# Appendix for Model 03070201

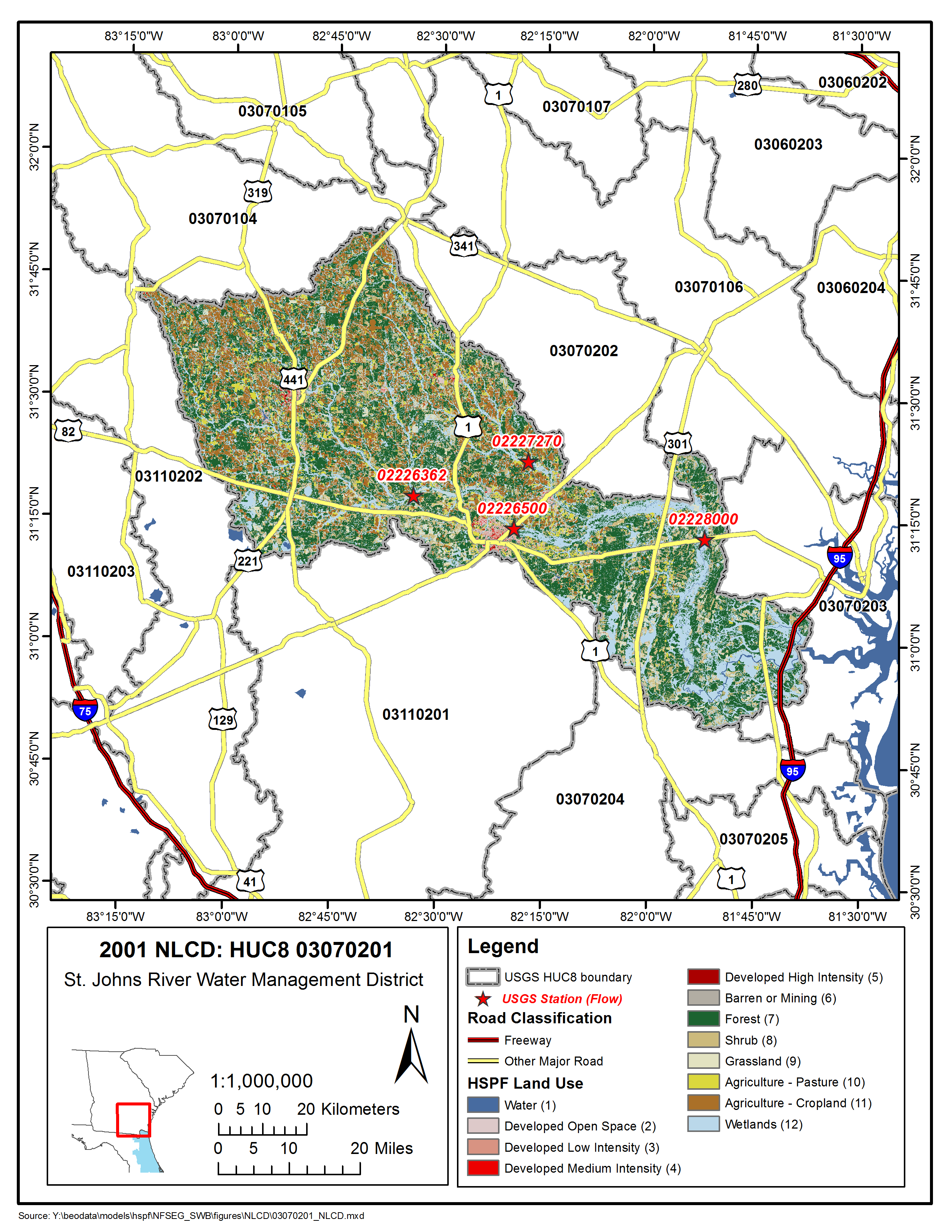


Figure 03070201-1: Land Cover from the National Land Cover Database.

