# Appendix for Model 03110202

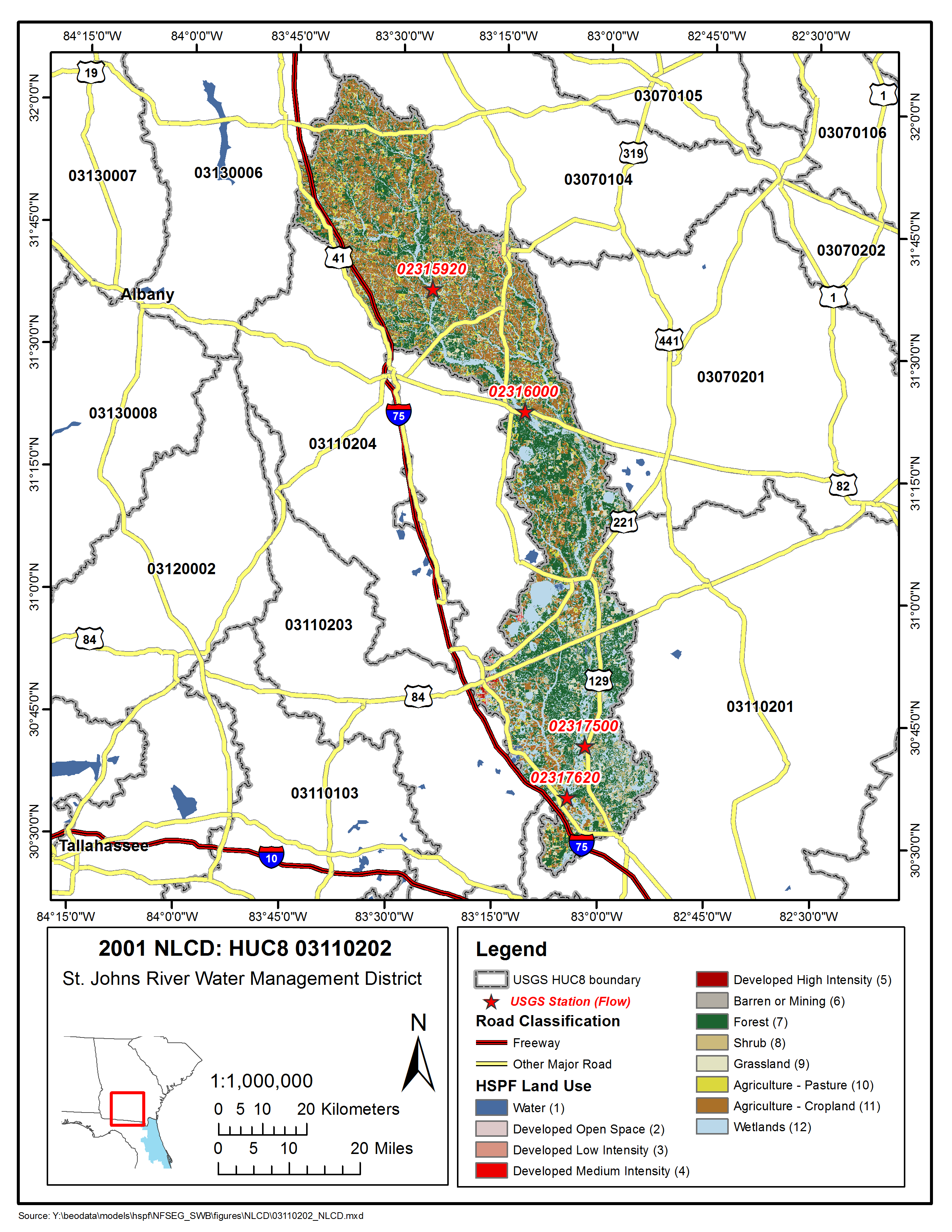


Figure 03110202-1: Land Cover from the National Land Cover Database.

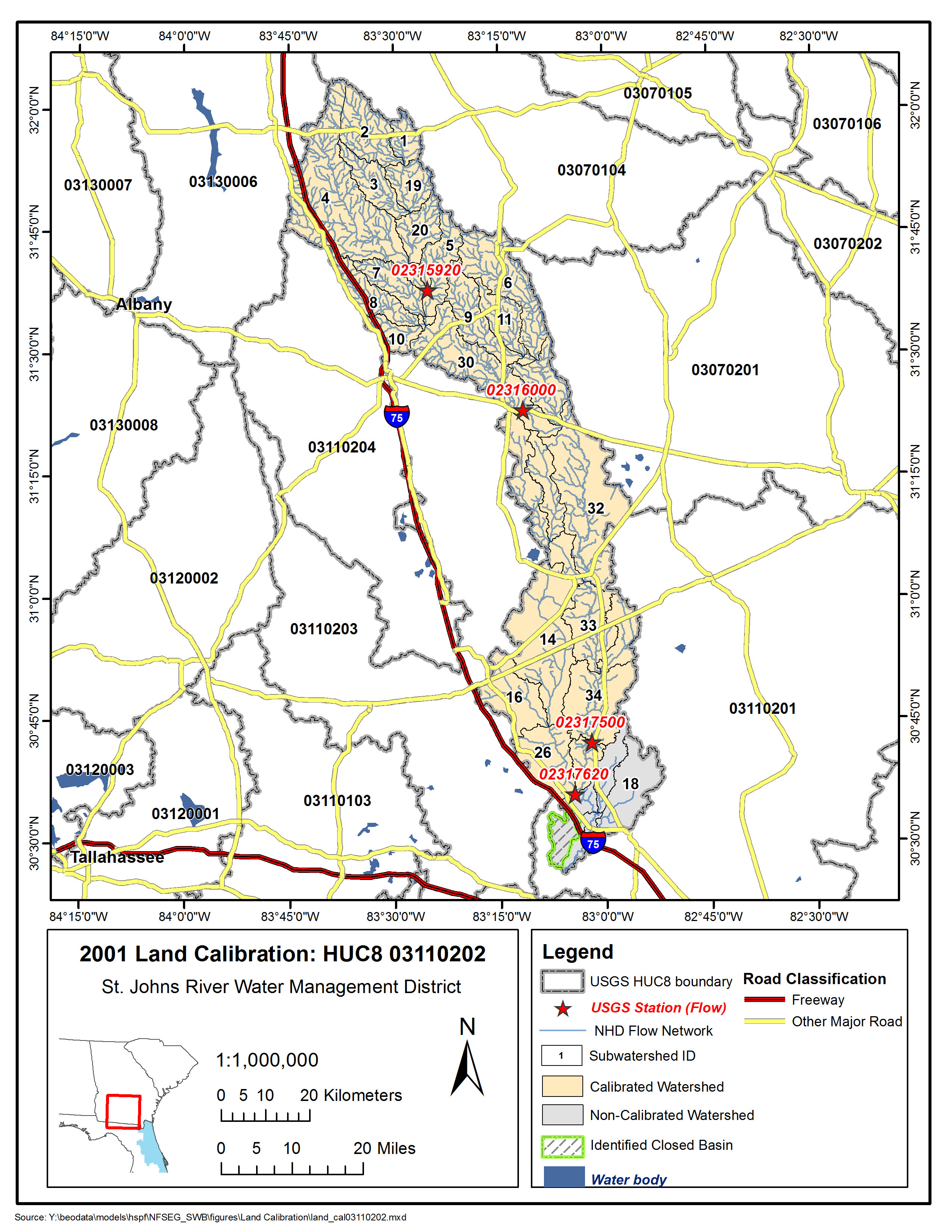


Figure 03110202-2: Calibrated sub-watersheds.

