# Appendix for Model 03130005

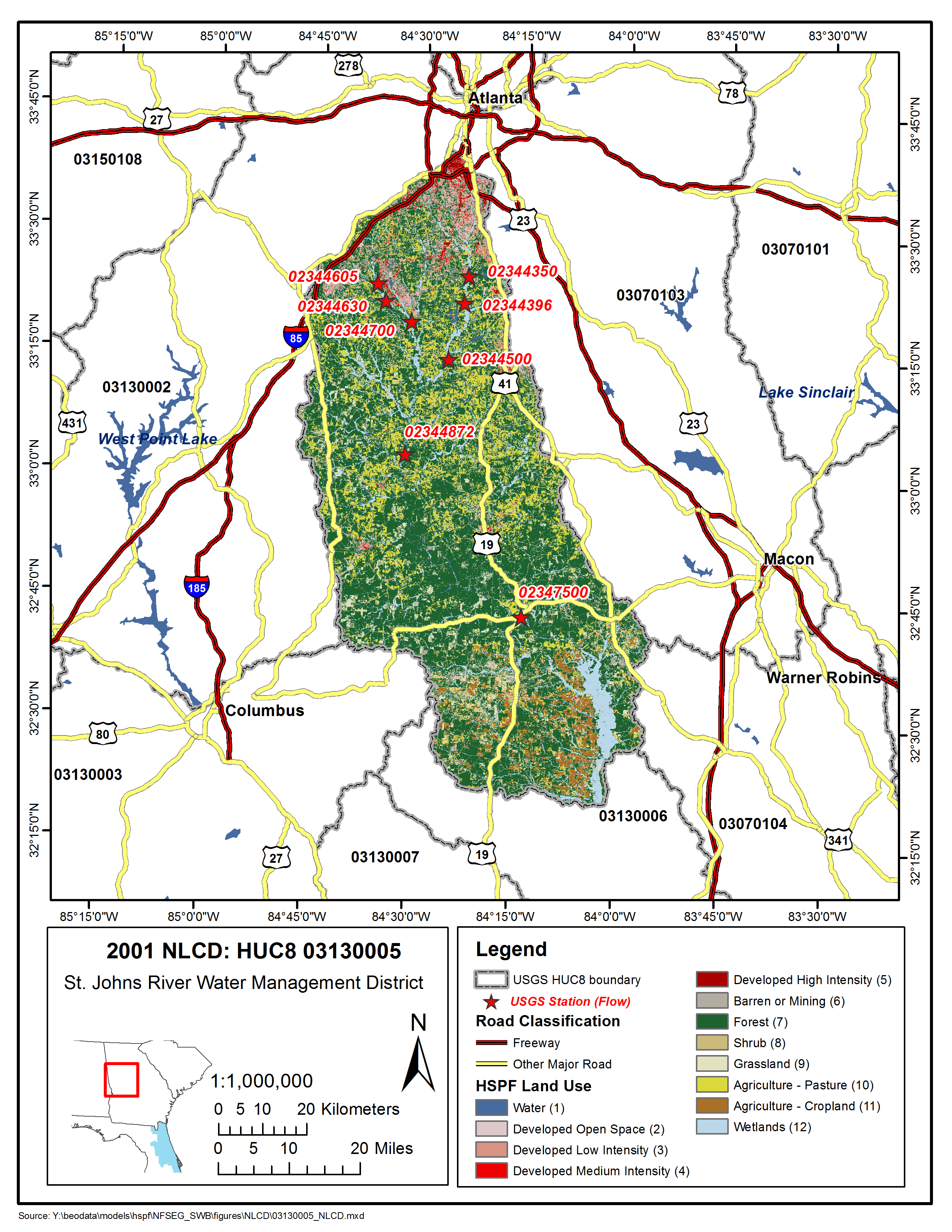


Figure 03130005-1: Land Cover from the National Land Cover Database.

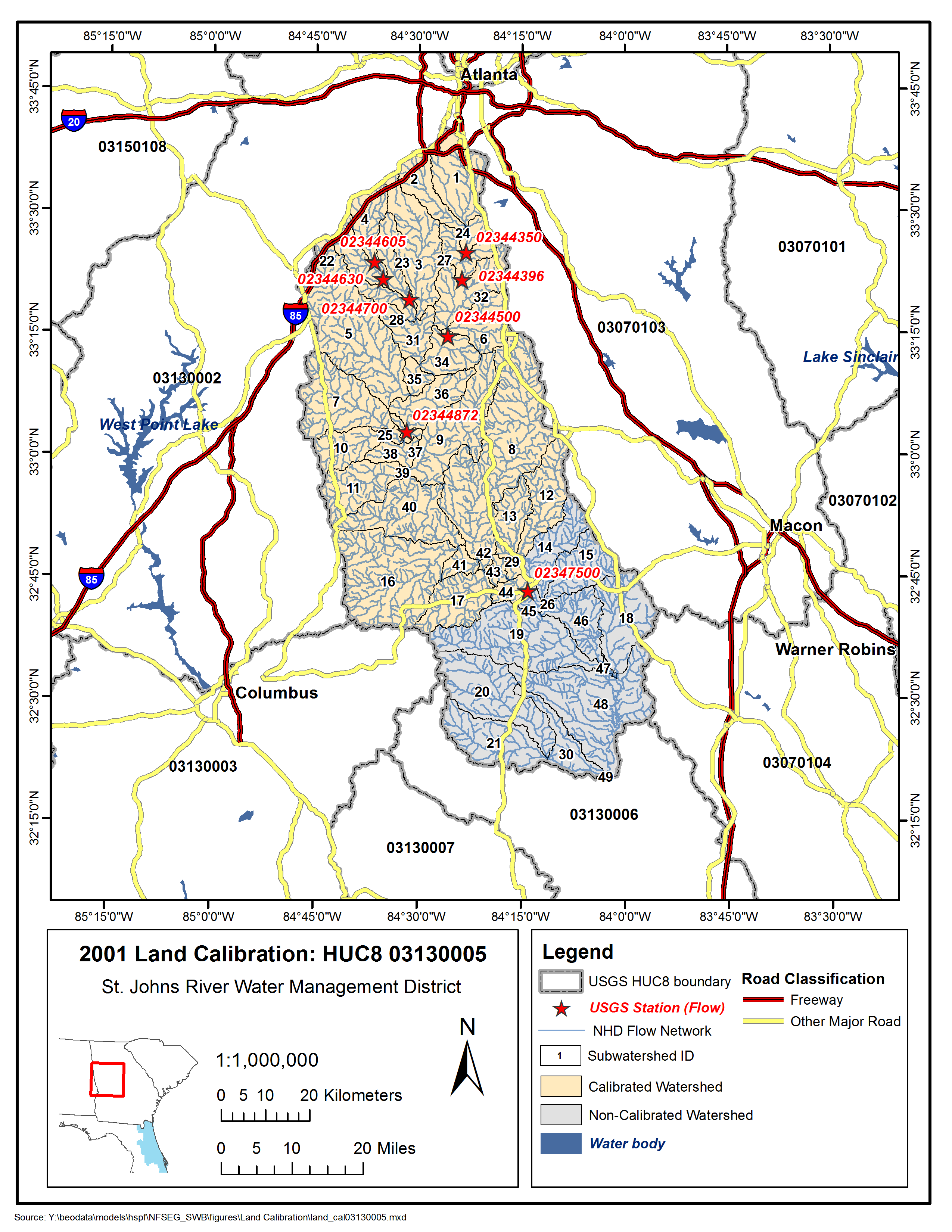


Figure 03130005-2: Calibrated sub-watersheds.

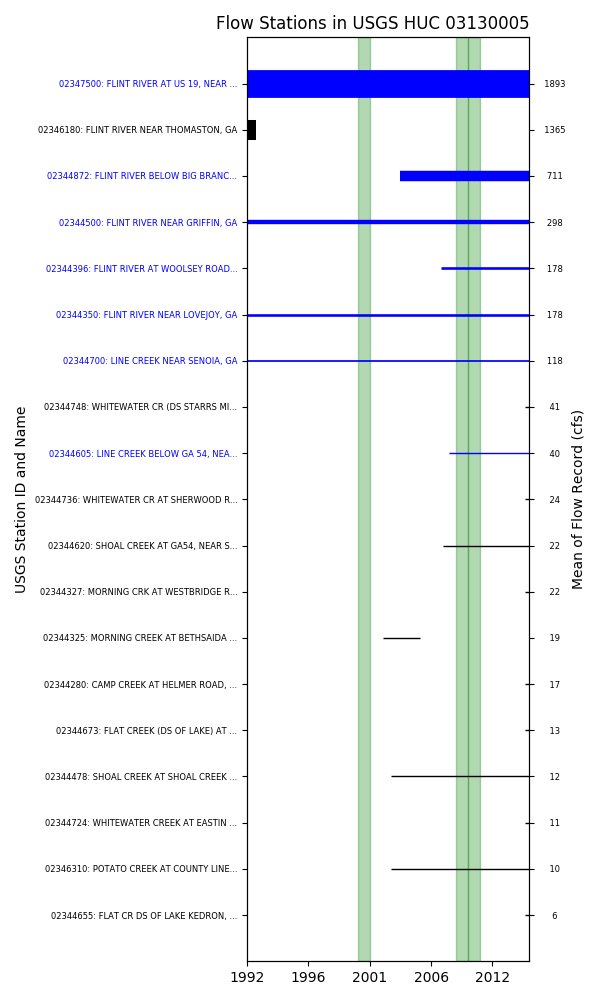


Figure 03130005-3: Station period of record. Blue color identifies gauges used for calibration.

## HSPF Reach 04, USGS Gauge 02344605

Table 03130005-1: Comparison Statistics Between HSPF Reach 04 and USGS Gauge 02344605.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | -8.85 |
| Standard error | 18.56 |
| Relative bias | -0.21 |
| Relative standard error | 0.44 |
| Nash-Sutcliffe coefficient | 0.81 |
| Kling-Gupta coefficient | 0.76 |
| Coefficient of efficiency | 0.66 |
| Index of agreement | 0.83 |