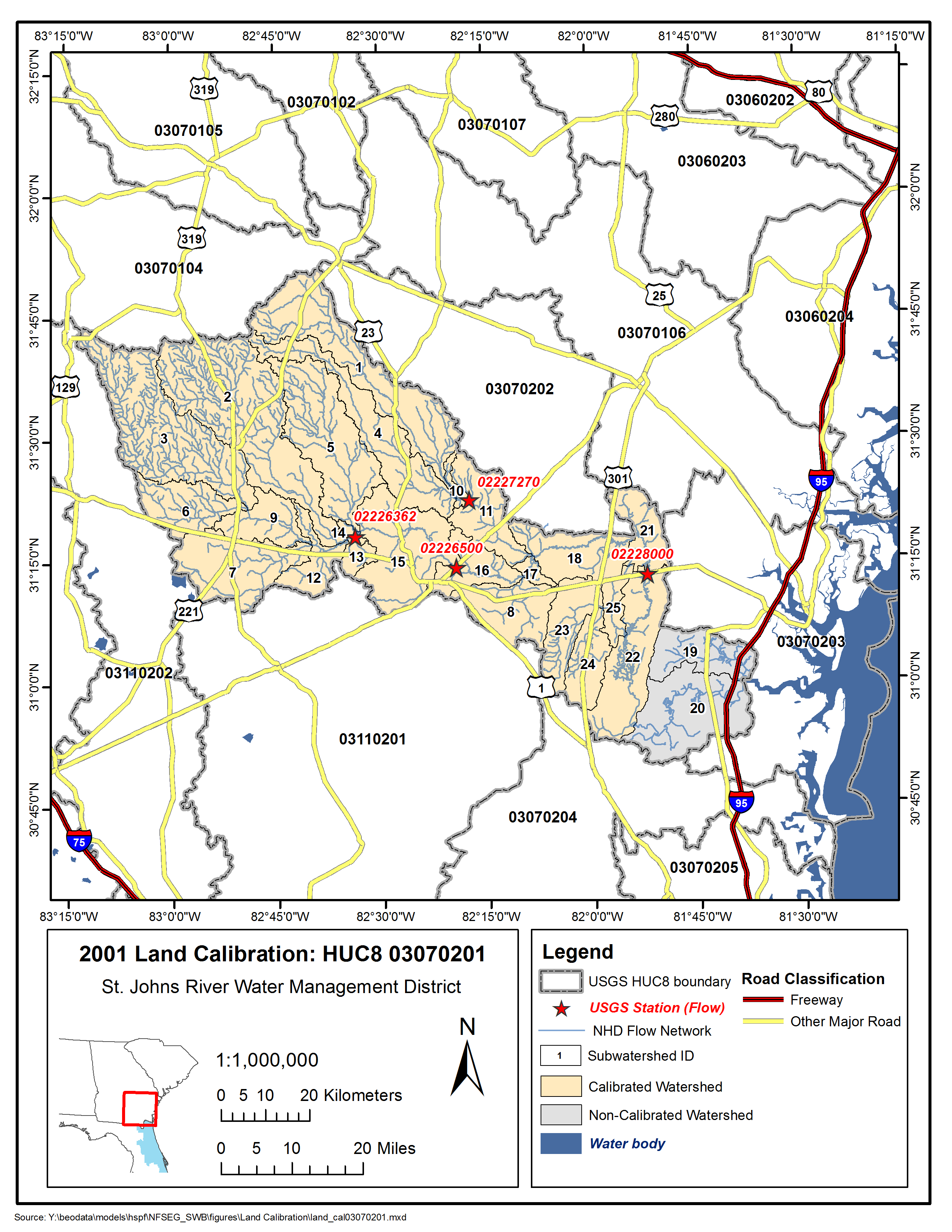


Figure 03070201-2: Calibrated sub-watersheds.

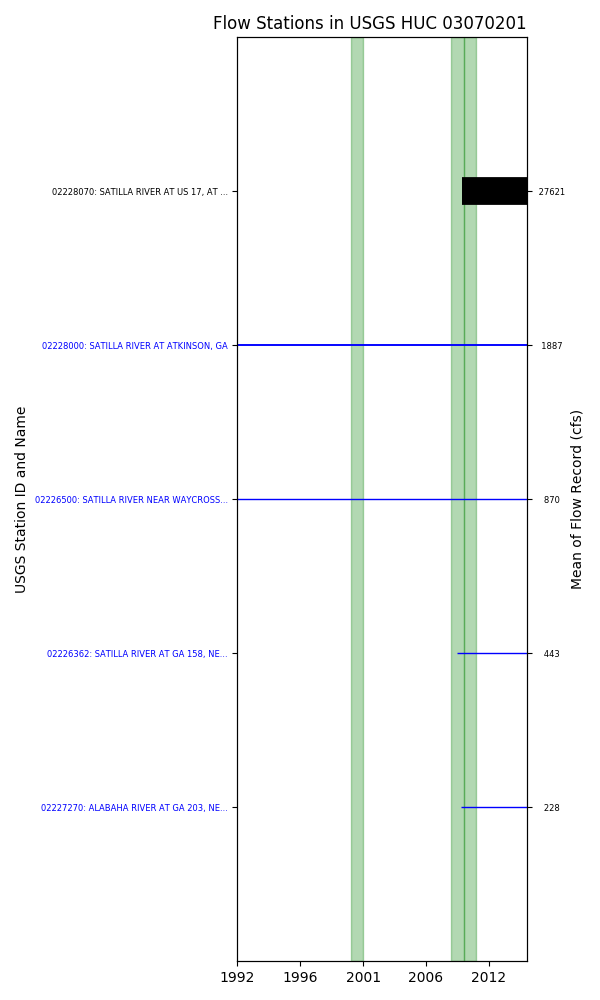


Figure 03070201-3: Station period of record. Blue color identifies gauges used for calibration.

## HSPF Reach 10, USGS Gauge 02227270

Table 03070201-1: Comparison Statistics Between HSPF Reach 10 and USGS Gauge 02227270.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | -88.40 |
| Standard error | 191.05 |
| Relative bias | -0.43 |
| Relative standard error | 0.59 |
| Nash-Sutcliffe coefficient | 0.65 |
| Coefficient of efficiency | 0.60 |
| Index of agreement | 0.77 |

Table 03070201-2: Hydrologic Indices Between USGS Gauge 02227270 and HSPF Reach 10.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02227270 | Simulated Reach 10 | Percent Difference |
| MA1: Mean, all daily flows | 199.89 | 116.13 | -41.90 |
| MA2: Median, all daily flows | 18.00 | 21.39 | 18.83 |
| MA3: CV, all daily flows | 165.21 | 160.06 | -3.12 |
| MA4: CV, log of all daily flows | 182.65 | 169.57 | -7.16 |
| MA5: Mean daily flow / median daily flow | 11.10 | 5.43 | -51.11 |
| MA9: (Q10 - Q90) / median daily flow | 35.55 | 15.84 | -55.46 |
| MA10: (Q20 - Q80) / median daily flow | 14.51 | 6.48 | -55.33 |
| MA11: (Q25 - Q75) / median daily flow | 9.53 | 4.27 | -55.24 |
| MA12: Mean monthly flow, January | 270.22 | 188.33 | -30.31 |
| MA13: Mean monthly flow, February | 375.28 | 217.84 | -41.95 |
| MA14: Mean monthly flow, March | 353.51 | 221.57 | -37.32 |
| MA15: Mean monthly flow, April | 128.10 | 56.41 | -55.97 |
| MA16: Mean monthly flow, May | 96.16 | 39.57 | -58.85 |
| MA17: Mean monthly flow, June | 120.86 | 48.76 | -59.66 |
| MA18: Mean monthly flow, July | 267.18 | 107.25 | -59.86 |
| MA19: Mean monthly flow, August | 258.79 | 195.69 | -24.38 |
| MA20: Mean monthly flow, September | 59.95 | 44.45 | -25.85 |
| MA21: Mean monthly flow, October | 18.68 | 12.74 | -31.82 |
| MA22: Mean monthly flow, November | 23.87 | 9.31 | -61.01 |
| MA23: Mean monthly flow, December | 190.49 | 101.81 | -46.55 |
| ML1: Mean minimum monthly flow, January | 148.58 | 80.32 | -45.94 |
| ML2: Mean minimum monthly flow, February | 106.00 | 63.61 | -39.99 |
| ML3: Mean minimum monthly flow, March | 87.78 | 67.45 | -23.16 |
| ML4: Mean minimum monthly flow, April | 45.16 | 21.69 | -51.99 |
| ML5: Mean minimum monthly flow, May | 5.95 | 6.38 | 7.22 |
| ML6: Mean minimum monthly flow, June | 9.10 | 12.06 | 32.63 |
| ML7: Mean minimum monthly flow, July | 116.61 | 44.70 | -61.67 |
| ML8: Mean minimum monthly flow, August | 10.75 | 19.59 | 82.23 |
| ML9: Mean minimum monthly flow, September | 5.91 | 6.32 | 6.91 |
| ML10: Mean minimum monthly flow, October | 6.36 | 3.20 | -49.60 |
| ML11: Mean minimum monthly flow, November | 4.80 | 2.70 | -43.85 |
| ML12: Mean minimum monthly flow, December | 42.63 | 22.00 | -48.40 |
| ML13: CV of minimum monthly flows | 239.73 | 196.02 | -18.23 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.02 | 0.08 | 225.17 |
| ML15: Mean minimum annual flow / mean annual flow | 0.00 | 0.02 | 250.84 |
| ML16: Median minimum annual flow / median annual flow | 0.00 | 0.00 | -19.37 |
| ML20: Ratio of baseflow volume to total flow volume | 0.31 | 0.33 | 7.14 |
| ML22: Mean annual minimum flow divided by catchment area | 0.01 | 0.01 | 88.79 |
| RA1: Mean of positive changes from one day to next (rise rate) | 73.26 | 34.62 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 318.62 | 334.30 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 38.18 | 12.63 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 316.20 | 299.22 |  |
| RA5: Ratio of days that are higher than previous day | 0.31 | 0.27 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.24 | 0.21 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.18 | 0.12 |  |
| RA8: Number of flow reversals from one day to the next | 66.00 | 65.40 |  |
| RA9: CV, number of flow reversals from one day to the next | 39.47 | 41.09 |  |

