# Appendix for Model 03130007

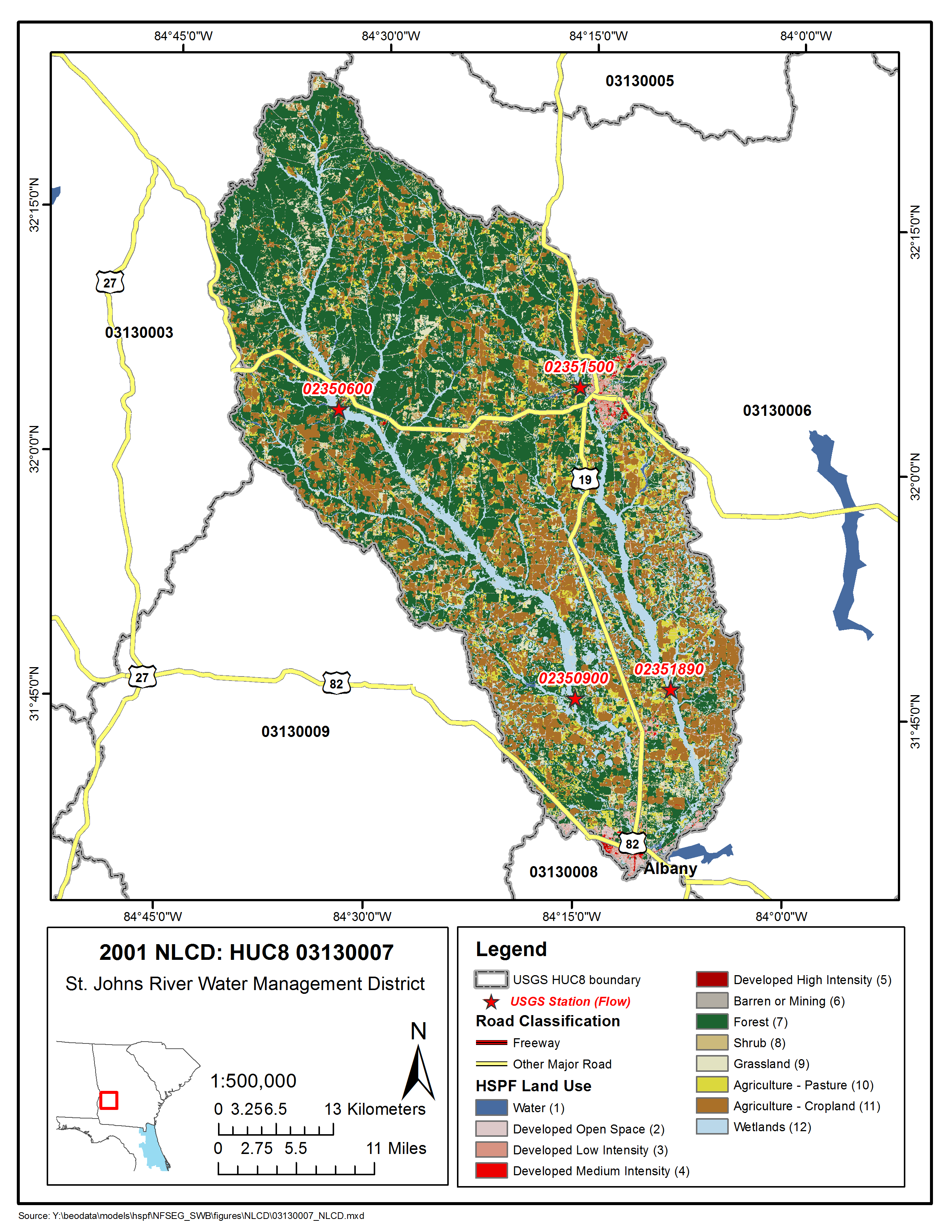


Figure 03130007-1: Land Cover from the National Land Cover Database.