Table 03130005-2: Hydrologic Indices Between USGS Gauge 02344605 and HSPF Reach 04.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02344605 | Simulated Reach 04 | Percent Difference |
| MA1: Mean, all daily flows | 41.35 | 32.70 | -20.91 |
| MA2: Median, all daily flows | 18.00 | 11.21 | -37.70 |
| MA3: CV, all daily flows | 172.43 | 166.10 | -3.67 |
| MA4: CV, log of all daily flows | 126.82 | 144.74 | 14.12 |
| MA5: Mean daily flow / median daily flow | 2.30 | 2.92 | 26.95 |
| MA9: (Q10 - Q90) / median daily flow | 5.35 | 6.99 | 30.75 |
| MA10: (Q20 - Q80) / median daily flow | 2.95 | 3.67 | 24.59 |
| MA11: (Q25 - Q75) / median daily flow | 2.37 | 2.61 | 10.14 |
| MA12: Mean monthly flow, January | 57.76 | 45.57 | -21.11 |
| MA13: Mean monthly flow, February | 53.74 | 49.84 | -7.25 |
| MA14: Mean monthly flow, March | 58.15 | 56.04 | -3.63 |
| MA15: Mean monthly flow, April | 34.46 | 23.49 | -31.84 |
| MA16: Mean monthly flow, May | 24.39 | 19.54 | -19.87 |
| MA17: Mean monthly flow, June | 16.14 | 8.91 | -44.81 |
| MA18: Mean monthly flow, July | 20.58 | 11.73 | -42.98 |
| MA19: Mean monthly flow, August | 19.34 | 4.89 | -74.73 |
| MA20: Mean monthly flow, September | 13.39 | 11.43 | -14.66 |
| MA21: Mean monthly flow, October | 17.37 | 15.57 | -10.35 |
| MA22: Mean monthly flow, November | 25.83 | 19.57 | -24.23 |
| MA23: Mean monthly flow, December | 65.72 | 54.33 | -17.33 |
| ML1: Mean minimum monthly flow, January | 31.40 | 23.83 | -24.11 |
| ML2: Mean minimum monthly flow, February | 18.56 | 18.74 | 0.98 |
| ML3: Mean minimum monthly flow, March | 21.70 | 18.75 | -13.61 |
| ML4: Mean minimum monthly flow, April | 14.20 | 11.35 | -20.09 |
| ML5: Mean minimum monthly flow, May | 4.99 | 7.06 | 41.66 |
| ML6: Mean minimum monthly flow, June | 0.58 | 2.59 | 349.26 |
| ML7: Mean minimum monthly flow, July | 2.89 | 2.02 | -30.03 |
| ML8: Mean minimum monthly flow, August | 3.41 | 1.67 | -50.95 |
| ML9: Mean minimum monthly flow, September | 1.32 | 0.82 | -37.54 |
| ML10: Mean minimum monthly flow, October | 3.79 | 2.55 | -32.73 |
| ML11: Mean minimum monthly flow, November | 6.84 | 5.09 | -25.58 |
| ML12: Mean minimum monthly flow, December | 13.27 | 9.03 | -31.96 |
| ML13: CV of minimum monthly flows | 164.74 | 141.57 | -14.06 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.04 | 0.10 | 132.69 |
| ML15: Mean minimum annual flow / mean annual flow | 0.02 | 0.02 | 5.58 |
| ML16: Median minimum annual flow / median annual flow | 0.00 | 0.00 | -34.80 |
| ML20: Ratio of baseflow volume to total flow volume | 0.29 | 0.31 | 5.92 |
| ML22: Mean annual minimum flow divided by catchment area | 0.01 | 0.01 | -52.08 |
| RA1: Mean of positive changes from one day to next (rise rate) | 32.65 | 27.42 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 283.35 | 299.57 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 20.07 | 9.65 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 302.58 | 300.79 |  |
| RA5: Ratio of days that are higher than previous day | 0.36 | 0.26 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.38 | 0.40 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.25 | 0.19 |  |
| RA8: Number of flow reversals from one day to the next | 89.29 | 82.86 |  |
| RA9: CV, number of flow reversals from one day to the next | 48.63 | 41.38 |  |

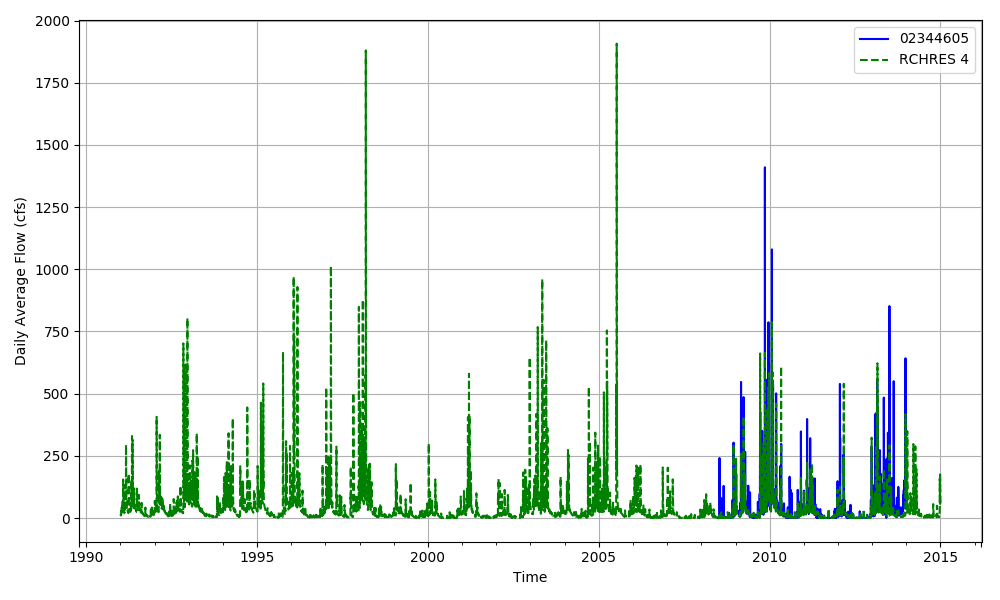


Figure 03130005-4: Daily flow for HSFP reach 04 and USGS station 02344605.

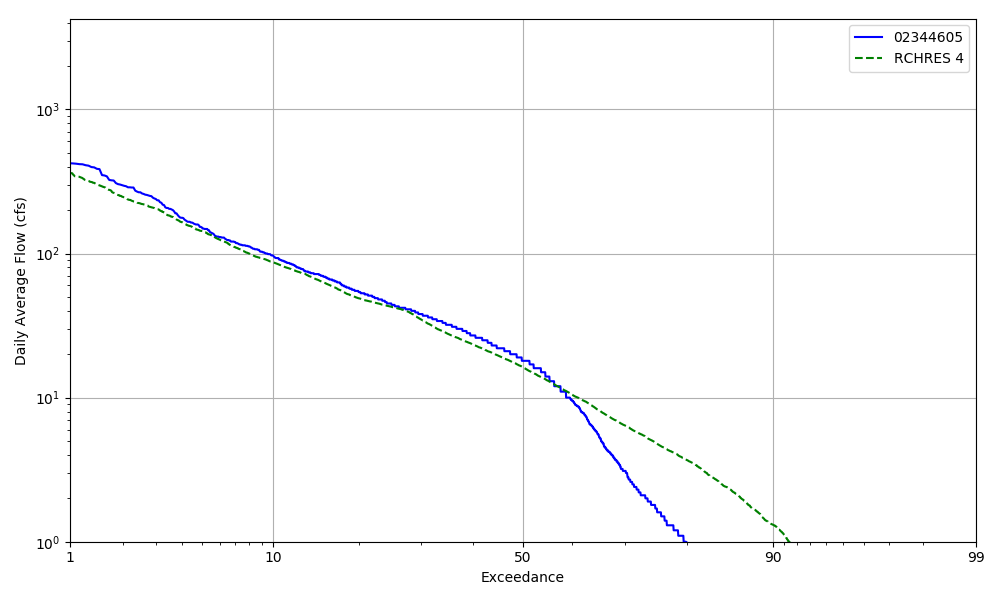


Figure 03130005-5: Daily exceedance for HSFP reach 04 and USGS station 02344605.

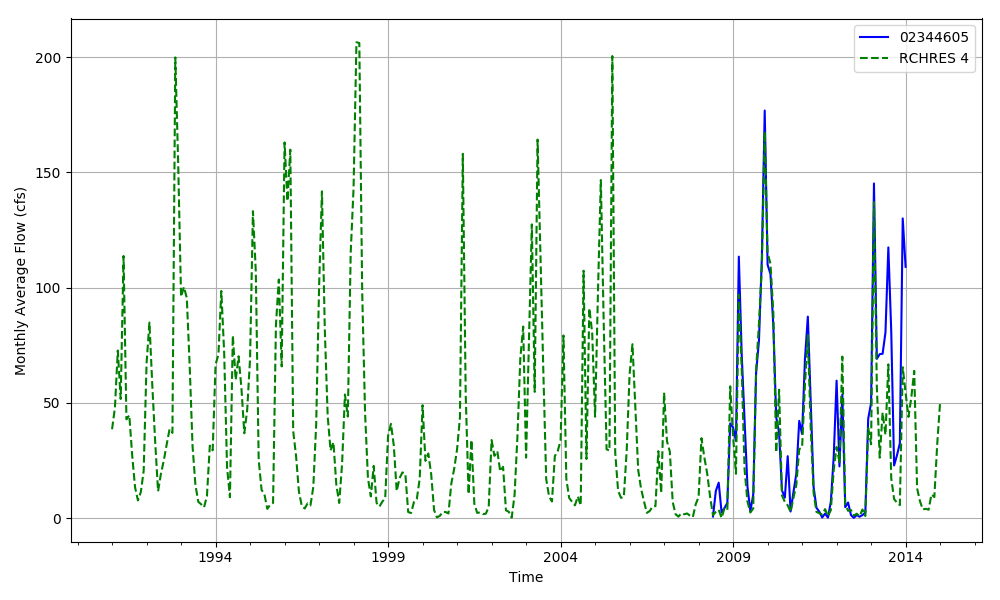


Figure 03130005-6: Monthly flow for HSFP reach 04 and USGS station 02344605.

## HSPF Reach 22, USGS Gauge 02344630

Table 03130005-3: Comparison Statistics Between HSPF Reach 22 and USGS Gauge 02344630.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | 2.31 |
| Standard error | 22.19 |
| Relative bias | 0.06 |
| Relative standard error | 0.54 |
| Nash-Sutcliffe coefficient | 0.71 |
| Kling-Gupta coefficient | 0.83 |
| Coefficient of efficiency | 0.60 |
| Index of agreement | 0.80 |

Table 03130005-4: Hydrologic Indices Between USGS Gauge 02344630 and HSPF Reach 22.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02344630 | Simulated Reach 22 | Percent Difference |
| MA1: Mean, all daily flows | 35.33 | 37.57 | 6.34 |
| MA2: Median, all daily flows | 16.00 | 17.19 | 7.43 |
| MA3: CV, all daily flows | 193.26 | 186.38 | -3.56 |
| MA4: CV, log of all daily flows | 116.13 | 118.64 | 2.16 |
| MA5: Mean daily flow / median daily flow | 2.21 | 2.19 | -1.02 |
| MA9: (Q10 - Q90) / median daily flow | 5.69 | 5.09 | -10.60 |
| MA10: (Q20 - Q80) / median daily flow | 3.30 | 3.18 | -3.61 |
| MA11: (Q25 - Q75) / median daily flow | 2.67 | 2.40 | -10.12 |
| MA12: Mean monthly flow, January | 67.39 | 85.60 | 27.02 |
| MA13: Mean monthly flow, February | 38.11 | 47.62 | 24.97 |
| MA14: Mean monthly flow, March | 40.52 | 52.78 | 30.26 |
| MA15: Mean monthly flow, April | 34.23 | 27.07 | -20.93 |
| MA16: Mean monthly flow, May | 21.22 | 23.96 | 12.91 |
| MA17: Mean monthly flow, June | 23.73 | 23.60 | -0.54 |
| MA18: Mean monthly flow, July | 20.75 | 21.36 | 2.95 |
| MA19: Mean monthly flow, August | 22.34 | 15.14 | -32.24 |
| MA20: Mean monthly flow, September | 10.06 | 6.65 | -33.88 |
| MA21: Mean monthly flow, October | 11.52 | 8.39 | -27.20 |
| MA22: Mean monthly flow, November | 16.12 | 7.72 | -52.13 |
| MA23: Mean monthly flow, December | 71.77 | 79.45 | 10.71 |
| ML1: Mean minimum monthly flow, January | 55.30 | 56.27 | 1.75 |
| ML2: Mean minimum monthly flow, February | 32.00 | 29.97 | -6.33 |
| ML3: Mean minimum monthly flow, March | 13.60 | 30.23 | 122.28 |
| ML4: Mean minimum monthly flow, April | 18.35 | 15.15 | -17.46 |
| ML5: Mean minimum monthly flow, May | 6.30 | 11.57 | 83.65 |
| ML6: Mean minimum monthly flow, June | 5.21 | 9.54 | 83.27 |
| ML7: Mean minimum monthly flow, July | 11.14 | 9.50 | -14.75 |
| ML8: Mean minimum monthly flow, August | 13.60 | 8.51 | -37.45 |
| ML9: Mean minimum monthly flow, September | 2.99 | 4.52 | 51.18 |
| ML10: Mean minimum monthly flow, October | 3.87 | 3.17 | -18.14 |
| ML11: Mean minimum monthly flow, November | 4.40 | 3.58 | -18.56 |
| ML12: Mean minimum monthly flow, December | 15.13 | 6.18 | -59.19 |
| ML13: CV of minimum monthly flows | 170.35 | 163.04 | -4.29 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.11 | 0.22 | 95.75 |
| ML15: Mean minimum annual flow / mean annual flow | 0.05 | 0.06 | 12.73 |
| ML16: Median minimum annual flow / median annual flow | 0.06 | 0.05 | -8.95 |
| ML20: Ratio of baseflow volume to total flow volume | 0.38 | 0.35 | -7.85 |
| ML22: Mean annual minimum flow divided by catchment area | 0.03 | 0.03 | -10.40 |
| RA1: Mean of positive changes from one day to next (rise rate) | 20.91 | 27.46 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 292.04 | 238.82 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 10.99 | 10.39 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 313.57 | 254.90 |  |
| RA5: Ratio of days that are higher than previous day | 0.32 | 0.28 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.30 | 0.35 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.18 | 0.18 |  |
| RA8: Number of flow reversals from one day to the next | 82.67 | 85.67 |  |
| RA9: CV, number of flow reversals from one day to the next | 53.75 | 54.56 |  |