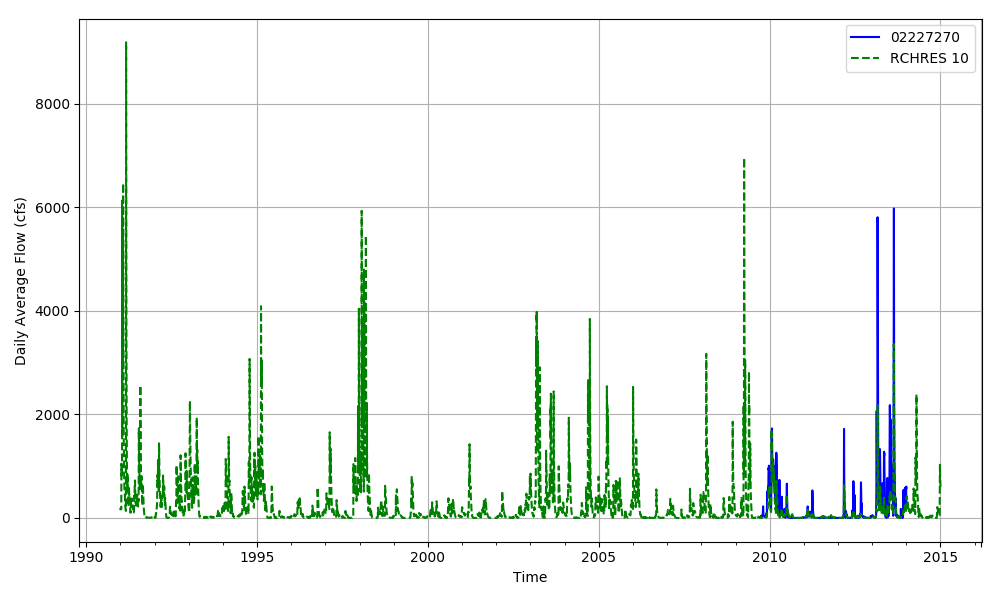


Figure 03070201-4: Daily flow for HSFP reach 10 and USGS station 02227270.

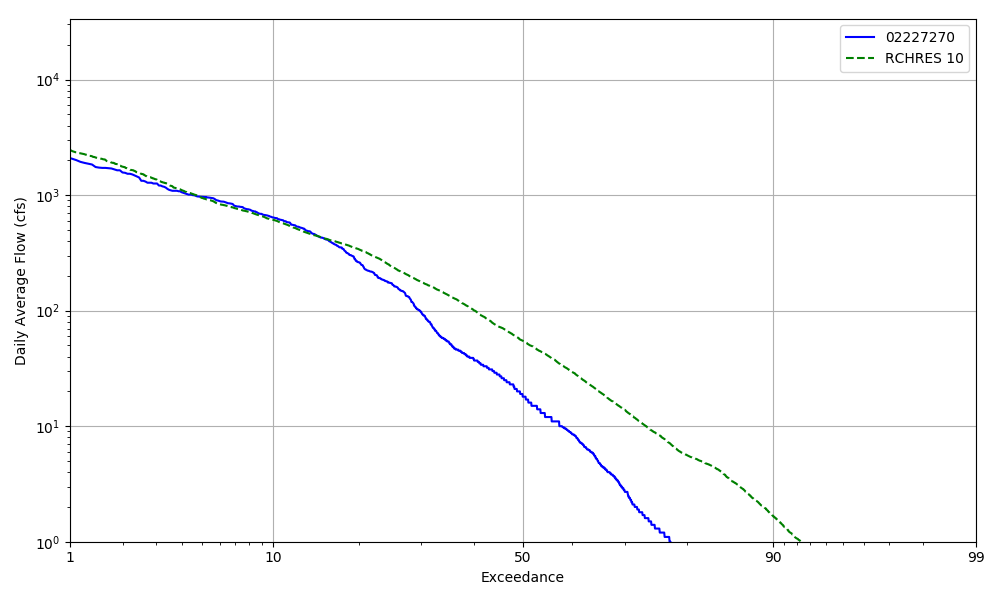


Figure 03070201-5: Daily exceedance for HSFP reach 10 and USGS station 02227270.

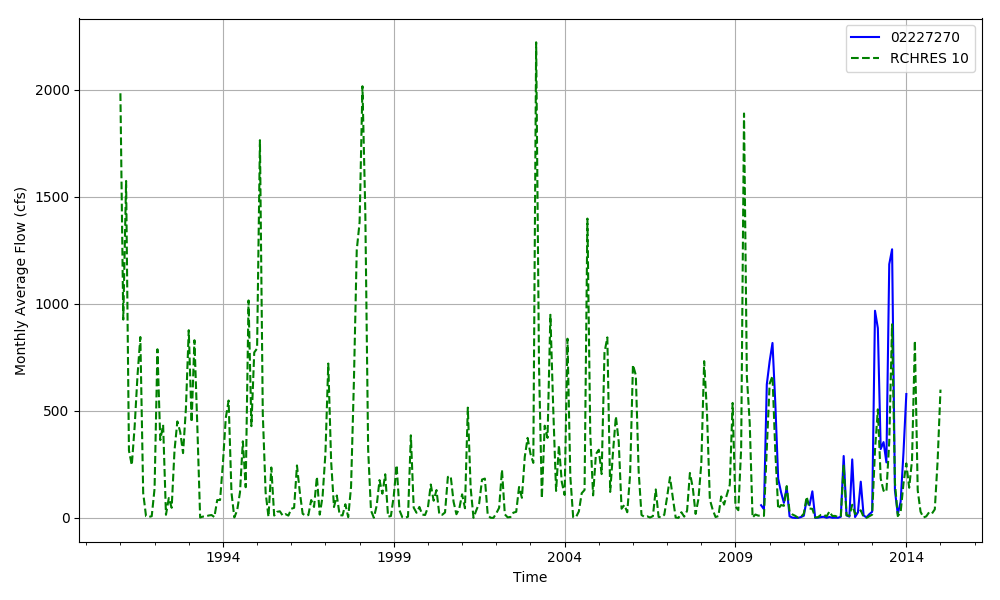


Figure 03070201-6: Monthly flow for HSFP reach 10 and USGS station 02227270.