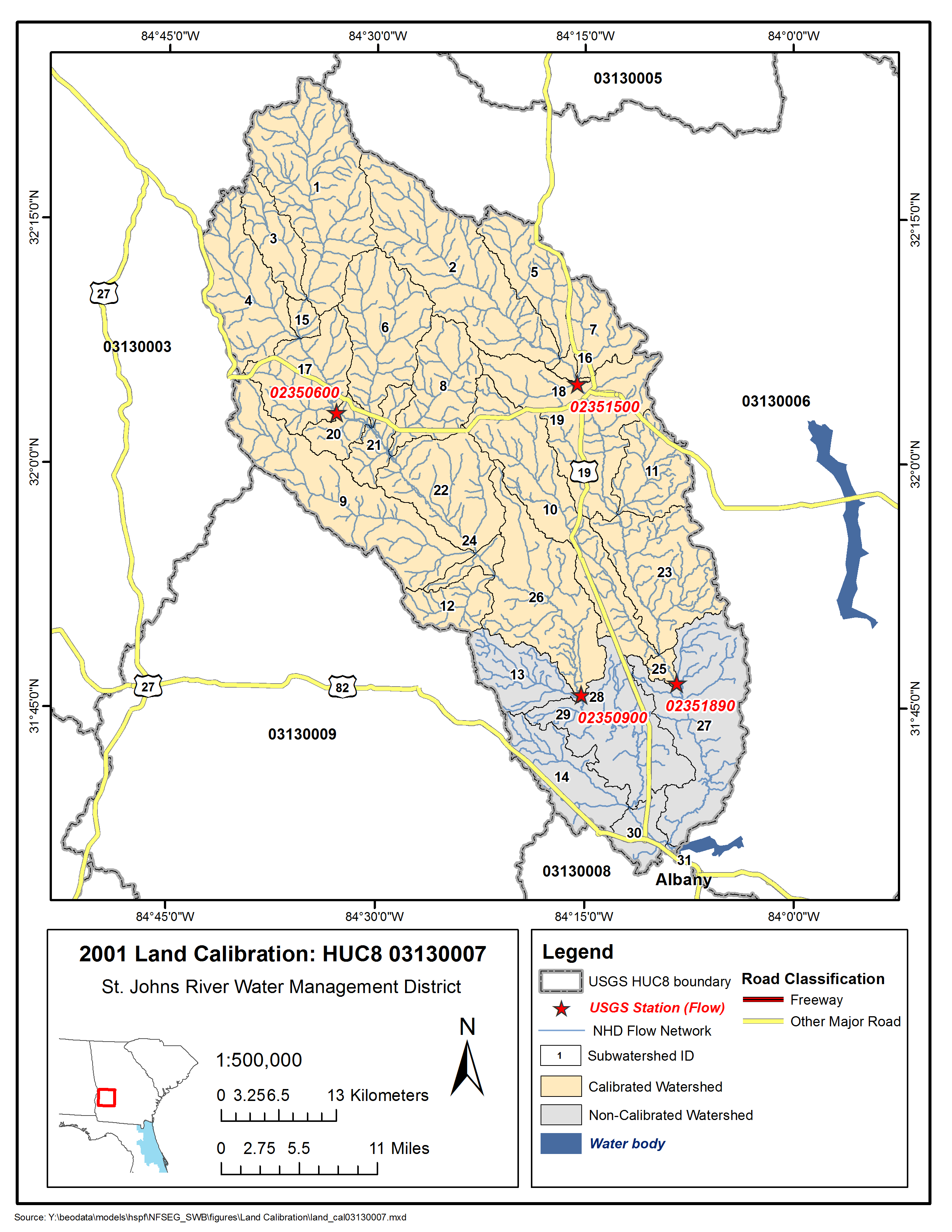


Figure 03130007-2: Calibrated sub-watersheds.

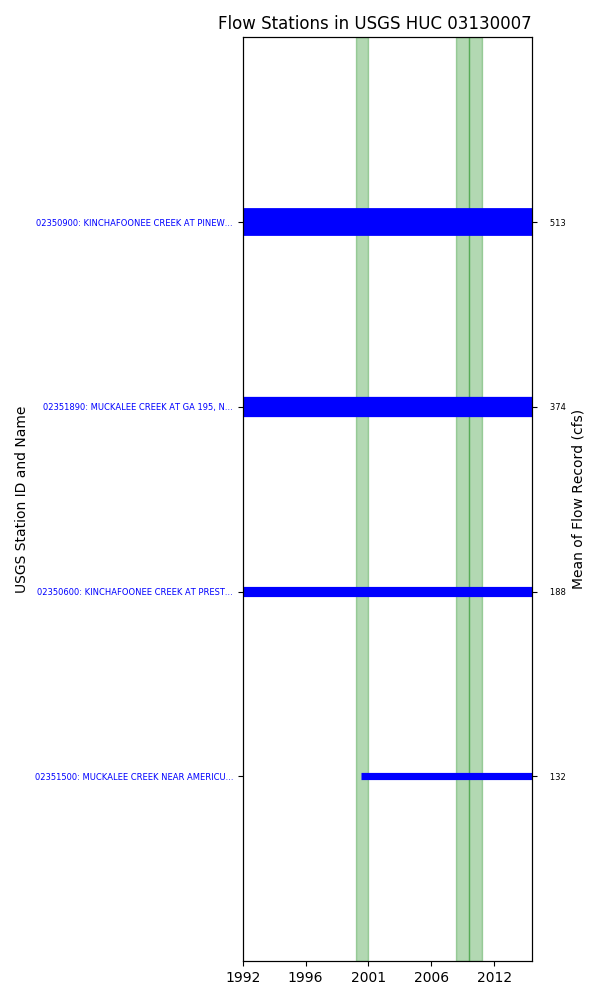


Figure 03130007-3: Station period of record. Blue color identifies gauges used for calibration.

## HSPF Reach 17, USGS Gauge 02350600

Table 03130007-1: Comparison Statistics Between HSPF Reach 17 and USGS Gauge 02350600.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | -18.88 |
| Standard error | 78.93 |
| Relative bias | -0.10 |
| Relative standard error | 0.45 |
| Nash-Sutcliffe coefficient | 0.80 |
| Kling-Gupta coefficient | 0.86 |
| Coefficient of efficiency | 0.63 |
| Index of agreement | 0.81 |

Table 03130007-2: Hydrologic Indices Between USGS Gauge 02350600 and HSPF Reach 17.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02350600 | Simulated Reach 17 | Percent Difference |
| MA1: Mean, all daily flows | 200.88 | 169.79 | -15.48 |
| MA2: Median, all daily flows | 127.00 | 103.51 | -18.49 |
| MA3: CV, all daily flows | 92.74 | 70.78 | -23.68 |
| MA4: CV, log of all daily flows | 82.69 | 83.76 | 1.29 |
| MA5: Mean daily flow / median daily flow | 1.58 | 1.64 | 3.70 |
| MA9: (Q10 - Q90) / median daily flow | 2.86 | 3.06 | 7.04 |
| MA10: (Q20 - Q80) / median daily flow | 1.56 | 1.87 | 19.72 |
| MA11: (Q25 - Q75) / median daily flow | 1.24 | 1.42 | 14.63 |
| MA12: Mean monthly flow, January | 195.88 | 185.85 | -5.12 |
| MA13: Mean monthly flow, February | 256.03 | 226.56 | -11.51 |
| MA14: Mean monthly flow, March | 290.38 | 257.88 | -11.19 |
| MA15: Mean monthly flow, April | 196.46 | 159.05 | -19.04 |
| MA16: Mean monthly flow, May | 104.80 | 86.87 | -17.11 |
| MA17: Mean monthly flow, June | 77.41 | 53.37 | -31.06 |
| MA18: Mean monthly flow, July | 108.67 | 59.46 | -45.28 |
| MA19: Mean monthly flow, August | 57.16 | 43.58 | -23.75 |
| MA20: Mean monthly flow, September | 54.37 | 49.66 | -8.66 |
| MA21: Mean monthly flow, October | 68.75 | 57.67 | -16.10 |
| MA22: Mean monthly flow, November | 113.15 | 98.84 | -12.65 |
| MA23: Mean monthly flow, December | 149.78 | 135.60 | -9.47 |
| ML1: Mean minimum monthly flow, January | 146.50 | 136.27 | -6.98 |
| ML2: Mean minimum monthly flow, February | 171.92 | 177.44 | 3.21 |
| ML3: Mean minimum monthly flow, March | 176.67 | 181.57 | 2.77 |
| ML4: Mean minimum monthly flow, April | 121.25 | 138.07 | 13.87 |
| ML5: Mean minimum monthly flow, May | 68.92 | 77.25 | 12.09 |
| ML6: Mean minimum monthly flow, June | 49.17 | 51.81 | 5.37 |
| ML7: Mean minimum monthly flow, July | 42.00 | 40.21 | -4.27 |
| ML8: Mean minimum monthly flow, August | 40.17 | 49.46 | 23.15 |
| ML9: Mean minimum monthly flow, September | 39.58 | 48.90 | 23.55 |
| ML10: Mean minimum monthly flow, October | 55.36 | 56.71 | 2.43 |
| ML11: Mean minimum monthly flow, November | 87.09 | 77.01 | -11.58 |
| ML12: Mean minimum monthly flow, December | 132.18 | 126.23 | -4.50 |
| ML13: CV of minimum monthly flows | 71.80 | 74.06 | 3.15 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.15 | 0.18 | 15.74 |
| ML15: Mean minimum annual flow / mean annual flow | 0.10 | 0.12 | 17.87 |
| ML16: Median minimum annual flow / median annual flow | 0.18 | 0.21 | 19.99 |
| ML20: Ratio of baseflow volume to total flow volume | 0.55 | 0.68 | 23.67 |
| ML22: Mean annual minimum flow divided by catchment area | 29411.97 | 29411.97 | 0.00 |
| RA1: Mean of positive changes from one day to next (rise rate) | 93.34 | 37.38 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 307.92 | 375.83 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 50.31 | 16.81 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 338.05 | 278.46 |  |
| RA5: Ratio of days that are higher than previous day | 0.33 | 0.31 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.17 | 0.05 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.09 | 0.04 |  |
| RA8: Number of flow reversals from one day to the next | 69.00 | 63.41 |  |
| RA9: CV, number of flow reversals from one day to the next | 67.22 | 69.23 |  |