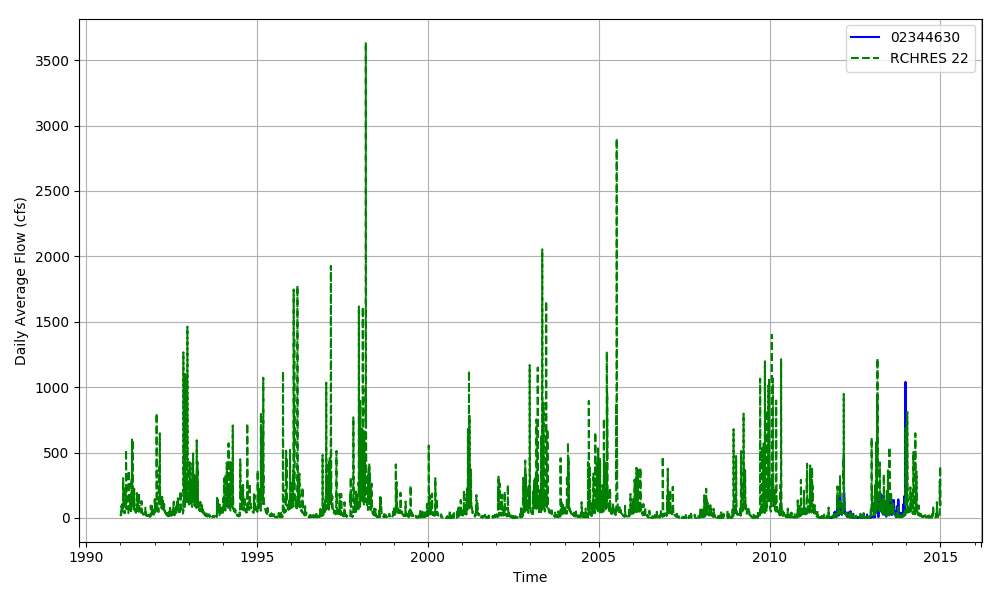


Figure 03130005-7: Daily flow for HSFP reach 22 and USGS station 02344630.

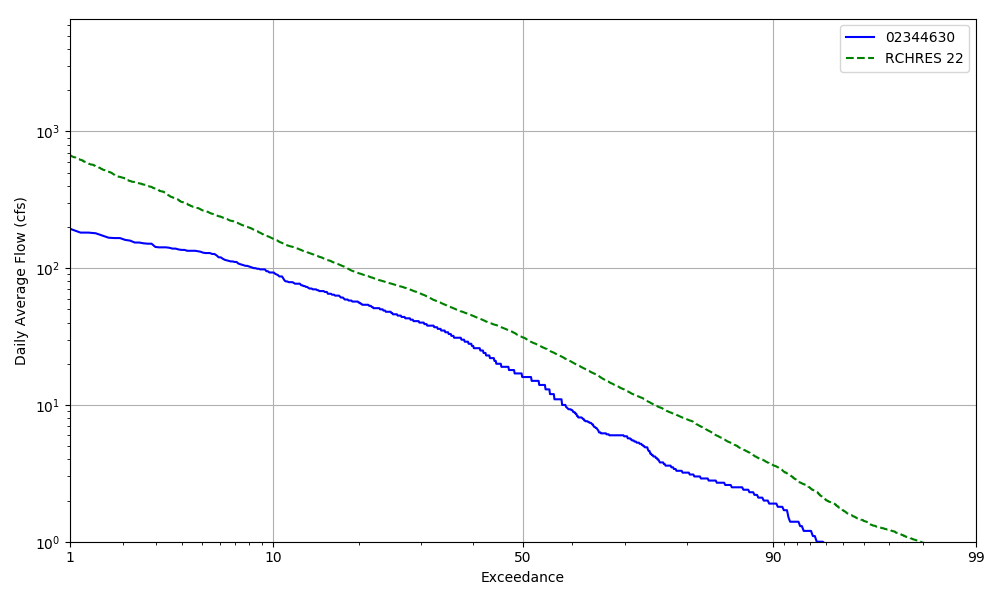


Figure 03130005-8: Daily exceedance for HSFP reach 22 and USGS station 02344630.

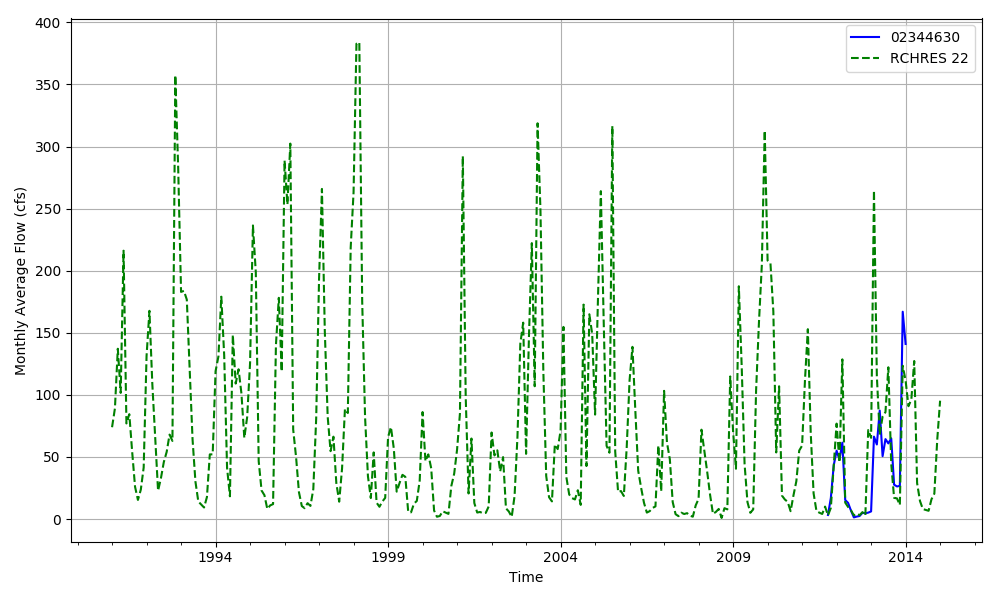


Figure 03130005-9: Monthly flow for HSFP reach 22 and USGS station 02344630.

## HSPF Reach 23, USGS Gauge 02344700

Table 03130005-5: Comparison Statistics Between HSPF Reach 23 and USGS Gauge 02344700.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | -13.64 |
| Standard error | 60.87 |
| Relative bias | -0.11 |
| Relative standard error | 0.48 |
| Nash-Sutcliffe coefficient | 0.77 |
| Kling-Gupta coefficient | 0.82 |
| Coefficient of efficiency | 0.66 |
| Index of agreement | 0.84 |

Table 03130005-6: Hydrologic Indices Between USGS Gauge 02344700 and HSPF Reach 23.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02344700 | Simulated Reach 23 | Percent Difference |
| MA1: Mean, all daily flows | 119.98 | 106.16 | -11.52 |
| MA2: Median, all daily flows | 58.00 | 45.31 | -21.88 |
| MA3: CV, all daily flows | 191.67 | 165.77 | -13.51 |
| MA4: CV, log of all daily flows | 106.79 | 122.98 | 15.16 |
| MA5: Mean daily flow / median daily flow | 2.07 | 2.34 | 13.27 |
| MA9: (Q10 - Q90) / median daily flow | 4.14 | 5.40 | 30.50 |
| MA10: (Q20 - Q80) / median daily flow | 2.21 | 2.98 | 35.00 |
| MA11: (Q25 - Q75) / median daily flow | 1.67 | 2.17 | 29.69 |
| MA12: Mean monthly flow, January | 152.52 | 165.41 | 8.46 |
| MA13: Mean monthly flow, February | 202.98 | 205.97 | 1.47 |
| MA14: Mean monthly flow, March | 224.79 | 215.55 | -4.11 |
| MA15: Mean monthly flow, April | 127.51 | 101.24 | -20.60 |
| MA16: Mean monthly flow, May | 94.10 | 81.25 | -13.65 |
| MA17: Mean monthly flow, June | 75.48 | 51.08 | -32.33 |
| MA18: Mean monthly flow, July | 122.85 | 63.32 | -48.46 |
| MA19: Mean monthly flow, August | 58.15 | 30.60 | -47.37 |
| MA20: Mean monthly flow, September | 48.56 | 43.34 | -10.75 |
| MA21: Mean monthly flow, October | 60.22 | 51.30 | -14.81 |
| MA22: Mean monthly flow, November | 101.50 | 94.94 | -6.47 |
| MA23: Mean monthly flow, December | 123.59 | 130.89 | 5.91 |
| ML1: Mean minimum monthly flow, January | 63.96 | 56.53 | -11.62 |
| ML2: Mean minimum monthly flow, February | 69.65 | 65.02 | -6.65 |
| ML3: Mean minimum monthly flow, March | 73.00 | 61.93 | -15.17 |
| ML4: Mean minimum monthly flow, April | 54.96 | 39.12 | -28.82 |
| ML5: Mean minimum monthly flow, May | 29.31 | 24.44 | -16.62 |
| ML6: Mean minimum monthly flow, June | 22.36 | 15.31 | -31.52 |
| ML7: Mean minimum monthly flow, July | 17.11 | 12.45 | -27.27 |
| ML8: Mean minimum monthly flow, August | 17.22 | 12.29 | -28.62 |
| ML9: Mean minimum monthly flow, September | 12.17 | 8.43 | -30.79 |
| ML10: Mean minimum monthly flow, October | 17.23 | 12.70 | -26.31 |
| ML11: Mean minimum monthly flow, November | 29.52 | 21.92 | -25.75 |
| ML12: Mean minimum monthly flow, December | 45.13 | 40.54 | -10.16 |
| ML13: CV of minimum monthly flows | 87.07 | 108.90 | 25.07 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.14 | 0.07 | -49.86 |
| ML15: Mean minimum annual flow / mean annual flow | 0.07 | 0.03 | -56.32 |
| ML16: Median minimum annual flow / median annual flow | 0.12 | 0.03 | -73.67 |
| ML20: Ratio of baseflow volume to total flow volume | 0.38 | 0.36 | -4.55 |
| ML22: Mean annual minimum flow divided by catchment area | 0.08 | 0.04 | -50.40 |
| RA1: Mean of positive changes from one day to next (rise rate) | 88.69 | 82.24 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 452.55 | 299.80 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 43.40 | 29.31 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 466.53 | 335.90 |  |
| RA5: Ratio of days that are higher than previous day | 0.31 | 0.26 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.25 | 0.37 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.14 | 0.17 |  |
| RA8: Number of flow reversals from one day to the next | 98.83 | 105.04 |  |
| RA9: CV, number of flow reversals from one day to the next | 18.57 | 19.33 |  |