## HSPF Reach 13, USGS Gauge 02226362

Table 03070201-3: Comparison Statistics Between HSPF Reach 13 and USGS Gauge 02226362.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | 0.39 |
| Standard error | 189.15 |
| Relative bias | 0.00 |
| Relative standard error | 0.30 |
| Nash-Sutcliffe coefficient | 0.91 |
| Coefficient of efficiency | 0.75 |
| Index of agreement | 0.88 |

Table 03070201-4: Hydrologic Indices Between USGS Gauge 02226362 and HSPF Reach 13.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02226362 | Simulated Reach 13 | Percent Difference |
| MA1: Mean, all daily flows | 398.70 | 402.17 | 0.87 |
| MA2: Median, all daily flows | 59.00 | 75.69 | 28.29 |
| MA3: CV, all daily flows | 143.02 | 133.83 | -6.43 |
| MA4: CV, log of all daily flows | 175.08 | 174.96 | -0.07 |
| MA5: Mean daily flow / median daily flow | 6.76 | 5.31 | -21.37 |
| MA9: (Q10 - Q90) / median daily flow | 17.72 | 14.48 | -18.25 |
| MA10: (Q20 - Q80) / median daily flow | 8.40 | 6.42 | -23.59 |
| MA11: (Q25 - Q75) / median daily flow | 5.80 | 3.88 | -33.09 |
| MA12: Mean monthly flow, January | 485.41 | 493.07 | 1.58 |
| MA13: Mean monthly flow, February | 711.38 | 799.43 | 12.38 |
| MA14: Mean monthly flow, March | 709.39 | 718.70 | 1.31 |
| MA15: Mean monthly flow, April | 241.64 | 261.18 | 8.09 |
| MA16: Mean monthly flow, May | 159.71 | 183.98 | 15.20 |
| MA17: Mean monthly flow, June | 178.81 | 135.20 | -24.39 |
| MA18: Mean monthly flow, July | 473.35 | 349.30 | -26.21 |
| MA19: Mean monthly flow, August | 348.90 | 346.71 | -0.63 |
| MA20: Mean monthly flow, September | 138.21 | 86.01 | -37.77 |
| MA21: Mean monthly flow, October | 39.22 | 32.47 | -17.22 |
| MA22: Mean monthly flow, November | 21.35 | 26.09 | 22.18 |
| MA23: Mean monthly flow, December | 241.27 | 320.15 | 32.69 |
| ML1: Mean minimum monthly flow, January | 245.18 | 203.63 | -16.94 |
| ML2: Mean minimum monthly flow, February | 290.75 | 256.58 | -11.75 |
| ML3: Mean minimum monthly flow, March | 290.00 | 347.67 | 19.89 |
| ML4: Mean minimum monthly flow, April | 127.95 | 145.21 | 13.49 |
| ML5: Mean minimum monthly flow, May | 28.00 | 61.63 | 120.10 |
| ML6: Mean minimum monthly flow, June | 27.62 | 38.11 | 37.98 |
| ML7: Mean minimum monthly flow, July | 95.20 | 117.68 | 23.62 |
| ML8: Mean minimum monthly flow, August | 26.12 | 45.59 | 74.56 |
| ML9: Mean minimum monthly flow, September | 28.92 | 22.64 | -21.71 |
| ML10: Mean minimum monthly flow, October | 8.20 | 10.83 | 32.10 |
| ML11: Mean minimum monthly flow, November | 7.70 | 11.29 | 46.68 |
| ML12: Mean minimum monthly flow, December | 41.98 | 52.62 | 25.35 |
| ML13: CV of minimum monthly flows | 204.07 | 182.23 | -10.70 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.17 | 0.07 | -56.68 |
| ML15: Mean minimum annual flow / mean annual flow | 0.05 | 0.03 | -36.05 |
| ML16: Median minimum annual flow / median annual flow | 0.14 | 0.03 | -77.51 |
| ML20: Ratio of baseflow volume to total flow volume | 0.29 | 0.35 | 19.99 |
| ML22: Mean annual minimum flow divided by catchment area | 0.07 | 0.04 | -40.06 |
| RA1: Mean of positive changes from one day to next (rise rate) | 130.34 | 125.49 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 324.34 | 412.05 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 66.56 | 54.56 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 359.33 | 356.87 |  |
| RA5: Ratio of days that are higher than previous day | 0.31 | 0.30 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.17 | 0.15 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.12 | 0.11 |  |
| RA8: Number of flow reversals from one day to the next | 47.17 | 50.17 |  |
| RA9: CV, number of flow reversals from one day to the next | 43.04 | 52.84 |  |

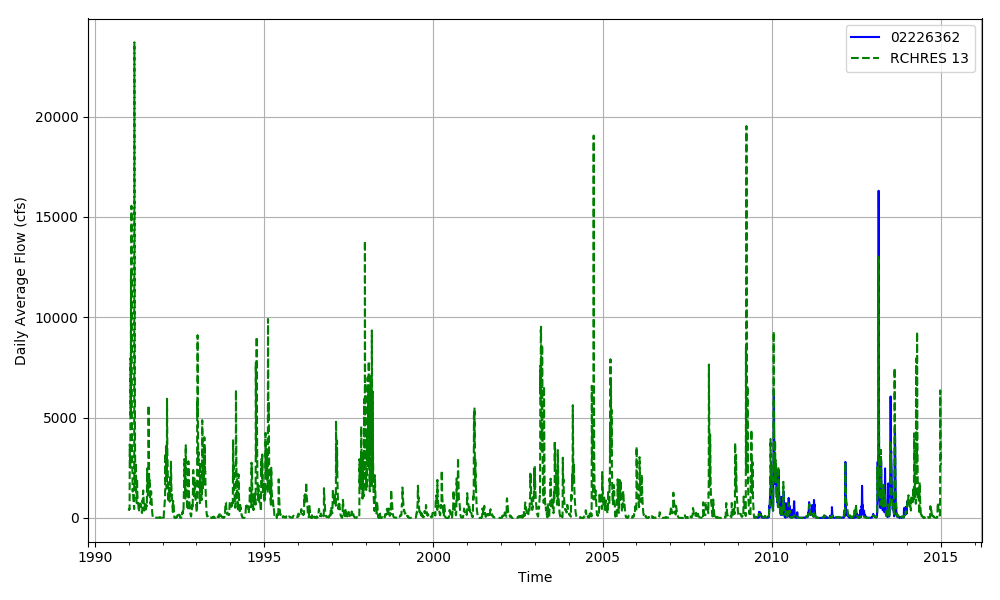


Figure 03070201-7: Daily flow for HSFP reach 13 and USGS station 02226362.