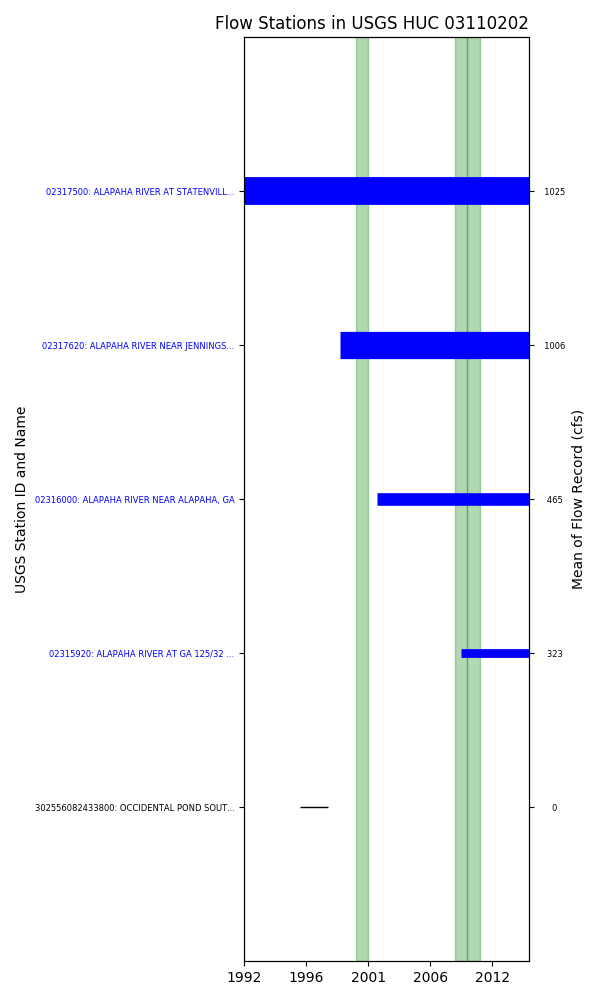


Figure 03110202-3: Station period of record. Blue color identifies gauges used for calibration.

## HSPF Reach 27, USGS Gauge 02315920

Table 03110202-1: Comparison Statistics Between HSPF Reach 27 and USGS Gauge 02315920.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | -4.12 |
| Standard error | 216.65 |
| Relative bias | -0.01 |
| Relative standard error | 0.38 |
| Nash-Sutcliffe coefficient | 0.85 |
| Kling-Gupta coefficient | 0.92 |
| Coefficient of efficiency | 0.76 |
| Index of agreement | 0.87 |

Table 03110202-2: Hydrologic Indices Between USGS Gauge 02315920 and HSPF Reach 27.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02315920 | Simulated Reach 27 | Percent Difference |
| MA1: Mean, all daily flows | 280.47 | 274.06 | -2.29 |
| MA2: Median, all daily flows | 3.70 | 17.33 | 368.44 |
| MA3: CV, all daily flows | 198.34 | 176.16 | -11.18 |
| MA4: CV, log of all daily flows | 217.16 | 200.60 | -7.62 |
| MA5: Mean daily flow / median daily flow | 75.80 | 15.81 | -79.14 |
| MA9: (Q10 - Q90) / median daily flow | 180.00 | 40.58 | -77.45 |
| MA10: (Q20 - Q80) / median daily flow | 68.65 | 16.71 | -75.65 |
| MA11: (Q25 - Q75) / median daily flow | 30.61 | 11.64 | -61.96 |
| MA12: Mean monthly flow, January | 555.23 | 542.71 | -2.26 |
| MA13: Mean monthly flow, February | 658.05 | 899.47 | 36.69 |
| MA14: Mean monthly flow, March | 378.32 | 481.93 | 27.39 |
| MA15: Mean monthly flow, April | 210.21 | 164.89 | -21.56 |
| MA16: Mean monthly flow, May | 190.04 | 134.85 | -29.04 |
| MA17: Mean monthly flow, June | 54.95 | 24.77 | -54.93 |
| MA18: Mean monthly flow, July | 136.57 | 99.57 | -27.09 |
| MA19: Mean monthly flow, August | 361.49 | 187.30 | -48.19 |
| MA20: Mean monthly flow, September | 18.92 | 40.64 | 114.81 |
| MA21: Mean monthly flow, October | 6.18 | 11.45 | 85.26 |
| MA22: Mean monthly flow, November | 13.89 | 23.34 | 67.98 |
| MA23: Mean monthly flow, December | 472.65 | 402.70 | -14.80 |
| ML1: Mean minimum monthly flow, January | 247.14 | 246.06 | -0.44 |
| ML2: Mean minimum monthly flow, February | 158.68 | 137.65 | -13.25 |
| ML3: Mean minimum monthly flow, March | 151.35 | 197.83 | 30.71 |
| ML4: Mean minimum monthly flow, April | 38.63 | 58.88 | 52.44 |
| ML5: Mean minimum monthly flow, May | 17.82 | 9.04 | -49.28 |
| ML6: Mean minimum monthly flow, June | 3.85 | 1.30 | -66.29 |
| ML7: Mean minimum monthly flow, July | 21.25 | 30.16 | 41.93 |
| ML8: Mean minimum monthly flow, August | 30.00 | 16.17 | -46.10 |
| ML9: Mean minimum monthly flow, September | 7.75 | 8.02 | 3.51 |
| ML10: Mean minimum monthly flow, October | 0.28 | 0.84 | 201.33 |
| ML11: Mean minimum monthly flow, November | 4.52 | 8.83 | 95.63 |
| ML12: Mean minimum monthly flow, December | 30.51 | 34.49 | 13.05 |
| ML13: CV of minimum monthly flows | 270.71 | 247.56 | -8.55 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.01 | 0.02 | 123.37 |
| ML15: Mean minimum annual flow / mean annual flow | 0.00 | 0.00 | 23.37 |
| ML16: Median minimum annual flow / median annual flow | 0.00 | 0.00 |  |
| ML20: Ratio of baseflow volume to total flow volume | 0.26 | 0.39 | 50.57 |
| ML22: Mean annual minimum flow divided by catchment area | 0.00 | 0.00 | 137.29 |
| RA1: Mean of positive changes from one day to next (rise rate) | 150.93 | 89.59 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 297.47 | 367.38 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 83.41 | 38.52 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 296.16 | 303.35 |  |
| RA5: Ratio of days that are higher than previous day | 0.23 | 0.30 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.28 | 0.21 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.18 | 0.14 |  |
| RA8: Number of flow reversals from one day to the next | 42.20 | 52.40 |  |
| RA9: CV, number of flow reversals from one day to the next | 44.66 | 35.41 |  |