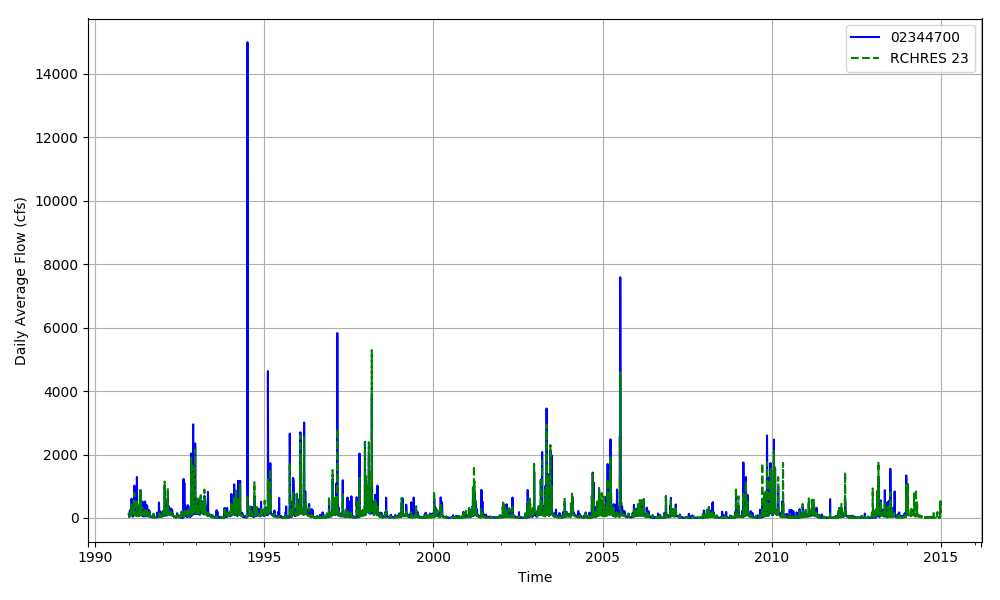


Figure 03130005-10: Daily flow for HSFP reach 23 and USGS station 02344700.

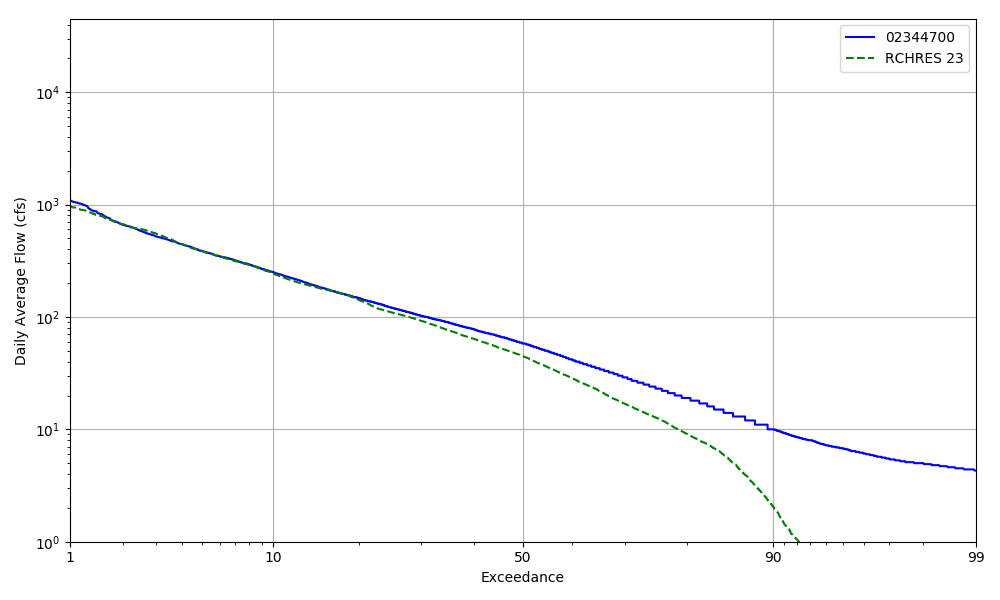


Figure 03130005-11: Daily exceedance for HSFP reach 23 and USGS station 02344700.

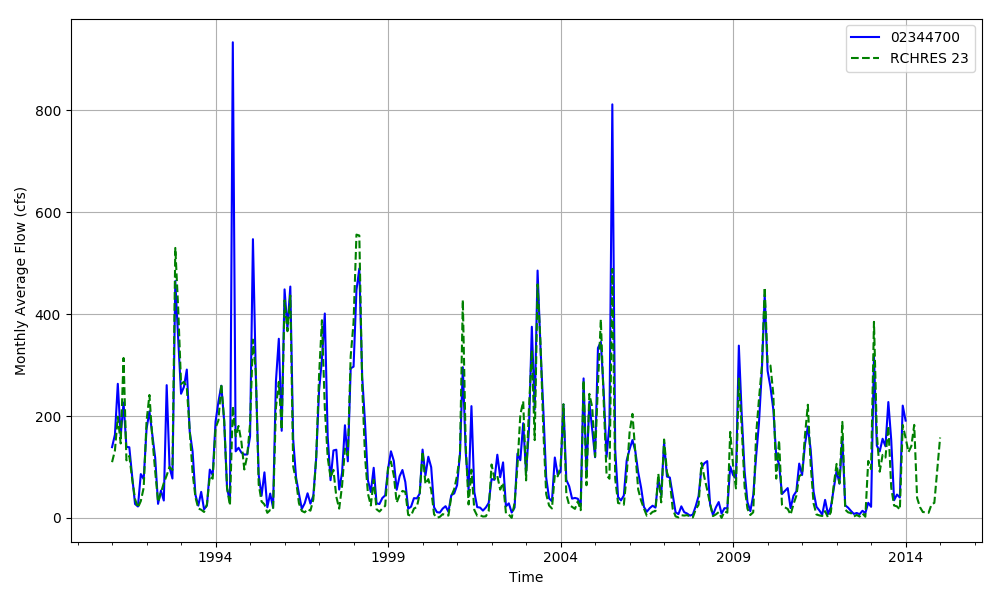


Figure 03130005-12: Monthly flow for HSFP reach 23 and USGS station 02344700.

## HSPF Reach 24, USGS Gauge 02344350

Table 03130005-7: Comparison Statistics Between HSPF Reach 24 and USGS Gauge 02344350.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | -17.37 |
| Standard error | 56.59 |
| Relative bias | -0.10 |
| Relative standard error | 0.36 |
| Nash-Sutcliffe coefficient | 0.87 |
| Kling-Gupta coefficient | 0.88 |
| Coefficient of efficiency | 0.71 |
| Index of agreement | 0.86 |

Table 03130005-8: Hydrologic Indices Between USGS Gauge 02344350 and HSPF Reach 24.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02344350 | Simulated Reach 24 | Percent Difference |
| MA1: Mean, all daily flows | 180.46 | 162.60 | -9.90 |
| MA2: Median, all daily flows | 83.00 | 80.49 | -3.02 |
| MA3: CV, all daily flows | 194.20 | 154.03 | -20.69 |
| MA4: CV, log of all daily flows | 115.35 | 108.57 | -5.87 |
| MA5: Mean daily flow / median daily flow | 2.17 | 2.02 | -7.09 |
| MA9: (Q10 - Q90) / median daily flow | 4.21 | 4.19 | -0.62 |
| MA10: (Q20 - Q80) / median daily flow | 1.92 | 2.34 | 21.66 |
| MA11: (Q25 - Q75) / median daily flow | 1.46 | 1.90 | 30.64 |
| MA12: Mean monthly flow, January | 224.90 | 216.35 | -3.80 |
| MA13: Mean monthly flow, February | 271.92 | 266.63 | -1.95 |
| MA14: Mean monthly flow, March | 305.05 | 290.04 | -4.92 |
| MA15: Mean monthly flow, April | 168.68 | 142.82 | -15.33 |
| MA16: Mean monthly flow, May | 132.16 | 124.38 | -5.88 |
| MA17: Mean monthly flow, June | 122.24 | 94.98 | -22.30 |
| MA18: Mean monthly flow, July | 182.29 | 145.02 | -20.44 |
| MA19: Mean monthly flow, August | 98.79 | 70.60 | -28.54 |
| MA20: Mean monthly flow, September | 120.13 | 108.12 | -10.00 |
| MA21: Mean monthly flow, October | 112.84 | 100.20 | -11.20 |
| MA22: Mean monthly flow, November | 158.79 | 146.70 | -7.62 |
| MA23: Mean monthly flow, December | 190.78 | 182.30 | -4.45 |
| ML1: Mean minimum monthly flow, January | 78.62 | 73.22 | -6.87 |
| ML2: Mean minimum monthly flow, February | 85.22 | 84.37 | -1.00 |
| ML3: Mean minimum monthly flow, March | 84.78 | 82.99 | -2.11 |
| ML4: Mean minimum monthly flow, April | 63.70 | 54.80 | -13.96 |
| ML5: Mean minimum monthly flow, May | 39.57 | 40.13 | 1.44 |
| ML6: Mean minimum monthly flow, June | 31.42 | 28.80 | -8.32 |
| ML7: Mean minimum monthly flow, July | 29.19 | 30.07 | 3.02 |
| ML8: Mean minimum monthly flow, August | 26.25 | 22.76 | -13.28 |
| ML9: Mean minimum monthly flow, September | 22.60 | 15.53 | -31.27 |
| ML10: Mean minimum monthly flow, October | 25.91 | 21.67 | -16.36 |
| ML11: Mean minimum monthly flow, November | 40.90 | 31.83 | -22.16 |
| ML12: Mean minimum monthly flow, December | 60.26 | 52.67 | -12.59 |
| ML13: CV of minimum monthly flows | 68.88 | 95.70 | 38.95 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.19 | 0.08 | -59.70 |
| ML15: Mean minimum annual flow / mean annual flow | 0.08 | 0.04 | -55.04 |
| ML16: Median minimum annual flow / median annual flow | 0.16 | 0.05 | -67.45 |
| ML20: Ratio of baseflow volume to total flow volume | 0.32 | 0.35 | 10.33 |
| ML22: Mean annual minimum flow divided by catchment area | 0.15 | 0.07 | -51.83 |
| RA1: Mean of positive changes from one day to next (rise rate) | 167.97 | 151.11 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 270.90 | 248.24 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 87.98 | 46.11 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 321.32 | 313.50 |  |
| RA5: Ratio of days that are higher than previous day | 0.33 | 0.23 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.39 | 0.44 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.16 | 0.16 |  |
| RA8: Number of flow reversals from one day to the next | 110.83 | 96.25 |  |
| RA9: CV, number of flow reversals from one day to the next | 16.59 | 17.83 |  |

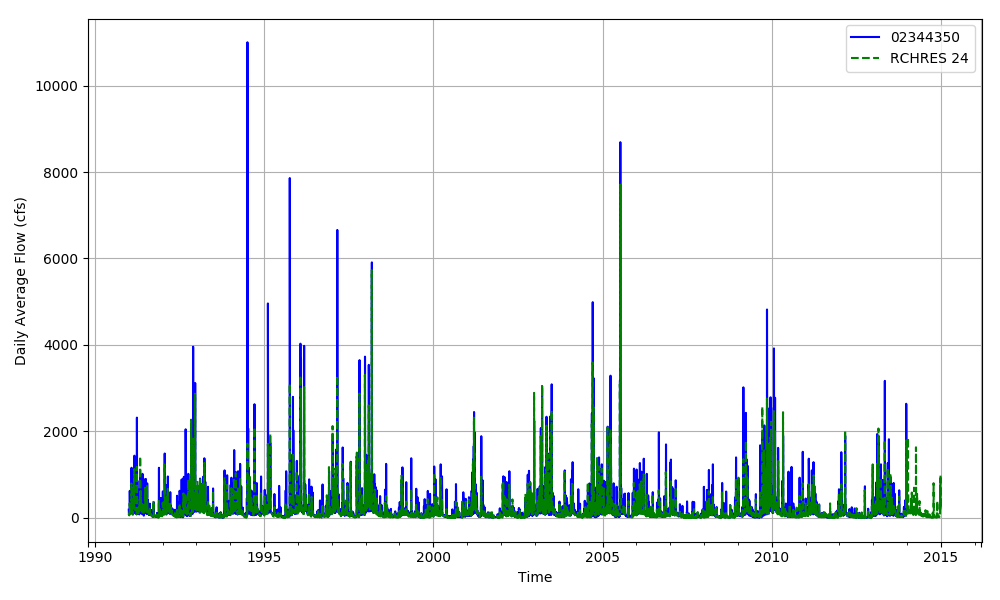


Figure 03130005-13: Daily flow for HSFP reach 24 and USGS station 02344350.

