.06 |
| ML10: Mean minimum monthly flow, October | 120.43 | 88.43 | -26.58 |
| ML11: Mean minimum monthly flow, November | 95.22 | 76.94 | -19.19 |
| ML12: Mean minimum monthly flow, December | 100.30 | 87.10 | -13.16 |
| ML13: CV of minimum monthly flows | 129.41 | 142.85 | 10.39 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.20 | 0.12 | -40.32 |
| ML15: Mean minimum annual flow / mean annual flow | 0.08 | 0.05 | -37.25 |
| ML16: Median minimum annual flow / median annual flow | 0.15 | 0.10 | -34.71 |
| ML20: Ratio of baseflow volume to total flow volume | 0.40 | 0.36 | -12.13 |
| ML22: Mean annual minimum flow divided by catchment area | 0.28 | 0.17 | -40.32 |
| RA1: Mean of positive changes from one day to next (rise rate) | 184.27 | 236.20 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 417.84 | 427.10 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 69.00 | 68.37 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 333.43 | 389.86 |  |
| RA5: Ratio of days that are higher than previous day | 0.25 | 0.22 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.13 | 0.17 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.08 | 0.09 |  |
| RA8: Number of flow reversals from one day to the next | 58.96 | 59.33 |  |
| RA9: CV, number of flow reversals from one day to the next | 21.27 | 18.41 |  |

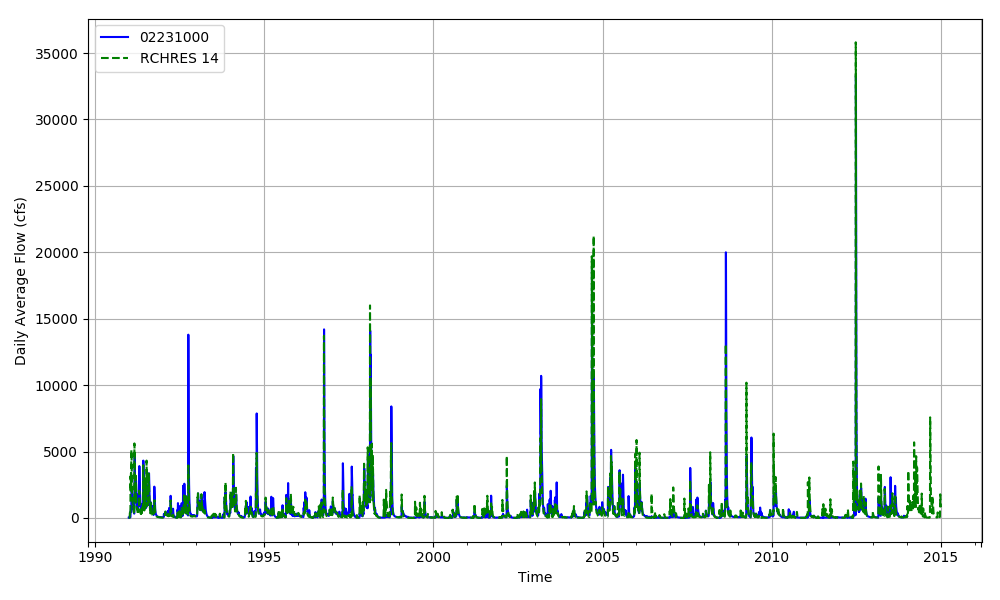


Figure 03070204-13: Daily flow for HSFP reach 14 and USGS station 02231000.

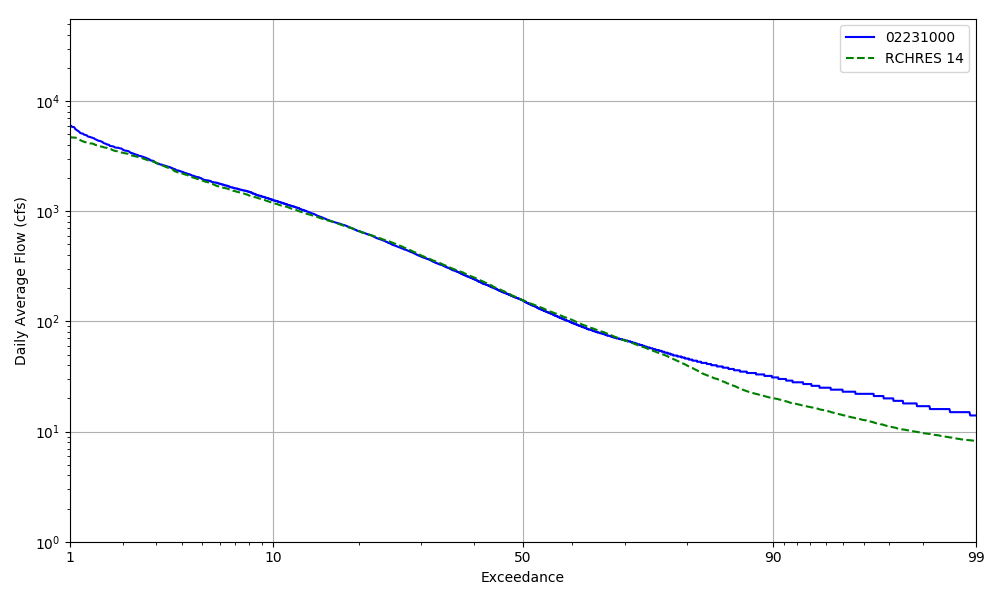


Figure 03070204-14: Daily exceedance for HSFP reach 14 and USGS station 02231000.

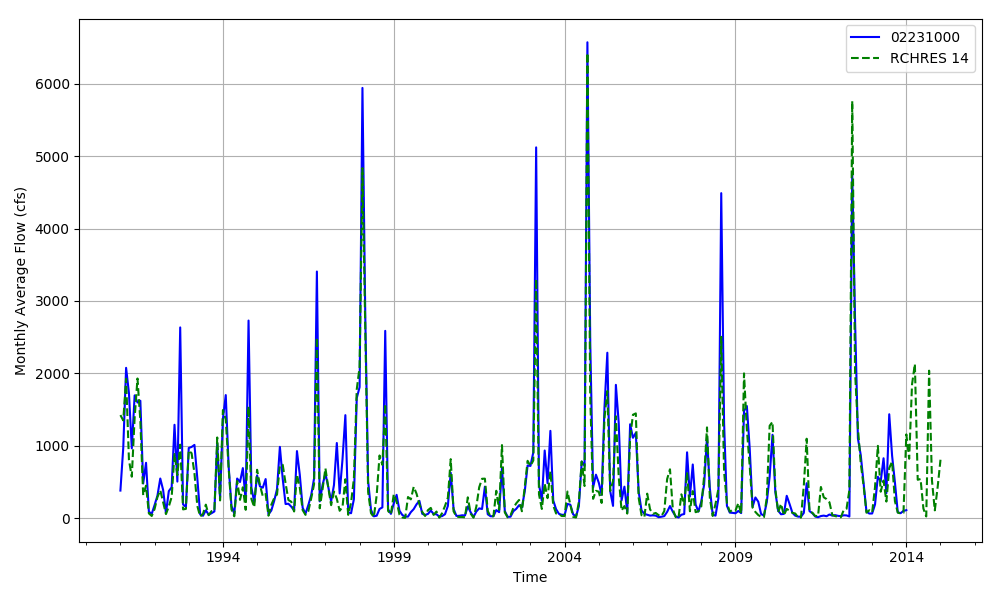


Figure 03070204-15: Monthly flow for HSFP reach 14 and USGS station 02231000.