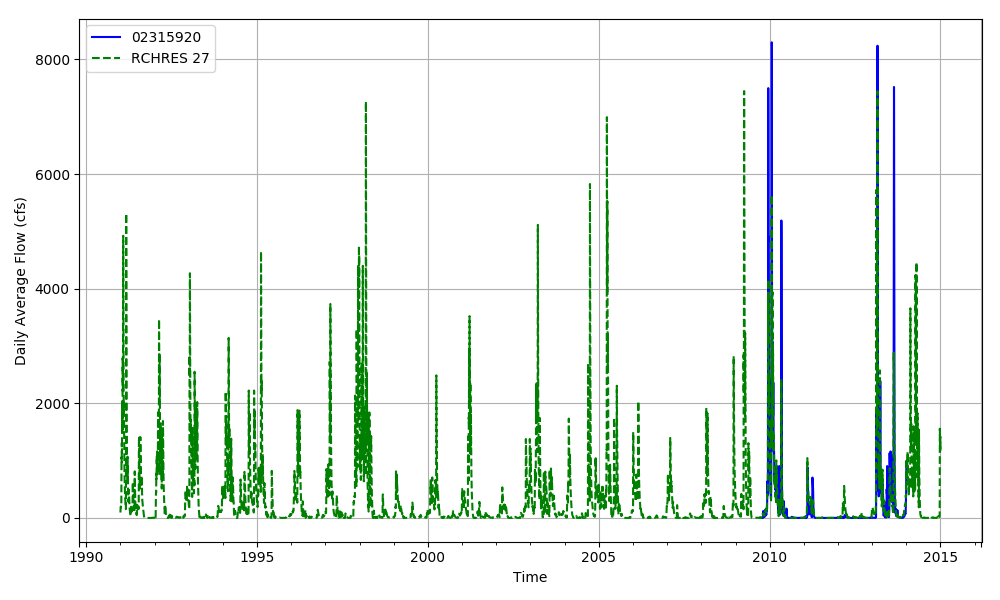


Figure 03110202-4: Daily flow for HSFP reach 27 and USGS station 02315920.

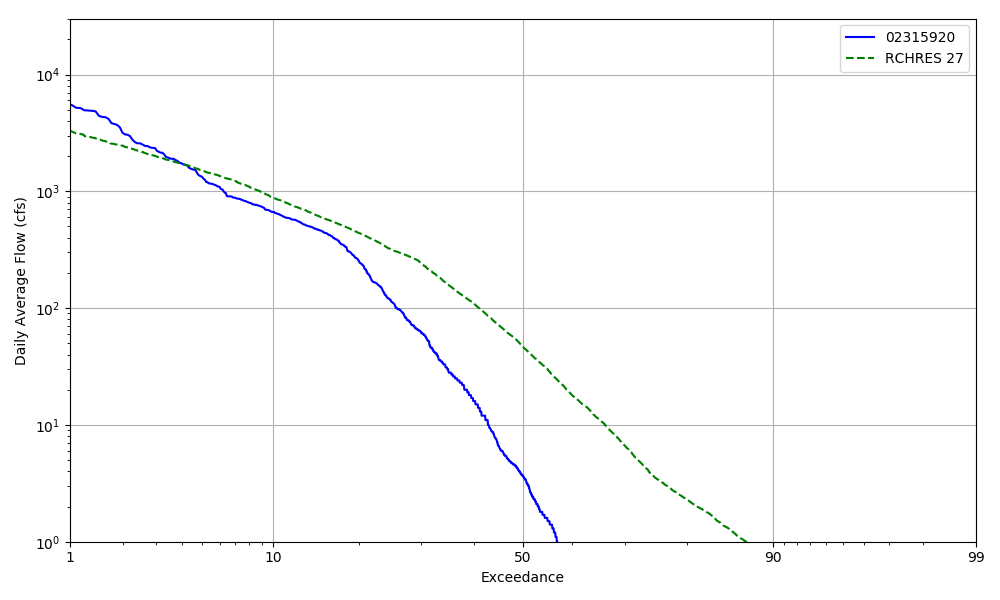


Figure 03110202-5: Daily exceedance for HSFP reach 27 and USGS station 02315920.

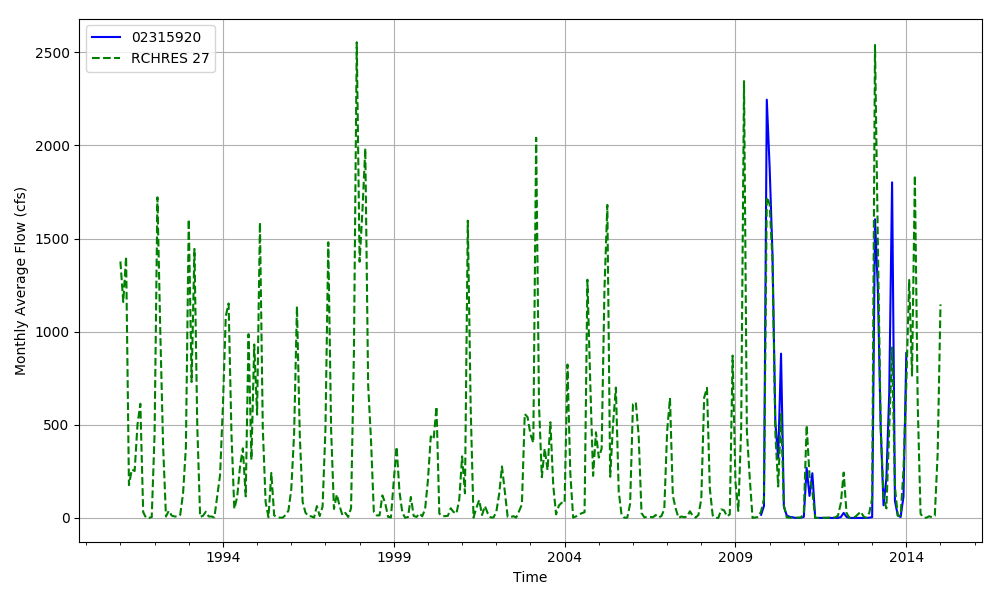


Figure 03110202-6: Monthly flow for HSFP reach 27 and USGS station 02315920.