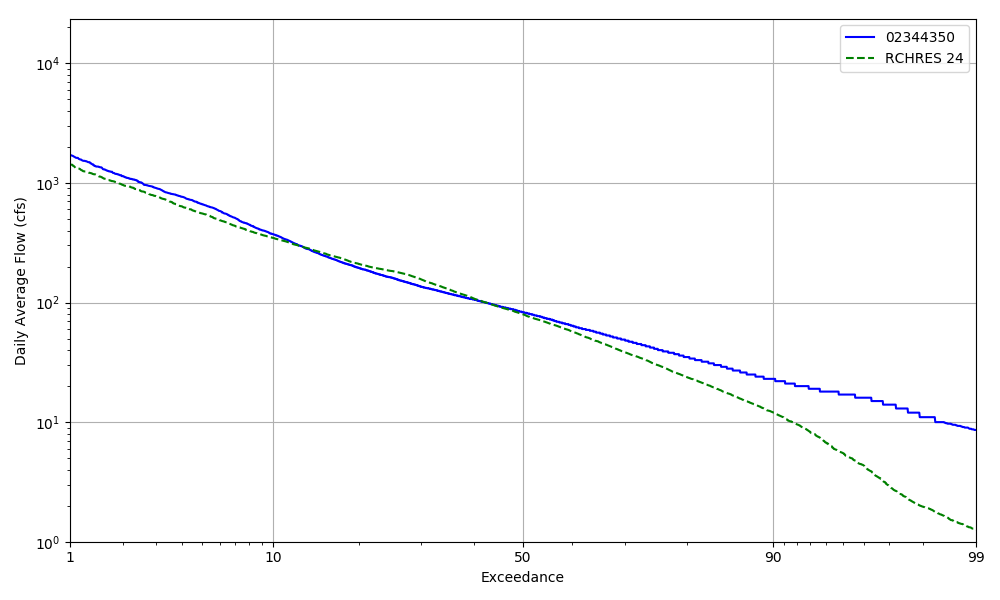


Figure 03130005-14: Daily exceedance for HSFP reach 24 and USGS station 02344350.

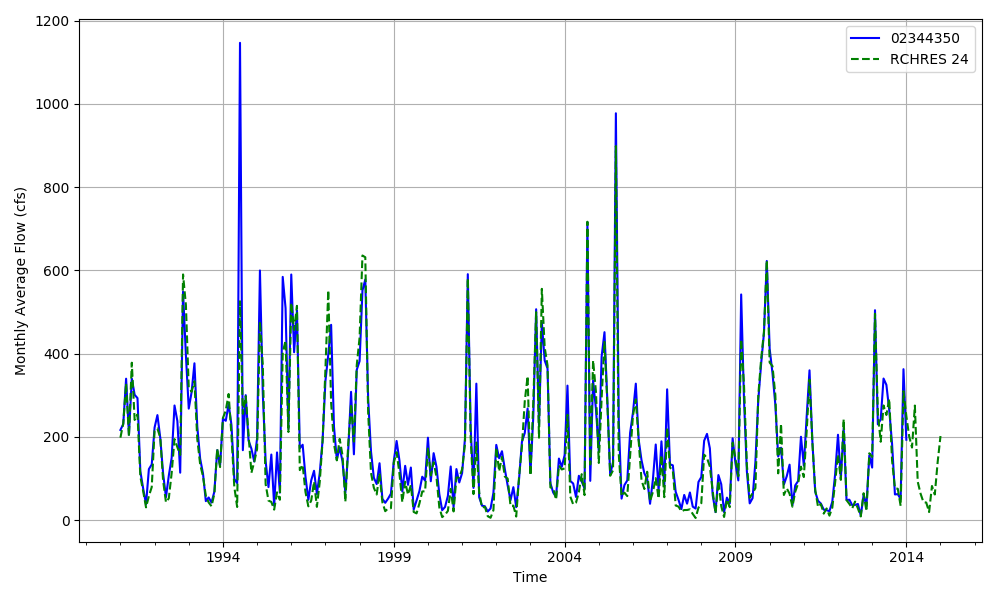


Figure 03130005-15: Monthly flow for HSFP reach 24 and USGS station 02344350.

## HSPF Reach 27, USGS Gauge 02344396

Table 03130005-9: Comparison Statistics Between HSPF Reach 27 and USGS Gauge 02344396.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | -7.80 |
| Standard error | 38.46 |
| Relative bias | -0.04 |
| Relative standard error | 0.24 |
| Nash-Sutcliffe coefficient | 0.94 |
| Kling-Gupta coefficient | 0.95 |
| Coefficient of efficiency | 0.78 |
| Index of agreement | 0.89 |

Table 03130005-10: Hydrologic Indices Between USGS Gauge 02344396 and HSPF Reach 27.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02344396 | Simulated Reach 27 | Percent Difference |
| MA1: Mean, all daily flows | 180.48 | 170.84 | -5.34 |
| MA2: Median, all daily flows | 68.00 | 81.27 | 19.51 |
| MA3: CV, all daily flows | 178.41 | 151.80 | -14.91 |
| MA4: CV, log of all daily flows | 139.42 | 114.29 | -18.03 |
| MA5: Mean daily flow / median daily flow | 2.65 | 2.10 | -20.80 |
| MA9: (Q10 - Q90) / median daily flow | 6.08 | 4.57 | -24.85 |
| MA10: (Q20 - Q80) / median daily flow | 2.35 | 2.67 | 13.67 |
| MA11: (Q25 - Q75) / median daily flow | 1.71 | 2.14 | 25.20 |
| MA12: Mean monthly flow, January | 217.18 | 220.04 | 1.32 |
| MA13: Mean monthly flow, February | 241.89 | 246.40 | 1.87 |
| MA14: Mean monthly flow, March | 307.57 | 297.55 | -3.26 |
| MA15: Mean monthly flow, April | 191.47 | 170.11 | -11.16 |
| MA16: Mean monthly flow, May | 130.85 | 138.87 | 6.13 |
| MA17: Mean monthly flow, June | 90.62 | 74.17 | -18.15 |
| MA18: Mean monthly flow, July | 100.56 | 100.26 | -0.30 |
| MA19: Mean monthly flow, August | 98.40 | 58.58 | -40.47 |
| MA20: Mean monthly flow, September | 66.95 | 72.72 | 8.61 |
| MA21: Mean monthly flow, October | 104.64 | 109.00 | 4.17 |
| MA22: Mean monthly flow, November | 121.79 | 111.89 | -8.13 |
| MA23: Mean monthly flow, December | 271.97 | 260.74 | -4.13 |
| ML1: Mean minimum monthly flow, January | 91.29 | 103.03 | 12.86 |
| ML2: Mean minimum monthly flow, February | 78.83 | 82.19 | 4.26 |
| ML3: Mean minimum monthly flow, March | 84.33 | 109.90 | 30.31 |
| ML4: Mean minimum monthly flow, April | 62.83 | 73.87 | 17.56 |
| ML5: Mean minimum monthly flow, May | 42.00 | 52.43 | 24.84 |
| ML6: Mean minimum monthly flow, June | 23.97 | 29.58 | 23.40 |
| ML7: Mean minimum monthly flow, July | 28.57 | 26.94 | -5.70 |
| ML8: Mean minimum monthly flow, August | 23.35 | 20.49 | -12.24 |
| ML9: Mean minimum monthly flow, September | 17.78 | 12.29 | -30.91 |
| ML10: Mean minimum monthly flow, October | 22.83 | 22.89 | 0.25 |
| ML11: Mean minimum monthly flow, November | 34.14 | 28.89 | -15.40 |
| ML12: Mean minimum monthly flow, December | 50.00 | 40.51 | -18.98 |
| ML13: CV of minimum monthly flows | 83.79 | 112.71 | 34.51 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.23 | 0.10 | -57.22 |
| ML15: Mean minimum annual flow / mean annual flow | 0.08 | 0.04 | -56.40 |
| ML16: Median minimum annual flow / median annual flow | 0.14 | 0.03 | -75.29 |
| ML20: Ratio of baseflow volume to total flow volume | 0.30 | 0.35 | 17.69 |
| ML22: Mean annual minimum flow divided by catchment area | 0.14 | 0.07 | -52.56 |
| RA1: Mean of positive changes from one day to next (rise rate) | 155.79 | 153.07 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 207.38 | 232.75 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 85.67 | 45.20 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 267.91 | 276.44 |  |
| RA5: Ratio of days that are higher than previous day | 0.34 | 0.23 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.40 | 0.42 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.15 | 0.15 |  |
| RA8: Number of flow reversals from one day to the next | 106.29 | 83.43 |  |
| RA9: CV, number of flow reversals from one day to the next | 33.05 | 31.00 |  |

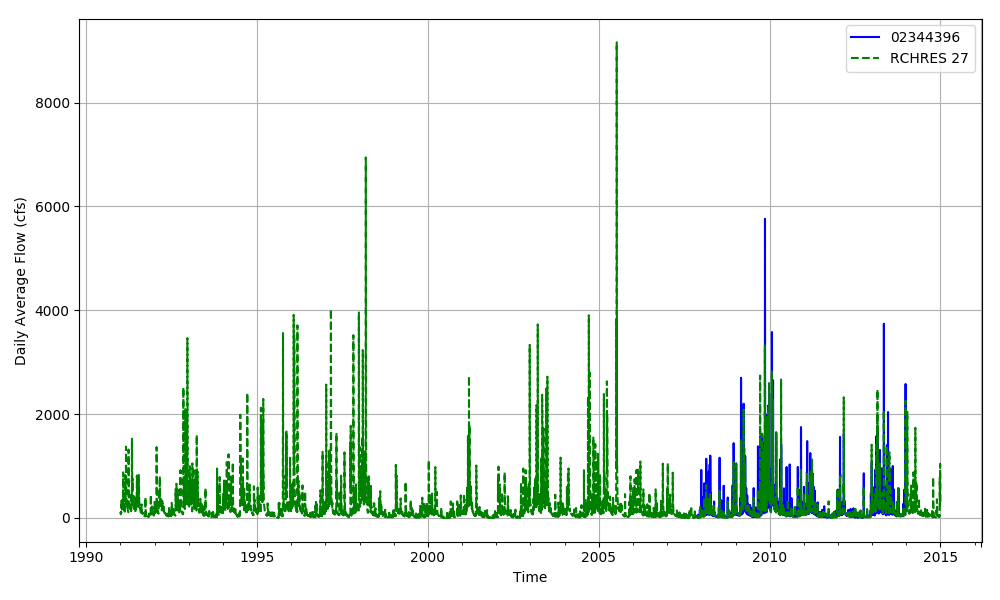


Figure 03130005-16: Daily flow for HSFP reach 27 and USGS station 02344396.