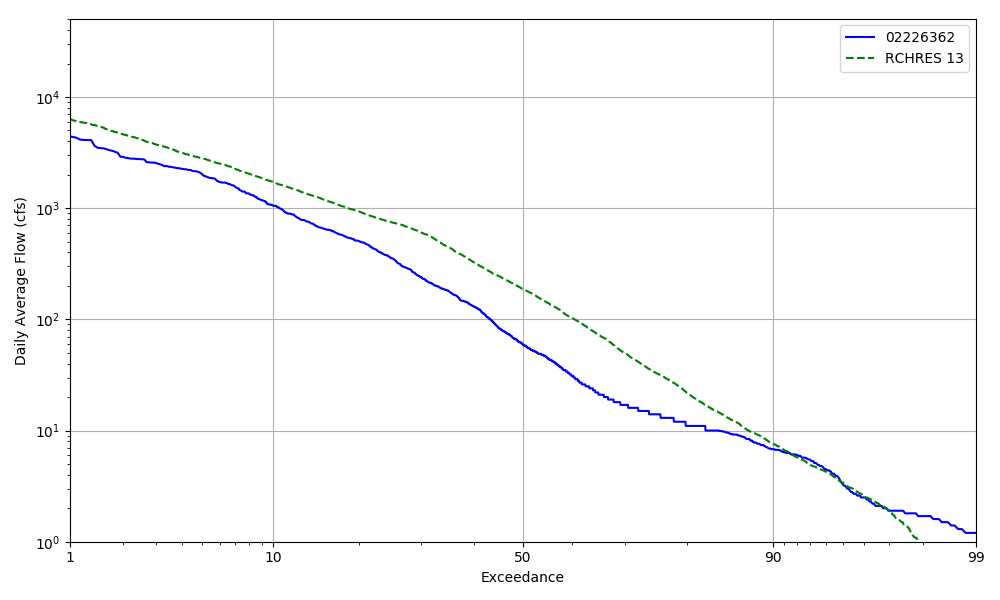


Figure 03070201-8: Daily exceedance for HSFP reach 13 and USGS station 02226362.

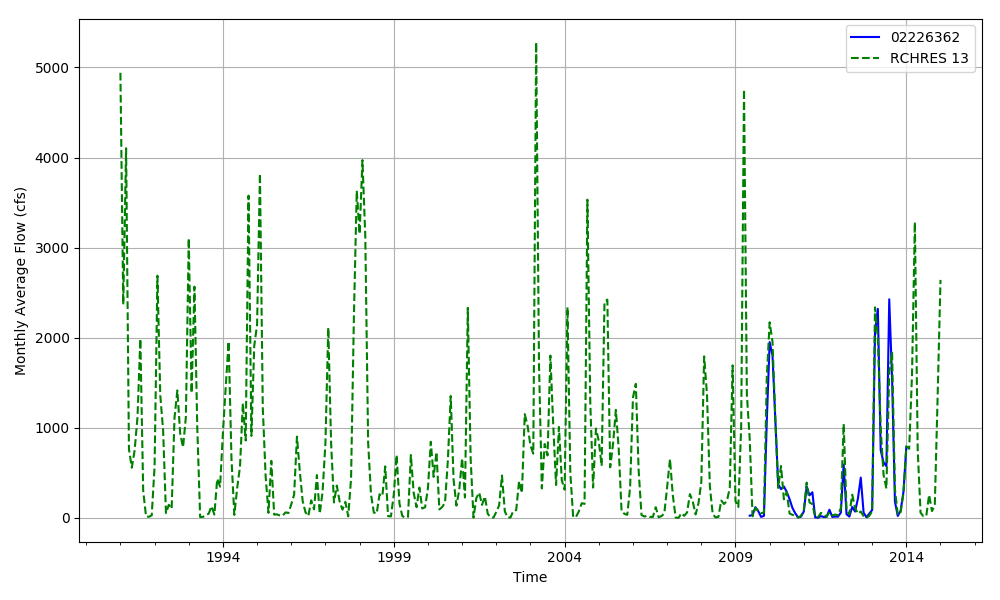


Figure 03070201-9: Monthly flow for HSFP reach 13 and USGS station 02226362.

## HSPF Reach 15, USGS Gauge 02226500

Table 03070201-5: Comparison Statistics Between HSPF Reach 15 and USGS Gauge 02226500.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | -50.53 |
| Standard error | 450.88 |
| Relative bias | -0.05 |
| Relative standard error | 0.31 |
| Nash-Sutcliffe coefficient | 0.91 |
| Coefficient of efficiency | 0.78 |
| Index of agreement | 0.88 |