## HSPF Reach 30, USGS Gauge 02316000

Table 03110202-3: Comparison Statistics Between HSPF Reach 30 and USGS Gauge 02316000.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | 2.88 |
| Standard error | 260.16 |
| Relative bias | 0.01 |
| Relative standard error | 0.36 |
| Nash-Sutcliffe coefficient | 0.87 |
| Kling-Gupta coefficient | 0.93 |
| Coefficient of efficiency | 0.76 |
| Index of agreement | 0.88 |

Table 03110202-4: Hydrologic Indices Between USGS Gauge 02316000 and HSPF Reach 30.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02316000 | Simulated Reach 30 | Percent Difference |
| MA1: Mean, all daily flows | 446.46 | 444.11 | -0.53 |
| MA2: Median, all daily flows | 57.00 | 66.71 | 17.03 |
| MA3: CV, all daily flows | 155.27 | 166.80 | 7.42 |
| MA4: CV, log of all daily flows | 162.46 | 164.66 | 1.35 |
| MA5: Mean daily flow / median daily flow | 7.83 | 6.66 | -15.00 |
| MA9: (Q10 - Q90) / median daily flow | 20.87 | 17.13 | -17.92 |
| MA10: (Q20 - Q80) / median daily flow | 11.67 | 9.02 | -22.73 |
| MA11: (Q25 - Q75) / median daily flow | 8.63 | 6.68 | -22.61 |
| MA12: Mean monthly flow, January | 509.13 | 565.17 | 11.01 |
| MA13: Mean monthly flow, February | 776.41 | 941.20 | 21.22 |
| MA14: Mean monthly flow, March | 839.23 | 944.09 | 12.50 |
| MA15: Mean monthly flow, April | 878.56 | 686.32 | -21.88 |
| MA16: Mean monthly flow, May | 203.09 | 188.17 | -7.35 |
| MA17: Mean monthly flow, June | 246.62 | 142.40 | -42.26 |
| MA18: Mean monthly flow, July | 220.51 | 178.15 | -19.21 |
| MA19: Mean monthly flow, August | 324.51 | 219.54 | -32.35 |
| MA20: Mean monthly flow, September | 132.75 | 224.42 | 69.06 |
| MA21: Mean monthly flow, October | 121.59 | 117.94 | -3.00 |
| MA22: Mean monthly flow, November | 95.13 | 119.72 | 25.85 |
| MA23: Mean monthly flow, December | 395.76 | 446.45 | 12.81 |
| ML1: Mean minimum monthly flow, January | 210.39 | 254.44 | 20.94 |
| ML2: Mean minimum monthly flow, February | 330.03 | 279.53 | -15.30 |
| ML3: Mean minimum monthly flow, March | 363.02 | 347.43 | -4.29 |
| ML4: Mean minimum monthly flow, April | 209.25 | 169.28 | -19.10 |
| ML5: Mean minimum monthly flow, May | 27.50 | 14.56 | -47.07 |
| ML6: Mean minimum monthly flow, June | 26.76 | 19.87 | -25.76 |
| ML7: Mean minimum monthly flow, July | 45.07 | 39.78 | -11.73 |
| ML8: Mean minimum monthly flow, August | 70.54 | 62.90 | -10.82 |
| ML9: Mean minimum monthly flow, September | 12.97 | 18.61 | 43.52 |
| ML10: Mean minimum monthly flow, October | 16.85 | 24.22 | 43.72 |
| ML11: Mean minimum monthly flow, November | 16.32 | 36.12 | 121.31 |
| ML12: Mean minimum monthly flow, December | 85.03 | 122.52 | 44.08 |
| ML13: CV of minimum monthly flows | 180.96 | 188.14 | 3.96 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.08 | 0.01 | -81.26 |
| ML15: Mean minimum annual flow / mean annual flow | 0.03 | 0.01 | -82.34 |
| ML16: Median minimum annual flow / median annual flow | 0.00 | 0.00 | -95.77 |
| ML20: Ratio of baseflow volume to total flow volume | 0.41 | 0.38 | -8.76 |
| ML22: Mean annual minimum flow divided by catchment area | 0.02 | 0.01 | -49.02 |
| RA1: Mean of positive changes from one day to next (rise rate) | 109.63 | 113.12 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 302.55 | 397.09 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 57.86 | 58.68 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 280.21 | 283.71 |  |
| RA5: Ratio of days that are higher than previous day | 0.32 | 0.34 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.14 | 0.15 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.11 | 0.10 |  |
| RA8: Number of flow reversals from one day to the next | 59.46 | 46.31 |  |
| RA9: CV, number of flow reversals from one day to the next | 38.59 | 40.43 |  |

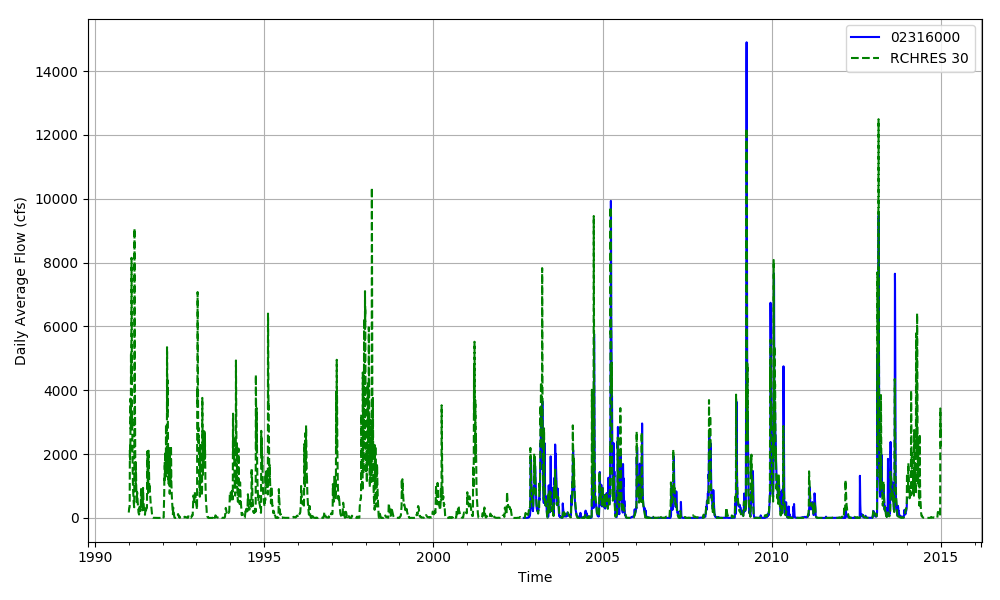


Figure 03110202-7: Daily flow for HSFP reach 30 and USGS station 02316000.