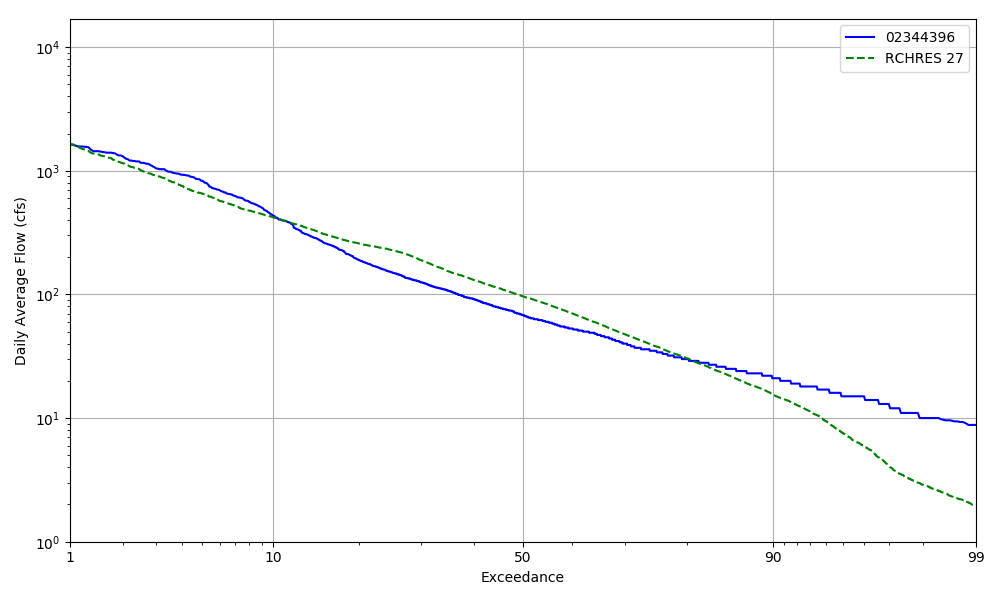


Figure 03130005-17: Daily exceedance for HSFP reach 27 and USGS station 02344396.

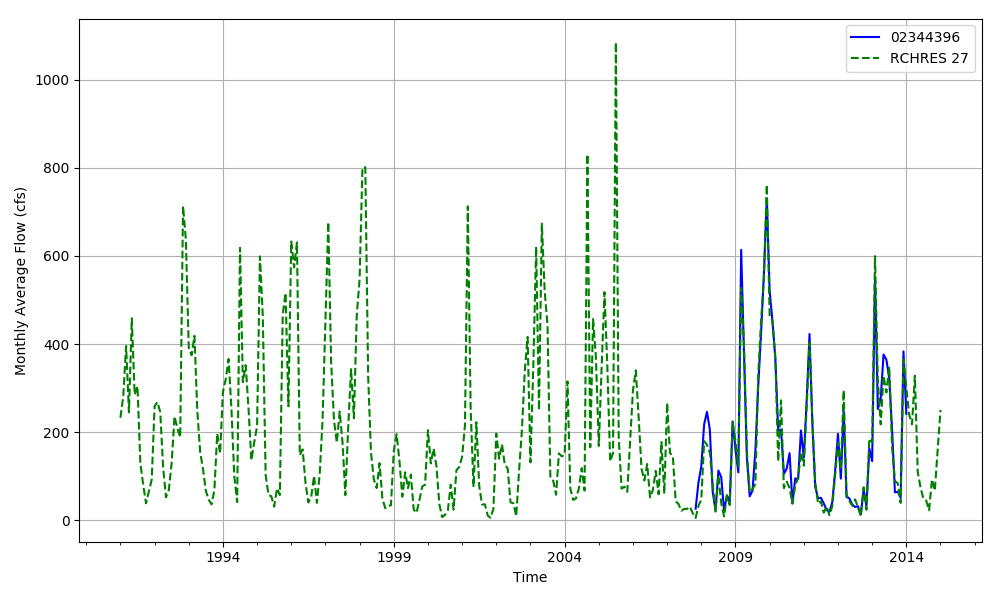


Figure 03130005-18: Monthly flow for HSFP reach 27 and USGS station 02344396.

## HSPF Reach 33, USGS Gauge 02344500

Table 03130005-11: Comparison Statistics Between HSPF Reach 33 and USGS Gauge 02344500.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | 4.22 |
| Standard error | 122.89 |
| Relative bias | 0.01 |
| Relative standard error | 0.38 |
| Nash-Sutcliffe coefficient | 0.85 |
| Kling-Gupta coefficient | 0.90 |
| Coefficient of efficiency | 0.78 |
| Index of agreement | 0.89 |

Table 03130005-12: Hydrologic Indices Between USGS Gauge 02344500 and HSPF Reach 33.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02344500 | Simulated Reach 33 | Percent Difference |
| MA1: Mean, all daily flows | 302.40 | 307.90 | 1.82 |
| MA2: Median, all daily flows | 136.00 | 156.36 | 14.97 |
| MA3: CV, all daily flows | 176.68 | 142.32 | -19.45 |
| MA4: CV, log of all daily flows | 116.38 | 103.22 | -11.31 |
| MA5: Mean daily flow / median daily flow | 2.22 | 1.97 | -11.44 |
| MA9: (Q10 - Q90) / median daily flow | 4.80 | 4.01 | -16.44 |
| MA10: (Q20 - Q80) / median daily flow | 2.46 | 2.28 | -7.41 |
| MA11: (Q25 - Q75) / median daily flow | 1.86 | 1.78 | -4.30 |
| MA12: Mean monthly flow, January | 395.97 | 413.20 | 4.35 |
| MA13: Mean monthly flow, February | 501.85 | 525.48 | 4.71 |
| MA14: Mean monthly flow, March | 584.66 | 578.92 | -0.98 |
| MA15: Mean monthly flow, April | 313.00 | 297.60 | -4.92 |
| MA16: Mean monthly flow, May | 226.34 | 240.26 | 6.15 |
| MA17: Mean monthly flow, June | 181.17 | 178.97 | -1.22 |
| MA18: Mean monthly flow, July | 303.56 | 252.21 | -16.92 |
| MA19: Mean monthly flow, August | 127.80 | 127.21 | -0.47 |
| MA20: Mean monthly flow, September | 152.48 | 176.83 | 15.97 |
| MA21: Mean monthly flow, October | 170.34 | 180.10 | 5.73 |
| MA22: Mean monthly flow, November | 253.70 | 262.59 | 3.50 |
| MA23: Mean monthly flow, December | 318.72 | 344.90 | 8.21 |
| ML1: Mean minimum monthly flow, January | 170.12 | 161.23 | -5.23 |
| ML2: Mean minimum monthly flow, February | 160.48 | 190.37 | 18.63 |
| ML3: Mean minimum monthly flow, March | 166.70 | 193.00 | 15.78 |
| ML4: Mean minimum monthly flow, April | 117.35 | 129.53 | 10.38 |
| ML5: Mean minimum monthly flow, May | 65.52 | 94.72 | 44.56 |
| ML6: Mean minimum monthly flow, June | 51.29 | 71.65 | 39.70 |
| ML7: Mean minimum monthly flow, July | 45.37 | 68.87 | 51.80 |
| ML8: Mean minimum monthly flow, August | 36.41 | 53.86 | 47.94 |
| ML9: Mean minimum monthly flow, September | 28.94 | 38.13 | 31.76 |
| ML10: Mean minimum monthly flow, October | 37.70 | 50.65 | 34.36 |
| ML11: Mean minimum monthly flow, November | 69.35 | 71.88 | 3.65 |
| ML12: Mean minimum monthly flow, December | 106.61 | 119.71 | 12.29 |
| ML13: CV of minimum monthly flows | 102.42 | 91.71 | -10.46 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.14 | 0.12 | -14.76 |
| ML15: Mean minimum annual flow / mean annual flow | 0.06 | 0.06 | 5.55 |
| ML16: Median minimum annual flow / median annual flow | 0.12 | 0.10 | -19.20 |
| ML20: Ratio of baseflow volume to total flow volume | 0.34 | 0.42 | 23.87 |
| ML22: Mean annual minimum flow divided by catchment area | 0.18 | 0.21 | 20.51 |
| RA1: Mean of positive changes from one day to next (rise rate) | 160.50 | 200.43 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 314.78 | 296.61 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 104.42 | 68.06 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 343.61 | 330.04 |  |
| RA5: Ratio of days that are higher than previous day | 0.38 | 0.25 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.25 | 0.24 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.15 | 0.11 |  |
| RA8: Number of flow reversals from one day to the next | 102.12 | 84.04 |  |
| RA9: CV, number of flow reversals from one day to the next | 17.48 | 18.94 |  |

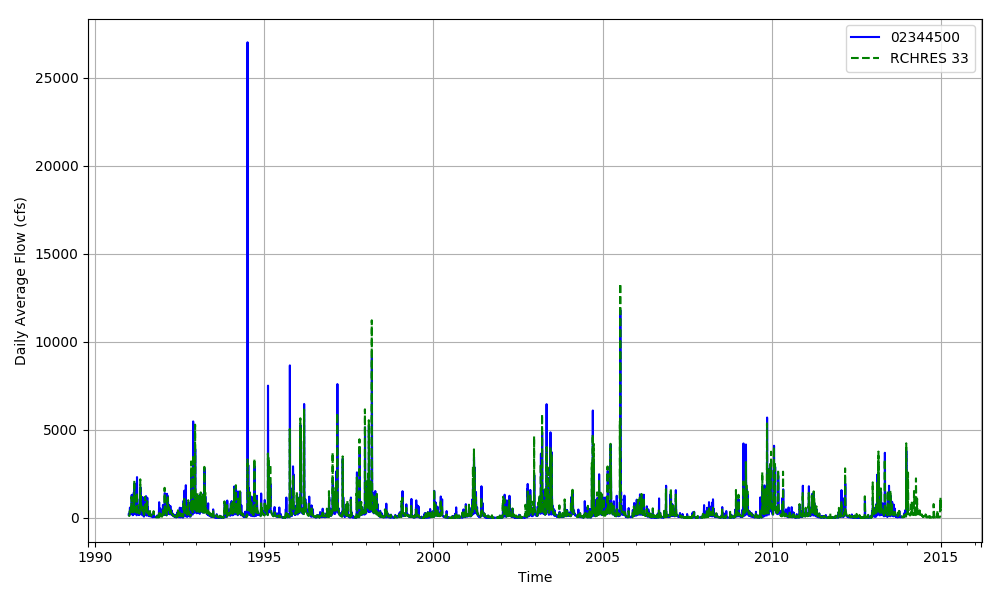


Figure 03130005-19: Daily flow for HSFP reach 33 and USGS station 02344500.

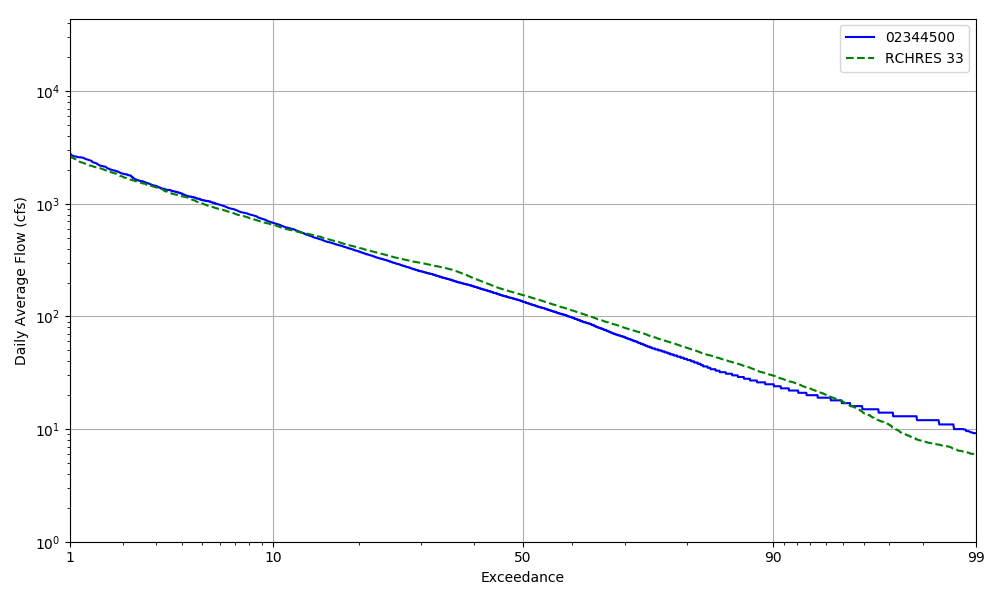


Figure 03130005-20: Daily exceedance for HSFP reach 33 and USGS station 02344500.