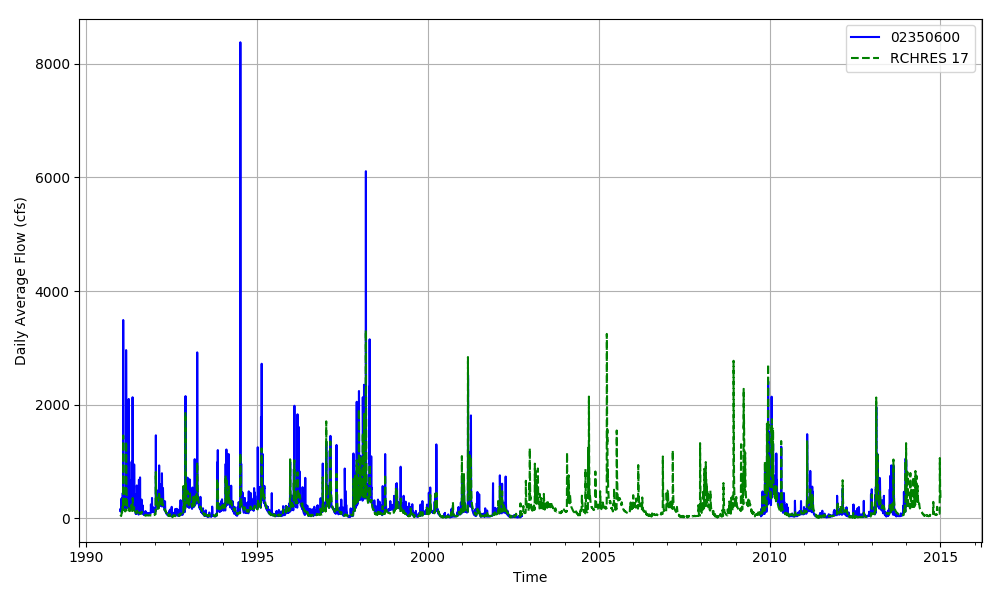


Figure 03130007-4: Daily flow for HSFP reach 17 and USGS station 02350600.

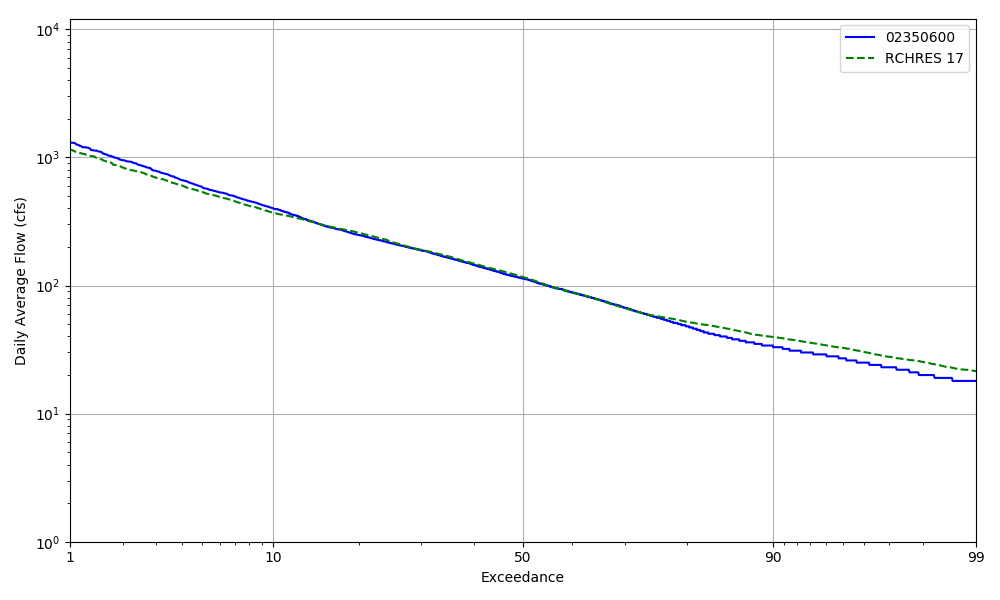


Figure 03130007-5: Daily exceedance for HSFP reach 17 and USGS station 02350600.

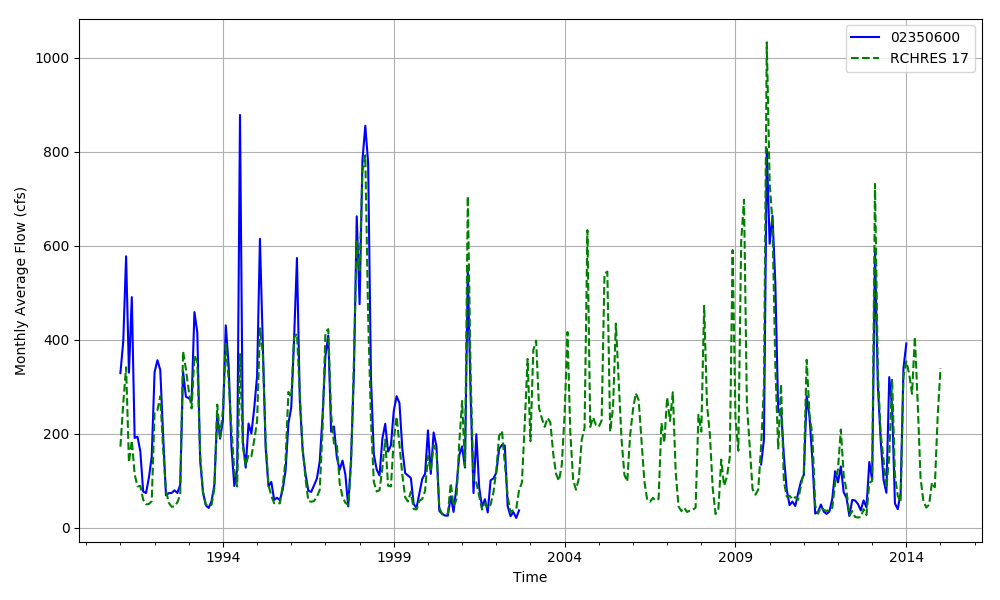


Figure 03130007-6: Monthly flow for HSFP reach 17 and USGS station 02350600.