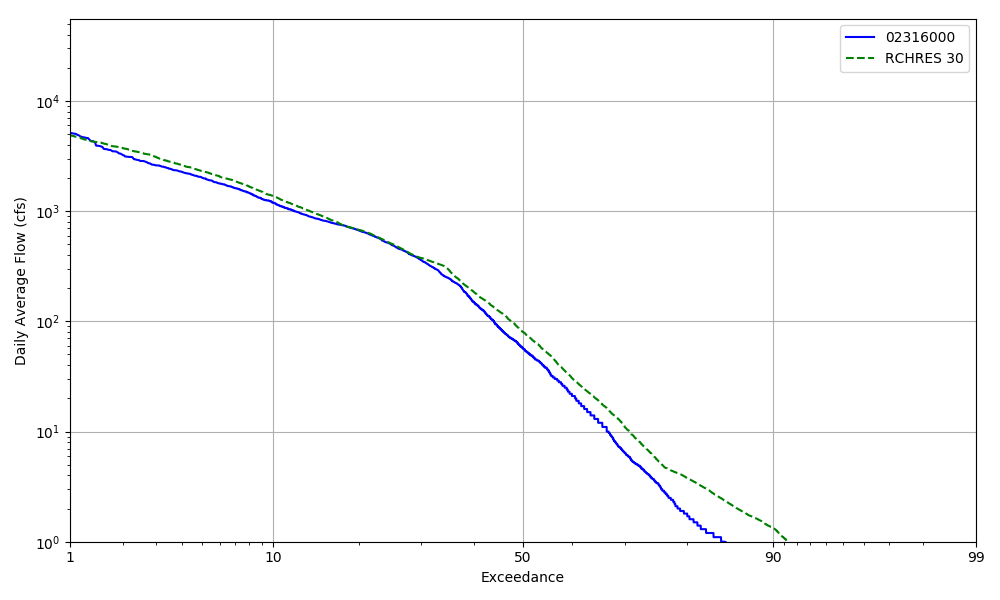


Figure 03110202-8: Daily exceedance for HSFP reach 30 and USGS station 02316000.

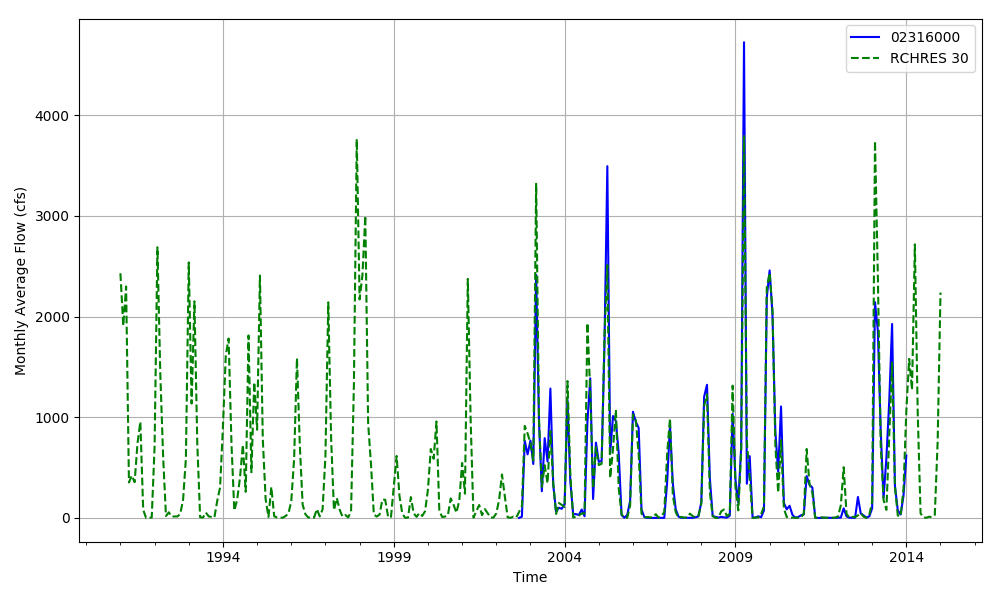


Figure 03110202-9: Monthly flow for HSFP reach 30 and USGS station 02316000.

## HSPF Reach 34, USGS Gauge 02317500

Table 03110202-5: Comparison Statistics Between HSPF Reach 34 and USGS Gauge 02317500.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | -69.27 |
| Standard error | 560.14 |
| Relative bias | -0.06 |
| Relative standard error | 0.34 |
| Nash-Sutcliffe coefficient | 0.88 |
| Kling-Gupta coefficient | 0.83 |
| Coefficient of efficiency | 0.75 |
| Index of agreement | 0.87 |