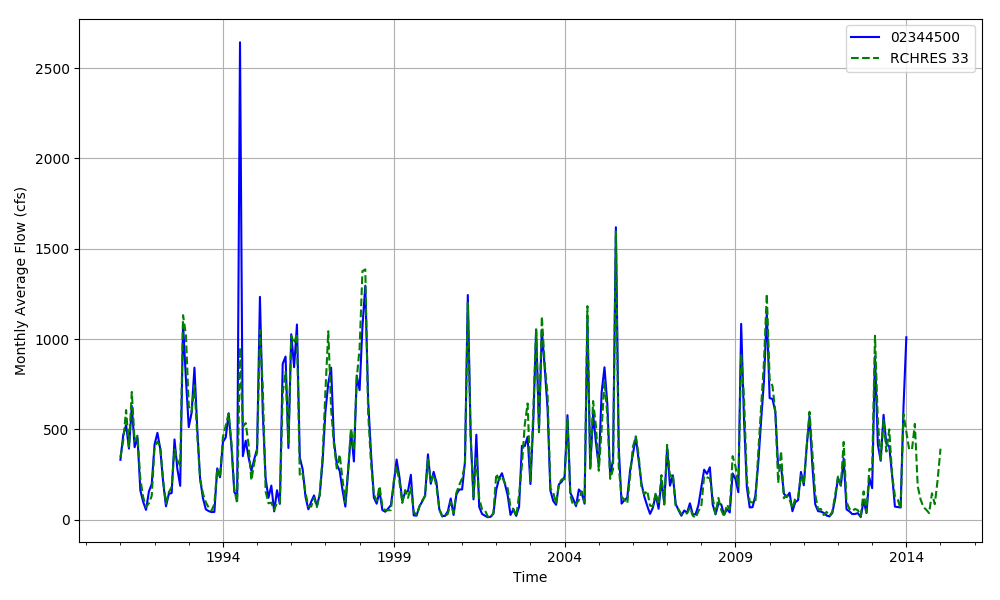


Figure 03130005-21: Monthly flow for HSFP reach 33 and USGS station 02344500.

## HSPF Reach 36, USGS Gauge 02344872

Table 03130005-13: Comparison Statistics Between HSPF Reach 36 and USGS Gauge 02344872.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | 24.56 |
| Standard error | 223.32 |
| Relative bias | 0.03 |
| Relative standard error | 0.28 |
| Nash-Sutcliffe coefficient | 0.92 |
| Kling-Gupta coefficient | 0.95 |
| Coefficient of efficiency | 0.77 |
| Index of agreement | 0.88 |

Table 03130005-14: Hydrologic Indices Between USGS Gauge 02344872 and HSPF Reach 36.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02344872 | Simulated Reach 36 | Percent Difference |
| MA1: Mean, all daily flows | 715.94 | 750.53 | 4.83 |
| MA2: Median, all daily flows | 357.00 | 373.29 | 4.56 |
| MA3: CV, all daily flows | 148.30 | 151.28 | 2.01 |
| MA4: CV, log of all daily flows | 113.58 | 106.88 | -5.90 |
| MA5: Mean daily flow / median daily flow | 2.01 | 2.01 | 0.26 |
| MA9: (Q10 - Q90) / median daily flow | 4.36 | 4.09 | -6.06 |
| MA10: (Q20 - Q80) / median daily flow | 2.50 | 2.39 | -4.36 |
| MA11: (Q25 - Q75) / median daily flow | 1.95 | 1.91 | -2.22 |
| MA12: Mean monthly flow, January | 997.81 | 935.46 | -6.25 |
| MA13: Mean monthly flow, February | 1023.03 | 1067.88 | 4.38 |
| MA14: Mean monthly flow, March | 1253.94 | 1273.96 | 1.60 |
| MA15: Mean monthly flow, April | 778.87 | 723.48 | -7.11 |
| MA16: Mean monthly flow, May | 447.53 | 488.25 | 9.10 |
| MA17: Mean monthly flow, June | 288.50 | 309.15 | 7.16 |
| MA18: Mean monthly flow, July | 668.39 | 656.60 | -1.76 |
| MA19: Mean monthly flow, August | 291.41 | 242.92 | -16.64 |
| MA20: Mean monthly flow, September | 344.15 | 433.94 | 26.09 |
| MA21: Mean monthly flow, October | 304.57 | 350.96 | 15.23 |
| MA22: Mean monthly flow, November | 473.08 | 536.29 | 13.36 |
| MA23: Mean monthly flow, December | 841.46 | 950.57 | 12.97 |
| ML1: Mean minimum monthly flow, January | 672.00 | 503.99 | -25.00 |
| ML2: Mean minimum monthly flow, February | 491.44 | 476.88 | -2.96 |
| ML3: Mean minimum monthly flow, March | 550.56 | 592.88 | 7.69 |
| ML4: Mean minimum monthly flow, April | 366.67 | 394.36 | 7.55 |
| ML5: Mean minimum monthly flow, May | 205.89 | 264.28 | 28.36 |
| ML6: Mean minimum monthly flow, June | 116.44 | 171.61 | 47.38 |
| ML7: Mean minimum monthly flow, July | 142.50 | 147.86 | 3.76 |
| ML8: Mean minimum monthly flow, August | 118.90 | 148.02 | 24.49 |
| ML9: Mean minimum monthly flow, September | 71.10 | 86.90 | 22.22 |
| ML10: Mean minimum monthly flow, October | 89.40 | 120.39 | 34.67 |
| ML11: Mean minimum monthly flow, November | 158.70 | 178.19 | 12.28 |
| ML12: Mean minimum monthly flow, December | 288.70 | 290.20 | 0.52 |
| ML13: CV of minimum monthly flows | 128.04 | 99.56 | -22.24 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.19 | 0.18 | -3.49 |
| ML15: Mean minimum annual flow / mean annual flow | 0.08 | 0.08 | 8.28 |
| ML16: Median minimum annual flow / median annual flow | 0.12 | 0.12 | -0.70 |
| ML20: Ratio of baseflow volume to total flow volume | 0.43 | 0.44 | 4.49 |
| ML22: Mean annual minimum flow divided by catchment area | 0.53 | 0.65 | 23.53 |
| RA1: Mean of positive changes from one day to next (rise rate) | 266.99 | 415.44 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 242.24 | 345.17 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 153.76 | 147.13 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 279.23 | 358.88 |  |
| RA5: Ratio of days that are higher than previous day | 0.36 | 0.26 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.18 | 0.18 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.10 | 0.10 |  |
| RA8: Number of flow reversals from one day to the next | 79.91 | 66.18 |  |
| RA9: CV, number of flow reversals from one day to the next | 35.64 | 33.87 |  |

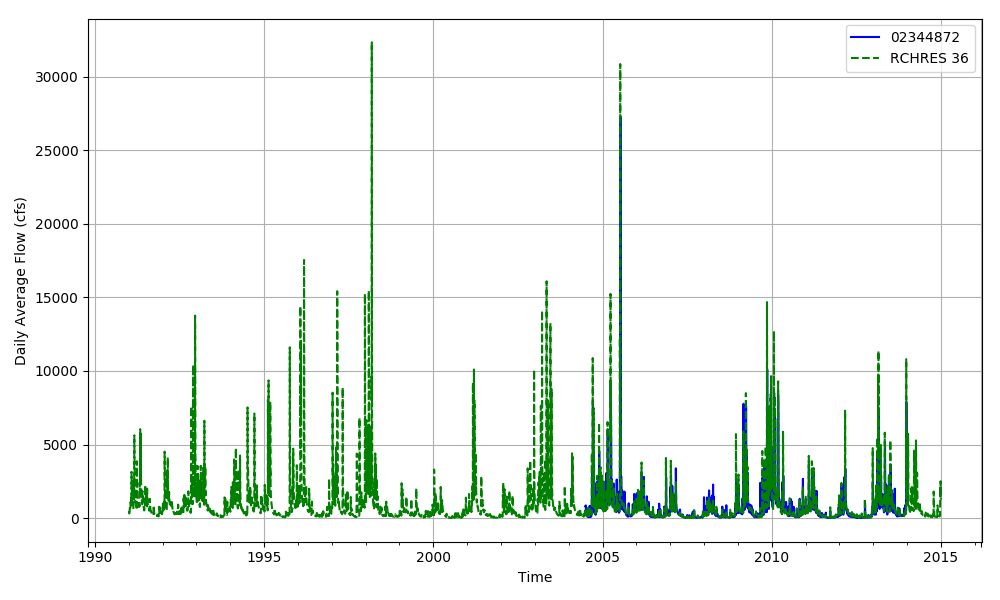


Figure 03130005-22: Daily flow for HSFP reach 36 and USGS station 02344872.

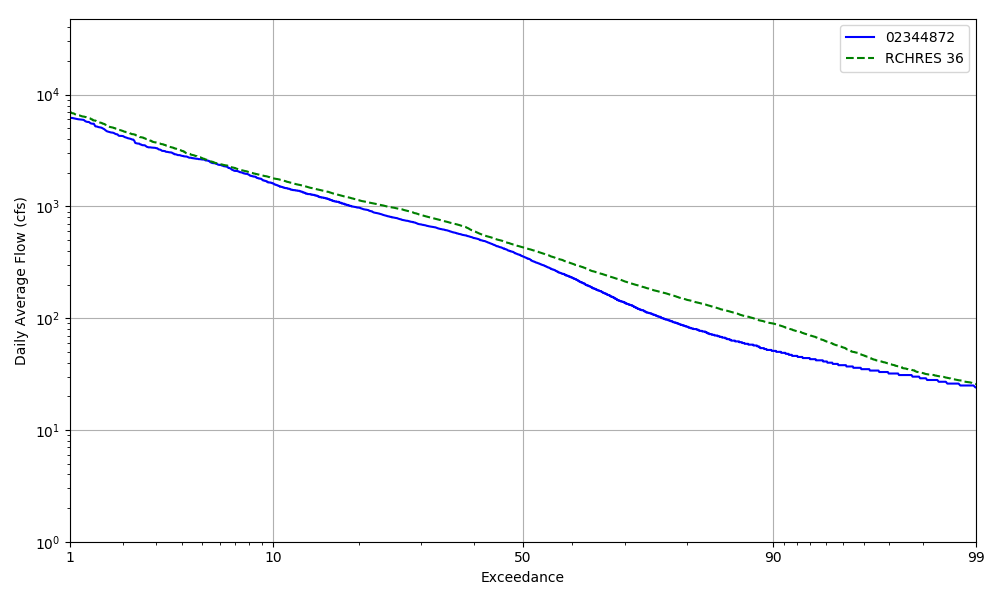


Figure 03130005-23: Daily exceedance for HSFP reach 36 and USGS station 02344872.