## HSPF Reach 18, USGS Gauge 02351500

Table 03130007-3: Comparison Statistics Between HSPF Reach 18 and USGS Gauge 02351500.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | 3.36 |
| Standard error | 47.86 |
| Relative bias | 0.03 |
| Relative standard error | 0.47 |
| Nash-Sutcliffe coefficient | 0.78 |
| Kling-Gupta coefficient | 0.72 |
| Coefficient of efficiency | 0.58 |
| Index of agreement | 0.81 |

Table 03130007-4: Hydrologic Indices Between USGS Gauge 02351500 and HSPF Reach 18.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02351500 | Simulated Reach 18 | Percent Difference |
| MA1: Mean, all daily flows | 131.06 | 132.93 | 1.42 |
| MA2: Median, all daily flows | 83.00 | 81.13 | -2.25 |
| MA3: CV, all daily flows | 116.04 | 121.78 | 4.95 |
| MA4: CV, log of all daily flows | 92.98 | 90.20 | -2.99 |
| MA5: Mean daily flow / median daily flow | 1.58 | 1.64 | 3.76 |
| MA9: (Q10 - Q90) / median daily flow | 3.22 | 2.99 | -7.16 |
| MA10: (Q20 - Q80) / median daily flow | 1.64 | 1.69 | 3.08 |
| MA11: (Q25 - Q75) / median daily flow | 1.27 | 1.33 | 4.86 |
| MA12: Mean monthly flow, January | 178.96 | 179.68 | 0.40 |
| MA13: Mean monthly flow, February | 195.44 | 219.42 | 12.27 |
| MA14: Mean monthly flow, March | 178.24 | 193.89 | 8.78 |
| MA15: Mean monthly flow, April | 146.58 | 146.44 | -0.10 |
| MA16: Mean monthly flow, May | 77.30 | 80.13 | 3.66 |
| MA17: Mean monthly flow, June | 79.71 | 64.84 | -18.65 |
| MA18: Mean monthly flow, July | 77.33 | 78.28 | 1.22 |
| MA19: Mean monthly flow, August | 77.68 | 83.02 | 6.89 |
| MA20: Mean monthly flow, September | 77.42 | 91.08 | 17.65 |
| MA21: Mean monthly flow, October | 67.06 | 63.09 | -5.93 |
| MA22: Mean monthly flow, November | 100.15 | 75.74 | -24.37 |
| MA23: Mean monthly flow, December | 184.18 | 201.12 | 9.20 |
| ML1: Mean minimum monthly flow, January | 105.54 | 115.29 | 9.24 |
| ML2: Mean minimum monthly flow, February | 99.17 | 107.68 | 8.59 |
| ML3: Mean minimum monthly flow, March | 98.83 | 104.42 | 5.65 |
| ML4: Mean minimum monthly flow, April | 65.83 | 83.13 | 26.27 |
| ML5: Mean minimum monthly flow, May | 32.59 | 45.49 | 39.58 |
| ML6: Mean minimum monthly flow, June | 25.47 | 36.47 | 43.20 |
| ML7: Mean minimum monthly flow, July | 25.36 | 36.86 | 45.35 |
| ML8: Mean minimum monthly flow, August | 28.64 | 45.35 | 58.36 |
| ML9: Mean minimum monthly flow, September | 25.69 | 42.91 | 67.02 |
| ML10: Mean minimum monthly flow, October | 38.00 | 44.60 | 17.36 |
| ML11: Mean minimum monthly flow, November | 54.38 | 49.74 | -8.53 |
| ML12: Mean minimum monthly flow, December | 75.69 | 66.49 | -12.16 |
| ML13: CV of minimum monthly flows | 76.72 | 87.10 | 13.53 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.24 | 0.27 | 12.10 |
| ML15: Mean minimum annual flow / mean annual flow | 0.14 | 0.15 | 8.72 |
| ML16: Median minimum annual flow / median annual flow | 0.19 | 0.19 | 0.19 |
| ML20: Ratio of baseflow volume to total flow volume | 0.50 | 0.58 | 14.28 |
| ML22: Mean annual minimum flow divided by catchment area | 0.19 | 0.22 | 15.51 |
| RA1: Mean of positive changes from one day to next (rise rate) | 58.45 | 41.89 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 219.97 | 402.57 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 32.29 | 16.90 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 262.42 | 284.28 |  |
| RA5: Ratio of days that are higher than previous day | 0.34 | 0.29 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.18 | 0.07 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.12 | 0.05 |  |
| RA8: Number of flow reversals from one day to the next | 93.36 | 87.00 |  |
| RA9: CV, number of flow reversals from one day to the next | 27.37 | 30.61 |  |

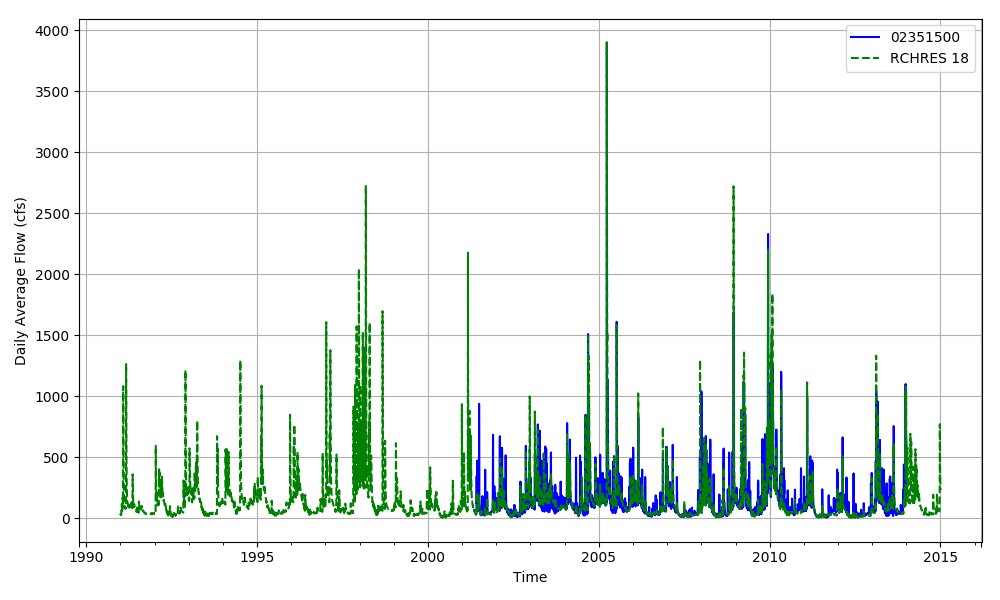


Figure 03130007-7: Daily flow for HSFP reach 18 and USGS station 02351500.