Table 03110202-6: Hydrologic Indices Between USGS Gauge 02317500 and HSPF Reach 34.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02317500 | Simulated Reach 34 | Percent Difference |
| MA1: Mean, all daily flows | 1065.28 | 995.67 | -6.53 |
| MA2: Median, all daily flows | 277.00 | 317.98 | 14.79 |
| MA3: CV, all daily flows | 139.46 | 138.60 | -0.62 |
| MA4: CV, log of all daily flows | 147.13 | 138.14 | -6.11 |
| MA5: Mean daily flow / median daily flow | 3.85 | 3.13 | -18.58 |
| MA9: (Q10 - Q90) / median daily flow | 10.36 | 8.52 | -17.74 |
| MA10: (Q20 - Q80) / median daily flow | 5.53 | 4.21 | -23.77 |
| MA11: (Q25 - Q75) / median daily flow | 4.00 | 3.23 | -19.35 |
| MA12: Mean monthly flow, January | 1391.15 | 1412.35 | 1.52 |
| MA13: Mean monthly flow, February | 2196.52 | 2246.74 | 2.29 |
| MA14: Mean monthly flow, March | 2682.81 | 2489.04 | -7.22 |
| MA15: Mean monthly flow, April | 1917.81 | 1496.65 | -21.96 |
| MA16: Mean monthly flow, May | 473.30 | 450.95 | -4.72 |
| MA17: Mean monthly flow, June | 459.97 | 335.92 | -26.97 |
| MA18: Mean monthly flow, July | 496.44 | 389.93 | -21.46 |
| MA19: Mean monthly flow, August | 643.12 | 496.80 | -22.75 |
| MA20: Mean monthly flow, September | 470.52 | 480.03 | 2.02 |
| MA21: Mean monthly flow, October | 512.11 | 511.60 | -0.10 |
| MA22: Mean monthly flow, November | 370.06 | 387.86 | 4.81 |
| MA23: Mean monthly flow, December | 753.08 | 869.50 | 15.46 |
| ML1: Mean minimum monthly flow, January | 531.00 | 535.36 | 0.82 |
| ML2: Mean minimum monthly flow, February | 1177.43 | 1024.03 | -13.03 |
| ML3: Mean minimum monthly flow, March | 1107.70 | 1053.67 | -4.88 |
| ML4: Mean minimum monthly flow, April | 644.17 | 645.11 | 0.15 |
| ML5: Mean minimum monthly flow, May | 174.35 | 183.92 | 5.49 |
| ML6: Mean minimum monthly flow, June | 131.87 | 143.35 | 8.71 |
| ML7: Mean minimum monthly flow, July | 237.74 | 200.55 | -15.64 |
| ML8: Mean minimum monthly flow, August | 262.26 | 266.47 | 1.61 |
| ML9: Mean minimum monthly flow, September | 113.13 | 144.82 | 28.01 |
| ML10: Mean minimum monthly flow, October | 136.91 | 170.27 | 24.36 |
| ML11: Mean minimum monthly flow, November | 210.09 | 181.59 | -13.56 |
| ML12: Mean minimum monthly flow, December | 343.87 | 370.53 | 7.75 |
| ML13: CV of minimum monthly flows | 162.67 | 138.36 | -14.95 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.20 | 0.15 | -25.37 |
| ML15: Mean minimum annual flow / mean annual flow | 0.07 | 0.06 | -19.98 |
| ML16: Median minimum annual flow / median annual flow | 0.15 | 0.12 | -19.20 |
| ML20: Ratio of baseflow volume to total flow volume | 0.55 | 0.60 | 9.94 |
| ML22: Mean annual minimum flow divided by catchment area | 0.45 | 0.47 | 4.49 |
| RA1: Mean of positive changes from one day to next (rise rate) | 149.44 | 169.49 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 306.88 | 361.53 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 85.30 | 83.56 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 264.52 | 253.54 |  |
| RA5: Ratio of days that are higher than previous day | 0.34 | 0.33 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.07 | 0.06 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.06 | 0.05 |  |
| RA8: Number of flow reversals from one day to the next | 60.17 | 38.75 |  |
| RA9: CV, number of flow reversals from one day to the next | 23.13 | 26.90 |  |

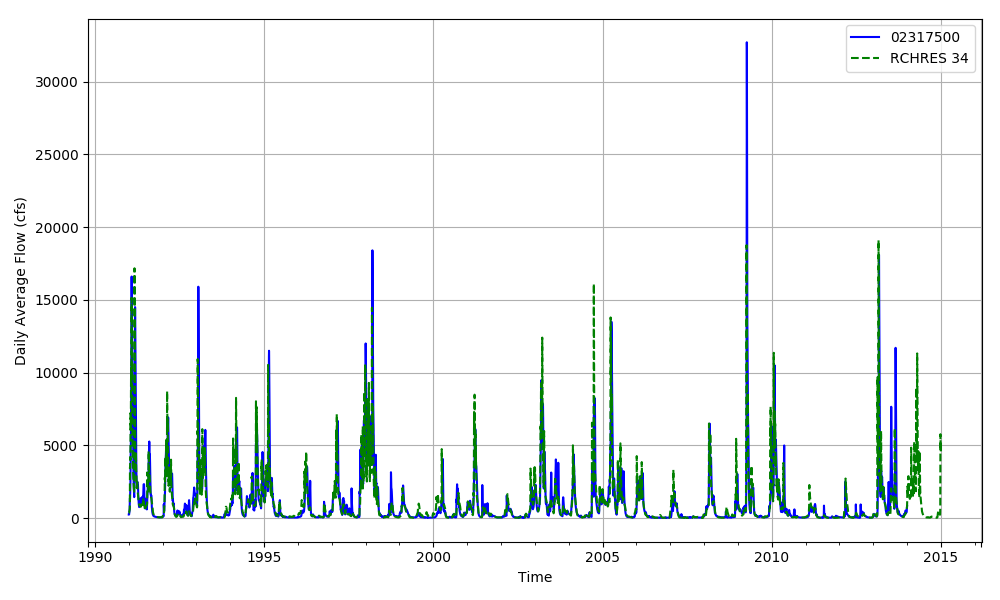


Figure 03110202-10: Daily flow for HSFP reach 34 and USGS station 02317500.

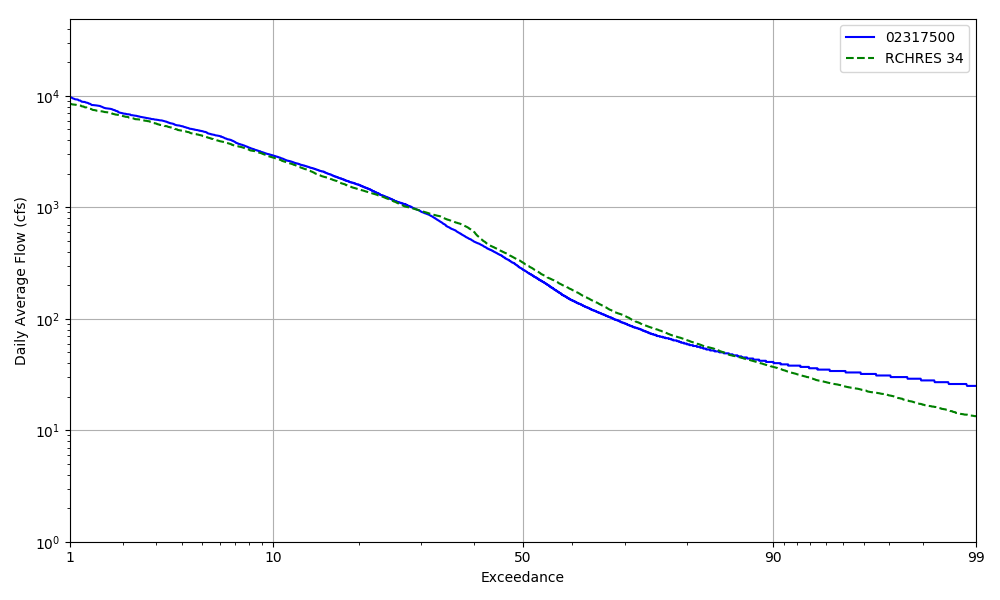


Figure 03110202-11: Daily exceedance for HSFP reach 34 and USGS station 02317500.