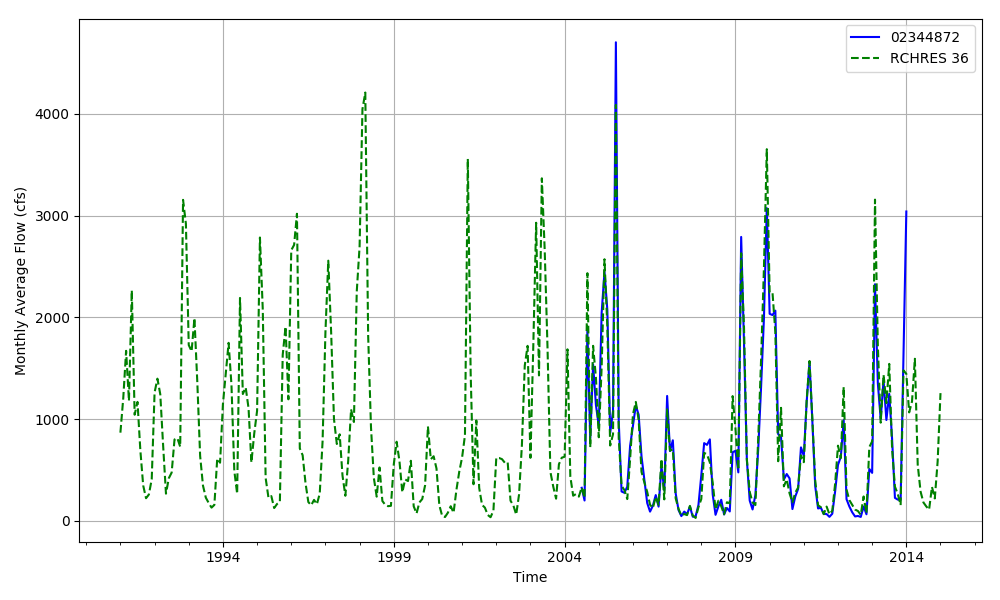


Figure 03130005-24: Monthly flow for HSFP reach 36 and USGS station 02344872.

## HSPF Reach 44, USGS Gauge 02347500

Table 03130005-15: Comparison Statistics Between HSPF Reach 44 and USGS Gauge 02347500.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | -48.66 |
| Standard error | 752.25 |
| Relative bias | -0.03 |
| Relative standard error | 0.38 |
| Nash-Sutcliffe coefficient | 0.86 |
| Kling-Gupta coefficient | 0.92 |
| Coefficient of efficiency | 0.77 |
| Index of agreement | 0.89 |

Table 03130005-16: Hydrologic Indices Between USGS Gauge 02347500 and HSPF Reach 44.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02347500 | Simulated Reach 44 | Percent Difference |
| MA1: Mean, all daily flows | 1905.15 | 1856.42 | -2.56 |
| MA2: Median, all daily flows | 1020.00 | 958.09 | -6.07 |
| MA3: CV, all daily flows | 141.46 | 131.61 | -6.96 |
| MA4: CV, log of all daily flows | 98.02 | 101.77 | 3.83 |
| MA5: Mean daily flow / median daily flow | 1.87 | 1.94 | 3.74 |
| MA9: (Q10 - Q90) / median daily flow | 3.74 | 4.03 | 7.79 |
| MA10: (Q20 - Q80) / median daily flow | 2.10 | 2.46 | 17.01 |
| MA11: (Q25 - Q75) / median daily flow | 1.63 | 1.96 | 20.67 |
| MA12: Mean monthly flow, January | 2422.64 | 2451.52 | 1.19 |
| MA13: Mean monthly flow, February | 3252.16 | 3361.78 | 3.37 |
| MA14: Mean monthly flow, March | 3932.16 | 3948.75 | 0.42 |
| MA15: Mean monthly flow, April | 2340.65 | 2156.34 | -7.87 |
| MA16: Mean monthly flow, May | 1551.75 | 1508.84 | -2.77 |
| MA17: Mean monthly flow, June | 1113.72 | 1061.58 | -4.68 |
| MA18: Mean monthly flow, July | 1761.89 | 1297.24 | -26.37 |
| MA19: Mean monthly flow, August | 812.41 | 719.08 | -11.49 |
| MA20: Mean monthly flow, September | 724.88 | 794.82 | 9.65 |
| MA21: Mean monthly flow, October | 846.74 | 845.03 | -0.20 |
| MA22: Mean monthly flow, November | 1461.40 | 1396.02 | -4.47 |
| MA23: Mean monthly flow, December | 2001.83 | 2119.67 | 5.89 |
| ML1: Mean minimum monthly flow, January | 1309.58 | 1188.89 | -9.22 |
| ML2: Mean minimum monthly flow, February | 1398.09 | 1398.31 | 0.02 |
| ML3: Mean minimum monthly flow, March | 1493.48 | 1499.78 | 0.42 |
| ML4: Mean minimum monthly flow, April | 1120.83 | 1015.22 | -9.42 |
| ML5: Mean minimum monthly flow, May | 658.39 | 721.29 | 9.55 |
| ML6: Mean minimum monthly flow, June | 495.96 | 544.47 | 9.78 |
| ML7: Mean minimum monthly flow, July | 443.52 | 486.44 | 9.68 |
| ML8: Mean minimum monthly flow, August | 365.78 | 417.23 | 14.07 |
| ML9: Mean minimum monthly flow, September | 272.48 | 286.25 | 5.05 |
| ML10: Mean minimum monthly flow, October | 332.83 | 349.96 | 5.15 |
| ML11: Mean minimum monthly flow, November | 518.57 | 478.87 | -7.65 |
| ML12: Mean minimum monthly flow, December | 875.70 | 859.47 | -1.85 |
| ML13: CV of minimum monthly flows | 86.06 | 93.61 | 8.77 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.17 | 0.18 | 9.92 |
| ML15: Mean minimum annual flow / mean annual flow | 0.09 | 0.10 | 9.73 |
| ML16: Median minimum annual flow / median annual flow | 0.13 | 0.14 | 11.18 |
| ML20: Ratio of baseflow volume to total flow volume | 0.48 | 0.51 | 6.64 |
| ML22: Mean annual minimum flow divided by catchment area | 1.83 | 1.79 | -2.37 |
| RA1: Mean of positive changes from one day to next (rise rate) | 709.26 | 760.81 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 324.57 | 355.53 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 357.92 | 297.99 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 291.87 | 328.39 |  |
| RA5: Ratio of days that are higher than previous day | 0.33 | 0.28 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.12 | 0.11 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.09 | 0.07 |  |
| RA8: Number of flow reversals from one day to the next | 90.71 | 67.79 |  |
| RA9: CV, number of flow reversals from one day to the next | 17.92 | 18.99 |  |

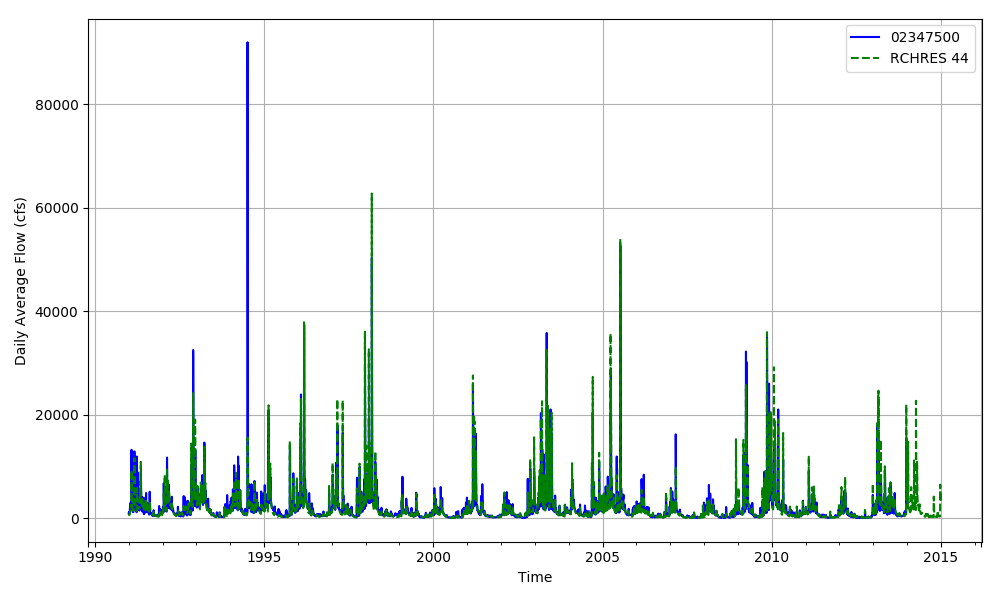


Figure 03130005-25: Daily flow for HSFP reach 44 and USGS station 02347500.

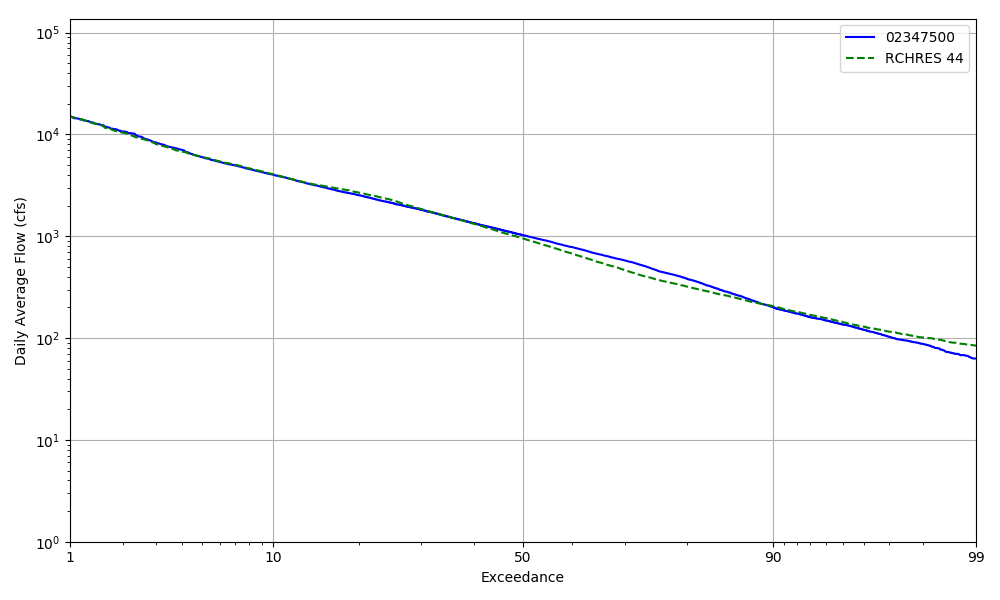


Figure 03130005-26: Daily exceedance for HSFP reach 44 and USGS station 02347500.

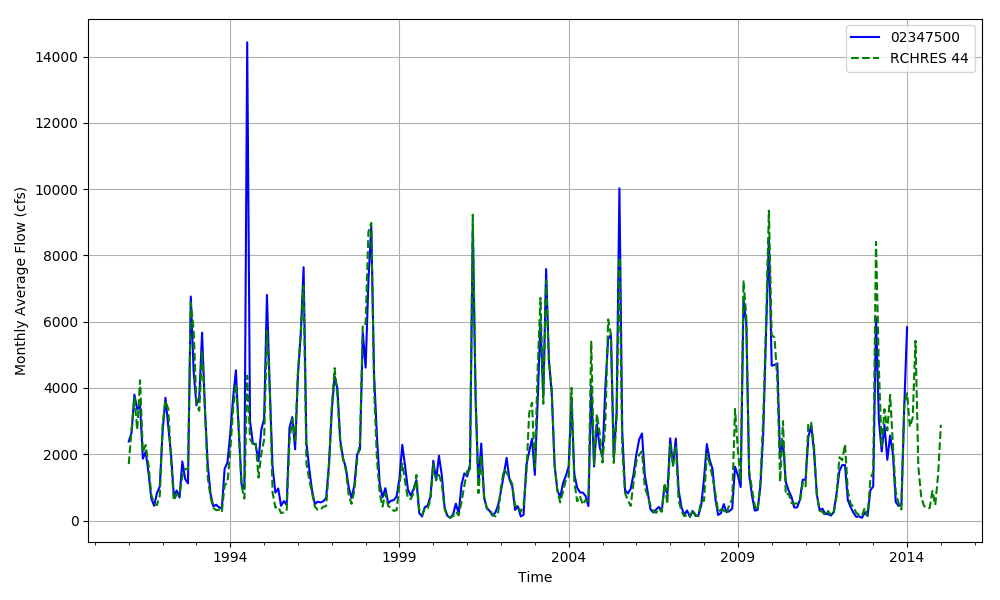


Figure 03130005-27: Monthly flow for HSFP reach 44 and USGS station 02347500.