Table 03070201-6: Hydrologic Indices Between USGS Gauge 02226500 and HSPF Reach 15.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02226500 | Simulated Reach 15 | Percent Difference |
| MA1: Mean, all daily flows | 925.63 | 876.15 | -5.35 |
| MA2: Median, all daily flows | 196.00 | 261.57 | 33.45 |
| MA3: CV, all daily flows | 159.02 | 149.96 | -5.70 |
| MA4: CV, log of all daily flows | 159.15 | 141.44 | -11.13 |
| MA5: Mean daily flow / median daily flow | 4.72 | 3.35 | -29.07 |
| MA9: (Q10 - Q90) / median daily flow | 13.51 | 8.68 | -35.74 |
| MA10: (Q20 - Q80) / median daily flow | 6.05 | 4.56 | -24.62 |
| MA11: (Q25 - Q75) / median daily flow | 4.31 | 3.52 | -18.31 |
| MA12: Mean monthly flow, January | 1251.79 | 1339.84 | 7.03 |
| MA13: Mean monthly flow, February | 1950.94 | 1784.23 | -8.55 |
| MA14: Mean monthly flow, March | 2183.07 | 1935.04 | -11.36 |
| MA15: Mean monthly flow, April | 1314.07 | 990.80 | -24.60 |
| MA16: Mean monthly flow, May | 315.09 | 282.42 | -10.37 |
| MA17: Mean monthly flow, June | 396.40 | 346.72 | -12.53 |
| MA18: Mean monthly flow, July | 534.43 | 439.23 | -17.81 |
| MA19: Mean monthly flow, August | 656.34 | 665.76 | 1.43 |
| MA20: Mean monthly flow, September | 548.32 | 632.73 | 15.39 |
| MA21: Mean monthly flow, October | 500.62 | 537.32 | 7.33 |
| MA22: Mean monthly flow, November | 407.80 | 428.05 | 4.97 |
| MA23: Mean monthly flow, December | 686.17 | 779.70 | 13.63 |
| ML1: Mean minimum monthly flow, January | 392.46 | 388.66 | -0.97 |
| ML2: Mean minimum monthly flow, February | 750.35 | 620.57 | -17.30 |
| ML3: Mean minimum monthly flow, March | 648.65 | 549.63 | -15.27 |
| ML4: Mean minimum monthly flow, April | 289.61 | 241.76 | -16.52 |
| ML5: Mean minimum monthly flow, May | 81.53 | 49.47 | -39.33 |
| ML6: Mean minimum monthly flow, June | 58.97 | 61.57 | 4.42 |
| ML7: Mean minimum monthly flow, July | 141.29 | 156.78 | 10.96 |
| ML8: Mean minimum monthly flow, August | 173.45 | 218.01 | 25.69 |
| ML9: Mean minimum monthly flow, September | 87.17 | 127.30 | 46.03 |
| ML10: Mean minimum monthly flow, October | 89.98 | 110.60 | 22.92 |
| ML11: Mean minimum monthly flow, November | 152.64 | 175.83 | 15.19 |
| ML12: Mean minimum monthly flow, December | 236.21 | 313.99 | 32.93 |
| ML13: CV of minimum monthly flows | 176.40 | 152.91 | -13.32 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.12 | 0.02 | -79.05 |
| ML15: Mean minimum annual flow / mean annual flow | 0.04 | 0.01 | -75.17 |
| ML16: Median minimum annual flow / median annual flow | 0.06 | 0.00 | -95.61 |
| ML20: Ratio of baseflow volume to total flow volume | 0.42 | 0.44 | 7.00 |
| ML22: Mean annual minimum flow divided by catchment area | 0.19 | 0.06 | -67.81 |
| RA1: Mean of positive changes from one day to next (rise rate) | 214.18 | 238.75 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 313.00 | 409.55 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 113.87 | 118.93 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 320.96 | 317.08 |  |
| RA5: Ratio of days that are higher than previous day | 0.33 | 0.33 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.13 | 0.12 |  |
| 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 | 66.42 | 52.58 |  |
| RA9: CV, number of flow reversals from one day to the next | 22.91 | 20.44 |  |

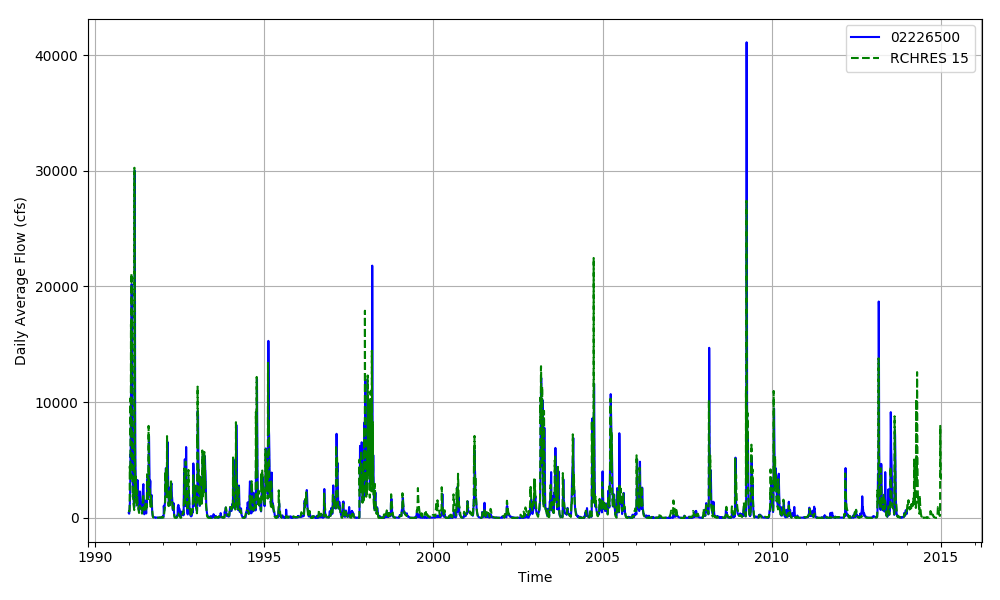


Figure 03070201-10: Daily flow for HSFP reach 15 and USGS station 02226500.

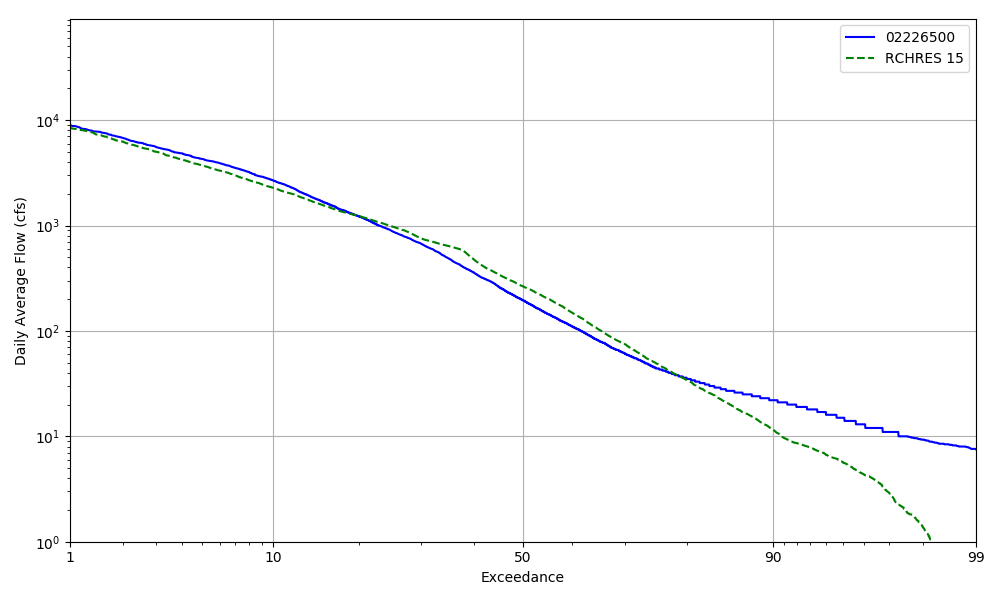


Figure 03070201-11: Daily exceedance for HSFP reach 15 and USGS station 02226500.