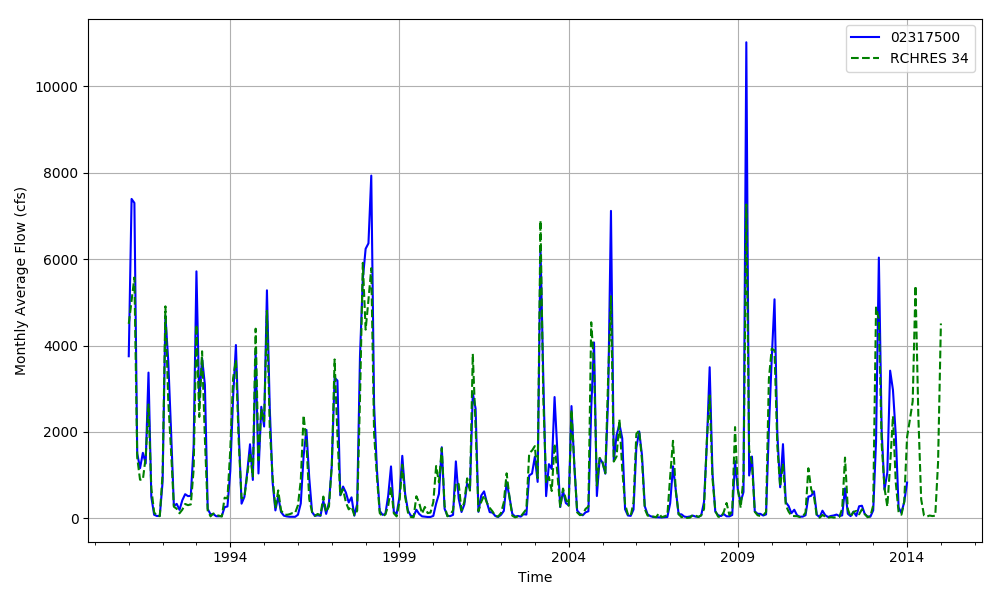


Figure 03110202-12: Monthly flow for HSFP reach 34 and USGS station 02317500.

## HSPF Reach 36, USGS Gauge 02317620

Table 03110202-7: Comparison Statistics Between HSPF Reach 36 and USGS Gauge 02317620.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | -72.49 |
| Standard error | 649.57 |
| Relative bias | -0.07 |
| Relative standard error | 0.40 |
| Nash-Sutcliffe coefficient | 0.84 |
| Kling-Gupta coefficient | 0.82 |
| Coefficient of efficiency | 0.68 |
| Index of agreement | 0.84 |

Table 03110202-8: Hydrologic Indices Between USGS Gauge 02317620 and HSPF Reach 36.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02317620 | Simulated Reach 36 | Percent Difference |
| MA1: Mean, all daily flows | 925.94 | 910.51 | -1.67 |
| MA2: Median, all daily flows | 274.00 | 319.04 | 16.44 |
| MA3: CV, all daily flows | 81.84 | 75.93 | -7.22 |
| MA4: CV, log of all daily flows | 141.76 | 136.52 | -3.70 |
| MA5: Mean daily flow / median daily flow | 3.38 | 2.85 | -15.55 |
| MA9: (Q10 - Q90) / median daily flow | 7.25 | 6.15 | -15.24 |
| MA10: (Q20 - Q80) / median daily flow | 3.71 | 3.43 | -7.48 |
| MA11: (Q25 - Q75) / median daily flow | 2.86 | 2.86 | 0.08 |
| MA12: Mean monthly flow, January | 302.35 | 371.50 | 22.87 |
| MA13: Mean monthly flow, February | 535.74 | 593.10 | 10.71 |
| MA14: Mean monthly flow, March | 973.58 | 1056.41 | 8.51 |
| MA15: Mean monthly flow, April | 1789.77 | 1375.28 | -23.16 |
| MA16: Mean monthly flow, May | 195.87 | 265.55 | 35.57 |
| MA17: Mean monthly flow, June | 352.71 | 265.60 | -24.70 |
| MA18: Mean monthly flow, July | 169.28 | 139.06 | -17.85 |
| MA19: Mean monthly flow, August | 162.99 | 132.14 | -18.93 |
| MA20: Mean monthly flow, September | 82.06 | 127.02 | 54.78 |
| MA21: Mean monthly flow, October | 103.62 | 141.10 | 36.17 |
| MA22: Mean monthly flow, November | 55.52 | 68.96 | 24.20 |
| MA23: Mean monthly flow, December | 243.34 | 341.60 | 40.38 |
| ML1: Mean minimum monthly flow, January | 421.75 | 457.58 | 8.49 |
| ML2: Mean minimum monthly flow, February | 586.25 | 594.32 | 1.38 |
| ML3: Mean minimum monthly flow, March | 675.00 | 636.46 | -5.71 |
| ML4: Mean minimum monthly flow, April | 856.75 | 910.61 | 6.29 |
| ML5: Mean minimum monthly flow, May | 181.50 | 214.18 | 18.00 |
| ML6: Mean minimum monthly flow, June | 123.00 | 142.47 | 15.83 |
| ML7: Mean minimum monthly flow, July | 190.50 | 196.23 | 3.01 |
| ML8: Mean minimum monthly flow, August | 98.75 | 121.86 | 23.40 |
| ML9: Mean minimum monthly flow, September | 105.50 | 142.25 | 34.84 |
| ML10: Mean minimum monthly flow, October | 83.00 | 108.12 | 30.27 |
| ML11: Mean minimum monthly flow, November | 81.00 | 99.02 | 22.24 |
| ML12: Mean minimum monthly flow, December | 216.50 | 273.62 | 26.39 |
| ML13: CV of minimum monthly flows | 133.64 | 132.90 | -0.56 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.10 | 0.08 | -16.85 |
| ML15: Mean minimum annual flow / mean annual flow | 0.03 | 0.02 | -24.61 |
| ML16: Median minimum annual flow / median annual flow | 0.00 | 0.00 |  |
| ML20: Ratio of baseflow volume to total flow volume | 0.43 | 0.69 | 60.14 |
| ML22: Mean annual minimum flow divided by catchment area | 55555.80 | 55555.77 | -0.00 |
| RA1: Mean of positive changes from one day to next (rise rate) | 157.45 | 167.37 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 357.74 | 350.03 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 75.46 | 69.39 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 263.12 | 278.11 |  |
| RA5: Ratio of days that are higher than previous day | 0.31 | 0.29 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.08 | 0.07 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.06 | 0.05 |  |
| RA8: Number of flow reversals from one day to the next | 32.22 | 24.89 |  |
| RA9: CV, number of flow reversals from one day to the next | 119.65 | 124.63 |  |