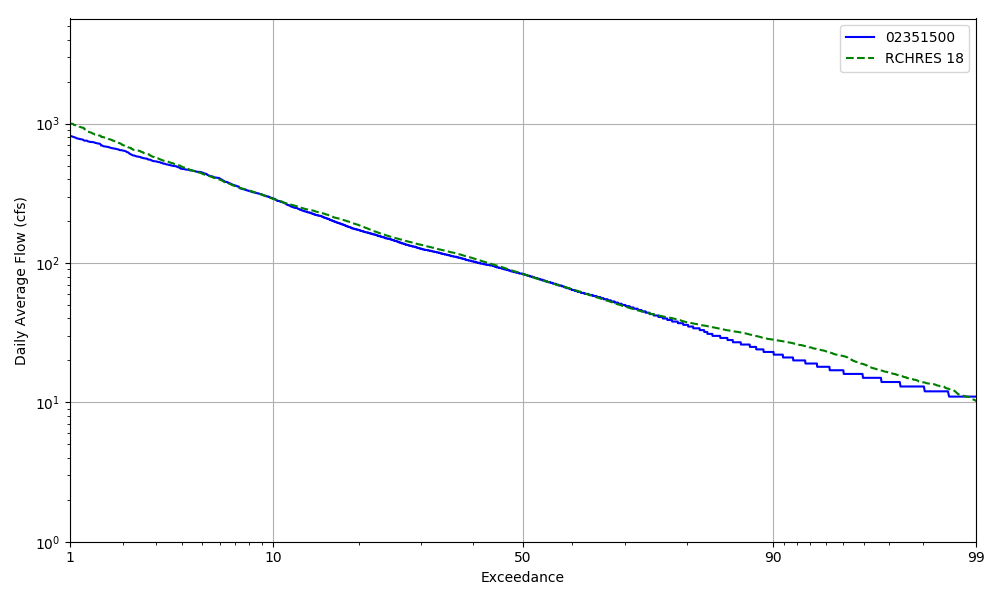


Figure 03130007-8: Daily exceedance for HSFP reach 18 and USGS station 02351500.

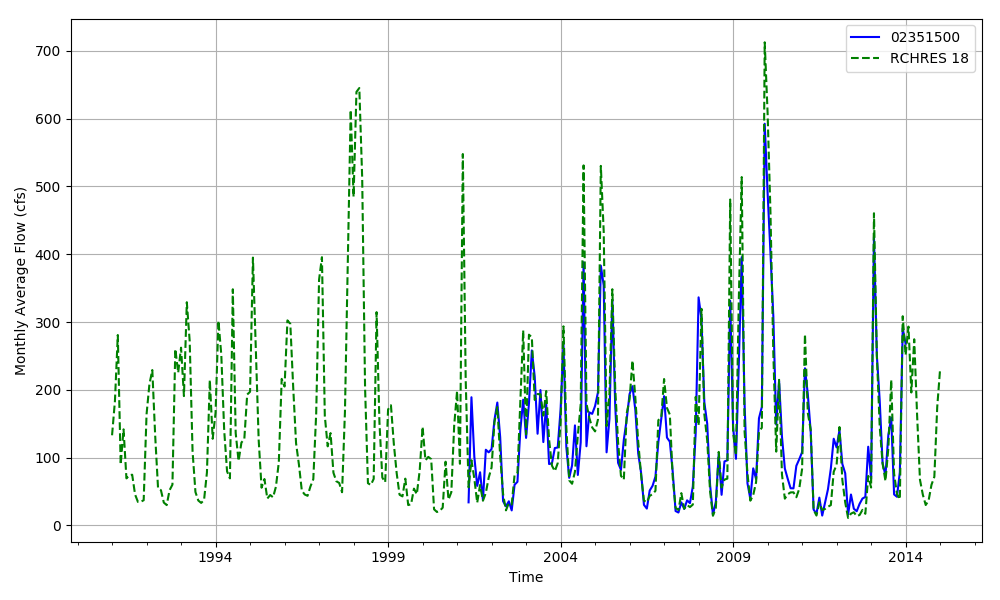


Figure 03130007-9: Monthly flow for HSFP reach 18 and USGS station 02351500.

## HSPF Reach 25, USGS Gauge 02351890

Table 03130007-5: Comparison Statistics Between HSPF Reach 25 and USGS Gauge 02351890.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | -9.73 |
| Standard error | 181.83 |
| Relative bias | -0.03 |
| Relative standard error | 0.48 |
| Nash-Sutcliffe coefficient | 0.77 |
| Kling-Gupta coefficient | 0.84 |
| Coefficient of efficiency | 0.68 |
| Index of agreement | 0.84 |