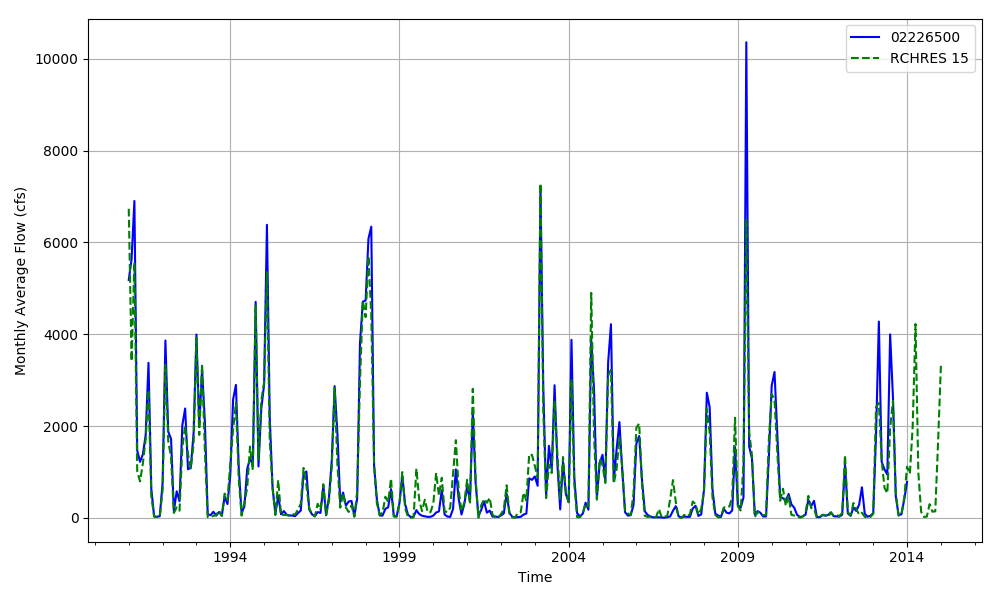


Figure 03070201-12: Monthly flow for HSFP reach 15 and USGS station 02226500.

## HSPF Reach 21, USGS Gauge 02228000

Table 03070201-7: Comparison Statistics Between HSPF Reach 21 and USGS Gauge 02228000.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | -28.84 |
| Standard error | 1134.64 |
| Relative bias | -0.01 |
| Relative standard error | 0.38 |
| Nash-Sutcliffe coefficient | 0.86 |
| Coefficient of efficiency | 0.70 |
| Index of agreement | 0.85 |

Table 03070201-8: Hydrologic Indices Between USGS Gauge 02228000 and HSPF Reach 21.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02228000 | Simulated Reach 21 | Percent Difference |
| MA1: Mean, all daily flows | 1998.96 | 1968.60 | -1.52 |
| MA2: Median, all daily flows | 590.00 | 673.06 | 14.08 |
| MA3: CV, all daily flows | 137.54 | 148.54 | 8.00 |
| MA4: CV, log of all daily flows | 141.02 | 136.79 | -3.00 |
| MA5: Mean daily flow / median daily flow | 3.39 | 2.92 | -13.67 |
| MA9: (Q10 - Q90) / median daily flow | 9.09 | 7.33 | -19.35 |
| MA10: (Q20 - Q80) / median daily flow | 4.64 | 3.91 | -15.83 |
| MA11: (Q25 - Q75) / median daily flow | 3.46 | 2.95 | -14.85 |
| MA12: Mean monthly flow, January | 2510.05 | 3006.06 | 19.76 |
| MA13: Mean monthly flow, February | 3924.78 | 4014.81 | 2.29 |
| MA14: Mean monthly flow, March | 4339.66 | 4081.58 | -5.95 |
| MA15: Mean monthly flow, April | 2944.09 | 2079.69 | -29.36 |
| MA16: Mean monthly flow, May | 680.50 | 561.84 | -17.44 |
| MA17: Mean monthly flow, June | 1033.09 | 737.93 | -28.57 |
| MA18: Mean monthly flow, July | 1204.49 | 1071.00 | -11.08 |
| MA19: Mean monthly flow, August | 1541.03 | 1708.07 | 10.84 |
| MA20: Mean monthly flow, September | 1466.37 | 1673.95 | 14.16 |
| MA21: Mean monthly flow, October | 1346.69 | 1278.87 | -5.04 |
| MA22: Mean monthly flow, November | 841.04 | 943.00 | 12.12 |
| MA23: Mean monthly flow, December | 1351.40 | 1693.48 | 25.31 |
| ML1: Mean minimum monthly flow, January | 1046.92 | 975.47 | -6.82 |
| ML2: Mean minimum monthly flow, February | 1859.22 | 1356.66 | -27.03 |
| ML3: Mean minimum monthly flow, March | 1659.39 | 1177.38 | -29.05 |
| ML4: Mean minimum monthly flow, April | 782.83 | 598.89 | -23.50 |
| ML5: Mean minimum monthly flow, May | 261.09 | 150.07 | -42.52 |
| ML6: Mean minimum monthly flow, June | 246.35 | 168.85 | -31.46 |
| ML7: Mean minimum monthly flow, July | 451.22 | 422.37 | -6.39 |
| ML8: Mean minimum monthly flow, August | 683.78 | 606.51 | -11.30 |
| ML9: Mean minimum monthly flow, September | 324.30 | 438.08 | 35.08 |
| ML10: Mean minimum monthly flow, October | 310.09 | 316.66 | 2.12 |
| ML11: Mean minimum monthly flow, November | 540.91 | 427.07 | -21.05 |
| ML12: Mean minimum monthly flow, December | 614.26 | 699.87 | 13.94 |
| ML13: CV of minimum monthly flows | 164.45 | 135.54 | -17.58 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.15 | 0.05 | -63.84 |
| ML15: Mean minimum annual flow / mean annual flow | 0.07 | 0.02 | -70.01 |
| ML16: Median minimum annual flow / median annual flow | 0.12 | 0.03 | -71.93 |
| ML20: Ratio of baseflow volume to total flow volume | 0.52 | 0.46 | -11.57 |
| ML22: Mean annual minimum flow divided by catchment area | 0.93 | 0.30 | -67.83 |
| RA1: Mean of positive changes from one day to next (rise rate) | 290.22 | 491.59 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 344.78 | 394.38 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 175.92 | 240.23 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 296.01 | 289.56 |  |
| RA5: Ratio of days that are higher than previous day | 0.37 | 0.33 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.08 | 0.09 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.06 | 0.07 |  |
| RA8: Number of flow reversals from one day to the next | 46.46 | 35.42 |  |
| RA9: CV, number of flow reversals from one day to the next | 26.03 | 31.24 |  |