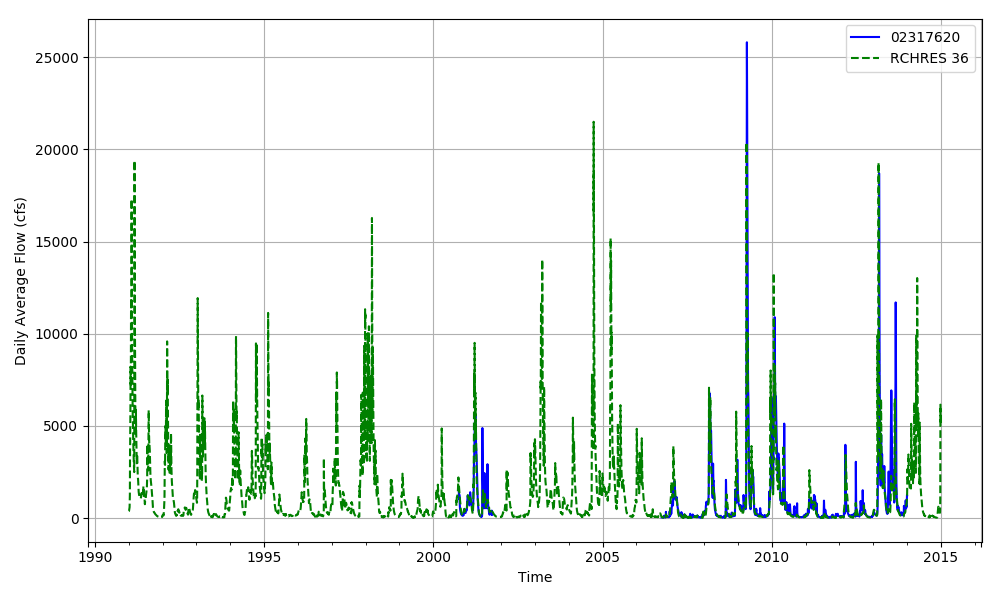


Figure 03110202-13: Daily flow for HSFP reach 36 and USGS station 02317620.

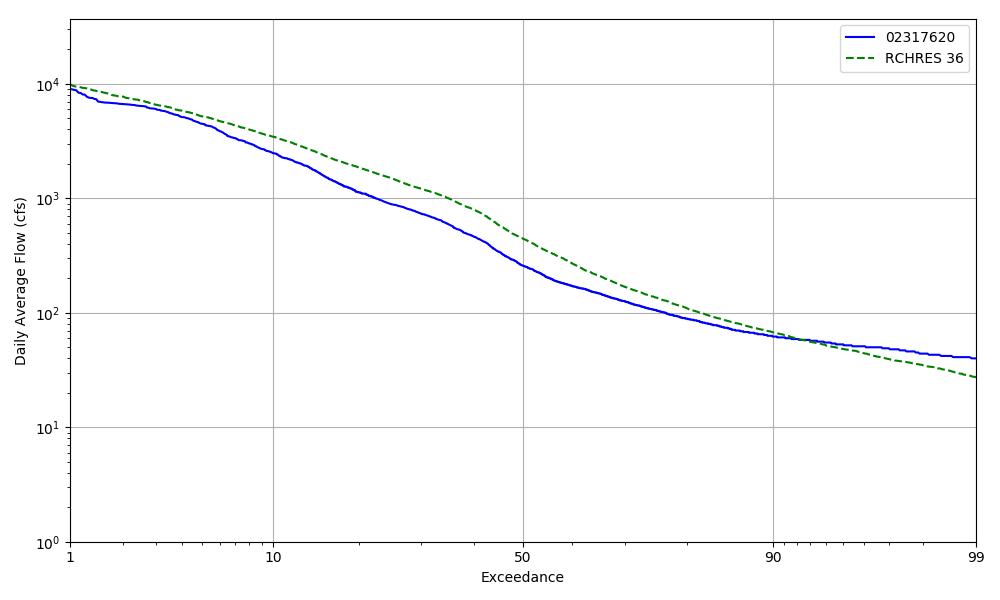


Figure 03110202-14: Daily exceedance for HSFP reach 36 and USGS station 02317620.

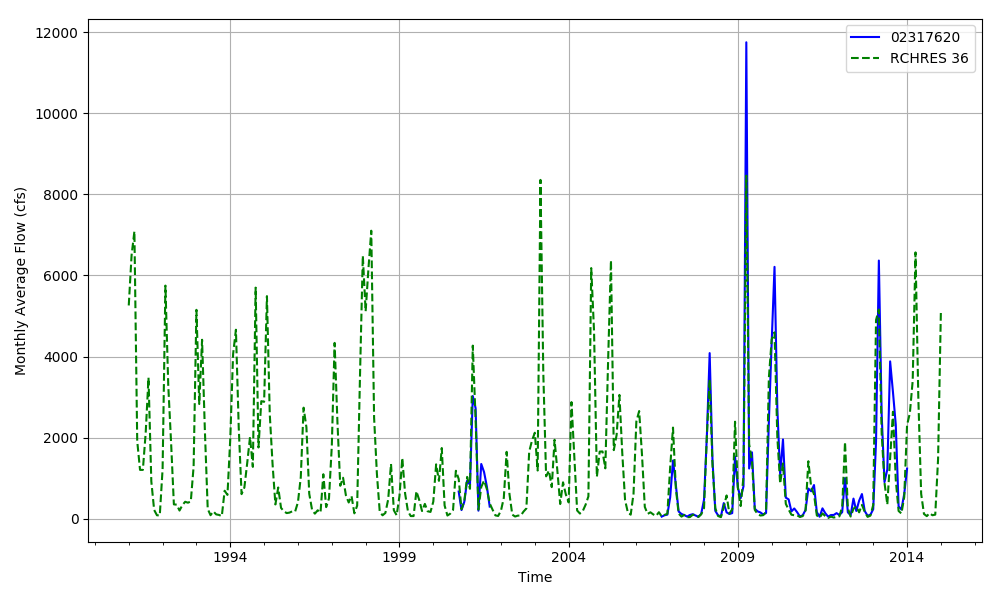


Figure 03110202-15: Monthly flow for HSFP reach 36 and USGS station 02317620.