Table 03130007-6: Hydrologic Indices Between USGS Gauge 02351890 and HSPF Reach 25.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02351890 | Simulated Reach 25 | Percent Difference |
| MA1: Mean, all daily flows | 377.02 | 367.02 | -2.65 |
| MA2: Median, all daily flows | 223.00 | 226.62 | 1.63 |
| MA3: CV, all daily flows | 128.08 | 114.28 | -10.77 |
| MA4: CV, log of all daily flows | 88.21 | 86.75 | -1.66 |
| MA5: Mean daily flow / median daily flow | 1.69 | 1.62 | -4.21 |
| MA9: (Q10 - Q90) / median daily flow | 3.20 | 3.03 | -5.36 |
| MA10: (Q20 - Q80) / median daily flow | 1.83 | 1.68 | -8.20 |
| MA11: (Q25 - Q75) / median daily flow | 1.39 | 1.32 | -5.12 |
| MA12: Mean monthly flow, January | 542.49 | 558.57 | 2.97 |
| MA13: Mean monthly flow, February | 622.20 | 654.51 | 5.19 |
| MA14: Mean monthly flow, March | 670.29 | 639.42 | -4.61 |
| MA15: Mean monthly flow, April | 478.32 | 437.00 | -8.64 |
| MA16: Mean monthly flow, May | 260.41 | 225.82 | -13.28 |
| MA17: Mean monthly flow, June | 213.91 | 178.73 | -16.45 |
| MA18: Mean monthly flow, July | 325.88 | 216.91 | -33.44 |
| MA19: Mean monthly flow, August | 190.20 | 198.44 | 4.33 |
| MA20: Mean monthly flow, September | 198.50 | 239.63 | 20.72 |
| MA21: Mean monthly flow, October | 185.29 | 190.71 | 2.93 |
| MA22: Mean monthly flow, November | 247.12 | 253.90 | 2.74 |
| MA23: Mean monthly flow, December | 469.12 | 497.75 | 6.10 |
| ML1: Mean minimum monthly flow, January | 321.54 | 290.18 | -9.75 |
| ML2: Mean minimum monthly flow, February | 315.61 | 309.42 | -1.96 |
| ML3: Mean minimum monthly flow, March | 314.09 | 312.25 | -0.59 |
| ML4: Mean minimum monthly flow, April | 215.13 | 226.22 | 5.16 |
| ML5: Mean minimum monthly flow, May | 109.91 | 110.59 | 0.61 |
| ML6: Mean minimum monthly flow, June | 79.16 | 88.34 | 11.60 |
| ML7: Mean minimum monthly flow, July | 86.48 | 88.49 | 2.33 |
| ML8: Mean minimum monthly flow, August | 83.10 | 114.97 | 38.35 |
| ML9: Mean minimum monthly flow, September | 74.93 | 109.08 | 45.57 |
| ML10: Mean minimum monthly flow, October | 106.57 | 120.24 | 12.83 |
| ML11: Mean minimum monthly flow, November | 146.43 | 149.50 | 2.10 |
| ML12: Mean minimum monthly flow, December | 224.91 | 215.87 | -4.02 |
| ML13: CV of minimum monthly flows | 87.97 | 82.25 | -6.49 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.20 | 0.23 | 13.12 |
| ML15: Mean minimum annual flow / mean annual flow | 0.13 | 0.14 | 9.15 |
| ML16: Median minimum annual flow / median annual flow | 0.18 | 0.19 | 9.24 |
| ML20: Ratio of baseflow volume to total flow volume | 0.54 | 0.58 | 7.76 |
| ML22: Mean annual minimum flow divided by catchment area | 0.50 | 0.56 | 11.83 |
| RA1: Mean of positive changes from one day to next (rise rate) | 101.64 | 107.17 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 547.23 | 372.21 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 64.77 | 45.15 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 627.31 | 279.53 |  |
| RA5: Ratio of days that are higher than previous day | 0.38 | 0.30 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.11 | 0.07 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.08 | 0.05 |  |
| RA8: Number of flow reversals from one day to the next | 81.71 | 77.08 |  |
| RA9: CV, number of flow reversals from one day to the next | 16.72 | 20.82 |  |

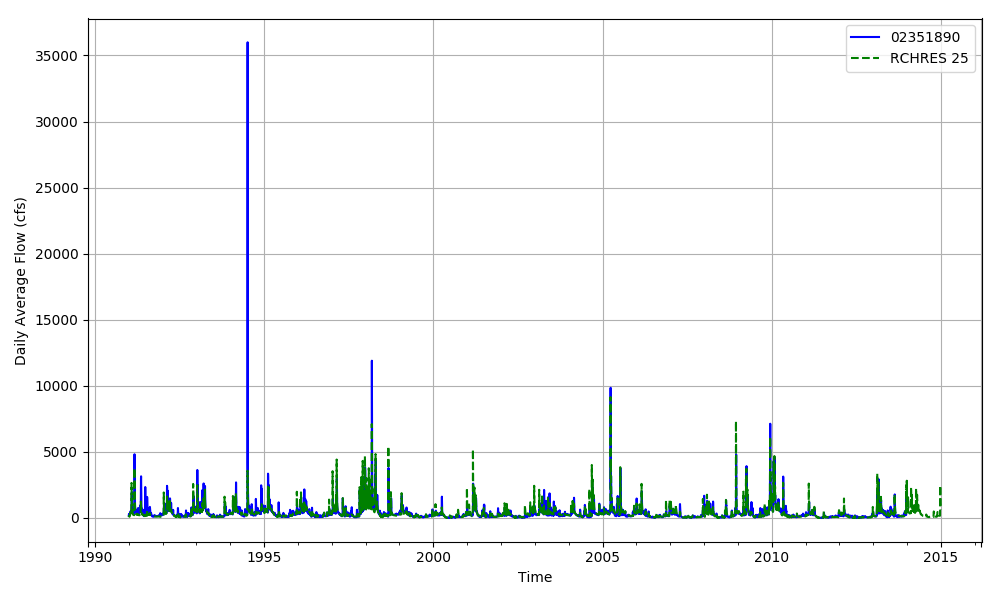


Figure 03130007-10: Daily flow for HSFP reach 25 and USGS station 02351890.

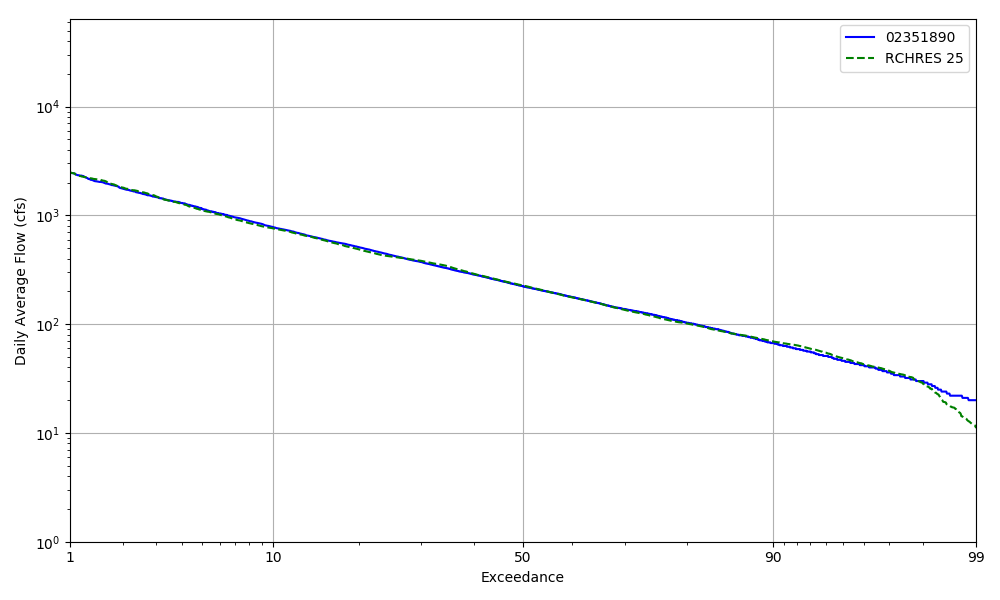


Figure 03130007-11: Daily exceedance for HSFP reach 25 and USGS station 02351890.