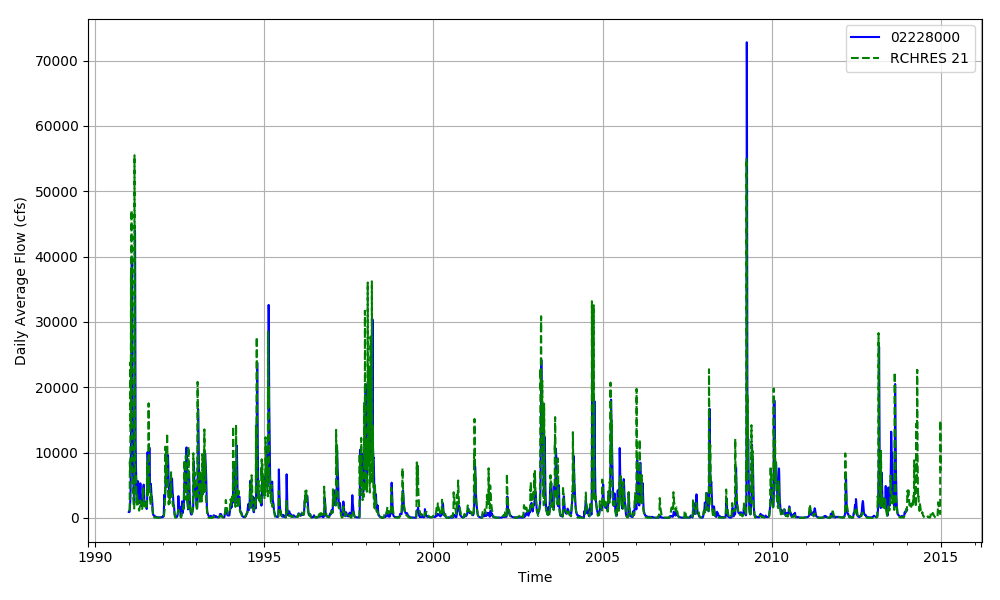


Figure 03070201-13: Daily flow for HSFP reach 21 and USGS station 02228000.

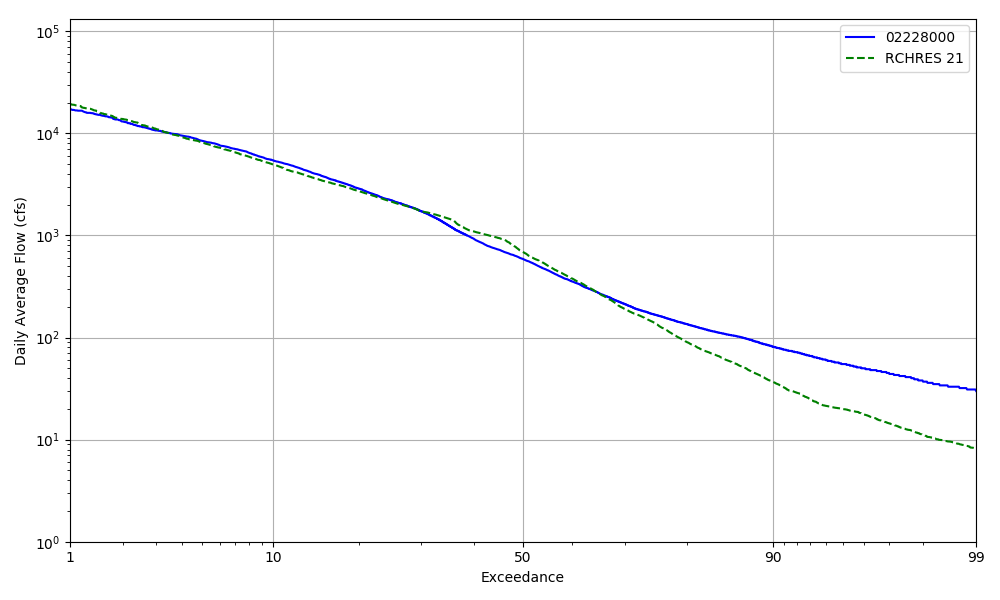


Figure 03070201-14: Daily exceedance for HSFP reach 21 and USGS station 02228000.

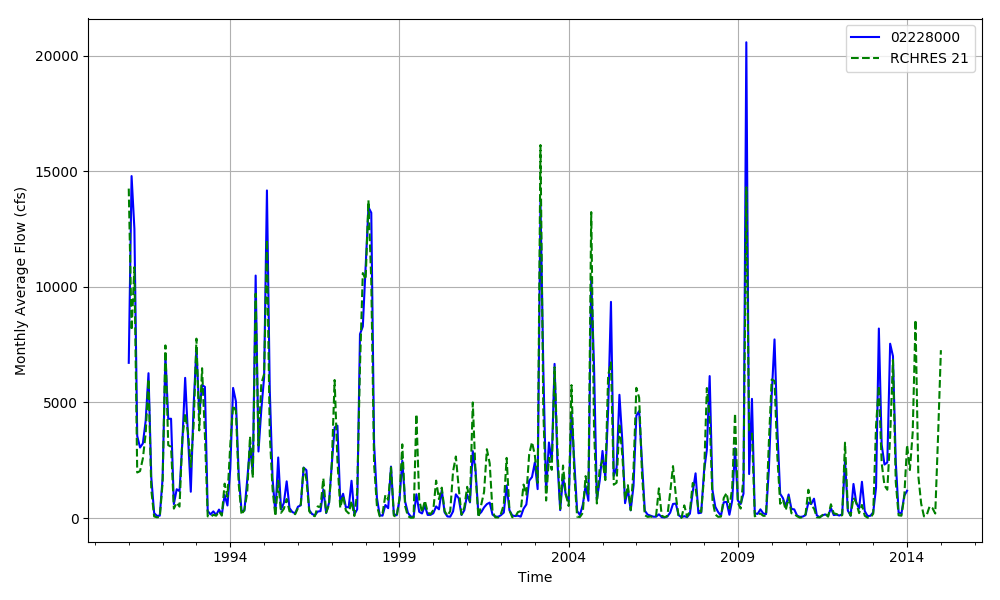


Figure 03070201-15: Monthly flow for HSFP reach 21 and USGS station 02228000.