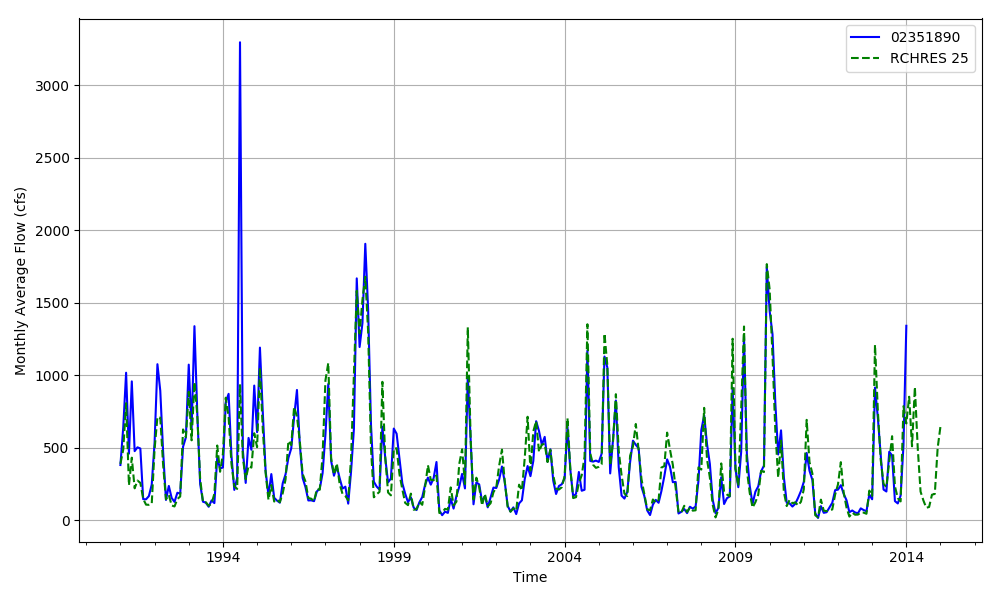


Figure 03130007-12: Monthly flow for HSFP reach 25 and USGS station 02351890.

## HSPF Reach 26, USGS Gauge 02350900

Table 03130007-7: Comparison Statistics Between HSPF Reach 26 and USGS Gauge 02350900.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | -13.79 |
| Standard error | 196.65 |
| Relative bias | -0.03 |
| Relative standard error | 0.40 |
| Nash-Sutcliffe coefficient | 0.84 |
| Kling-Gupta coefficient | 0.89 |
| Coefficient of efficiency | 0.69 |
| Index of agreement | 0.84 |

Table 03130007-8: Hydrologic Indices Between USGS Gauge 02350900 and HSPF Reach 26.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02350900 | Simulated Reach 26 | Percent Difference |
| MA1: Mean, all daily flows | 516.16 | 502.23 | -2.70 |
| MA2: Median, all daily flows | 329.00 | 320.04 | -2.72 |
| MA3: CV, all daily flows | 109.35 | 106.32 | -2.77 |
| MA4: CV, log of all daily flows | 86.53 | 83.83 | -3.12 |
| MA5: Mean daily flow / median daily flow | 1.57 | 1.57 | 0.02 |
| MA9: (Q10 - Q90) / median daily flow | 2.98 | 2.86 | -3.86 |
| MA10: (Q20 - Q80) / median daily flow | 1.76 | 1.69 | -3.85 |
| MA11: (Q25 - Q75) / median daily flow | 1.34 | 1.30 | -2.86 |
| MA12: Mean monthly flow, January | 744.35 | 747.75 | 0.46 |
| MA13: Mean monthly flow, February | 885.77 | 916.85 | 3.51 |
| MA14: Mean monthly flow, March | 938.74 | 907.35 | -3.34 |
| MA15: Mean monthly flow, April | 689.21 | 625.56 | -9.24 |
| MA16: Mean monthly flow, May | 366.53 | 330.43 | -9.85 |
| MA17: Mean monthly flow, June | 273.74 | 237.30 | -13.31 |
| MA18: Mean monthly flow, July | 414.76 | 285.75 | -31.10 |
| MA19: Mean monthly flow, August | 259.95 | 267.53 | 2.92 |
| MA20: Mean monthly flow, September | 244.29 | 289.95 | 18.69 |
| MA21: Mean monthly flow, October | 235.01 | 248.57 | 5.77 |
| MA22: Mean monthly flow, November | 332.36 | 350.06 | 5.33 |
| MA23: Mean monthly flow, December | 645.34 | 663.81 | 2.86 |
| ML1: Mean minimum monthly flow, January | 453.58 | 420.79 | -7.23 |
| ML2: Mean minimum monthly flow, February | 485.61 | 478.65 | -1.43 |
| ML3: Mean minimum monthly flow, March | 482.26 | 473.37 | -1.84 |
| ML4: Mean minimum monthly flow, April | 339.13 | 354.25 | 4.46 |
| ML5: Mean minimum monthly flow, May | 172.96 | 187.30 | 8.29 |
| ML6: Mean minimum monthly flow, June | 117.26 | 139.87 | 19.28 |
| ML7: Mean minimum monthly flow, July | 130.78 | 137.76 | 5.34 |
| ML8: Mean minimum monthly flow, August | 129.39 | 171.38 | 32.45 |
| ML9: Mean minimum monthly flow, September | 110.74 | 159.44 | 43.98 |
| ML10: Mean minimum monthly flow, October | 137.78 | 170.26 | 23.57 |
| ML11: Mean minimum monthly flow, November | 193.00 | 210.02 | 8.82 |
| ML12: Mean minimum monthly flow, December | 310.70 | 314.11 | 1.10 |
| ML13: CV of minimum monthly flows | 85.42 | 78.53 | -8.06 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.22 | 0.24 | 7.02 |
| ML15: Mean minimum annual flow / mean annual flow | 0.15 | 0.15 | 4.44 |
| ML16: Median minimum annual flow / median annual flow | 0.19 | 0.20 | 7.11 |
| ML20: Ratio of baseflow volume to total flow volume | 0.59 | 0.64 | 7.37 |
| ML22: Mean annual minimum flow divided by catchment area | 0.74 | 0.83 | 12.53 |
| RA1: Mean of positive changes from one day to next (rise rate) | 122.79 | 117.25 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 319.25 | 382.06 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 69.41 | 54.07 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 349.54 | 277.09 |  |
| RA5: Ratio of days that are higher than previous day | 0.35 | 0.32 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.10 | 0.05 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.07 | 0.04 |  |
| RA8: Number of flow reversals from one day to the next | 81.12 | 70.33 |  |
| RA9: CV, number of flow reversals from one day to the next | 16.52 | 22.17 |  |

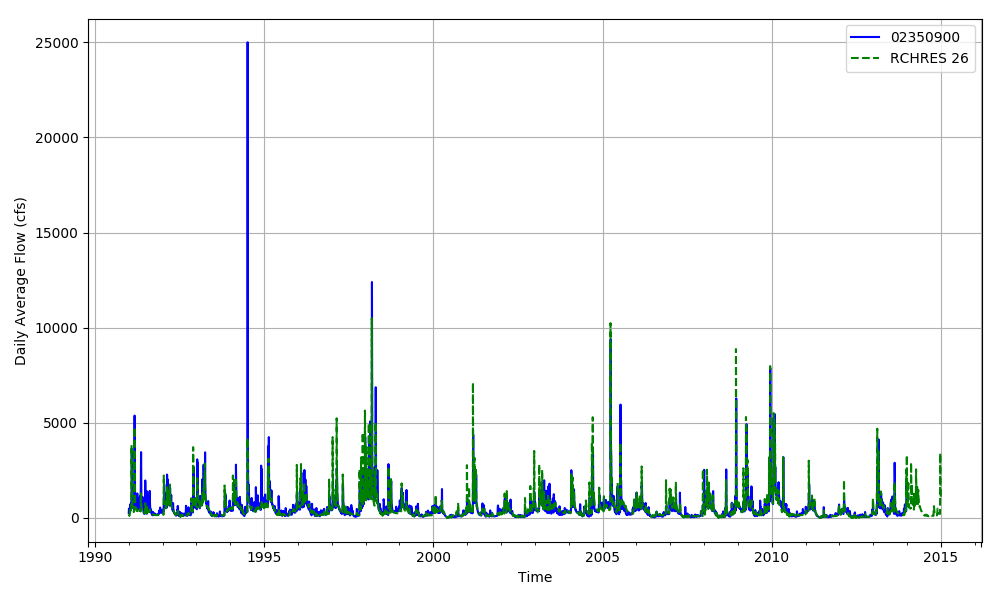


Figure 03130007-13: Daily flow for HSFP reach 26 and USGS station 02350900.

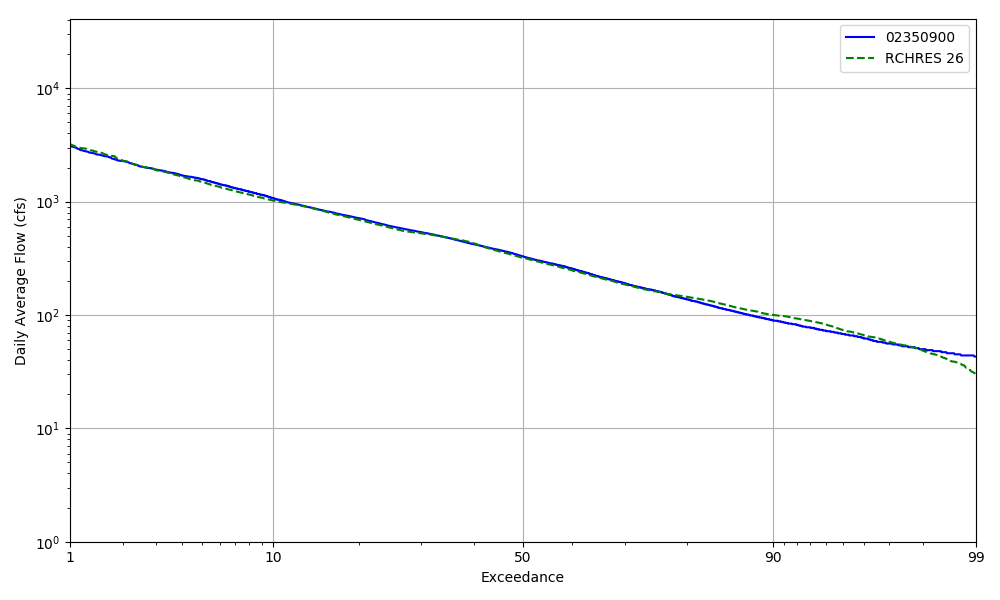


Figure 03130007-14: Daily exceedance for HSFP reach 26 and USGS station 02350900.

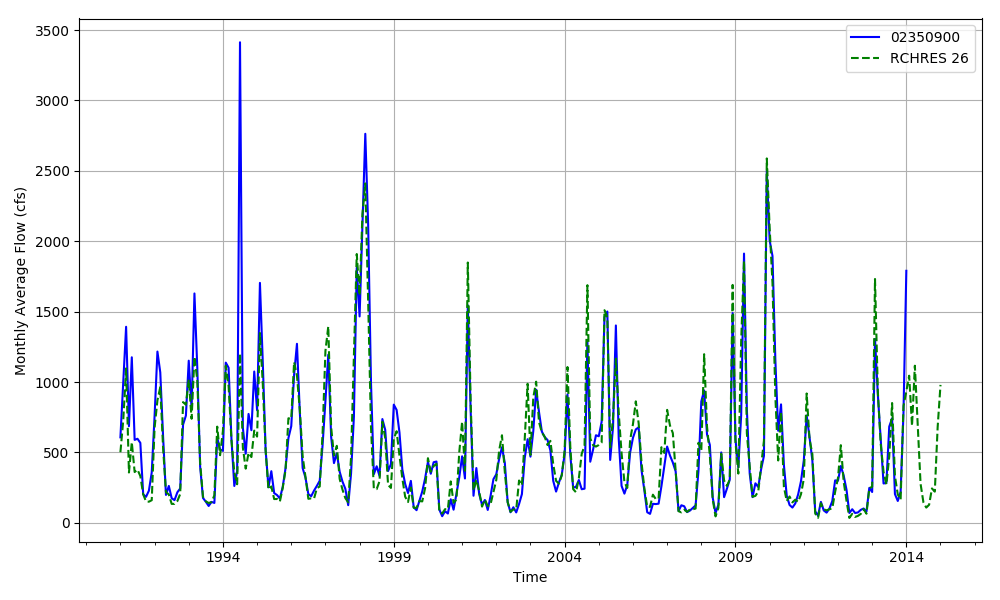


Figure 03130007-15: Monthly flow for HSFP reach 26 and USGS station 02350900.